Environmental Product Declarations (EPDs) as a competitive parameter within sustainable buildings and building materials

IOP Conf. Series: Earth and Environmental Science **323** (2019) 012145 doi:10.1088/1755-1315/323/1/012145

Environmental Product Declarations (EPDs) as a competitive parameter within sustainable buildings and building materials

Andersen S C[1, 2, 5], Larsen H F[1, 2], Raffnsøe L[3], Melvang C[4]

[1] EPD Danmark, Gregersensvej, DK-2630 Taastrup, Denmark
[2] Buildings & Environment, Danish Technological Institute, Gregersensvej, DK-2630 Taastrup, Denmark
[3] Green Building Council Denmark, Frederiksborggade 22, DK-1360 Copenhagen, Denmark
[4] MiljøForum Fyn Byggeri, Forskerparken 10, DK-5230 Odense, Denmark
[5] Corresponding author

sara@teknologisk.dk

Abstract. The demand for technical and verified documentation of buildings and building materials is growing, along with the increasing focus on sustainability in the built environment. However, despite a common wish to build sustainably, it is still found that EPDs and LCAs are not always similarly interpreted, leading to misunderstandings on how they should be used to quantify and verify sustainability along with being a competitive parameter when choosing materials.
To overcome this barrier this project seeks to discover:

1. How can EPDs be used as a competitive parameter within the sustainable built environment?
2. How can product specific EPDs, used as an input to building-level LCAs, help to quantify the concept of 'circular economy'?
3. How do some countries seem to succeed in introducing EPDs to industry while others only succeed to a lesser extent?

By involving the Danish building-industry's value-chain through qualitative interviews, workshops and reference groups, as well as by contacting EPD programme operators throughout Europe and USA, a mapping has been performed on the tendencies of how and to what extend EPDs are used to quantify and support material decision-making in buildings. Further, the drivers as to why EPDs are used in some countries is investigated along with suggestions on how to boost the development, use and integration of EPDs with the aim of quantifying and documenting sustainability in the built environment.

1. Introduction

Due to an increasing demand for sustainability in the built environment a natural need for documentation and transparency has evolved – both globally and locally in Denmark [1,2]. In Denmark, while the construction industry is actively seeking a development towards increased sustainability, authorities and the regulatory system are lagging behind and fail to provide a structured, holistic approach to this transition. Therefore, a part of the industry is starting to come up with various individual initiatives and strategies on how to move forward [3,4].

A Danish report from 2017: "Roadmap 2030 – Bygningers rolle I den grønne omstilling" [3] (which roughly translates into: Roadmap 2030 – The role of buildings in the green transition) touches on several matters and suggestions for actions to be taken within e.g. energy consumption, indoor climate and environmental aspects. Being managed by a Danish innovation network for sustainable construction, InnoBYG, the project included a broad variety of stakeholders within the built environment, covering NGOs, universities, consultants, engineers, architects etc.
One of the recommendations made within the environmental considerations was to improve and strengthen the documentation of materials and their impact on building environmental sustainability by performing Life Cycle Assessments (LCAs) that are based on the principles for Environmental Product Declarations (EPDs), and thus measuring embodied energy and environmental impacts. Additionally, they suggest an implementation of a voluntary sustainability classification system within the building regulations of Denmark.

However, despite a common wish to build sustainable, it is still found that EPDs and the underlying LCAs are not always similarly interpreted, leading to misunderstandings on how they should be used to quantify and verify sustainability along with being a competitive parameter when choosing materials.

In Denmark, while the interest in EPDs is rapidly increasing, as well as the number of new EPDs published every year, the total number of EPDs developed and verified so far at the Danish EPD Programme Operator (EPD Danmark) is still clearly in the low end, compared to other European and American EPD Programme Operators. Considering the infographic by Jane Anderson [5], see Figure 1, it is seen that the 'dominating' EPD programmes can be found in Germany, USA, France, Sweden and Norway, i.e. many of the neighbouring countries of Denmark. It is uncertain why this difference occurs.

