PAPER

Opportunities and barriers for circular procurement in the built environment

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Executive summary

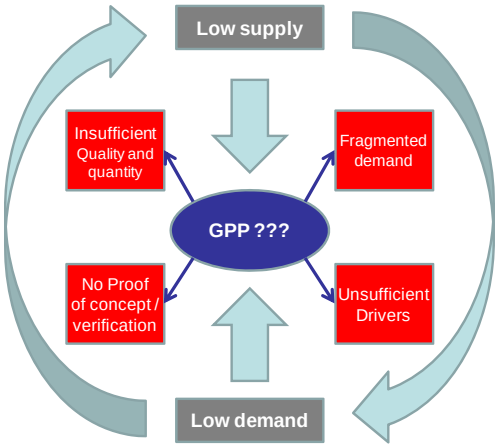
The construction and use of buildings in the EU accounts for about half of all extracted materials [1] and energy consumption [2] and generates about one third of all waste at different stages in a building's life-cycle [3]. By adopting principles of the circular economy, the environmental performance of the sector can be enhanced significantly. The European Commission (EC) and member states have already adopted several measures to boost energy performance of buildings [10]. Actions on improving resource efficiency in the built environment are in a less advanced phase. Several actions are being prepared and projects are starting up.

The objective of this paper is to identify gaps in EU policies and barriers for the construction sector moving towards a circular economy by improving resource efficiency. The paper focuses on the opportunities of green public procurement (GPP) in relation to circular buildings and building materials.

Barriers identified

Through interviews and literature study, four categories of major barriers have been identified. These barriers concentrate on low demand for circular buildings and low supply of products and services for circular buildings:

1. Insufficient quality and quantity of secondary materials
2. Fragmented demand in member states for circular buildings, products and services
3. Lack of proof of circular concepts and verification methods
4. Insufficient drivers and little urgency to improve resource efficiency



Several actions are being prepared by the EC and others to break down these barriers. The Circular Economy Package and EU Action Plan released in December 2015 form the main EU strategy to stimulate Europe's transition towards a circular economy and contain primary actions to make the transition happen. Specific actions for the construction sector are also mentioned. Concerning quality and quantity of secondary materials, the EC plans to revise the Waste Framework Directive [4] and has announced (voluntary) quality standards for secondary materials [5] and a recycling protocol for construction and demolition waste (CDW) [6]. To harmonize demand, the Joint Research Centre (JRC) is developing core indicators for the environmental performance of buildings [7]. In May 2016, it released new GPP criteria for the construction sector [8]. Regarding proof of concept, several EU funded projects have been launched in which new concepts to optimize resource efficiency are being developed and tested [9].

Two recommendations

The barriers show that these actions will not be sufficient to get all the (useful but voluntary) EC tools implemented. We recommend two further actions to enhance resource efficiency in the construction sector by using GPP:

1. Develop a platform for GPP and the built environment at EU level with regional networks
2. Investigate synergies between policies driving resource efficiency measures and current policies / regulations for buildings, especially with policies aimed at improving energy efficiency.

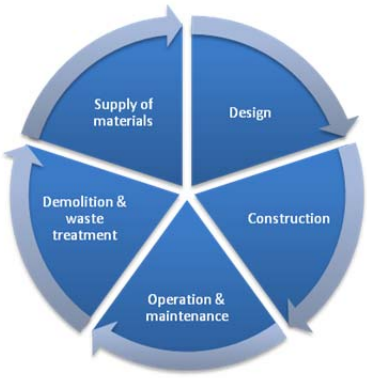
Action 1) The platform can serve multiple goals. Relevant stakeholders of industry (building material manufacturers and construction sector) and the public sector can participate in the platform. Stakeholders can help each other by exchanging information on best practices, working policies, lessons learned, innovations and training and dissemination activities. Industry can give examples of what is feasible and what and how public authorities could tender. This action helps to boost circular demand and supply by developing proof of concept and creating drivers for improving resource efficiency in the built environment.

