Building approval data and the quantification of the uptake of sustainability over time: A case study of Australia and England.

Purpose of this paper
The fifth IPCC report on climate change concluded current progress to mitigate anthropocentric climate change is not making any impact. As the built environment emits 50% of total greenhouse gas emissions, mitigating climate change through sustainable construction and adaptation is a priority. Although many new buildings have sustainability ratings, they comprise a minute amount of the total stock. Meanwhile policy makers are adopting strategies to become carbon neutral with targets that require measurement. This paper proposes a means of quantifying the uptake of sustainability across all stock over time using existing policy frameworks.

Design/methodology/approach
Given that this is a scoping study to explore the potential to adapt existing frameworks to facilitate the quantification of the uptake of sustainability measures over time, the research adopted a focus group technique with experienced stakeholders in Australia and England.
Qualitative research is inductive and hypothesis generating. That is; as the research assimilates knowledge and information contained in the literature ideas and questions are formed, which are put to research participants and from this process conclusions are drawn.

Findings
It is technologically feasible to collect data on sustainability measures within the building approvals systems in Victoria and NSW Australia and England and Wales and a conceptual model is proposed. Economically, costs need to be covered, and it is unclear which group should pay. Socially, the benefits would be to determine how society is progressing towards goals. The benefits of achieving reduced carbon emissions would be mitigation of the predicted changes to climate and informing society of progress. Politically, it is unlikely there is a will to make provisions for this proposal in existing regulatory systems.

Research limitations/implications (if applicable)
The key limitations of the research were that the views expressed are those of a select group of experienced practitioners and may not represent the consensus view of the professions and industry as a whole. The limitations and criticisms of focus group data collection are that the sessions may be dominated by individuals holding strong views.

Practical implications
(if applicable)
The findings show that adaptation of the existing data collected by building control authorities could allow some quantification of the uptake of sustainability measures over time. A simple initial system could be implemented with relative ease to ascertain the value of the data. Over time the system could be extended to collect more data that could facilitate more precise quantification of sustainability. Significantly policy makers would have a tool that would allow them to measure the success or otherwise of mandatory and voluntary measures introduced to increase the uptake of sustainability.

What is original/value of paper
To date, no one has considered the practicality or potential utility of adapting existing information gathered for building approval purposes for the quantification of the up-take of sustainability across the whole stock over time. The value of using building approval data is that all building types are required to have building approvals prior to work being undertaken.

Keywords: Building permits, building approvals, sustainability, Australia, UK, policy makers.

Introduction

The built environment emits around 50% of total greenhouse gas emissions (GHG) and mitigating climate change through sustainable adaptation is a high priority (IGT, 2010). Typically 1 to 2% is added to the total building stock annually and around 87% of the stock the UK will have in 2050, is already built (Kelly, 2008). *"While buildings offer the largest share of cost-effective opportunities for GHG mitigation among the sectors examined, achieving a lower carbon future will require very significant efforts to enhance programmes and policies for energy efficiency in buildings and low-carbon energy sources well beyond what is happening today"* (IPCC, 2007). This research explored a potential policy innovation in the quantification of the uptake of sustainability measures into buildings over time. Measurement is imperative; we cannot manage what we cannot measure. Data, in respect of the sustainability measures incorporated into new and existing buildings, should be recorded and measured. The potential benefits are that built environment related GHG reductions may be measured and quantified and that policy and regulations may be made more efficient and their effectiveness may be enhanced on the basis of empirical evidence.

Australia and England were selected as case study countries for the study as each country has a system of building regulation which must be adhered to and recorded. They are geographically and climatically different and their systems of building regulation also differ. A comparison of the proposal in different countries was beneficial; as the findings widen application.

Policy Background

The United Kingdom's (UK) commitment is to reduce GHG emissions is embodied in the Climate Change Act 2008 (IGT, 2010) by 26% by 2020 (compared to 1990 levels) and by 80% by 2050. The Low Carbon Transition Plan sets targets for residential and non-domestic buildings using energy efficiency, zero carbon new build, smart metering and major retrofit programmes (IGT, 2010). Australia has agreed to limit annual carbon pollution to an average of 108% of 1990 levels during the Kyoto period (2008 to 2012) and to reduce emissions by between 5 and 15, or 25% below 2000 levels by 2020 (DOE, 2014). The 5% target is unconditional, whereas the 'up to 15%' and '25%' targets are conditional on international action. Australia will reduce GHG emissions by 80% compared with 2000 levels by 2050; in line with the UK target. Target setting is crucial for society to know what to strive for. Important questions arise, such as; *how do we measure the changes which occur in our built environment?* Furthermore *how can we track the changes that are being implemented in the built environment over time?*