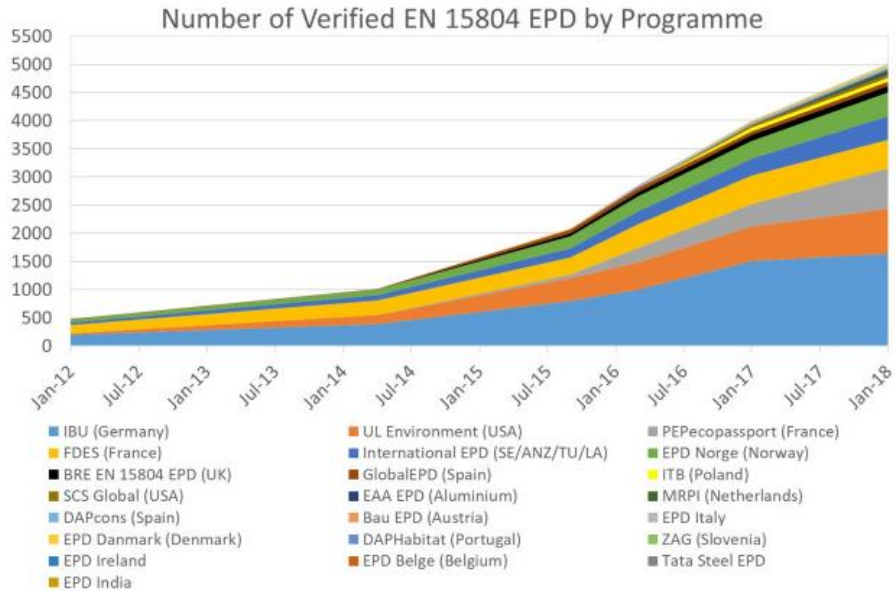

Figure 1. Infographic, showing the numbers of verified EPDs for construction products which align to EN15804 from 2012-2018. Reprinted by permission of Jane Anderson, ConstructionLCA Ltd.

This project aims at defining a consensus for the use and usability of EPDs and their underlying LCAs by gathering knowledge from the industry and provide real-life and practical examples of Danish value-chain stakeholders of the construction industry. Additionally, it is investigated why EPDs seem to be used to a greater extend in some countries and how this has occurred.
The three main questions worked with are thus:

1. How can EPDs be used as a competitive parameter within the sustainable built environment?

2. How can product specific EPDs, used as an input to building level LCAs, help to quantify the concept of 'circular economy'?
3. How do some countries seem to succeed in introducing EPDs to industry while others only succeed to a lesser extent?

1.1. Literature

The main focus of the project was to investigate how EPDs are used by the Danish construction industry and value chain, through inclusion of stakeholders. However, to define a starting point of the study, a preliminary literature study was performed. The results are shown below.

A study considering some of the aspects in question was done by the Green Building Council in Iceland (IGBC) and a Nordic project group, consisting of Norway, Sweden, Iceland and Finland [6]. The project conducted two surveys, representing stakeholder groups of respectively building owners/consultants/contractors and producers/providers of building products, in the summer of 2015. The report points at the lack of market demand as one of the main obstacles for the use of EPDs. The study found that the first group of respondents (building owners, consultants and contractors) did want fairly more information on environmental impacts of building materials. Other obstacles, beside lack of market demands, were pointed out, such as lack of knowledge about the documentation, high costs and lack of synchronisation of EPDs. This is agreed upon, when considering the second group of respondents in the study by IGBC (material manufacturers).

Ibáñez-Forés et al. (2016) [7] who investigated the barriers towards use and implementation of EPDs in the construction industry, confirmed the findings of the above study by IGBC. Identified barriers included a general lack of knowledge about EPD programs and content of EPDs, the cost of developing the LCA (i.e. the basis for the EPD), lack of international standardisation, and the fact that the content of EPDs can be hard to read for non-specialists [7]. Among the advantages mentioned by Ibáñez-Forés et al. (2016) are the possibility for manufacturers to communicate verified environmental information objectively, thereby also proving their interest in transparency, improve their corporate image, and achieving better knowledge of production processes [7,8]. The latter was additionally observed through the fact that 90% of the manufacturers having an EPD of their product were also enrolled in a voluntary environmental management system [7].

