A UNIT OF SPACE FOR UK URBAN ENERGY MODELLING

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ABSTRACT

Urban-scale energy modelling based on the characteristics of individual commercial premises poses a number of challenges, the most immediate of which is what precisely to model. For a range of reasons connected with their self-contained nature, individual non-domestic buildings would ideally be selected. However, the main information sources available, digital mapping and business taxation data, are not based on "buildings" and do not use the concept, thus making an automatic approach problematic. At the same time, manual identification of the distinct buildings in a city is not a practical proposition because of the numbers involved. A solution was found by identifying a new element of space in the built environment from an analysis of the relationships between the main data sources captured in the Local Land and Property Gazetteer.

INTRODUCTION

Increasingly, energy policy in the UK is focusing on the community level and there is a concomitant need for energy modelling at a suitable, i.e. urban, scale. Top-down methods are considered inappropriate at this scale, because the attribution of aggregate data on which they depend does not support meaningful comparisons and they generally do not capture relevant technological and behavioural change. For the domestic stock, so-called bottom-up methods can be scaled up, e.g. Min et al (2010). Such an approach is based on the adaptation of relatively simple steady state models used for single dwellings, although dataset reduction is still potentially problematic. In the case of the non-domestic stock, however, the methods used for single buildings are far less readily adaptable. Even accepting that a fully dynamic modelling approach is currently unrealistic at this scale, simpler models (e.g. SBEM) still have massive data requirements and there are additional problems relating to the complex relationships between occupant activity, the mapping of premises as units of activity to buildings and the difficulty of accounting for all such units in the model. This paper deals with a fundamental aspect of the problem and is based on work on the 4M project (Lomas et al 2010, 4M 2012), which is using the city of Leicester, UK as a case study. For this project a model has been developed, based closely on ISO 13790, which determines energy consumption primarily as a result of the balance between heat gains from occupants, electricity use and the heating system, and heat losses through the walls. The question addressed here is the scale at which the modelling should be carried out. In other words, a decision is needed on the unit of space the calculations should be performed upon: business premises, individual buildings (if they can be defined clearly enough), blocks of adjoining buildings, or some other unit.

DATA SOURCES

In the UK, two data sources are available that are potentially valuable as enablers of non-domestic building energy modelling at the city-scale: the Ordnance Survey digital MasterMap data (OS 2012), which depict the outlines of all buildings and parts of buildings as polygons known as building TOIDs ("bTOIDs" hereafter); and the Valuation Office Agency (VOA) Rating List of premises (strictly, hereditaments) attracting business taxation ("premises"). Although there is a drive to link these two datasets at national level so that premises can be geo-referenced straightforwardly, at the time of writing this effort remains very partial. There may therefore be an initial challenge to relate the addresses of premises in the VOA dataset to map objects and this must be achieved before the datasets can be integrated to give useful information. In the case of Leicester – as will be described below – this process is already largely complete. Commercial and research software is available to automate the linkage of these datasets where necessary, although this approach is unlikely to deliver the accuracy or completeness of manual exercises, and they are not the focus of this paper. The main challenge is to establish the basic modelling unit.

If bTOIDs represented the building footprint in an invariant one-to-one relationship, they would provide the energy modeller with a straightforward approach. However, often buildings comprise several bTOIDs. This is at least partly due to the intention (OS 2001, p. 74ff) to represent different types of construction, although in some cases the division into separate bTOIDs appears arbitrary. One consequence is the significant excess of bTOIDs in the analysis described later.

The VOA Rating List includes the great majority of non-domestic premises, and most of them appear in the more detailed Summary Valuation (SMV) database which provides the taxable (roughly, occupied) area, overall function (e.g. office or shop) and for larger premises some breakdown by room or floor of the use of space. It seems unlikely that this "subpremises data" could be related reliably to buildings or parts of buildings, and so the unit of interest in this dataset is the premises, with the further detail available in the subpremises data enabling the determination of average premises properties. So among other things, each premises will be assigned an average internal temperature: one might have a value of 21 °C while an another might be 18 °C.

