construction products association

APPLYING EXTENDED PRODUCER RESPONSIBILITY IN THE CONSTRUCTION SECTOR

A DISCUSSION PAPER

Abstract

The more efficient, wiser use of natural resources coupled with waste reduction is a goal of many governments, including the UK (Resources and Waste Strategy, 2018). Given that the built environment represents the largest material flow and the greatest waste stream in volume terms in the UK (though 90% of construction waste – mainly mineral products such as bricks and concrete and excavated soil and stones - is recovered annually (Defra Waste Stats) then construction waste always comes into focus in any considerations of national waste reduction either for better resource use, and/or in the context of decarbonisation or implementing a circular economy. A range of policy interventions are available to governments from regulation to incentives (taxes etc) and innovation. There is an emerging debate now amongst policy makers whether the concept of Extended Producer Responsibility (EPR) could and should be extended out to a wider range of products including construction products. This discussion paper seeks to explore the applicability of the concept of EPR to construction products - is it applicable to all, to some, or no products at all - and whether any general principles to guide potential application can be identified.

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Introduction

The more efficient, wiser use of natural resources coupled with waste reduction is a goal of many governments, including the UK (Resources and Waste Strategy, 2018). One of the tools used to reach this goal is Extended Producer Responsibility (EPR) in the form of regulation.

According to the OECD[1], "Extended Producer Responsibility is a concept where manufacturers and importers of products should bear a significant degree of responsibility for the environmental impacts of their products throughout the product life-cycle, including upstream impacts inherent in the selection of materials for the products, impacts from manufacturers' production process itself, and downstream impacts from the use and disposal of the products. Producers accept their responsibility when designing their products to minimise life-cycle environmental impacts, and when accepting legal, physical or socio-economic responsibility for environmental impacts that cannot be eliminated by design."

Extended Producer Responsibility is applied in a variety of policies and regulations which transfer financial and / or physical responsibility for management of waste products from local government and the general taxpayer to the producer[2]. The overarching objective is to provide an incentive for the producer to consider durability, reparability, reuse, disassembly and product recycling in the course of product design. Control and reduction of hazardous substances through separate waste collection and/or eco-design are also sought. There is a debate now amongst policy makers whether to extend the application of EPR to additional product groups including some construction products.

This document is intended to inform the debate - both within the sector and between industry and government - about the relevance of EPR to the construction products sector and about where it might be sensibly applied in the sector. To do that, it reflects on the application of EPR in other sectors before highlighting some general principles and practical considerations specific to the construction sector that could guide the effective application of EPR there.

EPR in Existing Regulations

EPR has long been present in EU waste strategy (as far back as the 1989 'Community Strategy for Waste Management'). EPR is - notably - implemented through a group of EU directives referred to as "waste stream directives"[3]. These cover Packaging and Packaging Waste, Batteries and Accumulators, End of Life Vehicles (ELV) and Waste Electrical & Electronic Equipment (WEEE). EPR schemes for a variety of other products also exist in some European states, either as voluntary schemes or implemented through national regulation[4]. In practice, each aims to move the management of wastes from a particular industry sector up the waste hierarchy (Fig.1). For most, the focus is on post-consumer (end-of-life, EoL) waste.

1. http://www.oecd.org/env/waste/factsheetextendedproducerresponsibility.htm Greenpeace also proposed a similar definition: EPR is "the principle that producers bear a degree of responsibility for all the environmental impacts of their products" (Greenpeace's Briefing on Extended Producer Responsibility, 1995)
2. Some voluntary schemes and industry self-regulation schemes implement EPR to varying degrees. Output-based targets and performance monitoring are important constituents of any effective programme.
3. Directive 94/62/EC on Packaging and Packaging Waste End of Life Vehicles; Directive 91/157/EEC on Batteries and Accumulators; Directive 2000/53/EC on End of Life Vehicles; Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE); Directive 2002/95/EC on the Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS).
4. Several are listed on p.32 of "Development of Guidance on Extended Producer Responsibility (EPR) Final Report" V.Monier et al, European Commission - DG Environment 2014

All of the EU waste stream directives contain specific, quantitative targets for rates of recycling & recovery, expressed as percentages of waste and/or product placed on the market. Additional targets for removal of particular hazardous substances have been included in some of them, as well as qualitative objectives relating to prevention and re-use. All have been in operation for some years and have been subject to review and / or evaluation[5]. Some points are worth noting:

- "responsibility" can be divided into responsibility to pay and responsibility to act
- "producer" is interpreted in different ways for the purposes of implementation: as the final producer of the finished good (e.g. End of Life Vehicles) or as a collective of actors along the value chain (packaging). This reflects EPR's overarching aim of influencing product design, over which bulk material producers, component manufacturers, finished product makers and other actors such as retailers have different levels of control.
- the concept of "product" itself is applied flexibly: few people would probably think of packaging or many non-edible oils as being finished products in the way that a vehicle is.
- data collection (both to establish targets and monitor progress in meeting them) poses significant challenges, even in the case of vehicles, which are all registered by a central authority. Existing classifications used for official statistics are a consideration; for example battery production is covered by a 4-digit NACE code and waste batteries are also covered by just a few codes in the European Waste Catalogue (EWC); packaging wastes and final producers of packaging can also be identified with relative ease in these statistics.
- defining the boundaries for these product types is not straightforward. Questions arise such as: is a toothpaste tube packaging or an essential part of the product? Are socks that play Christmas carols electrical & electronic equipment or clothing? Are scooters with electric motors vehicles? And so on.
- improvements in recycling and recovery have been achieved as a result of all the waste stream directives.
- there is some evidence that waste has been "prevented" - for example by lightweighting of packaging - and that packaging re-use has possibly decreased rather than increased. But these aspects are particularly difficult to measure; one study concluded that "there is no clear evidence of a strong positive impact of EPR on the ecodesign of the products[6]".

Buildings And Construction Products

EPR therefore has a track record, and existing examples show that an EPR scheme needs careful design that takes account of the nature of the sector, market and product to which it applies.

The construction sector is complex. If we think of buildings as products in their own right, then clearly they contain multiple materials and products (or components). The same can be said of cars, but buildings and infrastructure exhibit a much wider variety of typologies than even all road vehicles: i.e. homes, schools, offices, factories, roads and airports are hugely diverse "products".

5. For example: Final Report, Ex-post evaluation of certain waste stream Directives, S. Mudgal, M. Van Acoleyen et al., European Commission – DG Environment, April 2014; report of the Joint workshop on "all WEEE flows" European Commission, DG Environment & DIGITALEUROPE, February 2017
6. p.23 of "Development of Guidance on Extended Producer Responsibility (EPR) Final Report" V.Monier et al, European Commission – DG Environment 2014

Buildings & cars: how much alike?

Buildings and cars are both relatively long-lived (compared to packaging and batteries); although of course buildings typically exist for decades longer than the average car. Both have permanent structural elements and more easily-changed superficial elements; both need regular maintenance that involves changing or renewing materials and/or components; steel, aluminium and glass are widely used in both; both are the final physical output of extensive supply systems. So it may be tempting to think that EPR for End-of-Life vehicles offers a useful model for EPR in the construction sector.

But these similarities only go so far. The structures of the respective supply systems are in stark contrast: automotive supply-chains are tightly integrated in stable configurations with rather few major firms at their heads. As well as the greater diversity among buildings and pieces of infrastructure than among vehicles, there are thousands of diverse businesses in the construction sector. Construction supply systems are flexible and commonly renewed for each project; decision-making is much more dispersed. Design decisions that might influence the potential for reparability or upgrading, disassembly and product recycling, and overall durability are taken at many points in the construction value chain, and often many steps away from a manufacturer.

What characteristics of the construction sector might be relevant to EPR application? Numerous questions arise when we try to transfer to this sector the thinking that underpins EPR schemes in other sectors. These questions raise substantial conceptual and practical issues:

What is the product?

- Each of the goods referred to as a "construction product" ultimately forms part of a larger product, or system, i.e. a building or other structure; the construction product is a component with a function within that system (to deliver a required performance), just as a wheel or a seat is a component with a function within a vehicle.

Who can influence durability, reparability, reuse, disassembly and product recycling, and who should be responsible for the product as waste?

- If an owner of an office or retail space decides to reconfigure a building space after a few years' use in order to change its image, then "construction products" may become waste before the end of their designed service life. The original manufacturer who selected that service life is not involved in the decision that prompted the waste to arise; the building owner or another actor may need incentivising to ensure re-use or material recycling.