Melbourne has a carbon neutral strategy to deliver emissions reductions through policy initiatives largely directed to building adaptation. Melbourne seeks to be carbon neutral by 2020 with a goal of 1,200 sustainable commercial building retrofits to deliver 38% GHG reductions. Whilst some owners use environmental rating tools such as Green Star, most do not. Furthermore sustainable adaptations and new builds are so few they will not deliver sufficient reductions in the timeframe on current take up (Wilkinson, 2012). However, *what about the collective contribution to GHG emissions reduction of all the small retrofit projects which are not part of these programmes?* Predicted significant increases in gas and electricity consumption in buildings present challenges to policy makers, professional practitioners and the community, and a method of calculating building related carbon emissions across all the stock is required.

The framework for quantifying emissions reductions in the total stock over time is fragmented and undeveloped. Existing efforts mostly focus on individual buildings and are measured through rating tools such as BREEAM (UK) and Green Star (Australia). When a new building is proposed or an existing building is altered, an approval/permit is required under legislation with building data outlined in the approval. This system is adopted in most countries globally, and whilst standards vary, the approach is similar. Wilkinson (2011) demonstrated the value and potential of permit data when permit data formed the starting point for analysis of all building adaptations in Melbourne CBD from 1998 to 2008. Expanding the collection of data regarding sustainability measures implemented allows quantification of the type and extent of sustainability measures undertaken across the whole stock over time; capturing all works, particularly the myriad of small projects which are un-quantified in existing models and projections. Such an approach allows policy makers to track progress, and to refine and target policy making measures more effectively

Research aims

The research aimed to;

1. To evaluate the viability of collecting data on sustainability measures integrated into buildings through an expansion of building permit data.
2. To ascertain the content and scope of building permit data collection across Australia and England and the types of collection and storage methods adopted.
3. To identify the barriers and scope for changing building permit data collection across Australia and England.
4. To propose a model for collecting sustainability data for building permits of all building types in Australia and England to deliver regulatory efficiency and effectiveness.

Regulatory Approaches

Minimum standards in respect of energy efficiency and water economy are embodied in building regulations or codes. These standards initially centred on health and safety measures, however over time the scope of regulations expanded. The 1970s oil crisis focused attention on energy efficiency in Europe as high oil prices increased operational costs and efficient buildings reduced reliance on Middle Eastern oil. In the 1990s standards were increased on concerns about climate change. In Australia energy efficiency was introduced as part of the Building Code in 2005 for residential and, in 2006 for commercial buildings. Initially regulations were limited to new construction though, they now cover refurbishment works over certain thresholds.

The Australian regulatory framework for building control consists of the National Construction Code (NCC), developed by the Council of Australian Governments (COAG) which incorporates all on-site construction requirements in one code. The Building Code of Australia (BCA) comprises volumes 1 and 2 and the Plumbing Code of Australia (PCA) as volume 3. The codes are performance based and allow a choice of Deemed-to-Satisfy (DTS) Provisions or Alternative Solutions (AS). The goal is to facilitate efficient and nationally consistent, minimum standards of safety, health, amenity and sustainability. Each State and Territory implements the BCA, and each system is slightly different, adopting different terms, though the standards are national. Within the BCA regional variations, due to climate, are permitted.

The PCA contains the technical provisions for the design, construction, installation, replacement, repair, alteration and maintenance of water services, sanitary plumbing and drainage systems, storm-water drainage systems, heating, ventilation and air conditioning systems, on-site wastewater management systems; and on-site liquid trade waste management systems. The BCA and PCA impact the amount of sustainability integrated into the built environment directly and indirectly throughout the lifecycle. Direct impacts include the carbon content of materials, whereas indirect impacts are levels of operating energy and water consumption enabled by the building design.

In Victoria, the building permit form requires disclosure of project description, contact information, property details, builder details (if known), building practitioner details and registration numbers. Applicants must specify whether the work is new build, extension, alterations or change of use, demolition, removal or re-erection of a building or other. The proposed use, the cost of the work and whether a contract exists is required. For staged work, the estimated value of the work for the stage covered by the permit is stated. The remaining information relates to the construction works covered in each relevant section of the BCA. Similar information is required in New South Wales (NSW) where permits are called development approvals (DAs). Though sustainability has been a part of the BCA since 2005, the existing form does not require any separate or specific information regarding sustainability measures that are integrated into new or existing buildings.