In order for non-domestic energy consumption modelling to be carried out, the two main data sources, MasterMap and VOA, need to be brought together in such a way that they apply to the same space. Fortunately for the 4M project, much of this linking has already been carried out for Leicester as part of the creation by Leicester City Council of the Local Land and Property Gazetteer (LLPG). For the moment we have taken this linking as correct and have studied it in detail. The results shed light on the subject of this paper, and so the analysis is presented separately in a later section. In summary, the following data are available:

1. All the built structures in the city, both domestic and non-domestic (from MasterMap)
2. The non-domestic premises (from the VOA)
3. The linkages between the two (from the LLPG).

Item 1 provides wall, roof and ground areas and orientation. A related dataset contains the heights of the structures associated with the bTOIDs expressed as a "2.5D model", obtained by combining the bTOID polygons with LIDAR data supplied by Infoterra, UK.

Item 2 provides the taxable area, the non-domestic function (shop, office, etc.) and, in most cases, some breakdown of space use. Analysis of the VOA data (Liddiard et al 2010, Liddiard 2012) has assigned some operational details, e.g. internal temperatures and electricity consumption, to the premises in item 2.

THE SELF-CONTAINED UNIT

Requirements for the modelling unit

An important question to address is the scale at which the modelling should be carried out. Some of the requirements can be identified fairly straightforwardly. Whatever unit is chosen, it must be amenable to modelling. For the approach adopted, this means being bounded by a well-defined (though possibly not well understood) building envelope and having consistent properties so that the less well known properties (e.g. thermal capacity) can be deduced from others, such as age or construction method, and so that assumptions about building

material and glazing in one wall are applicable to others.

Since the aim of the modelling is to understand energy consumption, the unit should have its own energy metering so that the characteristics of its energy use are correctly represented (Neffendorf et al 2009). These points correspond to a requirement for being self-contained and so are consistent with a further requirement that it be meaningful to consider the unit in isolation. The unit should be small enough to allow a reasonable degree of granularity, so that the results can be analysed and presented in different ways. There should ideally be no arbitrariness in the definition of the unit. Finally, the large quantity of data involved means that the unit should be straightforward to identify, work with and automate, with no requirement for human judgement.

So ideally the chosen unit, which will be referred to as the "self-contained unit" or SCU, should have the following properties:

1. Physically distinguishable or otherwise meaningful when considered in isolation
2. Appropriate for modelling:
   2.1. Bounded by a single building envelope whose properties are known or can be deduced
   2.2. Having consistent properties, probably due to having been built as a unit e.g. all walls having the same construction method and window type, thermal capacity consistent with date and type of construction, etc.
3. Self-contained (e.g. has its own energy metering)
4. Non-arbitrary
5. As small as possible consistent with the above, to allow a reasonable degree of granularity
6. Straightforward to identify and work with.

Analysis

Item 2.1 is probably the most important criterion. It means the SCU cannot be a premises, because a building envelope is not applicable. It also means that the SCU cannot be smaller than a bTOID or include parts of a bTOID because then there would be parts of the envelope for which there was no information. In some cases the SCU can be identified with a single bTOID, but not always, because some bTOIDs represent building subsections – parts of existing structures which are not self-contained and so do not satisfy item 3. If the SCU does consist of more than one bTOID, they must be in thermal contact in order for them to have a single building envelope. Item 2.1 also means that the unit should include all storeys in a multi-storey structure. To summarize this stage of the analysis, the SCU must consist of one or more bTOIDs in thermal contact.

The next stage is to decide which bTOIDs to include. One option would be to define the modelling unit as any set of contiguous bTOIDs. This has the advantage of clarity and simplicity. It provides a clear answer to the question about whether a terrace of five identical shops is five buildings or one – it is one. It takes care of bTOIDs representing building

subsections automatically. It would also be consistent with the natural way to approach modelling a modern shopping centre: as a single building.