Is EPR applicable across the construction sector and/or all construction products, or just to some elements?

- The products used in buildings are very diverse, ranging from simple materials that occur in nature (timber) to complex chemical blends (coatings, adhesives); from formed single materials (steel beams) to multi-component engineered assemblies (doors, HVAC systems); from those with densities of around 10kg/m3 (loft insulation) to those with densities over 2500kg/m3;
- These products are combined, in some cases irreversibly with chemical or physical transformation, into buildings;

- Completed buildings include many products that are not defined as "construction products" in regulation, for example as in the EU Construction Products Regulation;
- Some - possibly many - factories making products used in buildings make products used in other applications too. For example, wood panel materials like chipboard and MDF are used in buildings, but also in furniture and other products;
- Some products and materials can be substituted by others from different supply systems; for example glazed doors and doors made from other materials can fulfil the same function (within certain limits).

Which waste streams should be monitored?

While EPR schemes focus on products, the monitoring of their progress relies almost entirely on data about wastes.

- Construction, demolition and excavation (C,D&E) waste as measured is mostly comprised of excavated material (mass basis[7]).
- In the UK C&D waste recovery is greater than 90%, with local use as aggregate being important, even when excavated material is omitted[6]. Across Europe as a whole recycling / recovery rates range from c.10% to >90%, with an average of approx. 50%.
- Once the fraction fit for re-use as aggregate is removed from the total mass, C&D waste is heterogeneous, and includes the various products present in buildings that are not defined "construction products".
- In upstream manufacturing, wastes associated with manufacturing of products destined for construction may be indistinguishable from waste associated with products destined for other applications. So while all waste from a plasterboard factory may be from the upstream end of the construction supply chain, wastes from a wood panel factory construction could be associated with the construction supply-chain or the furniture supply chain, and will likely be classified - for statistics purposes - using the European Waste Catalogue code 03 01 xx, whatever the panels are used for.

In light of the above factors, are there principles that can be identified to determine where EPR is an appropriate regulatory tool, and guide the design of any scheme?

Principles & Objectives

Before considering the practical implications of the construction sector's characteristics, some high-level direction is needed for an EPR scheme, as with any policy tool. Taking account of the overall aims of environmental policy and EPR as well as reported experience[10], a few general principles should govern design of EPR initiatives:

1. Incentives generated in any EPR scheme in the construction sector must apply to those who have control over relevant decisions.

For example, consider window glass; it is recyclable, and there are significant environmental benefits associated with glass recycling as long as there is capacity available to re-melt it. It is said that window glass is seldom removed separately from commercial buildings when they are demolished, because of

6. p.23 of "Development of Guidance on Extended Producer Responsibility (EPR) Final Report" V.Monier et al, European Commission – DG Environment 2014
7. Mineral Products Association "From Waste to Resource" MPA 2019

time constraints and labour costs. Therefore if an objective is to increase glass recycled from current C&D waste, then incentives need to apply to those who make decisions about deconstruction and demolition. If an objective is to change window design to enable easier glass removal in future, then an incentive needs to apply to those who make/design windows and decide how glass is sealed into them. Incentivising window-designers is very unlikely to change current deconstruction & demolition practice; incentivising decision-makers for deconstruction & demolition may influence window-designers if cost signals feed back through building owners.

2. EPR in the construction sector should seek the most environmental benefit for the lowest possible cost[8] on the chosen timescale.

Life cycle assessment (LCA) is an indispensable tool for determining what - if any - environmental benefits are associated with particular End of Life (EoL) options, and whether any change involves the shifting of environmental burdens from one receptor to another. For example, recovery/recycling of some components is likely to be environmentally-inefficient by some, or even all, routes; low-density dirty materials such as end-of-life plastic wastewater pipes or loft insulation either need highly distributed first-stage processing or introduce high environmental burdens to the life cycle if transported "as is", while using waste glass as a substitute for aggregate has very little benefit and removes this "decarbonated" material from circulation[9].

Scheme costs are also an important consideration to enable this principle to be followed, of course. The 2014 study for the European Commission found that the fees paid by producers do not always reflect the full costs of the schemes, and also noted that "the best performing schemes are not the most expensive"[10].