Under the UK Building Act 1984 individuals carrying out building work arrange for their work to be assessed by a third party to verify that work meets minimum standards. This inspection can either be by a local authority building control officer or an "approved" independent inspector. In some cases installers (such as registered electricians) can self-certify that their work is compliant. The Department for Communities and Local Government (DCLG) is responsible for the building regulations and enacted a package of deregulatory changes to the building regulations in 2012 to ensure they continue to be current and effective. The Building Act 1984 introduced major changes with functional performance standards,

set in terms of what was adequate, reasonable or appropriate, supported by statutory guidance in the Approved Documents (ADs) and competition in building control through the addition of the optional use of private sector approved inspectors. The ADs cover technical aspects of the building regulations and comprise 14 parts including Part L Conservation of Fuel and Power and Part G Sanitation, Hot Water Safety and Water Efficiency. Part L has two sections; one deals with energy in new build, whilst the other covers existing buildings. The system includes the concept of consequential improvements where, if a certain level and scope of work is undertaken, owners are required to carry out consequential improvements. In some cases, depending on the economic outcomes, owners determine not to do certain works as consequential works will be triggered, although there is a cap to 10% of the value of the works. Similar information is required for submitting building approvals applications in England as outlined above for Australia. Politically in 2012, the Cabinet Office examined the potential to reduce regulation and DCLG initiated a review of the regulations framework and voluntary housing standards (DCLG, 2014).

Local Authority Building Control (LABC) are a member organisation, representing all local authority building control teams in England. LABC is a national service provider delivering services at local level (LABC, 2014). Significantly LABC has an online submission of applications via http://www.submitaplan.com/ to all Local Authorities in England. The website is designed as a single location for public and professional users and users can track the progress of their application online. As more clients use CAD and work online, LABC identified a need for a simple electronic application system that would extend to Building Control surveyors (LABC, 2014). It may be possible to adapt existing LABC software to accommodate the additional data collection proposed in this research.

Other legislation and incentives

In Australia the National Australian Built Environment Rating System (NABERS) rating is a base building or whole building energy rating which rates performance on a scale of 0 to 6 stars, where 6 stars represents a 50% reduction in greenhouse gas emissions or water use from a 5 star rating. A zero star rating means the building is performing well below average with considerable scope for improvement. The Building Sustainability Index (BASIX) aims to deliver water and GHG reductions across NSW and applies to all residential buildings (BASIX, 2014). BASIX sets sustainability targets for water and energy and minimum performance levels for the thermal comfort of proposed developments (BASIX 2014). Targets, based on NSW average benchmarks, include up to a 40% reduction in water consumption, up to a 40% reduction in GHG and minimum performance levels for thermal comfort. BASIX is a part of the building regulations approval process in NSW. Once design plans are complete, a certificate is obtained by completing an assessment online. By generating the certificate owners commit to constructing the project as described. The certificate is assessed by the council. If approved the building should be built as described and inspectors will attend site to survey the building and certify the project. Construction certificates are required before construction commences and the BASIX certificate is attached to the application for a construction certificate. Upon completion, the BASIX certificate is attached to the occupation certificate. The certifying authority will only issue a final occupation certificate when satisfied that the project has been built as described on the BASIX certificate (BASIX 2014).

Under the *Building Energy Efficiency Disclosure Act 2010* mandatory obligations apply to many commercial buildings. The Act aims to encourage building energy efficiency and is managed by the Department of Climate Change and Energy Efficiency. The scheme is similar to the EU Energy Performance Certificates (Warren, 2011). Sellers or lessors of office space above 2,000 square metres have to obtain and disclose a Building Energy Efficiency Certificate (BEEC). A BEEC comprises a NABERS Energy star rating for the building, an assessment of tenancy lighting in the area of the building that is being sold or leased and general energy efficiency guidance. BEECs are valid for 12 months and must be publicly accessible on the online Building Energy Efficiency Register. Mandatory Disclosure requires minimum standards of energy efficiency and the aim is to encourage the market to take up greater energy efficiency (Warren, 2011). Analysis of the Melbourne commercial building adaptation market from 2009 to 2011 showed greater levels of energy efficiency and that the policy appears to be making some impact (Wilkinson, 2012).

Environmental Upgrade Agreements (EUAs) provide access to finance for environmental improvements to existing commercial buildings in NSW and in Melbourne as part of the 1200 Buildings Program

(Environment NSW, 2014. City of Melbourne, 2014). EUAs are voluntary and aim to incentivise owners to undertake environmental upgrades. In Melbourne an EUA is a contract between building owner, bank and the City of Melbourne (City of Melbourne 2014). The loan repayment is collected through a rates charge and passed on as a loan repayment to the lender. The benefits include competitive and fixed interest rates, no re-financing is required, a repayment period of 10 years or more is available, the loan stays with the property owners decide to sell, and; the option of sharing the retrofit cost with tenants so both parties are better off economially, socially and environmentally. Investing in retrofitting improves the value and marketability of a building and EUAs will support better performing buildings (Newell et al, 2013). Key legislation and incentive programmes in Victoria and NSW are shown in Table 2.

