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Building with waste: non-monetary economics in reuse construction

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ABSTRACT

Direct equivalence is defined and introduced in this paper as a direct exchange for mutual benefit. REACH Homes, a not-for-profit housebuilder, use direct equivalence to access waste materials for construction. This is simultaneously a critique of the construction industry's waste practices and a way to engage in construction with little capital. Through this lens, this paper asks: How do non-monetary economics contextualise the lack of material reuse in UK construction? Furthermore, the case strengthens UK government claims that unreliable markets, material costs, and awareness attribute to the low rate of construction reuse whilst establishing policy as a further factor.

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Reciprocity; Construction; Reuse; Waste; Exchange; economic anthropology

1. Introduction

This paper examines the community-led housing project REACH (Recycled, Environmental, Affordable, Container Housing) Homes to reveal how its construction waste reuse practices are grounded in non-monetary economics. By relating the case to UK government guidance, the study assesses the barriers to construction waste reuse in the UK construction industry. It explores the concept of circular cities through strategies to reduce material waste through reuse. The analysis leads to five key research insights:

(1) **Rethinking Government Analysis**: Current government analysis on low rates of construction waste reuse do not fully capture existing sector practices.
(2) **Accessing Waste Materials**: Non-monetary economics currently plays a role in engaging with waste materials for construction reuse in the UK.
(3) **Introducing Direct Equivalence**: A previously undefined non-monetary exchange – termed *direct equivalence*—facilitates construction waste reuse.
(4) **Policy Constraints**: UK government policy and guidance represent an under-recognised factor that limits construction waste reuse.

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(5) **Actionable Recommendations**: Practical recommendations can be made to increase construction waste reuse.

This work builds on Devlieger et al. (2019) identification of salvage companies in the UK, as well as international studies on construction waste reuse (see Condotta and Zatta 2021; Giorgi et al. 2022; Gobbo et al. 2024; Zhang et al. 2022). Whilst these studies consider multiple cases at a larger scale and foreground construction waste as an international issue, this work offers an in-depth examination of a single case to uncover new insights through firsthand engagement with construction waste reuse practices. REACH performs as both a salvage and a construction company engaged with non-monetary economics to acquire waste materials. They provide a useful precedent for construction waste reuse where the formal construction industry has been slow to adopt reuse practices.

Although REACH did engage with monetary exchange, non-monetary economics were central to sourcing and reusing waste construction materials. Their prominence leads to this paper's research question: How do non-monetary economics contextualise the lack of material reuse in UK construction?

1.1. *REACH Homes*

> Our eco-homes, converted from shipping containers, start from just £35,000, cost 90% less to heat than a traditional home and use more than 60% recycled [reused] *local materials*. Reachhomes.Org, 2018.

REACH are a small not-for-profit housebuilder from Sheffield. They understand construction waste reuse as simultaneously a way to navigate their own lack of capital and to critique the formal construction sector and housing condition. Their critique proposes that low-cost housing can be achieved through building with construction waste. Construction waste is defined here as materials that possess a use value which cannot be realised by the owner. In other words, if the labour and storage costs required to reuse a material exceed the cost of purchasing a new equivalent, the material is deemed waste. It is during the disposal process that waste becomes a commodity, as waste disposal companies receive payment for managing the material.

By proposing to sell their houses at the cost of production and fixing this cost through protective covenants akin to community land trusts and mutual home ownership societies, REACH aims to reframe housing not as a financial asset. The use of protective covenants is yet to be tested by REACH as they are yet to complete a housing project for a client. They have built a prototype (Figure 1) and an office for the Ecology Building Society. This paper focusses on REACH's construction practices as a critique to the lack of construction waste reuse in the UK construction sector and the lack of access to housing, with a specific focus on REACH's base city, Sheffield.

1.2. *Direct equivalence*

REACH engages in a variety of non-monetary economics to reduce the cost of their buildings, including gift giving and salvaging. Most prominent in REACH's repertoire

Figure 1. REACH's prototype, a proof-of-concept house and base of operations that served as the home for the founder. REACH homes, 2016.

is a previously unrecognised transaction named here as direct equivalence. Direct equivalence is a non-equivalent exchange of commodities between two agents. Direct equivalence took many forms with REACH and the following three examples provide the breadth of this:

(1) REACH performed waste removal to gain materials for building.
(2) An unemployed volunteer for REACH did not want payment as it would affect their state-provided benefits. In return for secretarial tasks, REACH provided the volunteer a reference and found them employment at a social enterprise.
(3) REACH rented the land for their prototype in return for the excess energy produced by their solar panels.

As the primary way in which waste materials were acquired for reuse, defining and interrogating the effectiveness of direct equivalence answers the research question. Furthermore, it reveals that the use of non-monetary economics by REACH is both out of necessity and critique of the UK housing and construction sectors. This presents non-monetary economics as a symptom of both sectors which have a high financial barrier to entry.

The following section situates the contemporary housing and construction sectors that REACH seeks to critique, highlights the problem of construction waste, and introduces direct equivalence. The Methodological Approach follows, grounding how I engaged with REACH. The Research Outcomes section defines direct equivalence further, demonstrating it requires mutual benefit to occur, its likelihood of occurrence is related to the value of the commodities transacted, and its occurrence must be contextualised within wider urban processes. Concluding that it is best used as a practice to acquire waste materials. The discussion within this section explores how REACH's reuse of waste suggests the lack of material reuse in the wider sector. This

section contextualises DEFRA (2021) guidance on the low rates of reuse in the construction sector. DEFRA identifies markets, material prices, and knowledge on reuse materials as hindering the uptake of material reuse in construction. This paper suggests that a lack of policy on reuse also obstructs the reuse of construction materials.

Through direct equivalence, REACH demonstrates one of the few attempts to harness waste materials in UK construction. Case studies such as REACH and the difficulties they face should serve to inform government and the sector on the expansion of material reuse in construction.