Action 2) Explore how existing policy frameworks can support integration of resource efficiency requirements, before developing new policies, directives or regulations.For example the Energy Performance of Buildings Directive [10] and the Construction Products Regulation [11] offer opportunities for integrating resource efficiency. Further research to identify opportunities for synergies is recommended. This action helps to create a sense of urgency (driver) for improving resource efficiency in the built environment. It can also help to harmonize demand.

Introduction

The construction sector offers a huge potential in the transition towards a circular economy (CE) in Europe. The construction and use of buildings in the EU accounts for 40% of final energy consumption, about 35% of greenhouse gas emissions, 50% of all extracted materials, 30% of water consumption, and 35% of total generated waste [15]. The public sector is an important purchaser of buildings and can drive demand for green buildings significantly. With green public procurement (GPP), the public sector can create the right incentives and lead by example. In December 2015, the European Commission published the Circular Economy Package and Action Plan [12]. The construction and demolition sector was identified as a priority area that needs to be addressed in a targeted way. GPP is recognized in several documents and by several stakeholders as an important tool to accelerate the transition towards a CE in the construction and demolition sector. However, no specific actions for GPP are foreseen in the CE Package and Action plan.

Green public procurement (GPP)
GPP is a voluntary instrument for public authorities to procure goods, services and works with a better environmental impact throughout their life cycle. By utilizing the purchasing power of public bodies, it is easier for suppliers to get more sustainable goods and services onto the market [23]. Both the EC and individual member states have developed criteria for GPP. One step beyond GPP is circular procurement. This applies the principles of the circular economy to GPP and presupposes a more functional view of demand. Circular procurement enables the purchasing party to ensure a better environmental impact in the life cycle and that, at the end of their service life or useful life, products or materials will be re-used effectively in a new cycle. [24, 25].



Building Life cycle

Buildings last a long time. Nine out of every ten buildings currently standing in the EU will still be used by 2050 [28]. Buildings go through several phases during their lifecycle. The building life cycle takes into account design, manufacturing of materials, construction, operation, demolition, and the treatment of waste in which several sub steps can be addressed [26]. By taking the entire life cycle into account, the total environmental impact and total cost of ownership of a building can be assessed. In each phase of the life cycle of buildings, products and services will be procured.

Circular buildings
Circular buildings are designed in such a way that all materials used in them, are suitable for high quality reuse. Buildings are designed with disassembly in mind and optimal use of the available raw materials. To achieve this, environmental performance of a building should be assessed over its entire (or multiple) life cycles.

Resource efficiency

Resource efficiency focuses on using Earth's limited resources in a more sustainable way while minimizing the impacts on the environment. Resource efficiency is a key element in the Europe 2020 strategy [27].Building on the resource efficiency initiative is the EC communication "Towards a Circular Economy". This promotes the transition from a linear economy (take, make, destroy) towards a system maximizing the reuse of products and raw materials. In this situation, resources remain in the loop so they can be used longer. It focuses on measures driving better resource efficiency and waste minimization [4]. Resource usage during the life cycle of buildings is determined in large part by design decisions and choices of construction products and services fitting into a durable, sustainable and recyclable design. To help bring resource efficiency gains, designers, manufacturers, contractors, public authorities, and users have to work together and need useable and reliable information to support their decision-making.

Major barriers and EU initiatives

Through interviews and literature study, four categories of major barriers have been identified. The barriers concentrate around low demand for circular buildings and low supply of products and services for circular buildings:

1. Insufficient quality and quantity of secondary materials
2. Fragmented demand in member states for circular buildings (products and services)
3. Lack of proof of circular concepts and verification methods
4. Insufficient drivers and little urgency to improve resource efficiency

1. Insufficient quality and quantity of secondary materials

Markets for secondary materials have no economies of scale yet and the amount and quality of recycled materials supplied do not correspond to the potential demand from construction products companies. Recycling of most construction and demolition waste (CDW) is technically feasible. Some member states recycle almost 100% of CDW. In other member states, recycling rates are almost zero. Recycling of many CDW streams often faces barriers related to two distinct market failures [15]:

- the environmental damage cost is neither internalized in the landfill fees nor in the cost of virgin materials, which can result in recycled material being more costly than virgin material;
- the split incentives in the CDW value chain: the cost of dismantling, separating, and processing CDW is mostly borne at the phase of demolition while the potential benefits from using the recycled materials generally accrue at the production phase.