Table 2. Key legislation and incentive programmes in Victoria and NSW.

Legislation / Incentive	**Building type covered**	**New build**	**Existing**	**Sustainability attribute(s) covered**
BCA (Legislation)	All	X	X	Energy and water
NABERS (Legislation)	Residential commercial office	X		Energy and water
BASIX (Legislation)	Residential	X		Energy and water
BEECS (Legislation)	Commercial	X	X	Energy
EUAs (Incentive)	Commercial Industrial Residential	X	X	Energy water and other sustainability improvements

(Source: Author)

The European Union (EU) Directive on the Energy Performance of Buildings (EPBD) came into effect from 2007 and forms part of UK government strategy for climate change. The principle is to make energy use transparent by displaying the rating, with recommendations on how to improve efficiency. The Energy Performance Certificate (EPC) must be provided whenever a property is constructed, leased or sold. The EPC shows the energy efficiency rating (relating to running costs) of a dwelling. The rating is presented on an A–G rating scale. When a new building is completed, the builder or person responsible for the construction obtains the completion certificate for the owner; a duty under the Building Regulations. This applies to new construction, to conversions and to changes to heating, hot water or air conditioning/ventilation services. Domestic properties require an EPC on construction, and some commercial buildings with a gross floor area exceeding 500 m^2 are required to obtain and display an EPC on construction or conversion. The DCLG is introducing energy and cost saving measures to make all buildings more efficient to a zero carbon standard. The measures are being applied across all EU countries and are in line with the EPBD. Over time all buildings in the EU will need to have EPCs.

The Code for Sustainable Homes, the UK national standard for the sustainable design and construction of new homes, aims to decrease carbon emissions and create a more sustainable residential stock. The Code measures the sustainability of a new home against categories of sustainable design, rating the 'whole home' using a 1 to 6 star rating system. Given that 1% is added annually to the total stock it would take many decades and centuries to cover all buildings. Progress has faltered in respect of sustainability legislation, the UK Government suspended Home Information Packs (HIPs) in May 2010. Similarly the requirement for sellers to give a sustainability certificate to buyers of new homes was suspended. Although the Code for Sustainable Homes is still operational and remains the Government's national sustainability standard for new homes, it faces amendments or suspension in the future. Parts of the code were absorbed into the Building Regulations (Parts L and G). Other parts of the code may be dropped as a result of the Technical Housing Standards Review (IGT, 2010).

The Green Deal launched in 2013 is a UK government programme covering upfront cost of energy-efficiency improvements. The aim is to improve energy efficiency in over 14 million homes by 2020

(Wright, 2014. Gov UK, 2014) and allows owners to make energy-saving improvements without paying all costs upfront. Owners repay improvement costs over time; the Green Deal is a loan, not a grant. It is predicated on the basis that savings on energy bills post improvements cover the loan repayments. There have been problems with financing, with excessive amounts of paperwork and unclear information deterring customers. Delays in credit checking mean it can take a month to complete finance, compared to 24 hours with high street lenders (Wright, 2014). By October 2013, 71,000 Green Deal assessments had been completed, with 961 households signed up for financing; a conversion rate of 1.35%. The cost of the borrowing at 7.9% per annum was lower than most personal and credit card loans; but more expensive than a mortgage and this may deter some. It is early days for the scheme and there is growing interest and 81% of households who have a Green Deal assessment stated they have, are getting, or intend to install at least one measure. These measures will be recorded and collated by the companies involved in the Green Deal. However, it is possible that a new government might rescind the legislation or adapt it and the data collected would be amended. Statistical data on the Green Deal scheme is being collected and published on a monthly basis by the Department of Energy and Climate Change to track the changes to the building stock over time (DECC, 2104b). Table 3 summarises key legislation and incentive programmes.

Another voluntary initiative is CarbonBuzz, funded by the UK Technology Strategy Board and industry partners and launched in June 2013, it emerged from a realisation of the lack of awareness between CO_2 emissions and energy use in buildings (Carbonbuzz, 2015). Project partners support architects and engineers to close the gap between as designed and actual energy use. The initiative is a collaboration between the Royal Institute of British Architects and the Chartered Institution of Building Services Engineers (CIBSE). Using the CIBSE Energy Benchmarks with BRE software, CarbonBuzz benchmarks and tracks project energy use from design to operation (Carbonbuzz, 2015). Participating practices share and publish building energy use data anonymously, to increase the evidence base for low energy design solutions. The platform presents a visual template for communicating energy use to inform low carbon design and to influence future policy and regulation (Carbonbuzz, 2015). To date, it's weakness is that it is a voluntary measure and only captures parts of the sector which choose to engage in Carbonbuzz.