2. Literature review

2.1. *Housing and construction*

The UK construction sector consistently accounts for around 6% of economic output (Rhodes 2019) and is a key driver of growth (BIS 2013). The construction of housing in particular is extremely profitable. The 5 biggest housebuilder companies saw a 480% rise in profit between 2010 and 2015 (Minton 2017) and dividend payments to shareholders of the UK's biggest housebuilders in 2022 were 260% higher than pre-financial crisis years (Archer and Cole 2023). It is not just construction that fuels profit in housing, house prices have continued to rise since 2008 (Rolnik 2019). There has been a reframing for housing where its value as an asset is prioritised over its ability to provide shelter (Leijten and de Bel 2020) and this is happening internationally (Rolnik, ibid). This reframing has driven the demand for both housing and land to build upon, raising prices further and meaning many people are unable to afford private home-ownership (Rolnik, ibid). In contrast to the private sector, the UK's public sector housing has been undermined by a history of policies focussed on privatisation and deregulation (Minton, ibid; Bowie 2017), meaning that existing public stock cannot meet demand.

In reaction to this reframing of housing as an asset, there has been an international increase in community-led forms of housing that operate outside of the dichotomy of public/private provision (Mullins and Moore 2018). This type of housing provision locks the value of housing and land assets through collective, community ownership (Thompson 2015) ensuring the housing can be used for shelter as opposed to a vehicle for speculation. The primary barrier to community-led forms of housing is a lack of access to finance and the cost of land (Mullins & Moore, ibid). This makes it difficult for those most in need of housing to access community-led housing as it poses the same barrier as the private sector, a high cost of entry. In the context of increasing land prices and a lack of public provision, reducing the costs of construction becomes crucial to bypass the limitation of community-led forms of housing. Community-led is often more focussed on the costs of housing consumption, namely protective covenants to prohibit the housings' commodification (as is common in Community Land Trusts, Mutual Home Ownership Societies, and Co-operative Housing), than on the costs of production. Some projects, such as many Low Impact Developments (LIDs) have attempted to overcome a lack of money through building with waste to reduce construction costs, however they often skirt the margins of legitimacy and attempt to bypass planning law, as such, they tend to be small scale, one-off, and localised projects

(Pickerill and Maxey 2009). REACH attempts to work within planning laws to gain legitimacy for construction waste reuse and appeal to the need for housing in Sheffield.

Sheffield, known for its steel manufacturing and subsequent industrial decline, has an historic need for low-cost housing. Between 1990 and 2013, Sheffield had the highest social housing waiting list for any local authority (LA) in England, peaking at 97,818 households in 2009 (DLUHC 2023). The next highest LA waiting list for 2009 was Bradford with 56,072 households, a difference of over 40,000 (ibid). At the 2011 UK census Sheffield had 229,928 households (SCC, 2012), meaning that the waiting list equated to nearly half of the city's population. Between 2013 and 2014, Sheffield's waiting list plummeted from 61,204 to 20,123 (Department for Levelling Up, Housing & Communities, ibid). This dramatic shift may be due to The Localism Act 2011, which allowed local authorities to define their own criteria for eligibility to the list. Despite this dramatic decrease on Sheffield's waiting list, there are longstanding households without access to social housing in the city. 27% of people have been on Sheffield's waiting list for 10 years or longer, with one household waiting 62 years (Wilson 2022).

Dorling (2015) situates Sheffield's private housing market as lacking demand, which could be contextualised by the high number of households on the waiting list and would explain why Sheffield's house price is 23% lower than the UK average as of January 2024 (HM Land Registry 2024). Uncovering this urban condition foregrounds REACH's emergence, in both the UK and Sheffield's construction industry and housing, as a reaction to government policy and private industry.

2.2. *Construction waste*

The amount of construction waste produced in the UK was a key issue REACH wanted to critique. 100 million tonnes of waste are produced by the UK construction sector each year (WRAP n.d.) and material reuse is a core aim of the government's waste prevention programme (DEFRA 2023). Waste in construction amounts to 15% of materials and although 90% of construction waste is recycled or recovered it is mainly through energy-intensive processes (DEFRA 2021) and reuse of construction and demolition waste in the UK amounts to less than 1% (Devlieger et al. 2019). DEFRA (2023) cites only The Aggregates Levy as a policy implemented by the government to support material reuse. The levy is a tax of £2 per tonne of extracted sand, gravel, and rock (HMRC 2018). Part of its purpose is to encourage the reuse of aggregates over extracting new material.

The Construction Leadership Council places the responsibility of material reuse heavily on the industry and building owners, suggesting multiple ways they can engage with waste materials (Adams et al. 2021). Despite the high potential for the reuse of construction materials, the low rates of reuse in the industry are attributed to an abundance of cheap new materials, a lack of information on reusable materials and an unreliable market compared to new materials (DEFRA 2021). Each of these carry a cost implication. Furthermore, The DEFRA (ibid) publication implies that despite recent market disruption, including the Suez Canal blockage and war in Ukraine, that formal supply chains are more reliable than reuse supply chains.

Alongside these limiting factors as outlined by DEFRA, this paper introduces government policy and guidance. It argues that UK planning policy combined with

an unreliable market further detracts from material reuse. For example, if a contractor wanted to use waste windows but cannot acquire the window size specified by the architect in the planning document then there has to be an amendment to the submission. The planning department could deny the amendment but even if it was accepted, the amendment would still cause delays in the construction process. These factors of markets, material costs, awareness, and policy contextualise the lack of reuse in UK construction.

Despite this, the UK does have a niche market for reused materials. Devlieger et al. (2019) identify many UK material salvage companies. To survive these companies either find waste materials of enough value to compete with new materials or they provide other benefits, such as historic materials for projects subject to heritage policies.

The issue of construction waste is also present in Europe. Construction accounts for 35% of all greenhouse gas emissions in Europe whilst construction and demolition waste accounts for a third of all European waste by volume (Condotta and Zatta 2021). Contemporary studies find that, across Europe, energy-intensive recycling is used more frequently than reuse in construction waste management (Giorgi et al. 2022; Gobbo, 2024). Furthermore, despite incorporating circular economy principles into its Waste Framework Directive through waste hierarchy, a study found that many EU member states are still not improving waste prevention in construction (Zhang et al. 2022). The international issue that construction waste poses demonstrates the need for detailed studies into existing reuse practices in order to guide and develop future frameworks.

2.3. *Direct equivalence*

Construction waste and non-monetary economics are intrinsically linked to REACH because direct equivalence was their primary method of waste acquisition. Introducing direct equivalence as a previously uncategorised economic action, I argue it can be defined by three criteria. Firstly, it is for mutual benefit, with neither agent aiming to profit or outdo the other. This differentiates it from barter and monetary exchange. Secondly, it is non-equivalent, meaning that the commodities of exchange would not necessarily command equal price in the market. Thirdly, it is a direct exchange of commodities between two parties.