Similar incentives were identified by Passer et al. (2015) [9]. The main advantage identified by the authors was that EPDs are recognised as a feasible format for communication of environmental claims, requirements and demands, facilitating their export market development [9].

In general, main drivers for EPDs have in several studies/mappings been mentioned to be building certification schemes [6,8–11], e.g. HQE, Green Star, LEED, BREEAM and DGNB, being some of the most well-known and applied schemes – some of them having national editions to allow for country-specific aspects to be taken into account.
Many of these certification systems have included either direct (EPD) or indirect (building-LCA) requirements in their guidelines and criteria [8], for example:

- LEED has criteria within their 'Materials & Resources' category, that assign credits when applying LCA to prove building life-cycle impact reductions and when using materials which hold an EPD [12].
- BREEAM also allocates credits for criteria about life cycle impacts through the use of LCA and EPDs in the materials section. However, the weighting differs across national editions of the certification scheme, e.g. considering the international, UK and Norwegian editions [13–15].
- DGNB has national editions in some countries, thus the specific criteria may differ from country to country. The Danish version of DGNB contains criteria for both inclusion of EPDs and LCA, weighting respectively 1,5% and 13,5% (considering LCA for both environmental impact

categories and primary energy, representing respectively 7,9% and 5,6%) of the total score [16]. Considering the German DGNB, 'only' LCAs are credited, weighting 9,5% of the total score [17].

Other incentives to develop EPDs mentioned by the literature are Green Public Procurement (GPPs) plans, which are voluntary tools that aim at stimulating the market demand for 'greener decisions' [18]. The voluntary EU-GPP for '*Office Building Design, Construction and* Management' [19], prescribes mandatory LCA-based criteria [18] which can be based on EPDs of main building elements. However, as mentioned in Ibáñez-Forés et al. (2016), the incentives from governmental instances are quite low [7].

A study performed in 2015 by Passer et al. [9] reviewed and discussed the experiences with EPDs in European countries in the past 5-10 years. The review was based on an EPD workshop which was held prior to SB13 Graz conference and reviews the European status of the use and application of EPDs. Alongside a list of current (as per 2015) EPD programmes, authors looked into what is done specifically in five European countries (Austria, Belgium, Germany, France and Switzerland – however the latter not having an official EPD programme) and how EPDs are used, developed and applied. While all five countries follow the European standard for EPDs EN15804 as well as ISO14025, some of them have additional requirements and legislations, incentivising the use of EPDs. An example is Belgium, where the Royal Decree on Environmental Messages [20] imposes modules A4, C and D as obligatory as of 2017 [9], in addition to those already prescribed by EN15804 (A1-A3). In France, the EPD programme (INIES) combines Environmental and Health product declaration (EHPD, in French FDES) [9]. Additionally, the French national appendix for EN15804 set up requirements to include toxicity and ecotoxicity along with sanitary and comfort requirements, in order to conform with existing national requirements/standards. As of 2014 a further decree prescribes that manufacturers wishing to make environmental claims about their product need to support their claims through a cradle-to-grave EPD [9].

According to Sariola and Ilomäki (2016) [21], the Finnish EPD programme (RTS EPD) has set out additional requirements to the included LCA modules for an EPD, namely that modules A4, C1-C4 and D need to be included [21].

1.2. EPDs in Denmark

The programme operator for EPDs in Denmark is EPD Danmark. Currently there are more than 30 EPDs registered, covering 80+ products.

While the largest incentive for EPDs in Denmark is building certification, and specifically the Danish version of the German building certification scheme, DGNB, other incentives are actions from public instances, such as municipalities (e.g. Aalborg [22] and Copenhagen [23]) or partnerships where various public instances commits to follow a Green Public Procurement having outlined a Green purchasing method.