Table 3. Key legislation and incentive programmes in England.

Legislation / Incentive	**Building type covered**	**New build**	**Existing**	**Sustainability attribute(s) covered**
Building Regulations (Legislation)	All	X	X	Energy and water
EPC (Legislation)	Residential Commercial	X	X	Energy and water
Code for Sustainable Homes (Legislation)	Residential	X	X	Energy
Green Deal (Incentive)	Residential		X	Energy
New Non Domestic Buildings	Commercial	X		Energy
Carbonbuzz	All	X	X	Energy

(Source: Author).

Voluntary measures

The era of voluntary rating tools started in 1990 with the UK BREEAM. Initially tools focussed on new build and a limited range of sustainability metrics though this has evolved. Typically the tools cover management of the building, energy and transport emissions, health and wellbeing issues, water

consumption, land use and ecology and pollution and sustainable sites. Variation in the weighting of issues reflects the importance of the issues locally. For example, water issues are more important in drought stricken countries like Australia compared to flood prone countries like the UK (Table 4). The predominant systems in the UK and Australia are BREEAM and Green Star which have a large geographical market penetration in their respective property markets. However they are mostly directed on new building, where typically only 1-2% is added annually to the total building stock. Retrofit work may improve and upgrade with enhanced sustainability features, some of which may be captured in the tools and programmes which cover refurbishment. However, most are not captured and this is a missed opportunity for policy makers to quantify changes to the entire stock over time.

Table 4. Issue Weighting Comparison Table for New Office Construction.

Sustainability Measure	**BREEAM 2011**	**Green Star V3**
Management	12	9
Indoor Environment Quality		20
Energy	19	25
Transport	8	8
Health and wellbeing	15	-
Water	6	12
Materials	12.5	14
Land use and ecology	10	6
Pollution	10	6
Waste	7.5	-
Innovation	+10*	
Total	**100+10***	**100**

(Source: BRE 2014, GBCA 2014) * Additional points available.

Stakeholders

Decision-making in construction and adaptation is complex because of the multitude of stakeholders who influence the decision to varying degrees and at different points in the process (Ball 2002, Kincaid 2002). Ohemeng and Mole (1996) found the stakeholders represented diverse interests, with each having different educational and professional backgrounds. Furthermore some stakeholders fulfil more than one role in the process. Table 5 illustrates the relationships between the stakeholders; their roles and responsibilities. With this research it is the policy makers and regulators who hold the power to instigate the changes to mandate and enforce the collection of additional data in building permit applications. However, clearly there are numerous other parties who have an interest and who are affected by any proposed changes. This research study obtained the views from producers and regulators who most directly involved in compliance of regulations and the research is limited to their perspectives.

Table 5. Stakeholders involved in construction and adaptation of buildings.

Stakeholder	**Description**	**Stage where decisions made**
Investors	Pension / superannuation funds, insurance companies, banks, independent investors, professionals who find capital to invest	Beginning / early

Developers	Organisations that combine investment, production & marketing in whole or in part. Professionals from above bodies and others	Beginning / early
Owners	Business organisations Private individuals	Beginning / early
Policy makers	Federal, State and Local Government departments.	Indirect effect on decision-making in construction adaptation at all stages
Regulators	Local Authorities, Planners, Heritage, Building Surveyors, Fire engineers	During design stage (and possibly during construction if amendments are made)
Producers	Professional team – Facilities Manager, Quantity Surveyor, Architects, Contractors, Suppliers, Building Surveyors, Fire Engineers, Structural, Mechanical & Electrical Engineers	Quantity Surveyor / Architect at feasibility stage Design stage Construction stage
Marketeers	Surveyors, stakeholders, professionals who find users for buildings	During design (if selling off plan) and /or construction stage
Users – Corporate Residential	Large institutional owners and users, Individuals, Business organisations and Occupiers	

(Source: Adapted Wilkinson, 2011)

Research Methodology

The research methodology was designed to ensure the research aims were met. From the nature of the research problem and the research questions, this project embodies the characteristics associated with qualitative research (Silverman, 2000:8). Qualitative research has a preference for qualitative data with the analysis of words and images rather than numbers, featuring observation rather than experiment, and unstructured rather than structured interviews. This research prefers meaning rather than behaviour, rejects natural science as a model and, prefers inductive, hypothesis generating research (Silverman 2000:8).