I named the exchange 'direct equivalence' using Tunderman's (2021) theory of relating Laclau's political concept of equivalence to political economy. This compares Laclau's empty signifier, as the demand which connects disparate demands, to Marx's universal equivalent of money, as the commodity which connects all commodities. Laclau (2018) uses the term equivalence to link disparate and unfulfilled demands that are made towards a hegemony. The disparate demands are not commeasurable to each other directly but have equivalence because they are brought together against the hegemony (Howarth 2016). In the process of these demands becoming equivalences, one demand becomes the 'empty signifier', a demand which represents all the demands in equivalence (Howarth, ibid). This paper takes Tunderman's (ibid) relationship further to suggest that although they can be related and compared, they should be distinguished as equivalence and equivalent relationships respectively. The empty signifier creates equivalence between disparate demands that are not commeasurable, conversely the universal equivalent allows commodities to be quantifiably

commeasurable as each commodity is an embodiment of the socially necessary labour time required to produce it. Through this distinction, the definition of direct equivalence emerges. Direct equivalence is an 'equivalence' because although commodities are exchanged, they are not commeasured. This is because, in direct equivalence, commodities are exchanged for mutual benefit between the two parties, as such their socially necessary labour time is not used to calculate their exchange. Direct equivalence is 'direct' because it is an immediate economic transaction that does not use the universal equivalent to connect commodities. There is no chain of equivalence that relates many different commodities. Instead, the two commodities relate only to each other, directly, in exchange.

My initial exposure to direct equivalence was through the land rental agreement for REACH's prototype, situated at Heeley City Farm. The farm is another Sheffield not-for-profit, among other green initiatives it houses the South Yorkshire Energy Centre. The centre provides consumer advice for energy efficiency as a measure to tackle poverty, whilst also providing working examples of numerous green energy generators for homes. REACH rents the land for the prototype from the farm, however REACH cannot afford to use the money. Instead, it was agreed that the surplus energy from the prototype's solar panels provides the rent. The panels generate an average of 55KWH per week of energy, which has led to a considerable surplus.

This transaction demonstrates the three criteria of direct equivalence. Firstly, it is an exchange of mutual benefit. REACH needed land for the prototype but could not afford to purchase and the farm wanted to increase its renewable energy production and demonstrate more examples of low energy housing. Both agents in the exchange wanted the other to succeed in their agendas. Secondly, it was a non-equivalent exchange because, although the plot was a certain size, at the time of the agreement there was no guarantee on how much surplus energy would be generated by the solar panels. Thirdly, it was not mediated by any medium of exchange, it was a direct exchange between the two agents.

From this description, direct equivalence may appear as a form of reciprocity. However, this term has a contested definition, some literature would argue direct equivalence is reciprocity and some would argue the opposite. An analysis of this literature gives greater insight into direct equivalence's definition.

In The Great Transformation, Polanyi (2001) uses the categories of exchange, reciprocity, redistribution, and householding to decode economic interactions. Polanyi (ibid) understands reciprocity as gift giving and receiving. Hayden (2015) clarifies this definition by stipulating that reciprocity does not require a direct return delivery between two agents, however there is an expectation of some form of payback. For Kolm (2000), reciprocity is the giving of a gift without the obligation for gaining something in return, this lack of obligation differentiates Kolm's definition from Polanyi and Hayden. None of these definitions would understand direct equivalence as reciprocity. Using Polanyi's terms, direct equivalence is a local market exchange not a reciprocity because a Polanyian reciprocity does not necessitate a direct exchange. Furthermore, for Kolm, direct equivalence cannot be defined as reciprocity because it is a direct exchange of two commodities.

Conversely using Molm (2010), direct equivalence would be understood as a reciprocity, specifically a 'negotiated exchange direct reciprocity'. Molm defines

reciprocity as *'the giving of benefits to another in return for benefits received'* (ibid:119). By this definition, market exchange can be understood as a type of reciprocity. Molm (ibid) differentiates reciprocity from reciprocal exchange, where the latter refers to the flow of benefits between two agents in a non-negotiated way without an obligation to reciprocate, such as gift giving. Kranton (1996), 830) however, defines reciprocal exchange as gift giving with *'informally enforced agreements … in exchange for future compensation in kind'*. In this way, Molm's (2010) definition of reciprocal exchange is different to Kranton's (1996), as Molm's definition does not require a reciprocation of gifts, however Molm's reciprocal exchange is defined the same as Kolm's (2000) definition of reciprocity.

Sahlins (1972), identifies reciprocity as exchange between two parties. For Sahlins reciprocity is a continuum with generalised reciprocity, giving and receiving as needed, at one end and negative reciprocity, attempting to gain without giving, at the other. Balanced reciprocity sits in between the two and may be understood as direct exchange, the immediate exchange of goods of equivalent value. On this continuum, direct equivalence would sit between generalised and balanced reciprocity as it is an immediate exchange however the goods are not necessarily of equivalent value.

Instead of seeing reciprocity as its own category, Gibson-Graham (2013) has three categories of market. Direct equivalence would fall into Gibson-Graham's category of 'alternative market', again differentiating it from reciprocity, which is placed in the category of 'nonmarket'. Gibson-Graham's other category of 'market' seems to refer to monetary exchange where profit is the sole motive, given that 'alternative market' includes categories such as fairtrade and barter.

Although some would define direct equivalence as a reciprocity, I argue that it is not because direct equivalence is an immediate exchange between two agents. This aligns to the definitions of Polanyi, Hayden, and Kolm. Instead, I classify direct equivalence as a Polanyian exchange, akin to barter and monetary exchange. Schaniel and Neale, (2000:92) define this as *'(1) a two-way movement … (2) between willing transactors (3) neither of whom is required to transact with the other after the completion of the agreed-upon exchange'*. Whilst holding these characteristics in common with monetary exchange and barter, direct equivalence also differs from these as neither actor is attempting to profit from the exchange, and so they are not in competition to gain the best outcome for themselves. Furthermore, direct equivalence shares another property with barter, specifically, the 'double coincidence of wants' which means that for the exchange to be successful, both parties have to want what the other is offering. This is different to monetary exchange, where money acts as the general equivalent to enable complex networks of exchange.