While Denmark does not have any direct requirements or legislation about the use of LCA and EPDs, the construction sector is willing to improve and drive sustainability further. One of the initiatives is a voluntary add-on to the Danish building code, to classify buildings according to their overall sustainability level [4]. The system, which has been proposed and recommended by the construction industry itself, does not have a clearly defined format yet. However, one of the suggested parameters is the development of building LCAs, which should preferably be based on EPDs.

2. Method

Apart from the preliminary literature study, the project aimed to seek answers through stakeholders and implementation of real-life practice. This has been done through qualitative interviews, workshops and meetings with a reference group. Furthermore, the aspect of discovering as to why other programme operators seem to meet a greater demand for EPDs than experienced in Denmark, the project group has interviewed EPD programme operators throughout Europe and USA, certification bodies and Danish consultancy companies working internationally.

2.1. Qualitative interviews

The qualitative interviews where performed by setting up a list of questions specific for each interviewed group along the value-chain: consultants (architects and engineers), contractors, builders, manufacturers, public authorities and technical organisations (i.e. programme operators and certification bodies).

Due to the natural focus of the project on the building materials and competitivity effects as a consequence of the use of EPDs, the main group of interviewees were found within the manufacturers of building materials, as illustrated in Figure 2.

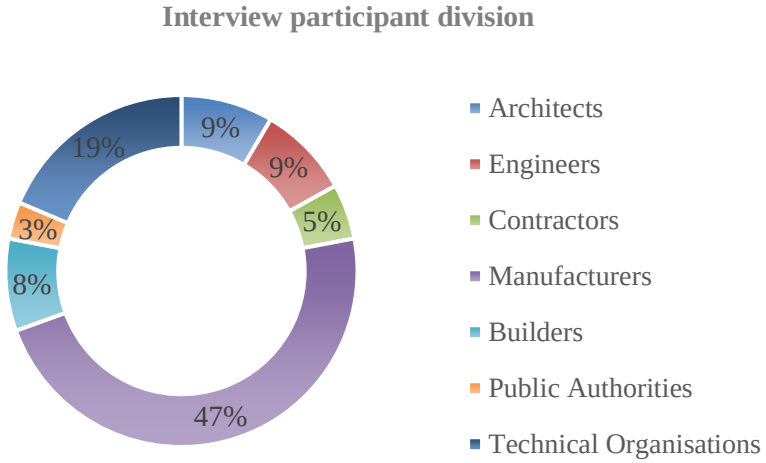

Figure 2. Interview participant division

The method was not strictly scientific, due to a limited number of participants (~60), however it does give an indication of the obstacles and opinions about EPDs and constitute a valuable starting point for further discussion at workshops.

2.2. Workshops

Throughout the project period, two workshops were held, where the building industry was invited across the value-chain. The topics of the workshops were respectively:

- EPDs as a competitive parameter
- Circularity in the built environment and documentation (with a focus on whether and how EPDs might be used)

As the invitation for the workshops were public, a broad spectre of participants showed up to discuss the given topic – some of them had previous experience with EPDs and some were new to the topic, wanting to expand their knowledge.

The workshops were used to discuss and analyse the qualitative interviews, extrapolate common tendencies, and investigate the underlying hypotheses. Additionally, guest-speakers provided their perspectives to the questions asked and gave input for further discussion to qualify the output.

2.3. Reference groups
Reference groups were used to provide opinions and guidelines to the questions asked in the project, along with supporting development of, and discussing, preliminary results before their publication.

2.4. Format of results
The main project outcome was a booklet of real-life examples (published in spring 2019 by EPD Danmark) referring to the Danish construction sector, explaining how and why EPDs should be used.

The results in this project cannot be divided into results found from one of the individual investigation methods, as the discussions were iterative and summed up all thoughts and angles found throughout. The results (which correspond to the content of the booklet) are presented in the following section, including the identified tendencies and a discussion on how to improve the understanding and increase the use of EPDs as a documentation for environmental sustainability in the built environment.