Several actions are being prepared to improve quality and quantity of secondary materials for the construction sector. The Waste Framework Directive [4] sets a 70% target for recycling (including backfilling) of CDW on a weight basis (currently 46% in the EU 28). This should increase the supply of secondary materials, although the mass-based approach does not stimulate member states to go beyond the recycling of heavy materials (concrete, brick, etc.), thereby often neglecting the recycling potential of light-weight materials (gypsum, insulation, glass, etc.). Another action to increase supply is the planned EU pre-demolition assessment guidelines for the construction sector [6].

Actions to improve quality of secondary materials were announced in the CE Package and Action Plan and consist of developing (voluntary) quality standards for secondary raw materials [5] and a recycling protocol for CDW [6]. The protocol should develop a set of technical, environmental, and managerial principles that are based on the highest common standard in each stage of the waste management chain. These principles would be recognized in all member states and should lead to a common CDW Management Protocol [6].

Elements which are not or minimally addressed in EC actions are:

- a focus on raw materials quality of *all* recyclable CDW streams. The focus in the development of (voluntary) quality standards for secondary raw materials is on plastics;
- light-weight recyclable CDW streams. Targets (and GPP) for CDW recycling rates are based on weight. Thereby the focus of stakeholders is mainly on “heavy” CDW (minerals) and less on smaller and lighter materials (glass, insulation materials, etc.). The recycling sector itself focuses mostly on economically feasible CDW stream;
- Backfilling is accounted in the recycling rates while it should be a separated target.

Example Olympic Park London
Ambitious GPP criteria applied to construction projects for the Olympic Park in London included a high percentage of recycled material. This meant that large volumes of recycled aggregates were needed which were not available in the area and had to be transported by ship from Scotland to London. Would the overall environmental performance in this case have been better if locally sourced virgin materials had been used? The answer at this question is that circularity requires a holistic vision of all impacts.

2. Fragmented demand in member states for circular buildings (products and services)

For a circular economy in the construction sector, the whole chain has to develop towards circular buildings, being the final 'product' delivered to the market. Whereas European policies regulate construction products (CPR [11]), member states are responsible for building requirements. As a consequence, they also have their own regulations and policies for GPP and Circular Economy. The policy focus in member states varies significantly. For producers of building materials, a focus on specific sustainability characteristics is important to develop economies of scale. This enables building materials with a high environmental performance to be competitive. The lack of common objectives, indicators, data and the lack of mutual recognition of different approaches could undo progress made to date. This could also lead to distortions in the internal market for professionals in the field of planning, designing, constructing and manufacturing [15].

Some actions have already been announced to break down this barrier. Those regarding CDW are mentioned under the previous barrier "Insufficient quality and quantity of secondary materials". The most important measures to harmonize demand are the JRC project on developing core indicators for the environmental performance of buildings [7] and the Construction Products Regulation (CPR) [11]. Other (private) schemes also play a role in structuring demand. Examples are, building certification schemes such as BREAAM, DGNB and HQE. The market penetration of these schemes is still low. Harmonization should be based on existing standards in this area, like the CEN TC 350 standards for sustainable construction.

The aim of the JRC project on core indicators is to develop a common indicator framework for the assessment of the lifecycle environmental performance of buildings and incentives for use of the framework. One of the focus areas is a resource efficient material life cycle: optimizing building design, engineering and form in order to support lean and circular flows, extend long-term material utility and reduce significant environmental impacts. The core indicators are planned for release in June 2017 [17].