3. Methodological approach

The fieldwork deployed a Participatory Action Research (PAR) methodology, and I undertook REACH's construction practices first-hand through participant observation. The primary project I was involved in with REACH was the construction of an office for the Ecology Building Society. My fieldwork charted a time from before the signing of contracts to just before the final installation on site, a period of thirteen months from August 2018.

The PAR methodology supported my relationship with REACH, allowing a space to deploy my knowledge of the construction industry and training in architecture to support their existing construction practices. In PAR, the boundaries between researcher and researched is challenged. All participants are seen as collaborators who are involved in making a positive change, which becomes the research output (McTaggart 1997). Some researchers go further to suggest that all elements of PAR research design should be co-produced (Gaffney 2008). As such, our relationship was no longer that of researcher and researched, but research participants engaging in different roles to achieve a positive change and, in doing so, gaining an understanding of REACH's routine practices (see Tripp 2005). The positive change became the construction of the Ecology Building Society office. Through my direct engagement with the construction process, REACH's routine practice of direct equivalence was revealed as a way of acquiring waste materials for construction reuse. This further revealed key insights into construction waste reuse.

At the beginning of the fieldwork, it was unclear if there would be a single project to engage with and so REACH's efforts were primarily based on land acquisition. As such, we engaged with community groups looking to build housing, attempted to acquire land from various state bodies, and marketed REACH generally. During my time with REACH, it was composed of two directors, who did not draw salaries, several on-hand labourers, and a few volunteers who I rarely interacted with as they were not involved in construction.

We initially met to discuss how our relationship could be mutually beneficial. I presented my research design and intent. We agreed that I would receive access to their organisation for my research, and they would receive my labour which, in turn, supported the research. This relationship aligns to the 'outsider in collaboration with insiders' positionality common within PAR where a researcher with no previous working relationship collaborates within an already existing group (Herr & Anderson, 2005). From the perspective of ethical approval, this meant I would record my interactions with participants who had signed consent forms permitting use of their names non-anonymised in interviews and field notes, and the use of photography that did not include faces.

My engagement with REACH was complex and continually in development. As my relationship with the people in REACH grew so did my critiques of their proposal to overcome, what they term, the housing crisis. This paper does not measure REACH's success in overcoming the contemporary housing condition, it reveals how REACH's use of non-monetary economics provides a case study for material reuse in construction.

Undertaking the role of a research participant for REACH through the method of participant observation meant engaging with a diverse range of tasks. I contributed to the design and construction of the office for the Ecology Building Society through involvement in drafting the proposal, producing regulatory documents, and engaging in construction labour. These were recorded in conventional methods of data collection including informal interviews, fieldnotes, and photography. This data was extracted into spreadsheets and keywords were then assigned to each piece of data including materiality, non-monetary exchange, not-for-profit, and market exchange. From this trends were identified. In particular, the method revealed the breadth of non-monetary

economics undertaken by REACH. Specifically, it highlighted the exchange that this paper terms direct equivalence. This research compares the findings from the engagement with REACH with contemporary government guidance to comment on construction waste reuse.

The following section analyses the success of direct equivalence within REACH's immediate context, it uncovers that it is most successful as a way to acquire waste materials. From this, the discussion opens into a wider UK context to reflect on this papers question – 'How do non-monetary economics contextualise the lack of material reuse in UK construction?'.

4. Research outcomes

4.1. *Direct equivalence and mutual benefit*

Direct equivalence is successful when both parties stand to mutually benefit from the exchange. This realisation emerged from comparing two of REACH's land acquisitions. As previously explored, the direct equivalence between REACH and Heeley City Farm demonstrated the ideological alignment between them, particularly their green housing agendas. Furthermore, the farm has a history of community activism, as it was acquired from Sheffield City Council in the 1980's as part of the Heeley community's fight against a proposed bypass that would split the neighbourhood. This alignment is contrasted by REACH's attempts to acquire the Castlebeck site from Sheffield City Council.

In March 2018, REACH were looking to use Council land for a pilot site to demonstrate that container housing could provide a rapid and low-cost response to Sheffield's social housing shortages. REACH had secured £75,000 in funding from a charity for a pilot scheme, however this funding would only be provided if REACH could acquire a site. The Council advised REACH to look at Castlebeck, a site for between nine and twelve homes. REACH provided a proposal and awaited a meeting that was eventually held in December 2018. The Council rejected the proposal and REACH's feelings were reflected in their newsletter:

> '[The council] made it clear that our new and innovative offer is not compatible with the existing drive to gentrify the S2 area with executive homes well out of the price range of local people and to exacerbate the problems which have led to a waiting list of 33,000 people in Sheffield while 6,500 properties stand empty and thousands cannot afford the affordable housing on offer from traditional developers.' Newsletter, 20/12/18

In the newsletter, REACH made clear their belief that the Council is wanting to sell the land to gentrify the area and generate revenue. The selling of Council assets was a Council strategy, but this was a way to fund services in the wake of austerity (Holden 2022). Furthermore, it was found that local authorities prioritise the support of vulnerable communities following budget cuts in 2010/11 and 2015/16 (Hastings et al. 2015). Through this lens, it becomes clear that the selling of assets is not an intentional act of the Council to gentrify an area, but an attempt at supporting critical services. This may result in community displacement, but it is not a deliberate act undertaken by the Council.

REACH thought that a direct equivalence exchange of land for housing could mutually benefit both parties. The Council would be able to reduce their social housing waiting list and REACH would be able to test their model whilst providing the Council with a potential housing strategy. However, the Council did not have the resource to expand their housing stock and instead their priority was to fund their existing services. Castlebeck was an asset that could be sold. Furthermore, an increase in social housing could potentially lead to further costs for the Council in maintenance.

The failure of this exchange in contrast to the success at the Heeley City Farm suggests that direct equivalence's success is predicated on there being mutual benefit for each party. The way in which the Council uses its land as an asset to be sold and fund services suggests that direct equivalence is linked to value. Specifically, the less exchange and use value a commodity has, the more likely direct equivalence is successful.