Where it does not work well is that in some cases (e.g. the row of shops referred to above) the unit will be large and will include many self-contained structures, possibly of very different ages and therefore construction types and which almost certainly have their own heating systems. It would therefore not be consistent with requirements 2.2, 3 and 5.

It would be preferable if the SCU corresponded to a building as normally understood. But this is problematic. There is no clear definition available (Neffendorf et al 2009) and in particular no obvious way of translating the available data (VOA and MasterMap) into units called "buildings". So as things stand it would be difficult to identify the bTOIDs comprising a building manually and impossible to do it automatically – and yet the large quantity of data in city-scale modelling (about 10,000 premises in Leicester) makes an automatic approach necessary.

A possible solution was developed by analysing the relationship between bTOIDs and premises, as captured in the LLPG.

STUDY OF THE LOCAL LAND AND PROPERTY GAZETTEER (LLPG)

Relationships between bTOIDs and premises

The bTOID and premises data, from the OS MasterMap and VOA databases respectively, provide complementary information about spaces used for commercial and industrial purposes.

The bTOIDs represent buildings, or parts of them, which exist physically. For present purposes they have constant, uniform properties and are permanent. Premises, by contrast, are a construct used by government for taxation purposes. They exist only as entries in a database and are relatively variable and transient, strongly dependent on the economic climate. But they provide vital evidence of the way an organization uses space, and up to now this has been their primary role in research of this type, e.g. Steadman et al (2000).

With the introduction of the LLPG, the bTOIDs and premises relating to the same spaces have been linked, thus defining the bTOIDs within which an organization operates. This feature is now examined in more detail.

The previous section showed that the definition of an appropriate unit for modelling led to the requirement that it should be one or more bTOIDs in thermal contact. An additional requirement is now proposed: if two bTOIDs in thermal contact are associated with the same premises, both bTOIDs should form part of the same modelling unit. The logic is that attached bTOIDs that form part of the same premises are highly likely to be part of the same building as normally understood; and if that is not the case, there

is still some commonality because the building is being operated by the same organization, lessening any errors due to the assumption.

This additional requirement provides a solution to the problem of how to deal with bTOIDs that represent building subsections. Provided they have been identified as being part of the same premises as the bTOID to which they are attached, the requirement will include them in the same modelling unit. The requirement also provides a natural distinction between two adjoining SCUs if they have no premises in common. The two requirements can now be combined to give a definition of the self-contained unit applicable to the data in the LLPG. There are several possible equivalent statements of the definition. The one below is chosen because it is the most succinct and straightforward to understand, and at the same time focuses on the most important feature of the SCU: the boundary.

An SCU is a set of one or more contiguous bTOIDs with a boundary defined by external walls and/or by party walls that are not crossed by premises.

The application of the definition to some simple cases is illustrated in Fig. 1. Each small rectangular block represents a bTOID, and the curved loops illustrate the extents of the premises inside and between them. Dotted lines around sets of bTOIDs represent the resulting six SCUs.
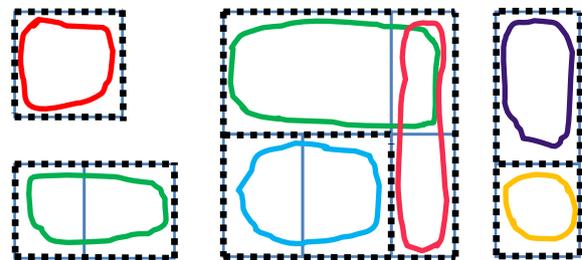
Figure 1 Definition of SCUs

It turned out that application of the definition to real data was facilitated by some preliminary analysis of the database, which is described next.