3. Fair competition must be maintained

Life cycle assessment (LCA) is an indispensable tool for determining what - if any - environmental benefits are associated with particular End of Life (EoL) options, and whether any change involves the shifting of environmental burdens from one receptor to another.

Having established these principles, it should go without saying that any EPR scheme needs to have clear objectives. For any scheme tackling the very long-lived final products of the construction sector (buildings) those objective(s) must acknowledge the time lag between a construction product being made and it becoming waste. That time lag varies from a few years for internal fittings to a few hundred years for some durable structural materials. Different objectives that can be imagined are:

- to direct resources into current waste management systems;
- to drive short-term change in the management of a certain category of waste;
- to deliver a particular environmental benefit (for instance "carbon" savings) on a defined timeframe;
- to influence product design so that reparability or upgrading, disassembly and product recycling are facilitated and durability optimised in the longer term

Initiatives will surely need different design according to whether long-term or short-term objectives are primary.

8. this principle echoes the concept of "Best Practicable Environmental Option" introduced by the Royal Commission on Environmental Pollution (RCEP, 12th Report, 1988)
9. the removal of CO_2 from minerals to produce glass is energy intensive and also releases the CO_2 itself. Once the process has been done, it is desirable to retain the "value" now embedded in the material. So, for example, WRAP's extensive review in 2007 of LCAs evaluating waste recycling found no benefits associated with glass recycling into both aggregate and water filtration media
10. "Development of Guidance on Extended Producer Responsibility (EPR) Final Report" V.Monier et al, European Commission - DG Environment 2014 p20

Policy instruments for waste minimisation

The OECD identified six different policy instruments that can drive waste minimisation:

- Product take-back: producers are required to take back EoL products
- End-of-life waste management fees: the final owner pays a fee for management of EoL products
- Advance disposal fee: a tax or charge is levied when the product is sold to reflect the cost of managing EoL products
- Mandatory deposit-refunds: a deposit is levied when the product is sold, and refunded when the product is returned to a collection point
- Recycling incentives: measures to stimulate recycling markets, such as subsidies to collectors, reprocessors or users of recycled materials, or minimum recycled-content regulations

Product Characteristics & EPR

Returning to the challenges posed by the multiplicity of materials & products present in buildings, the complexity and diversity of buildings as products, and the great variety in construction supply systems, what opportunities are there to clarify these aspects to facilitate the design of any EPR scheme?

Construction products can potentially be clustered into groups with particular characteristics which may facilitate discussion of the relevance or not of an EPR scheme, what sort of objective (in terms of which move up the waste hierarchy and what timeframe) might be relevant, and where attention might be focused - particularly if the objectives are longer-term and include those relevant to the circular economy. The following characteristics certainly merit consideration:

a) Material value

b) Performance availability & warranty

c) Material accessibility

d) Installed lifetime

e) Energy & eco-balance

There is some overlap and interconnection between these, and some might argue that value is at least a partial proxy for many of the others. Nevertheless they merit individual examination, which is undertaken in the sections that follow.

a) Material Value

Clearly, higher value provides a higher incentive for recovery and recycling. Higher-value materials are more likely to be recycled already, courtesy of market factors. Steel (along with aluminium and other metals) is the obvious example: the industry states that over 90% of structural steel is recycled, while around 6% is re-used[11]. So to bring additional environmental benefit, an EPR initiative aimed at steel would probably need to promote re-use (but see the discussion about performance availability in the next section).

Value questions?

Is there sufficient difference between the financial return from recycling and the financial return from re-use to cover the potential additional costs?

Are there high-value materials in C&D waste that are not being recycled already? If so, there is clearly potential for "market forces" to drive that up; what is the barrier? Is it a consequence of accessibility (see below)? If so, can that be addressed by eco-design?

Lower-value materials are less likely to be recycled already, although the aggregates levy-landfill tax combination has created an incentive structure that encourages high recycling or recovery of mineral-based materials for aggregate use; of course this is more attractive where transport costs can be saved too.

b) Performance Availability / Warranty

The value, indeed the purpose, of a product or material is linked to the performance[12] it delivers within a building or structure. That performance is often underpinned by a warranty and/or test certificates. The availability of performance (certified or not) is obviously key to waste avoidance (products become waste because they no longer perform, for example the seals around integrated glazing units fail) and to re-use: products cannot be re-used if they no longer perform, or if that performance is no longer certified where certification is essential to provide comfort to users that the safety and integrity of the material and product is still valid and thus the product is safe to use.