4.2. *Direct equivalence and value*

The link between value and direct equivalence is most clear in REACH's acquisition of waste materials. Reusing waste is a key strategy for REACH, 84% of the prototype's materials are from construction waste.[1] Direct equivalence allows REACH to acquire materials without money, a key strategy for their low-cost housing, as material costs can account for over half of construction costs (Petchpong, Hadikusumo, and Charoenngam 2005).

> "[the roof is] just Kingspan glued to the outside with render over the top … it came from the roof of the mosque, while they were replacing it, the panelling in the shower room was the front of the counter at the Indian restaurant opposite the mosque, which they were chucking out. Cymbal's up there [acting as a light fitting], bedhead's an old piano, every bit of wood here's reclaimed." Interview with a director speaking about the prototype, see Figure 2. 17/08/18.

Figure 2. An interior view of the REACH prototype at heeley city farm, the exposed wood column and beam were acquired from a church. (REACH homes, 2016).

For the owner, a waste material has no exchange value and cannot be used because it would cost more in labour and storage to reuse than to buy a new equivalent, thus they seek to dispose of it. For REACH, a waste material can realise its use value for two reasons. Firstly, because it is often used straight away, so REACH are not having to pay for storage, secondly because REACH primarily use volunteer labour, significantly reducing the labour cost of reusing the material. REACH enter into direct equivalence by exchanging the waste material for their labour in the form of waste disposal. This means that the owner no longer has to pay to dispose of the material.

In the case of the prototype's window frames, REACH discovered that recycling UPVC windows is an energy intensive and difficult process. This leads to the glass panes often being recycled but the frames themselves are left in glazing companies' yards. REACH take frames to use in their construction process and provide glaziers a removal service and a less energy intensive end of life process.

REACH was most successful in acquiring waste timber through its sister social enterprise, Strip the Willow. Strip is a wood upcycling shop that receives and collects waste wood from the neighbourhood in a similar way to REACH's acquisition of window frames. As both companies were founded by the same person, REACH are able to take any wood they need, which is used both structurally and for furnishing (see Figure 3).

The way in which REACH acquires waste demonstrates that direct equivalence is more successful when the new owners have a greater capacity to realise the use value of the commodities than the original owner. Owners of waste materials either do not want, or do not have the time, to reuse it and without these materials REACH's labour cannot be realised. An exchange can satisfy both parties, however because REACH lack money, they are only able to realise the exchange value of waste through non-monetary exchange.

In comparison to the acquisition of waste materials REACH failed to acquire new materials from manufacturers, companies who produce and commercially sell

Figure 3. An interior view of strip the Willow and the use of Strip's wood in the construction process (Author's own, 2019).

materials, through direct equivalence. REACH worked with a manufacturing company that was expanding into the construction industry through the development of a modular façade and roof cladding system. The company had been in negotiation with REACH, and both thought they could mutually benefit from each other. REACH proposed that the manufacturer should use REACH's construction of the Ecology Building Society office as a working prototype for their cladding in exchange for the supply of the cladding. The manufacturer could only justify providing the materials at the cost of production, £17,000 for the roof and cladding. As the total project budget was £40,000, REACH could not justify the expense for the cladding and instead purchased just the roofing system.

Alongside reinforcing the relation between direct equivalence and value, this engagement starts to suggest the difficulty REACH has when using direct equivalence to navigate the construction sector. The companies that engage in construction are bound to the procedures scripted in market exchange. In this scenario, the company needed some form of monetary transaction, even at the cost of production, to justify REACH's use of their materials. Here REACH failed to undertake a direct equivalence transaction with the manufacturer because the manufacturer was reliant on some form of remuneration.

Reflecting on REACH's attempts at land acquisition further demonstrates these links between direct equivalence and value. With Heeley City Farm, the small patch of land, which contains REACH's prototype was not being used and had little value for the farm as it was not large enough for livestock and had little growing space. Conversely, in the Castlebeck example, although REACH needed land for their pilot study, the land held value for the Council as an asset that could be sold to fund their budget. This contributes to the reason why they were unsuccessful.

Direct equivalence's relation to value reveals that it works best as a method of acquiring waste. These are non-commodities without value that become commodities as REACH ascribes them value. REACH save the owners of waste from either having to pay for waste disposal or the time of taking them to domestic disposal facilities.

4.3. *Direct equivalence and materiality*

Despite direct equivalence being the primary way REACH acquires waste for construction reuse, there were material considerations including contractual, environmental, and technical that also had to be considered in assessing the suitability of waste materials. Through the materiality involved in the construction of the office for the Ecology Building Society, these factors are revealed.

For the office's windows, REACH used the waste UPVC supply chain they had previously used in the construction of the prototype. The specification in the brief provided by the client stipulated the use of grey coloured window frames, however because grey UPVC was a current design trend, REACH's supplier did not have any. In order to meet their contractual agreement, and without the money to purchase grey frames, REACH engaged in material testing to explore different types of paint and how they would adhere to the plastic frame. These tests easily chipped and so REACH had to contract a specialist spray company, as it was calculated this was more cost effective than buying new grey UPVC frames (see Figure 4).

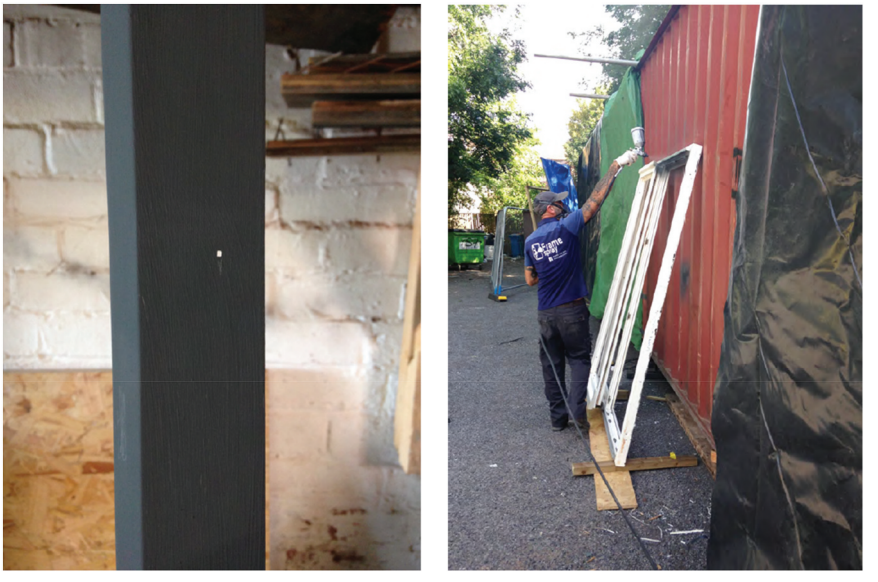

Figure 4. Chipped paint on a window frame from REACH's tests and the application of grey paint using a contractor. (Author's own, 2019).