Analysis of the Leicester LLPG

After removal of irrelevant records and minor corrections to a small number of entries, the LLPG could for the purposes of the present work be characterized as a two-column table. One column contains reference numbers to premises in the VOA; the other contains reference numbers to bTOIDs in MasterMap. A given row indicates a link between a premises and a bTOID, showing that at least some of that premises is contained within at least some of that bTOID.

Two features of the VOA Rating List meant that the LLPG needed to be modified for the planned task.

First, as described later, preliminary work established that the SCU concept does not work well for shopping centres, so the related premises and bTOID records were removed. Second, the Rating List does not apply to places of religion (churches, mosques, etc.) so LLPG records were created manually for such establishments. A further category of premises that the Rating List does not contain, Crown Estate properties, might in general need to be taken into account but no such properties exist in the city of Leicester (Crown Estate 2012).

After making the above changes there were 24,470 records in all, linking 10,862 premises to 16,358 bTOIDs. The large excess of bTOIDs over premises is a result of the finding referred to earlier, that structures that by any reasonable definition would be classed as buildings often consist of several bTOIDs, some of them very small (referred to as "building subsections" above). This alone shows that the bTOID is unsuitable as the unit of space for modelling: the part of a building represented by such a small bTOID would not be self-contained so it would make little sense to model it separately.

An examination of the database showed that a given premises could be linked to single or multiple bTOIDs, and vice versa. In some cases the relationships were more complex: a bTOID could be linked to a premises which is linked to several bTOIDs, some of which are linked to further premises and so on. Each set of bTOIDs and premises linked in this way was allocated to a "Group". So a Group consists of those bTOIDs and premises that are interconnected. Each member of a Group is linked to at least one other member, and no links extend outside the Group. 7,742 Groups were found in the database as shown in Table 1.

Table 1

Analysis of Leicester LLPG

Class	Records	Groups	Records /Group	Premises	bTOIDs
1	3921	3921	1.0	3921	3921
2	1440	489	2.9	1440	489
3	9437	2745	3.4	2745	9437
4	9672	587	16.5	2756	2511
Total	**24470**	**7742**	**3.2**	**10862**	**16358**

Groups were found to be useful for two reasons. First, they provide a simple conceptual basis for studying the relationships in the LLPG. The analysis is primarily about links among the data items. Since by definition no item in a Group has links with any items outside it, the Group defines the items that need to be studied together. Second, Groups reduce the combinatorial problem of working with large numbers of objects. In particular, it is much easier to determine spatial relationships like thermal contact among a Group of six objects than among 16,000.

A useful way of visualizing Groups is to plot simple examples on an (x,y) grid, where x and y represent the premises and bTOID reference numbers. This has been done in Fig. 2.

Each filled square represents a record in the LLPG database, linking a premises to a bTOID. The square nearest the origin represents a link between premises no. 11 and bTOID no. 100. There are no other entries in the same row or column, that is, with the same bTOID or premises reference number. So neither bTOID nor premises is linked to any other record, and the record is the only member of a Group.

The adjacent Group consists of two records with the same bTOID reference number, 101, and two different premises reference numbers, 12 and 13, forming a horizontal bar in the diagram. The next Group again consists of two records with a common reference number, this time the premises number 14, linked to different bTOID numbers, 102 and 103, resulting in a vertical bar in the diagram.

The final Group consists of links between both bTOIDs and premises, so that the cell with bTOID reference no. 105 and premises no. 15 is linked to other records by both numbers.
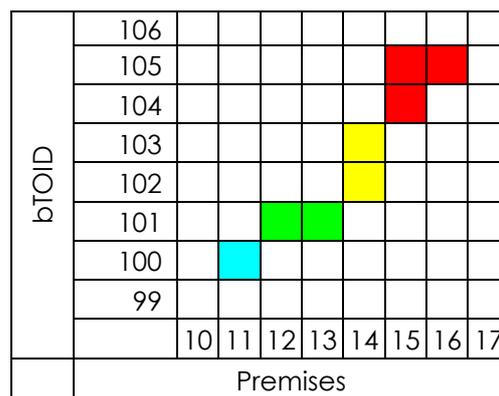

Figure 2 Types of bTOID/premises links

Key:

Class 1: one premises to one bTOID
Class 2: many premises to one bTOID
Class 3: one premises to many bTOIDs
Class 4: many premises to many bTOIDs.