3. Results & Discussion
As the project put up three main questions to be investigated, the results are presented coherently. However, as mentioned earlier, the answers and conclusions mix, which is why the discussions will overlap in between the project questions.

3.1. EPDs as a competitive parameter
An initially observed tendency showed that many stakeholders throughout the value-chain of the Danish construction industry did not find EPDs to be a competitive parameter. However, when putting up a hypothesis on this initial finding, arguments against this were made, summing up the value of getting an EPD depends on the definitions of value.

When added value and increase in competitiveness was defined as a 10% increase in the producers' customers portfolio, it was a common conclusion that EPDs could not be considered to have *direct* value. However, several stakeholders recognised the value of having EPDs when considering:
- The knowledge obtained by the manufacturer about a product, when utilising the LCA lying behind an EPD.
- The willingness from the manufacturer's side to be transparent about their products and processes, and their impacts on the environment.

Other mentioned that the value and ability to use an EPD as a competitive factor was dependent on the type of customer for the specific product. There was broad agreement about the fact that EPDs are not highly rated by general customers as much as other parameters, such as price, aesthetics and durability. However, if aiming to sell and distribute materials and products for larger construction projects (e.g. tenders from public authorities and large investment companies), there was a clear increase in the demand for documentation – especially for sustainability claims.

This again supports the perception that EPDs themselves are not the 'value', however the knowledge obtained about the product, through an LCA, and the willingness to be transparent about the product were. The EPD is thus 'only' the document that sums up the facts.
Thus, an EPD cannot provide value to the 'unknowing' and 'unenlightened' customers, as they do not have the tools to utilise the potential behind the EPD.

However, even though arguments in favour of EPDs and their possibilities appeared, there is still a cold fact that only front-runners have, and use, the EPDs. Recurring reasons for this were identified

as the cost of developing an EPD, lack of a requesting market when looking at tenders and a general lack of knowledge.

While the cost of getting an EPD might not be easy to reduce, due to the elaborate work going into developing the LCA at its basis (even though recent development within digitalisation and automation might shift this), issues about lack of demand and knowledge can be offset – and this might in the end also affect the cost of developing EPDs.

At current, the main, and virtually the only, driver for EPDs is building certification schemes. This lack of demand often leads to the industry pointing fingers at each other. The manufacturers keep repeating that they do not see a reason for getting EPDs for their products if the builders do not request them in e.g. tenders. On the other hand, builders say they cannot see a reason for demanding them, as there are not enough EPDs to accommodate this demand in tenders. Thus, there is a need for all stakeholders in the building industry to move simultaneously, as they all demand sustainability, but no-one appears to really move. Some stakeholders also point to the authorities when discussing who needs to make the move. This can be either authorities themselves, who put out requirements in their own tenders (as they often own large projects), or to legislate on the industry, e.g. the previously mentioned sustainability classification that the Danish construction industry suggested to be introduced in the Danish construction code, similar to the existing (and successful) operational energy classification regulations. Future implementation of the 7th basic requirement (BRCW7) of the Construction Products Regulation (CPR) regarding sustainable use of resources and related to the CE marking and Declaration of Performance (DoP) may increase the demand for LCA data on building products substantially.

Considering the lack of knowledge about EPDs and implied also the view on cost of EPDs, there is a clear need for more and better information about the groundwork, e.g. guidance on how to read an EPD or a general informative campaign on the added value gained through the LCA, which is the backbone of the 'bought' EPD.

3.2. EPDs as input to quantifying 'Circular economy'

The increasing focus on resources and 'circular economy' in Denmark [24] has led to initiating a discussion on how to quantify these concepts and the potential of using EPDs for this purpose.

While there was a general consensus about that fact that EPDs do not provide any specific information about circular economy, several participants throughout the project mentioned that EPDs might be used in building-level LCAs. This could have a significant effect with respect to circular economy, if the EPDs include the LCA phases about End of Life (EoL, C1-C4) and potential for Recycling (D). These phases may enable a verified and quantified knowledge about EoL and resource management.