Key stakeholder issues in respect of changing building permit data collection were identified as policymakers or regulators and practitioners or producers. Each stakeholder contributed to the discussion around effective ways of measuring the uptake of sustainability measures into the built environment over time. Stage two comprised collection of the views and perceptions via focus groups held in Melbourne and Canberra in 2012, Sydney in 2013 and London and Sheffield in the UK in June 2013. Focus groups allowed an exploration the views expressed by experienced professionals. Recording the focus groups ensured a good flow of ideas and views (Silverman, 2000). Best practice guidelines were followed to ensure all participants had the opportunity to express their views (Silverman, 2000). In stage three a conceptual model was produced to identify the measures which should be collected in revised building permit data for Australia and UK.

Qualitative research is inductive and hypothesis generating. As the research assimilates knowledge and information contained in the literature ideas, questions are formed which are put to research participants, and from this process conclusions are drawn. The limitations and criticisms of focus group data collection are that the sessions may be dominated by individuals holding strong views (Silverman, 2000). This effect

can be countered with an effective focus group coordinator who is able to direct the flow of information and views to ensure all views are heard and discussed.

Data Analysis and Interpretation

The Melbourne, Sydney and Canberra focus groups were attended by 24 participants from a range of stakeholders at Federal and State government level and leading practitioners working nationally and internationally. Participants included the Department of Climate Change and Energy Efficiency, the Victorian Building Commission, the Association of Refrigeration and Heating Engineers (AIRAH), leading professional consultants and Building Surveyors. Collectively they represented a range of perspectives in the legislative environment in Australia. They were asked;

1. What they thought of including data on sustainability measures in permit data?
2. What would we use this data for?
3. What data should we collect? And;
4. Which professional would be best to provide this information?

With regards to incorporating data on sustainability measures into building permits, overall responses were positive and all agreed it was desirable to come up with a solution that incorporated all building types. One Melbourne participant stated it *'has huge potential'* while another commented that he *'believe[s] that's been the biggest gap so far in the research that we are doing …we don't have any real-world, across-the-market understanding'* of what changes occur over time to individual buildings. He went to say "*having a program like this, where you've already got that data collection happening"* would facilitate the statistical analysis of the changes which are taking place in the built environment across all building types. A Sydney participant commented that *"data is everything"*; which reflects the growing importance and application of datasets in construction in Australia. The comment reveals that, with such data, it would be possible to make more informed decisions in respect of the built environment.

With regards to what sort of data should be collected. Currently the BCA is restricted to energy efficiency (Section J) and some water economy measures in the PCA. There was the potential to collect data to feed back into building energy models, increasing reliability and validity, as a participant noted; *'A lot of work in building codes is based on energy models – let's collect the data, build it back into the models and compare where the models were right and so when they build the next lot of models they build them on the evidence rather than on gut feel'*.

Concern was expressed about the amount of paperwork and who would be responsible for collating and submitting the data. Ultimately it depended on what you are trying to achieve; calculation of GHG emission reductions or a general tracking of changes and transformation in the built environment.

Another concern was duplication of exisitng schemes, i.e. BASIX. The proposal is that a basic level of data would be pulled out of the permit or approval application for incorporation into the State wide database on building permits. However, in Australia some States collate data on a state wide basis, others do not. State wide data collation enables analysis at national level.

Another issue is retaining flexibility when the permit is submitted. *"Clients generally try to be as non-committal as possible at building permit stage, because they want to be as flexible as possible … because sometimes you can have really long gestation periods"*. These views were reiterated. Although changes should be incorporated into an amended building permit, *'it may not always be'* undertaken. With this in mind the occupancy permit, which is signed off when the building is ready for occupation, is the place to incorporate data on the sustainability measures. Depending on the use and type of data collected, it could add *'another layer of information gathering which is of little use',* and therefore needs careful consideration. A concern raised in Sydney with regards to requirements for inspections was the reliability and accuracy of inspections; inspectors do miss items and omissions or inaccuracies would affect reliability.

All groups were concerned about over burdening inspectors with additional tasks. When asked, which professional should provide this information, different members of the design team and inspectors were discussed. An online permit system, with the permit number and password access, allows different professionals to submit information. A system of multiple choice questions might be an easier way to fulfil the obligations of supplying data in this approach. An advantage is that data analysis would be easier, as the system would pre-code data.