Groups were assigned to four different "Classes" depending on the nature of their links. The examples above are representative of each of the four Classes.

4,410 of the Groups (comprising 5,361 records) were in Classes 1 and 2 which means they consist of one bTOID linked to one (Class 1) or more (Class 2) premises.

Since the premises in the single bTOIDs of the Class 1 and 2 Groups do not extend beyond them, these Groups are SCUs according to the definition. They contain single bTOIDs, so the number of SCUs is equal to the number of Groups, namely 3,921 + 489 = 4,410. If the assumptions made earlier are correct then they can reasonably be identified with buildings.

The remainder, 3,332 Groups containing 19,109 records, are in Classes 3 and 4. They contain multiple bTOIDs linked to single (Class 3) or multiple (Class 4) premises. For these cases, further work is required to apply the SCU definition.

Spatial relationships between bTOIDs

A Group as defined above is a set of linked bTOIDS and premises. In a sense, each acts as a "glue" to join entities of the other type, and the analysis so far has treated bTOIDs and premises as equivalent.

However, there are some differences. There are spatial relationships between bTOIDs but not between premises: it is meaningful to ask whether two bTOIDs are in thermal contact, but that is not true of premises. So one interesting feature of Groups is that they can contain sets of bTOIDs which are in physical contact but isolated from other sets within the Group.

This an important issue in the light of the definition of an SCU. A Group defines a set of bTOIDs which are linked by premises and which have no premises in common with other bTOIDs. If, within this Group, sets of bTOIDs are identified that are in thermal contact, in almost all cases they will be SCUs according to the definition (there are some unusual configurations that make it theoretically possible for these contiguous sets to contain more than one SCU, though none was found in the Leicester data).

The further step was therefore made in the data analysis of identifying bTOIDs in thermal contact within groups. Note that it is quite possible for a bTOID to be isolated within its Group but attached to a bTOID outside the Group: isolation within a Group does not imply total isolation. The point is to identify the contiguity relations between bTOIDs within each Group in order to apply the definition of an SCU.

The earlier analysis shows that SCUs can be defined immediately for Class 1 and 2 Groups. Defining SCUs in Class 3 and 4 Groups requires more work because the spatial relationships between the bTOIDs comprising the Groups need to be analysed. This was done using specially-written software that determined whether or not the bTOIDs within the Group were in thermal contact, defined as sharing at least 50 cm of party wall. "Contact matrices" were then produced for each Group, indicating which bTOIDs were in thermal contact. Further routines in the software analysed the contact matrices to automatically identify the SCUs in each Group, allowing a total for Classes 3 and 4 to be determined of 5,886. Accepting for now the equivalence of SCUs and buildings, this allowed, for the first time, the total number of non-domestic buildings in Leicester (other than shopping centres and any categories missing from the Rating List) to be determined. The result was 4,410 + 5,886 = 10,296.

POTENTIAL OF THE SCU CONCEPT

Full proof of concept is under way and will be reported in a longer paper. Here, an example is presented that indicates the potential, and some limitations, of the proposed correspondence between SCUs and buildings.

Figure 3 shows the Ordnance Survey MasterMap representation of part of De Montfort University in Leicester. The buildings marked 1, 2 and 3 are, respectively, the Queens Building, the Kimberlin Library and the Eric Wood Building. A single premises includes all three buildings, but the main bTOID of building 2 is also linked to a distinct premises within the building: a bookshop. The Group that the linked premises and bTOIDs form is therefore Class 4.