The requirement for these frames demonstrates that even when REACH use direct equivalence to acquire waste, they may also need to pay to transform the material in order to meet their contractual agreements.

The external insulation for the build was primarily reused from waste and acquired through direct equivalence. Fibreglass insulation was provided by a renovator who could not find a way to responsibly dispose of it. REACH took the material to avoid it being sent to landfill. REACH's use of the fibreglass insulation requires a reflection on the other decisions that could have been taken. REACH could have decided to not use the fibreglass insulation and acquired other insulation, either by purchasing or acquiring from waste. They made the decision to use fibreglass firstly because of the environmental impact of fibreglass otherwise going to landfill, as opposed to making it inert through encasing it in the office. Secondly, due to their uncertainty about sourcing other waste insulation within the time constraints of the project. Ultimately, they chose, what they believed, was the most environmental solution despite it being difficult to work with and not a material that is typically associated with sustainable building.

For the internal insulation, REACH contracted a company to apply spray foam. This material has a potentially high environmental impact, which can be minimised if the type of foam has a low global warming potential (GWP), however REACH was unable to find a company with a low GWP product. The necessity of REACH to use spray foam can be explained in its use of shipping containers as a structural frame. As a construction material, a container is useful to provide a quick solution to structure and has become synonymous with REACH (the 'C' in REACH standing for container). When REACH cannot access them through direct equivalence they engage in market exchange and can buy containers at a relatively low price for a structural frame, the container for the office cost £1,200. However, containers

have an issue with condensation when inhabited. Human activity produces water vapour, when this meets the metal wall of the container and condenses the water droplets can rot the internal finishes and create mould. REACH's solution to this is to internally line the container with spray foam insulation. Spray foam expands when applied, creating an airtight seal. This means that water vapour cannot touch the metal to condense.

The use of spray foam demonstrates that the technical performance of materials is a factor in assessing the suitability of reusing waste. Spray foam cannot be acquired as a waste material, yet it is integral when building with shipping containers, therefore as containers are integral to REACH's ability to build, they have to purchase this insulation.

The use of each of these materials demonstrates that REACH cannot solely rely on direct equivalence to build. Some materials may not be found within the time constraints, other materials cannot be acquired as waste, and other materials acquired as waste have to be transformed to meet the requirements of building. Direct equivalence is the primary way in which REACH acquires waste materials for reuse in construction, however, the wider non-economic factors discussed suggest the limits and suitability of using direct equivalence in material acquisition.

4.4. *Direct equivalence and policy*

A final factor that influenced REACH's ability to reuse waste materials was policy. In the UK most built structures require an application to the planning authority, in which a case is made as to why the proposal will aesthetically and practically fit into, and benefit, the local context. Some community-led projects, such as LIDs, attempt to avoid the formal regulations of construction and may gain permission after completion (see Pickerill and Maxey 2009). REACH however was seeking to gain legitimacy and aimed to eventually work with local authorities to provide housing. As such, they attempted to adhere to the regulations and made use of my architectural training to navigate this.

REACH's planning application for the Ecology Building Society office argued that the materiality would blend into the site, that the size of the office would be unobtrusive and was set back from the road, and that it would support the growth of the Ecology Building Society. The proposed design was based on a 40 ft (imperial measurements being the industry standard) container as a base, meaning the footprint of the building would be less than 30 m2. This size is important because any building over 30 m2 is subject to UK building regulations.

Due to the time constraints of the build, REACH submitted the proposal without having sourced all the materials. The application was accepted, however, REACH could not acquire a 40 ft waste container, they could acquire a 45 ft waste container and told me they could just use that instead. Although from a technical standpoint the extra 5 ft length would not affect the build, the different size for the structure would require a substantial resubmission to the planning permission that may not be accepted. Furthermore, had the 45 ft container been used, the office would be over 30 m2 and therefore would be subject to building regulations, something that had previously not been accounted for. Due to the time constraints of resubmitting the planning

application and making a building regulations application, alongside the uncertainty of a revised planning application, REACH bought a 40 ft container.

The UK construction sector has a rigorous process to follow to acquire permission to build. This section demonstrates that this process became a hindrance for REACH because they could not acquire the container size specified in their planning application through direct equivalence, instead they had to purchase it. This issue is exacerbated by REACH's lack of storage space. When REACH acquire materials for reuse through waste, the original owner of the waste wants those materials taken as soon as possible. As such REACH either has to be able to use the materials immediately or have storage for them. Although REACH have Strip the Willow as a storage for their timber, they do not have anywhere to store other materials. As such, there are materials that people offer but REACH cannot accept and so they have to use either domestic or commercial waste facilities. This means REACH can never guarantee they will use direct equivalence to acquire a waste material specified in their planning application, because they do not know which materials are available. This creates a large uncertainty in their business model and can increase costs, whilst potentially undermining their aim of primarily reusing materials.

5. Discussion

Not only does REACH demonstrate examples of construction waste reuse, but it also provides lessons of material reuse that can be transferred to the wider construction sector. Furthermore, the REACH case introduces direct equivalence as a central non-monetary economic interaction. It allows them to propose a solution to, what they term, the housing crisis and represents a different way of building to the profit-driven relations of the wider construction sector. In both of REACH's built projects, the prototype and the office, direct equivalence was used to acquire the majority of building materials and some labour. In the prototype, direct equivalence also extended to the acquisition of land.