A fear was the quality of information that might be provided, especially for small projects where suppliers might be less well known and their products less reliably labelled; a scheme might operate more reliably for larger projects with mainstream consultants. Another issue was the possibility that users and owners modify measures shortly after installation. For example, the owner who installs water efficient shower fittings and removes them because the water pressure is insufficient for a *'good shower'*. In this case NABERS is a better tool as it measures actual energy and water usage.

There were concerns about introducing another system, and the lead-in period to raise awareness and understanding. The scope of the system was discussed, and concerns that some projects were outside of the system; e.g. defence projects where large projects are undertaken, but no data is disclosed publicly, and this would be an omission from the dataset.

Finally planned maintenance that improve sustainability would not be part of a development approval or a permit, e.g. all lights replaced with LEDs substantially reducing energy use and carbon dioxide emissions. This type of work is undertaken regularly and would not be captured, reducing it's accuracy as a decision making tool. Furthermore some of this data is collected under the BEECs, though currently only for spaces over 2,000m^2.

This data would monitor results to ensure that policy is working and inform future improvements. In addition it would be possible to establish pathways for attaining an increased stringency of regulations, based on empirical evidence. As a legislator commented; *'To make a case for collecting additional data through the building permit system, something that's been close to my heart for years, the key word is evidence. Link it to developing evidence around the effectiveness of the building regulations'*.

The London and Sheffield focus groups were attended by 8 participants drawn from senior leading practitioners who work nationally and internationally and academic backgrounds. Generally UK participants could see some benefits in the notion of incorporating data on sustainability measures into approvals. One stated it could enable us *'to draw conclusions on progress towards de-carbonising'* the built environment. There was agreement that it would be useful to collate data on energy, however there was a question of how best to do this. The current plethora of schemes, measuring different types of sustainability in different land uses at various stages in the lifecycle, are challenges. No central data collation point exists and the disparate groups are unlikely to share data, even if all the groups currently collate their own data to central databases.

The online system for submission of applications could be adapted to accommodate sustainability data. The proposed system would establish an additional time requirement, to separate the data which relates to compliance with all building regulations to track the integration and uptake of different sustainability measures. The cost of the time would become a stakeholder responsibility and, if the time requirement was onerous, it could lead to higher professional fees. If the task fell to public servants then the fees for building regulations may increase. With the UK government's commitment to cutting 'red tape' the notion was unlikely to gain support.

Data collection required an explanation to inform applicants about what data were required and why, what it would be used for, and how it would benefit the community. Thus people would have a greater understanding of their contribution to national statistics. The discussion on what form to have data collated, explored the merits of adopting simple or complex data collection that would enable insertion of data into a calculation that would predict the annual consumption based on typical consumption for that land use.

A possible conflict was perceived in England and Wales with the Green Deal legislation, which was considered *'a really complicated system',* and any scheme has to be simple to be understood and adopted. If the data submission was mandated with submission of the application, the issues of the Green Deal take-up would be circumvented. There are similarities in the Green Deal and the EUAs incentive structure in Melbourne and Sydney. The Green Deal should generate a lot of data which should enable government to track the type and amount of improvements over time, however it only applies to residential land use.

Although BREEAM and the Code for Sustainable Homes try to encourage and recognise sustainability in the various land uses, some are limited to new build; though BREEAM now includes refurbishment for some land uses. However, it is unclear whether data is collated and transferred to a central point as a means of determining nationally what change is occurring. Often it was felt, that sustainability measures

'captur[ed] the bigger building projects' with the rating schemes, and missed the opportunities from counting the collective contribution to sustainability made by smaller projects.

Practitioners expirenced confusion and ambiguity over some terms, for example, 'zero carbon' can mean very low carbon to no carbon. With new buildings there seems to be a clearer view of what is required, however the position with regards to existing stock is less clear *'looking at the existing stock we've got a slightly different picture and that's open to more debate'*. It was agreed, if the focus is on new build only *'its only going to scratch the surface'* of mitigating climate change through the built environment. A current strategy is incremental change through Part L up to 2020, with a small change scheduled in 2013 and 2016.

EPC programmes focussed are a means of recording levels of energy consumption and performance. The intention is to improve standards where by 2020 all new buildings will be rated A or A+ the best performance possible. Participants believed most stock will be performing at level E, D and C; i.e. relatively poorly. Although participants saw weaknesses in the EPC approach, the advantage was they are *'a simple measure'* and; are understood by practitioners. Practitioners constantly try to keep abreast of changes in legislation and practice and another scheme would be perceived as more work. Table 6 summarises some perceived benefits and concerns in Australia, England and Wales.

Table 6. Summary of perceived benefits and concerns in Australia and England.