The CPR regulates which and how information on the performance of construction products must be supplied. This is achieved by providing a 'common technical language' based on uniform assessment methods of the performance of construction products. Annex 1 of the Regulation lays down 'basic requirements for construction works' which include specific references to emissions to the environment (BWR3) and the sustainable use of natural resources (BWR7). The BWR7 states that a building should be designed, constructed and demolished in such a way that natural resources are used sustainably. This includes ensuring that materials can be reused or recycled after the building is demolished. The CPR sets the provisions for CE marking of building products. BWR7 is not elaborated yet into specific provisions. This means that it is not clear which product characteristics are relevant for BWR7 while CE-marking of products for BWR7 is not yet possible. The route to an EU-wide standardized methodology for setting up BWR7 is in an early stage. BWR7 could also be used to harmonize aspects in member states and introduce measures regarding resource efficiency [18].

3. Lack of proof of circular concepts and verification methods

The transition towards a circular economy is still in its initial phase and can be characterized as “highly uncertain”: specific targets and measures for the construction sector have not been set, proof of concept is lacking, and sufficient drivers to invest are not there. The direction in which the circular economy is heading is still unclear. The result is that in general the construction sector (as well as public authorities) is somewhat careful and reluctant to start making the transition.

Figure: Examples of circular buildings (Headquarter Alliander, Bullitt Centre.Seattle and town hall Brummen)

Before moving forward, direction (targets), proof of concept, and verification methods are needed. With this, the construction sector can show that a more resource efficient built environment is feasible (proof of concept) and suppliers can prove resource efficiency claims for their products. Several measures are being prepared in this area. Proof of concept is being worked on in EU funded projects (such as H2020). Examples of those are:

- BAMB [19]: investigate, and demonstrate in six pilots, new design, manufacturing, construction and maintenance approaches for dynamic and circular buildings.
- HISER [20]: demonstrate in five pilots resource efficient solutions to increase CDW recovery rates.
- ICROW [21]: develop and validate upgraded technological solutions to achieve efficient material recovery from CDW by considering a life cycle perspective.
- REBUS [22]: pilot and develop resource efficient, resilient, and profitable business models.

Example pilots NZEB buildings
Pilot projects of energy-efficient buildings are important to accelerate progress towards achieving nearly zero-energy buildings (NZEBs), as such projects provide relevant examples and practical experience. There is a public interest in finding out that these types of buildings – or even buildings with higher levels of energy efficiency – are already possible and understanding what they look like, what the cost implications are, the technologies used, user experiences, etc. In these pilot projects, innovative industry organisations can present their products, while advanced designers can showcase their capabilities [29]. The report “Selected examples of Nearly Zero-Energy Buildings” offers examples of various building types in 20 member states.

In some member states (such as UK [31], The Netherlands [24], Germany [31] and France [32]) progress has been made on green public procurement, recycling of CDW, circular buildings or innovative resource efficient concepts. Best practices and examples are available, but hard to find (for other member states). Where there are to be found it appears that two facts prevail: those are in countries where regulations for the disposal of C&DW exist and are enforced, and where there are standards introducing specific measures such as a minimum % of recycled materials (for specific materials such as concrete) to be used in buildings as seen in the Netherlands and Switzerland.

Regarding verification methods, the mentioned JRC project on core indicators can help as well. The aim is that the framework could also be used for assessment of and certification schemes for resource efficiency. Schemes are already available for other product categories and topics, such as the voluntary ecolabel award scheme and the Ecodesign Directive.

4. Insufficient drivers and urgency to improve resource efficiency

Without sufficient drivers, industry will be reluctant to invest significantly in circular concepts and to really adopt circular business models. Also, there needs to be a sense of urgency to get the transition in motion. Suppliers of building materials have indicated in interviews that there are no clear direction (vision) and insufficient incentives to improve resource efficiency in the built environment. Current drivers in the construction sector are predominantly price and technical performance.

Drivers for improving resource efficiency in the construction sector could be:

- Targets for resource efficiency: a strong vision with specific targets for the construction sector on resource efficiency is not present. Industry does not know where to focus on in circular product development.
- Demand through GPP: current demand through GPP for resource efficient buildings (products and services) is minimal according to suppliers of building products. This is caused by the voluntary character and poor implementation of GPP in many member states.
- Mandatory requirements: there are no EU Directives or Regulations prescribing minimum requirements for resource efficiency.
- Competitive pricing: price advantages for circular buildings (products and services) are missing. In the current practice there are mostly disadvantages due to missing economies of scale.