Although REACH's use of direct equivalence was necessary to engage in construction with a lack of capital, it also hindered their ability to expand. REACH's lack of money has stifled their progress to acquire land, they have not been able to find a landowner willing to engage in direct equivalence. Furthermore, REACH's acquisition of waste through direct equivalence can uphold existing waste practices even as it is used to critique waste management in construction. For example, the wasteful production of UPVC window frames is justified by REACH providing a way for them to be reused. The use of waste also creates an issue of scale, if REACH was to grow to a size that could impact the housing market, then at a certain point REACH would struggle to obtain enough waste materials to maintain their building practices. Through these examples, direct equivalence can be seen as simultaneously enabling and limiting REACH's aim. The engagement with REACH also reveals that direct equivalence is predicated on issues of mutual benefit, value, the physical properties of commodities and the legal frameworks they operate within.

Where REACH uses direct equivalence as a critique of current conditions other non-monetary economics, such as domestic labour, are widespread throughout the economy. Muehlebach (2017), for example, reveals how left-wing community volunteering

supports and justifies the retraction of state services in neoliberalism even as it appears as a critique. As such, in introducing direct equivalence in this paper, I also propose it can be observed to support and uphold current conditions. This can be seen within the REACH case, where the acquisition of waste materials provides a justification for manufacturers to continue wasteful practices. Furthermore, the scenario where REACH provided a reference and helped a volunteer find employment could easily have been manipulated by REACH to exploit the volunteer's labour. REACH was not critiquing UK labour relations by doing this but instead supporting someone to re-enter the job market. This then becomes another example of how direct equivalence can be used to support contemporary conditions.

In this paper, direct equivalence is used as a lens to answer the question 'How do non-monetary economics contextualise the lack of material reuse in UK construction?'. Direct equivalence was successful in acquiring waste materials for reuse in REACH's construction. DEFRA (2021) identifies unreliable reuse markets, cheap and readily available new materials, and a lack of information on reuse materials as key factors contributing to the lack of construction reuse in the UK. This paper also highlights a lack of policy on reuse and restrictive existing planning policy as a further factor. Through the REACH case, these factors are discussed.

5.1. *Markets*

REACH revealed that there are markets for materials that are suitable for construction reuse. Non-monetary economics enabled REACH to acquire a consistent supply of UPVC window frames, taking them for free from glazier's yards and diverting the frames from more energy intensive end-of-life processes. Furthermore, REACH created their own wood supply chain through Strip the Willow. Strip became known as a neighbourhood wood disposal facility and, although it did occasionally suffer from residents disposing other waste, it provided REACH a consistent source of waste wood for both structure and interiors. Strip meant that REACH never had to purchase timber for its builds.

This is not to say that REACH challenges DEFRA's observation that reuse markets are unreliable. To regularise their supply chain, REACH acted as both a waste removal company and a construction company, this would require vast restructuring and investment for builders to adapt in the UK construction sector. There were also many materials, including the insulation, that REACH acquired through one-off non-monetary exchanges. When REACH needed more insulation to continue building, but could not acquire any through direct equivalence, they had to purchase it. There is also an issue of scale, although Strip received a lot of waste wood and was able to provide timber for two small structures, it is unclear how many buildings could be provided for on the city scale that Strip operates.

Despite this, there are recommendations for regularising reuse markets in the construction sector that can be made through the experiences of REACH. Firstly, REACH identified a supply chain in the end-of-life processes for UPVC windows. This demonstrates, in contradiction to DEFRA analysis, that markets for waste materials exist, but they require identifying and regularising. Secondly, although it may be unfeasible for construction companies to act as waste management like

REACH, reuse can still be embedded into construction through existing waste management companies. These companies could expand their selection of bins on construction sites to include reuse bins and studies have demonstrated this would reduce waste (Ajayi et al. 2017). UK builders are already expected to sort and correctly dispose of waste in bins, therefore adding further on-site bins for sorting reusable materials would not require a large change in practices and the waste management companies could store and sell reusable materials. Recycle for Greater Manchester's Renew Hub is a working example of this in the domestic waste sector. Renew Hub has bins at domestic disposal centres where reusable items are stored. These are then taken to the hub, refurbished by numerous workshops, and sold. Renew Hub works with a diverse range of waste including bicycles, electronics, and furniture. This working example for domestic waste suggests that it could be expanded to construction waste. However, a study on ten different Chinese cities revealed that while sorting waste on-site is less labour-intensive and cheaper than doing so at a facility, it was less likely to happen without regulations (Ma et al, 2020). This suggests that a push for on-site sorting would also require regulations to support uptake.

5.2. *Material costs*

Although 90% of UK construction waste is recovered (DEFRA 2021), less than 1% is reused (Devlieger et al. 2019), this can be partly accounted for in the processes of deconstruction and demolition. Deconstruction is a more labour-intensive process than demolishing a building as materials have to be carefully dismantled, assessed, and suitably treated to be reused again. These labour processes contribute to the high price of reusable materials and has led many UK salvage companies to focus on acquiring materials that will sell for a high price (Devlieger et al, ibid). This means that many materials are not reused because the labour cost of extracting them would make the price uncompetitive against new materials. New materials are relatively cheap and this could, in part, be attributed to wage disparities between the countries that produce the material and the countries that consume it. This suggests that the higher labour costs in the UK are undercut by lower labour costs in other countries, justifying the high price of reuse materials in comparison to new materials.

REACH managed to keep the cost of materials low in two ways. Firstly, they acquired the majority of their materials through direct equivalence, and secondly their labour was primarily either volunteers or they were not seeking a wage. During the build for the office, REACH employed two general labourers, this is the only instance I am aware of where REACH employed workers. Because REACH used unpaid labour to acquire reuse materials for free, they did not need to rely solely on new materials. This practice is not transferable to the wider sector, and this means that the materials gained from material reclamation in building deconstruction has to be profitable by offsetting the cost of the labourers who acquire the materials. Perhaps, with growing instability, the cost of new materials will rise to a point where reuse materials are cheaper, however material prices are starting to decrease in the UK following up to 30% material price rises in 2022 (BCIS 2024).

5.3. *Material knowledge*

REACH provides many examples of how to reuse materials in construction, it specifically highlights that materials cannot be reused in isolation but must be considered within the wider build project. Firstly, in order to reuse materials, new materials may be required. REACH used new fixings to secure their reused timber in place. This is because reused fixings lose their material performance, for example, screws lose some of their threading meaning they do not hold as securely. Secondly, some reuse materials have to be processed in order to be useable, for example the UPVC window frames had to be painted to meet the clients brief. Thirdly, reuse materials may not meet energy efficiency stipulated in building specifications. For example, standards such as Passivhaus may not accept reused window frames as they might not meet the required airtightness. Therefore, engaging with reuse materials requires a reframing of sustainability in buildings, which is currently focused on inhabitation.