A recurring issue was however how to define the LCA phases C and D. While the intentions (increased documentation and transparent quantification) are seen as positive, several stakeholders, throughout the project, questioned the assumptions for EoL and recycling potential scenarios and the accuracy of the relevant data.

Well aware that this issue is part of a broader discussion throughout the industry and also the LCA communities (researchers, practitioners), the project group and the stakeholders recognised that we have at the current state little or no knowledge at all on how we will handle building demolition in 50-100 years (if not even longer) and how materials will be treated. It is therefore only possible to base the LCA phases C and D on today's know-how and practice, which is a significant limitation. It is difficult to say whether this will hold true, however we reasonably expect that today's 'standards'

will be conservative compared to what will be possible in the future. In general, there was common agreement, that documenting something and making necessary assumptions, although uncertain is better than ignoring these phases. In the coming revised version of EN 15804 (expected to come into force this summer, 2019) the inclusion of the phases C and D is mandatory (due to adaption to the EC PEF scheme, i.e. EU Single Market for Green Products).

The discussion focused also on the current practice for modelling EoL and regulatory challenges regarding waste handling were pointed out, calling out for authorities to take actions and lead the industry. Considering clear differences in e.g. cost of landfilling vs. recycling/reuse, regional waste management fees and the fact that manpower for selective demolition and proper dismantling for recycling is more expensive than new materials, the incentives to 'choose circular' are not necessarily supported, according to the Danish construction industry.

3.3. Use and demand of EPDs outside Danish borders

One of the research questions driving the project was why the amount of EPDs registered and used in Denmark was significantly lower than in neighbouring countries. An important consideration, which represents part of the answer, was made by several manufacturers. While they acknowledged that not many EPDs are registered by EPD Danmark, the Danish EPD Programme operator, compared to other countries, more EPDs exist from Danish manufacturers. For various reason these may just not be registered at EPD Danmark – some argue due to a large export market for which reason they've placed their EPDs where their buyers are, other already worked with environmental documentation even before EPD Danmark was established in 2014, for which reason their EPD is placed with other programme operators.

The lack of registered EPDs by EPD Danmark might thus support the argument discussed earlier, about a lack of incentive driven by a demand in the Danish construction industry, whereas countries like Germany, Norway and the UK have had better success in creating incentive – e.g. public procurement, regulation, building certification schemes and knowledge and requirements of documentation about environmental claims.

4. Conclusion and recommendations

The current project investigated the conditions for and the use of EPDs within the Danish construction industry. The project results confirm that most conditions and obstacles found in studies conducted between 2015 and 2018 still account as barriers. The most dominating ones include lack of demand from the authorities and builders, expenses for the LCA/EPD and lack of knowledge about how to document sustainability in the built environment. These barriers need to be addressed in order to strengthen the competitive power of EPDs within the Danish building sector.

Funding

This project has been supported by two Danish foundations: Grundejernes Investeringsfond and Bolig-fonden Kuben.

Acknowledgements

The project has been helped by contributors throughout the Danish construction industry and EPD programme operators throughout Europe and the US, by allocating time for interviews, workshops and conferences.

References

[1] Qvist M 2018 Debat: Tredjeparts-mærkning skal sætte skub i bæredygtigt byggeri *Altinget, By & Bolig, https://www.altinget.dk/by/artikel/debat-tredjeparts-maerkning-skal-saette-skub-i-*