To improve the environmental performance of buildings, the current focus is mostly on enhancing energy performance (also in GPP). Although energy performance is a very important aspect, a more integral life cycle approach is desirable, especially for future nearly-zero energy buildings. This integral life cycle approach would improve the environmental performance of buildings, building further on energy performance as a basis. Policies to enhance energy performance can be used to further improve resource efficiency. A milestone for enhancing energy performance is the EU 2020 package [13]. This package sets (in 2007) three key climate and energy targets for the year 2020. The Circular Economy Package only has targets for recycling rates, not for resource efficiency. Some member states do have targets for resource efficiency for the construction sector (see box below) or prepare for this (like the Dutch requirement to calculate the Abiotic Depletion Potential of the materials in a building for the building permit of new buildings (Netherlands) [33]). Binding energy efficiency measures for buildings are set out in the Energy Performance of Buildings Directive (EPBD) and Energy Efficiency Directive (EED) [16]. This has created a sense of urgency to enhance energy performance. As a result, GPP has a strong focus on the energy performance of buildings. By creating economies of scale, the extra cost for constructing residential buildings with high energy performance as opposed to standard ones has gone from 10 % in 2003 to below 1% today (based on studies in France and the UK) [15].

Examples of targets on resource efficiency in member states (general targets for the economy as a whole) [17]:

- Increase resource productivity by a factor of four (Austria)
- Double abiotic material productivity by 2020 compared to 1994 (Germany)
- Reduce Total Material Requirement (TMR) 75% by 2030 and 90% by 2050 (Italy)
- Reduce annual extraction of natural gravel to not more than 12 million tonnes by 2010 (Sweden)

Recommendations

Based on the barriers identified and the initiatives already set in motion, we recommend two further actions to enhance resource efficiency in the construction sector by using GPP:

1. Develop a platform for GPP and the built environment at EU level with regional networks
2. Investigate synergies between policies driving resource efficiency measures in current policies / regulations for buildings, especially with policies aimed at improving energy efficiency.

These actions can be executed in the short-term and can help break down barriers.

1. Develop a platform for GPP and the built environment

Relevant industry stakeholders (suppliers of building products and the construction sector) and the public sector should be able to participate in the platform. The platform would serve multiple purposes:

- Sharing: Stakeholders could help each other by exchanging information on best practices, effective (GPP) policies, lessons learned, innovations, and more. Many stakeholders are testing new circular concepts, policies, tools or products, as a result of which a better understanding of key success factors for such initiatives is emerging – and worthwhile sharing. Tools such as building passports and BIM are already used by frontrunners. The platform could help to introduce these tools to stakeholders and facilitate further development without risking re-inventing the wheel. Also, some member states public authorities are already very experienced in GPP. They know what works and what does not. These experiences should be easy to find for procurers from other public authorities who might have less experience. Information on those initiatives is often scattered and hard to find. The proposed platform can serve as a central information point where relevant information can be found and shared. Several interviewees have stated that few well-documented pilots and showcases are available at the moment.
- Proof of concept: Industry and public authorities can help each other in creating and demonstrating proof of concept. By asking industry which circular products and concepts are available, public authorities can demand these through GPP without running the risk of asking for something that is not feasible or increasing cost.
- Setting specific targets: By having a common agenda and working together, industry and public authorities can focus on the best ways to improve resource efficiency in the built environment. Ultimately, it will be possible to set specific targets for resource efficiency, which can then be adopted by GPP. Having a clear strategy for the performance of buildings, including short and medium term milestones, should make it easier for GPP to show the way forward, and maximize the exemplarity role public buildings roles can play.
- Defragmentation of the value chain: during the life cycle of a building, various works or services are being procured. Every phase / step in the life cycle is procured separately: contract for design, contract for construction, contract for maintenance, contract for renovation, and contract for demolition. The companies executing the various contracts are not in contact with each other. This hinders tuning of each other's needs and innovation. The platform can help defragmentize the value chain.
- Training: Training of procurers in circular procurement of buildings is essential. There is still a huge difference in professionalism in procurement between member states. This is a barrier to create demand. Training all procurers in all member states however seems impossible. Massive training of municipalities can be done by stakeholders in the market, and is crucial for further roll-out of the available knowledge. GPP training programs should have a regional or national approach because of cultural differences and differences in building techniques.