Although REACH provides many examples of how materials can be successfully reused in construction, I have focussed on the challenges here to demonstrate the limits of reuse and how REACH negotiated the interaction between new and reused materials, this is because in many cases reuse materials were used by REACH in the same way new materials are. REACH's ability to reuse materials as they would use new materials suggests that the construction sector does not lack the knowledge of how to reuse materials from a technical standpoint, instead it is a lack of awareness that they can be reused alongside a lack of procurement knowledge. This challenges current government narratives on construction reuse, which cites a lack of knowledge as a factor in low rates of reuse.

5.4. *Policy*

In the wider construction sector, monetary exchange has regularised the purchase of materials, providing relatively reliable supply chains. Therefore, if a planning application specifies a particular material or finish it is typically a simple process to acquire the material. REACH's reliance on construction waste reuse means the procedures of construction, such as planning permission, become constraints on their ability to build. This is because the reuse materials acquired in direct equivalence are not part of reliable supply chains. For example, if REACH specify a material they do not have, then they must either delay the project while they acquire it as waste or purchase it. In the construction of the office, REACH had to purchase a 40 ft container because the only waste container they could acquire was 45 ft. This size would take the building over its maximum footprint and would require major revisions to the planning application and a submission to building regulations. Here, the logics of formal construction, specifically the time constraints and planning agreement, limited REACH's ability to reuse materials. This example suggests that without more stable supply chains to regularise the acquisition of reuse materials, existing policy will continue to make material reuse difficult. Alternatively, these policies could be revised whilst still maintaining their commitment to safety for the users of the built environment.

6. Conclusion

How do non-monetary economics contextualise the lack of material reuse in UK construction? The research answers this question by demonstrating how non-monetary economics provide a lens through which current reuse practices can be observed and engaged with. This engagement has revealed how construction waste is acquired and repurposed, while the subsequent analysis has identified limitations to material reuse. Although this research is limited to a single case, it has allowed a deeper understanding of construction waste reuse practices through firsthand engagement. Now these practices of direct equivalence and waste reuse have been identified, a wider study could comment on their prevalence at scale.

The findings of this study can be summarised in the five research insights.

6.1. *Rethinking government analysis*

Current UK government guidance argues that extensive material reuse is not currently profitable. Unreliable supply cause delays and uncertainty, while the cost of deconstruction means that only a limited amount of high-value reuse materials can compete with equivalent new materials (Devlieger et al. 2019). Additionally, guidance suggests a lack of industry knowledge regarding material reuse, necessitating further investment in training (DEFRA 2021). This further reduces profitability. However, this research – through engagement with REACH Homes – demonstrates an overlooked approach: acquiring construction waste through non-monetary economics. Where the for-profit sector lacks experience, the not-for-profit sector provides valuable precedents for sourcing, acquiring, and reusing construction waste. This should play a part in government analysis.

6.2. *Accessing waste materials*

REACH has been able to engage extensively with material reuse precisely because it operates as a not-for-profit entity and employs non-monetary economics to acquire waste materials. This approach circumvents the financial barriers that currently make reuse unprofitable. REACH source materials at a city scale and reuse these materials to critique the amount of waste generated by the construction industry. Through engagement with non-monetary economics, regular supply chains for material reuse – such as window frames – have been identified.

6.3. *Introducing direct equivalence*

This paper introduces *direct equivalence* as a non-monetary, direct exchange for mutual benefit, navigating debates on conflicting definitions of reciprocity. The concept of direct equivalence presents new avenues for research. Future studies could examine how direct equivalence functions in profit-driven contexts and compare this with how REACH employs it while operating with minimal financial resources. Such research could illuminate whether direct equivalence can be used for exploitation. Expanding the range of contexts in which direct equivalence is

observed would allow for a refinement of its definition and a broader understanding of economic transactions that occur alongside monetary exchange.

In this study, direct equivalence was the primary method through which REACH acquired construction waste materials. It was also used in land acquisition and as a means of exchanging labour. Yet, direct equivalence has its limitations, particularly when engaging with commercial companies. This became evident when REACH had to pay for spray foam insulation because no equivalent material was available through reuse. This example illustrates broader constraints on material reuse in construction.

6.4. *Policy constraints*

This research identifies government guidance and policy as a primary constraint on material reuse in the UK. Current policy places most of the responsibility for increasing reuse on the construction industry itself. For example, recommendations such as *'Ensure materials are readily recoverable'* and *'Exploit offsite manufacture'* in Adams et al. (2021) *The Routemap for Zero Avoidable Waste in the Construction Sector* implies that significant industry-wide changes should occur without financial incentives. Without clear government policies, financial support, or a significant increase in the price of new materials, material reuse in the UK is unlikely to grow.

Additionally, planning policies can act as barriers to reuse. For instance, REACH had to purchase a 40 ft container to comply with planning regulations, because they could only find a 45 ft container as waste. This example highlights the precarity and unpredictability of waste material availability.

6.5. *Actionable recommendations*

For cities to become truly circular, they must establish circuits for construction waste reuse. Based on the research findings and insights gained from non-monetary economics, the following recommendations can be made:

(1) The not-for-profit sector should be analysed more closely, as this study demonstrates that it contains successful examples of material reuse.
(2) Circuits for reusable material waste should be better identified and developed.
(3) Planning policy could be restructured to incentivise material reuse and account for the uncertainty of waste material acquisition.

The circular reuse of construction waste has the potential to significantly reduce environmental impact. The case of REACH provides actionable strategies that could be implemented to improve material reuse. However, unless the profitability of reuse is addressed, non-monetary economics will remain a crucial mechanism for engaging in construction waste reuse in the UK.

Note

1. In the prototype, the 16% non-waste materials included screws and other fixings that needed to have good threading, the damp proof membrane which (to maintain a waterproof seal) could not be damaged, the spray foam insulation, and the recycled denim insulation. These were bought primarily because alternatives could not be found from waste in the timeframe for the build.

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In accordance with Taylor and Francis Generative AI policy, I confirm that I used ChatGPT (GPT-4o) for the purpose of checking the clarity of the writing.

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