baeredygtigt-byggeri, last accessed 24.05.2019
[2] Uhd T 2017 Hvornår er byggeri bæredygtigt? *Licitationen, https://www.licitationen.dk/article/view/568729/hvornar_er_byggeri_baeredygtigt, last accessed 23.05.2019*
[3] Energifonden 2017 *Roadmap 2030 – bygningers rolle i den grønne omstilling* ed L H Mortensen, N N Rasmussen and S Aggerholm, *https://www.innobyg.dk/media/75132/roadmap-rapport_final.pdf, last accessed 23.05.2019*
[4] InnoBYG 2018 *Frivillig bæredygtighedsklasse i bygningsreglementet - Oplæg fra byggebranchen* ed L H Mortensen, K Kanafani and S Aggerholm, *https://www.innobyg.dk/media/75595/frivillig-baeredygtighedsklasse-br-18_final-rapport.pdf, last accessed 24.05.2019*
[5] Anderson J 2018 EPD numbers continue to increase… *ConstructionLCA Ltd.*
[6] Icelandic Green Building Council 2015 WP 3: Survey results - Knowledge and demand of EPD *Nordic guide to sustainable materials* ed S B Jónsdóttir, B Marteinsson and H J Bjarnadóttir (Reykjavík: IGBC)
[7] Ibáñes-Forés V, Pacheco-Blanco B, Capuz-Rizo S F and Bovea M D 2016 Environmental Product Declarations: Exploring their evolution and the factors affecting their demand in Europe *J. Clean. Prod.* **116** 157–69
[8] Shepherd D D 2016 Environmental Product Declarations - Transparency reporting for sustainability *2016 Ieee-ias/pca Cem. Ind. Tech. Conf.*
[9] Passer A, Lasvaux S, Allacker K, De Lathauwer D, Spirinckx C, Wittstock B, Kellenberger D, Gschösser F, Wall J and Wallbaum H 2015 Environmental product declarations entering the building sector: critical reflections based on 5 to 10 years experience in different European countries *Int. J. Life Cycle Assess.* **20** 1199–212
[10] De Wolf C, Pomponi F and Moncaster A 2017 Measuring embodied carbon dioxide equivalent of buildings: A review and critique of current industry practice *Energy Build.* **140** 68–80
[11] Secher A Q, Collin C and Linnet A 2018 Construction Product Declarations and Sustainable Development Goals for Small and Medium construction Enterprises *Procedia Cirp* **69** 54–8
[12] U.S. Green Building Council 2019 LEED BD+C: New Construction *LEED v.4.1*
[13] Building Research Establishment Environmental Assessment Method (BREEAM) 2016 Technical manual SD233 2.0 *BREEAM Int. New Constr. 2016*
[14] Building Research Establishment Environmental Assessment Method (BREEAM) 2018 9.0 Materials *BREEAM New Constr. 2018*
[15] BREEAM Norway 2016 Technical manual SD5075NOR *BREEAM-NOR New Constr. 2016*
[16] Green Building Council Denmark 2016 *DGNB-manual for etageejendomme og rækkehuse* (Copenhagen, Denmark)
[17] German Green Building Council 2018 Grundstruktur des DGNB Systems *DGNB Syst. - Kriter. Gebäude Neubau*
[18] Ganassali S, Lavagna M, Campioli A and Saporetti S 2018 Green Public Procurement and Construction Sector: EPD and LCA based benchmarks of the whole-building *Designing Sustainable Technologies, Products and Policies* ed E Benetto Gericke, Kilian, Guiton, Mélanie (Springer International Publishing) pp 503–13
[19] European Commission 2016 *EU GPP criteria for office building design, construction and management* (Brussels)
[20] The Belgian EPD Programme B-EPD 2017 The Royal Decree on Environmental Messages *Fed. Public Serv. Heal. Food Chain Saf. Environ.*
[21] Sariola L and Ilomäki A 2016 RTS EPD's - Reliable source of environmental information of building products in Finland *Energy Procedia* **96** 77–81
[22] Aalborg Kommune 2015 Bæredygtighedsmanual for nybyggeri, *https://www.aalborg.dk/media/3998769/01-aalborg-kommune-manual_nybyggeri.pdf, last accessed 27.05.2019*

[23] Københavns Kommune 2016 Miljø i Byggeri og Anlæg 2016, *https://www.kk.dk/sites/default/files/mba2016_kravliste_kkbyggeri_170301.pdf, last accessed 27.05.2019*

[24] Miljø- og Fødevareministeriet and Erhvervsministeriet 2018 *Strategi for cirkulær økonomi - Mere værdi og bedre miljø gennem design, forbrug og genanvendelse*