Benefits	**Concerns**
Australia Could feedback into building energy models increasing reliability and validity. Can see what is happening to the built environment over time. Online application allows a range of professionals to provide data. Joining up a number of databases. Could make regulations more effective.	**Australia** Permits change during construction. Over burdening inspectors. Another layer of data which is of little use. Duplication with existing schemes. Quality of data provided. Quality of inspections and accuracy of data. Size of projects – very small jobs. Post inspection adaptation. Omission of planned maintenance works. State variations.
England Could feedback into progress on decarbonising Online approval allows a range of professionals to provide the information.	**England** Amendments during construction. Over burdening Inspectors. Another tier of information collection which may be of limited use. Possible overlap with existing schemes such as EPCs

(Source: Author)

The conceptual model

The conceptual model (figure 1) shows how permit data could measure and quantify the uptake of sustainability measures over time. The model starts with the submission online of application for permit/ approval. Stage 2 shows the potential for extraction of selected data for analysis. Depending on the system; applicants either input data in text form or, select from a series of drop down boxes. Drop down lists allows faster data inputting, e.g, when inputting data on building type, applicants select from residential, retail, commercial industrial or other. The third stage shows the options for analysis based on time (years or months or seasons), by location (allowing analysis of whole cities, suburbs within cities or sections of cities and comparisons made based on rural or urban locations). Further analysis is based on building type and it is possible to sub categorise building types for example, residential could be townhouse, detached, semi-detached, high rise apartment and so on.

The next section would be a list of the different energy efficiency measures undertaken. Typical measures would be identified and then other options for non-typical measures to be noted down. After energy efficiency, water economy measures would be covered in the same manner as energy measures. Further development could embrace measures to reduce waste and other sustainability criteria as they get incorporated into building permit legislation over time.

Figure 1 Conceptual model: the measurement of sustainability in the built environment using building permit data.

ABOUT HERE

(Source: Author)

Conclusions

This research has highlighted the opportunity to use an existing policy and data collection resource; namely building approval / building permit data in England and Australia. Existing measures, whether mandoatry or voluntary, are focussed on enhacing sustainability in the built environment rather than benchmarking current levels and measuring change over time. The proposal is to amend the system of recording data to include what is undertaken in respect of sustainability (mainly Part J and Part L) in new build and adaptations, and this is set out in the conceptual model proposed in figure 1. The research aims and findings were as follows;

1. To evaluate the viability of collecting data on sustainability measures integrated into buildings through an expansion of building permit data.

It was found that it is technologically feasible to collect data on sustainability measures within the permits in Victoria and NSW in Australia and in England. Economically, costs need to be covered, and it is unclear whether this should be passed onto taxpayers, clients or owners. Socially the benefits would be to determine how society is progressing towards sustainability goals across all sectors of the built environment. Policy makers would be empowered through having a more comprehensive dataset in respect of the uptake of sustainability measure within the built environment, and herein lies the major contribution to knowledge of this proposal. The benefits of achieving reduced carbon and GHG emissions would be mitigation of the predicted changes to climate and this proposal would inform society of progress. Politically, it is unlikely that there is a will to make provisions for this proposal in existing regulatory systems.

2. To ascertain the content and scope of building permit data collection across Australia and England and types of data collection and storage methods adopted.

Similar data is collected in Australia and England. Some online submission exists which offers potential to analyse data and to assess patterns of construction works over time, though data accuracy and consistency varies in jurisdictions. A lack of consistency across Australia with its three tiered government system means support in the Federal Government is unlikely.

3. To identify the barriers and scope for changing building permit data collection across Australia and England.

The barriers focus on costs, additional workloads and doubts about the usefulness of the data collected. Furthermore, changes during building works meant a more accurate approach might be to collect data from occupancy permits.

4. To propose a model for collecting sustainability data in building permits for all building types in Australia and England to deliver regulatory efficiency and effectiveness.

A conceptual model is proposed, starting with the submission online of applications, the second stage is the extraction of data for analysis. Data on energy and water would be collected. Further development

could embrace waste and other sustainability criteria, as they are incorporated into law. The potential outputs include an overall trend analysis in all building types. Time data allows insight into how things change over time and whether; other legislation and policy initiatives have an impact. It would be possible to see if regions and cities adopt changes at faster rates than others or whether different property types take up different measures. It would be possible also to determine whether building age or other attributes is a factor in the uptake of measures.

The environmental benefits are clear and technologically it is feasible, however economically there would be issues in terms of who pays for the costs of entering the data and; finally, there is likely to be a lack of political will to adopt such an approach. However we must be mindful that we cannot manage what we do not measure.

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