An EPR scheme aimed at enhancing re-use of current end-of-life materials and products may need to incentivise re-certification and re-testing of products; such arrangements are beginning to emerge already: the Steel Construction Institute has issued a protocol covering the reuse of structural steel in 2019[13] to provide a mechanism to overcome and address these challenges. A scheme seeking to improve re-use in the future must obviously also establish a mechanism for performance and test data about the original product to be retained so that the potential for performance to have been lost during the first use is better understood.

Optimising product durability is also important for longer-term improvement: if entire windows are being replaced because seals fail, then to reduce waste in the medium term more durable seals may be needed so that the replacement cycle is longer or they can be eventually re-used.

11. https://www.steelconstruction.info/Recycling_and_reuse
12. The idea that users purchase "function" or "performance" rather than products is at the heart of much circular economy / life cycle thinking
13. Structural Steel Reuse: Assessment, Testing And Design Principles. The Steel Construction Institute 2019

c) Material Accessibility

The more accessible a material or product is, the less resource (time, labour, energy) is required to return it to circulation from its situation in a building. Inaccessibility at end-of-life is an almost inevitable consequence of the way some materials are used: consider pigments in paint, paint on walls or sand in concrete. Other materials or products may be more or less accessible as a result of design decisions taken at various points in the system: manufacturers making composite products that facilitate installation, installers choosing to use adhesive rather than screws, etc. But it is critical to note that making materials accessible in the building can be in tension with technical requirements for air- or water-tight seals or fire safety; it may also be in tension with making products more durable.

An EPR initiative with the objective of achieving short-term change in C&D waste management should surely seek out materials that are readily accessible in existing (even ageing) buildings. One with the objective of longer-term change may need to put incentives in place that slow or reverse a trend towards use of compound products and composite materials.

EPR and the circular economy

The overall thrust of EPR is in line with the circular economy principles of maintaining the quality and extending the utility of products, keeping materials in circulation in the economy, and avoiding loss to landfill and incineration (even with energy recovery).

Certification schemes for buildings or products that encourage recyclability and/or re-use promote the same ends as EPR schemes. For example the Cradle-to-Cradle certification scheme gives products credits for recyclability, while two of the “good practice measures” for glazed partitions in the SKA rating scheme for fit-out are that the partitions installed are either re-used or re-locatable.

In the case of regulatory EPR schemes though, the challenges of measuring “prevention” and “re-use” or the degree of change in product design favour a focus on recovery and recycling metrics in monitoring the progress of EPR initiatives. In addition, material that has become defined as waste is subject to different handling and controls - for regulatory compliance purposes - than material that has not; as a result it is handled by organisations that are distinct from the original producers, and it becomes “visible” in statistics in a way that returned unused product (for example) is not. Some implementations of EPR also favour the establishment of Producer Responsibility Organisations (PRO), whose very mission becomes the delivery of targets derived from waste statistics. Perhaps as a result, EPR is perceived as first and foremost a tool to tackle waste rather than one to drive forward a variety of circular economy business models.

In the case of single-trip packaging, the “product” passes through the economy and becomes “waste” in a relatively short time. Changes in design or uptake of reusable packaging feed quickly through into recorded waste volumes. Such feedback will occur much more slowly for longer lived products; this is particularly true in the construction sector, with most buildings - the final product - lasting decades or even centuries.

D) Installed Lifetime

The installed lifetimes of construction products and materials, and indeed of buildings themselves, vary enormously. In the UK, stone buildings over 800 years old are still in use, while almost no massive stone is used in new buildings. Carpets and wallcoverings are present for a few years only, whatever the age of the building. This variety presents a number of challenges to any EPR scheme:

- the longer the installed life of a product or material, the more any waste of that material/ product in the current C&D waste stream will be the product of extinct businesses, made and installed using historic methods. Some of those methods will be obsolete, some of the materials used will no longer be considered safe[14]. Current producers are unlikely to be willing to pick up the bill for dealing with wastes that were produced by historic, unassociated businesses: they will - correctly in many cases - argue that doing so is not applying the principle of EPR set out in the first sentence of this document. But while the producers of bricks and cut stone used in ancient buildings are inaccessible now, some of the institutional owners of the buildings - for example religious bodies and universities - have endured.
- the longer the installed life of a product or material, the more difficult it is to create a meaningful mechanism for the current producer to bear responsibility for the product's handling when it is removed from the building. For example, product leasing or service provision are often mentioned as business models better-suited to the circular economy than simple ownership. This has considerable potential where the installed life is less than the typical tenure, but difficult to envisage as a viable option where the reverse is true. Thus leasing seems viable and has at least been tested for carpet tiles, interior lighting and road surfaces. But will individuals or organisations buy property for which the bricks are leased or the roof is the property of a service provider?

e) Energy / Eco-balance

EPR seeks to encourage recycling and re-use. For any material or product that may be subject to EPR, it is essential to consider the balance of environmental benefits and drawbacks associated with a move up the waste hierarchy. Not every option for handling end-of-life (EoL) materials or products that can be defined as recycling is environmentally beneficial; the diversion of glass waste to aggregate use has been mentioned and the benefits of displacing some timber products with recycled-polymer composite substitutes deserve an almost case-by-case examination. But before detailed assessment is undertaken, applying some general "rules-of-thumb" and lessons from the many LCAs already conducted could help to understand better potential / screen candidates for EPR. For example:

- the more a product / material is difficult to access (see above), the more retrieving it for recycling or reuse will add environmental burdens.
- the more contaminated (dirty) an EoL product or material is, the more preparing (i.e. cleaning) it for recycling or reuse will incur an environmental penalty.
- the lower the density of the EoL product or material, the higher the environmental cost to return it to centralised reprocessing facilities, because transport burdens are relatively high.

14. the potential for legacy materials to be unfit for recycling or re-use depresses the value of end-of-life product / material, because it introduces a need for testing to identify an appropriate handling method or confirm fitness-for-use in the current context.

- the lower the burdens associated with the original raw materials or components in the product, the less likely that a case for recycling will emerge from a "basic" LCA, energy balance or carbon footprint. Where a high proportion of the raw materials used are recycled from construction or other sectors (for example chipboard with relatively high recycled wood content, or glass mineral wool with high recycled glass content) the potential routes for and benefits associated with recycling the products themselves need particularly careful assessment.

Some of these potential barriers to EoL options higher up the waste hierarchy can be mitigated, of course: low-density products can be chipped or compressed at, or close to, the point of collection; insulation can be encapsulated in film to prevent contamination and to improve its accessibility. These "solutions" bring their own burdens, costs and further consequences that must be assessed. And if an EPR scheme seeks to promote their uptake to open up more possibilities for EoL construction products in future, then it needs to incentivise not just those who might produce them, but those who would specify them and use them too.

Non-regulatory schemes

Some non-regulatory schemes already exist in the UK to divert from landfill certain used products and materials from construction activities. They are operated by individual business, groups of companies or contracted specialists.

ReCofloor is a national take-back scheme that has run since 2009 to divert commercial vinyl flooring from landfill; it has collected 3600t of material since its launch (http://www.recofloor.org)

The gypsum plaster and plasterboard industry set out shared objectives for the diversion of waste plasterboard from landfill in the Ashdown Agreement under the GPDA (Gypsum Products Development Association) from April 2007. Over 123000t of plasterboard waste were recycled for use in plasterboard manufacture in 2015 (Ashdown Agreement Final Report to 31 December 2015, at https://www.plasterboardpartnership.org)

A manufacturer of plastic protective sheets used on construction sites takes these back for recycling after use, and a carpet tile producer runs a similar scheme for carpet tile offcuts.

These schemes focus on waste from new construction, which will contain current materials and will not have accumulated dirt from years of use. The incentive for site operators to take part - by segregating their waste for separate collection is avoidance of waste disposal fees and Landfill Tax.

And while take-back of installation waste is desirable, its prevention is better still; so it's hard to know whether reporting of small or shrinking volumes of collected waste by these schemes represent failure, or success in waste prevention.