Criteria documents, to be developed training materials and knowledge-sharing platforms can be supportive to training, but are not sufficient in itself. Alignment between several training and dissemination initiatives on GPP would be helpful for the market to better understand the market needs and harmonize demand. The platform could be helpful in that.

The development of this platform would help to boost circular demand and supply by developing proof of concept and creating drivers for improving resource efficiency in the built environment. What should be kept in mind is that GPP is not a “copy-paste exercise” of best practices because of cultural differences and differences in building techniques. Regional networks may be more successful (comparable climate regions, countries and language), for instance tailored to the stage of development, like the Northsea Resources Roundabout (NL, B, UK) introduced under the Dutch presidency [35].

Existing networks such as nearly zero energy buildings (NZEB) [ref] could be useful [36]. The network could be extended to Nearly Zero Impact solutions. The experience of developing long term building renovation strategies (EED art 4) can be valuable in terms of developing platforms to engage stakeholders over time, to secure a shared vision, and to ensure the full buy-in of those parties who will ultimately implement the strategy.

2. Investigate opportunities for resource efficiency synergies within current policies / regulation

Instead of developing new policies, directives or regulations to enhance resource efficiency in the built environment, it could be more effective to integrate resource efficiency into existing approaches. The current silo approach in policies is not effective for the market, as both energy efficiency and resource efficiency of buildings should be discussed at the same time when designing and renovating a building. Further research to identify opportunities for synergies is recommended. GPP can fulfil a role to make enhancing resource efficiency through synergies happen.

Synergies potentially exist between resource efficiency and other policies and measures:

- Energy performance: In policy terms, energy and resource efficiency are still largely unconnected although there are many potential synergies between the two [14]. The EPBD [10], for example, promotes the improvement of the energy performance of buildings. It applies to new buildings and existing ones undergoing renovation. The Energy Efficiency Directive (EED) [16], requires 3% of the buildings owned and occupied by central government to be renovated each year to at least minimum energy performance requirements, and asks member states to develop long term renovation strategies for their entire building stock.

  Silo thinking is not very helpful. Energy performance and resource efficiency are not separate policy topics but should be dealt with in a consolidated manner by exploring the best synergies, in order for new buildings to perform ambitiously on all dimensions, and for energy renovation to maximize positive impact on circularity. Energy savings and renovation are at the basis of resource efficient buildings, by saving fossil fuels and prolonging the lifetime of a building. Some requirements for enhancing resource efficiency could usefully be integrated into these directives. Particularly since buildings are only being renovated every 30-40 years and therefore ensuring it is done properly and in a holistic manner matters a lot. Some interviewees stated that deconstruction of buildings could become more difficult after renovation (for energy efficiency). So “deconstructibility” criteria for (energy) renovation of buildings are needed. Integration could help securing both the renovation targets and the further needs for recyclability of building products. This requires vision and could be brought to practice through GPP.

- Waste management: Material resource efficiency and waste management are viewed as very closely related issues. This indicates an opportunity to address both themes together, through, for example, the circular economy, the recovery of secondary materials or industrial symbiosis [14]. The Waste Framework Directive could improve resource efficiency by, for example, making the pre-demolition audit mandatory or asking member states to include all recyclable CDW streams in their waste roadmaps. This could be introduced through GPP.
- Core indicator framework: GPP (and existing building rating schemes) can be used to implement the EU framework of core indicators that is currently being developed in such a way that clarifies to the market which indicators are relevant for circular buildings. Implementation of the same indicators in several tools (such as GPP, BIM and BREEAM) will guide the market towards more resource efficient buildings, and the products and services that improve the building's performance.

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