Discussion

Overall, from the points raised in this document, it seems very unlikely that a single Extended Producer Responsibility scheme for the diverse set of construction products would work. Incentives to use resources more efficiently, to reduce waste and to move towards implementing a circular economy will need to bear on different actors in the construction sector and along the construction lifecycle, including those who specify and design as well as those who make, build and demolish.

It seems very unlikely, too, that one single instrument could achieve both a long-term objective of promoting a more fundamental shift towards a circular economy (e.g. as measured by total material consumption in the economy) and a short-term objective of changing practice in relation to current C&D waste (as measured by percentage recycled etc.).

Any EPR scheme that uses one of the "waste minimisation instruments" listed in the box on p.8, is very likely to encourage the emergence of companies in the waste and reprocessing sectors to increase reuse and recycling of construction materials; the direct involvement of the original construction product manufacturers in that is unlikely. Indeed, encouraging and nurturing these new waste reprocessing companies is an explicit aim of some EPR schemes. Furthermore, the resulting material may re-enter the manufacturing economy as a feedstock for sectors outside of the construction sector (just as today the plastic polymers from recycled plastic bottles are increasingly being used as a textile in the production of clothing).

The changing face of construction & EPR

The introduction of Building Information Modelling (BIM) and the growth of offsite construction are bringing significant change to the construction sector. What do they mean for EPR?

At one level, perhaps not very much: if EPR simply engages new entities in managing construction and demolition wastes, and routes funding to those entities to increase recycling of the current waste stream, then these changes are of incremental significance, although a shift to modular construction methods is said to lead to much lower levels of waste at the construction site (i.e. the location of the finished building) so there may be less waste available than existing statistics would suggest.

At another level, these developments bring profound change in the way materials are managed at the beginning of the building's life, and hold out the prospect of very different management of end-of-life buildings in the future. Modular building supply chains more closely resemble automotive supply chains, with just-in-time delivery of component assemblies to factories where modules are produced to be shipped out for final assembly on site. According to advocates of offsite, modular construction, material wastage can be minimised by ordering components in the correct size in the first place, while modular buildings can - at least in theory - be disassembled for the modules to be taken to an industrial dismantling facility at the end of their lives; this would allow dismantling to take place with fewer time constraints than apply at a site about to be used for a new building.

BIM, meanwhile, allows information to be retained about materials and products in a building for the building's life. It may, therefore, allow those who might - at some time in the future - want to reuse or recycle materials or components to have robust information about their composition, properties and history; offering much more clarity about some of the characteristics discussed in this paper.

Conclusion

As noted in the introduction, the aim of this is document is to inform debate. One conclusion that emerges, though, is that while the aims of EPR align with Circular Economy principles, EPR alone will not lead producers in the construction sector to engage in the more fundamental business re-engineering to which Circular Economy advocates aspire. EPR is first and foremost a tool for changing the way wastes are managed.

Some principles have been identified to guide the application of EPR in the sector; these overlap with and reinforce those to be found in other guidance[15].

This paper has also identified a sequence of questions that can, perhaps, be followed through to establish where EPR might be worthwhile and how a scheme might be designed. These will not be new to some, but bear repetition in the face of a complex product (a building) which is the output of a complex, extended and evolving industrial sector.

- Where is EoL product /material management in the waste hierarchy now?
- What benefits are available from moving it up the waste hierarchy?
- Are there benefits across all environmental themes associated with anticipated changes? If not, are any trade-offs acceptable to relevant stakeholders?
- Are those benefits to be sought now or in the future?
- What changes are required to deliver the potential benefits?
- What obstacles are in the way of those changes?
- Which actors in the construction value chain need to be incentivised to make the required changes?
- What kind of incentive will be effective with those actors?
- Where do we act to deliver the most environmental benefit at the lowest cost?

And in the end, design of any EPR scheme has to address the following question:

WHO will be responsible for …

HOW MUCH of…

EXACTLY WHAT, to achieve

WHICH MEASURABLE TARGETS, by

WHEN, using

WHAT MECHANISM?

And the links between incentive, agent of change, potential change, potential benefit and measurable outcome need to be clear.

15. "Development of Guidance on Extended Producer Responsibility (EPR) Final Report" V.Monier et al, European Commission – DG Environment 2014; OECD publications accessible from http://www.oecd.org/env/waste/factsheetextendedproducerresponsibility.htm

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