Figure 3 Non-domestic buildings in Leicester

A close examination of the map reveals that building 3 comprises two bTOIDs while there are eight bTOIDs in building 2 (two large and six small) and a similar number in building 1.

Application of the method described above leads to the automatic identification of three SCUs consistent with the three buildings described above. The complete physical separation of building 3 from the others demonstrates how the requirement for contiguity of the component bTOIDs leads to the definition of a separate building.

The definition of buildings 1 and 2 is, however, a little more problematical. It turns out that some of the smaller bTOIDs are absent from the LLPG. In most cases this has no serious consequences, although it does suggest that the SCU definition process adopted should include a comparison stage to check for the existence of such missing elements. But the absence of one particular bTOID does have an impact. This represents a bridge connecting the two buildings, and if it had appeared in the LLPG, Buildings 1 and 2 would have been defined as a single SCU.

On the face of it, this appears to represent a disadvantage in the proposed method. However, the bridge referred to was built precisely to allow Building 2 to be presented as a "Library extension", thus avoiding some administrative difficulties. So the presence of the missing bTOID would in this case have led to agreement with the official status of these buildings.

DISCUSSION

Status of the work

The key point about the proposed definition of space is that it comes against a background of very limited alternatives. Individual surveys of non-domestic buildings would allow the bTOIDs that comprise them in digital maps to be identified, but this is an unaffordable luxury for city-scale studies, as in the present case where the number of premises exceeds 10,000.

Other possibilities include modelling city blocks comprising all contiguous bTOIDs; studying a small area of a city in detail and assuming the results can be applied elsewhere; and modelling the business premises rather than the building, thus forsaking a physical basis for the modelling approach (Steadman et al 2000).

In this light, our proposed approach could enable an otherwise impracticable modelling task. Proof of concept will consist in identifying areas where it works well and those where it does not. Alternative methods can then be considered for the areas of difficulty. In this paper we concentrate on demonstrating the reasonableness of the approach given the scale of the task and its potential to cover a very large proportion of a typical urban setting.

Reasonableness of equating SCUs to buildings

The proposed approach can be broken down into two processes: the definition of SCUs and the equating of SCUs to buildings.

The definition of SCUs appears to be reasonably robust. No occasions have been discovered when the concept fails, though it is possible to conceive of combinations of premises and bTOIDs that make necessary a slightly more complex approach to the computational definition of SCUs than that described above. In practice, it was found that a simple test within the software could identify such cases.

As things stand, then, a technique that gathers together groups of contiguous bTOIDs in a well defined way for collective analysis seems unremarkable.

The aspect that makes the work interesting is the claim that SCUs are comparable to buildings. If correct, this means that assumptions about the building structure and operation based on the expected uniformity within a building can be applied with a reasonable degree of confidence, raising the possibility of reasonable accuracy from a model even when some detailed data are unavailable.

The principle of the correspondence between SCUs and buildings is that premises that extend from one bTOID to a contiguous one indicate that both bTOIDs are likely to be part of the same building as usually understood.

While this seems reasonable, it is likely that there will be cases where it does not apply. One that was identified early in the work was the shopping centre. On the one hand, shopping centres are sometimes defined as single bTOIDs (Neffendorf et al 2009, p. 15). On the other, if separate bTOIDs are defined for each retail outlet, as in the two shopping centres in Leicester, the one-to-one links with the premises suggest that they are distinct buildings. In some ways this is true, but within a larger structure. In addition, the existence of distinct "buildings" on upper and lower floors is also inconsistent with the basic assumption that the bTOIDs are valid at all heights unless they specifically represent overhanging structures, etc. These differences from the standard assumptions for buildings make it clear that shopping centres and comparable structures should be dealt with as special cases outside the SCU framework.

It is likely that the SCU concept also fails occasionally on a smaller scale. For example, it is possible to envisage a business centre comprising several bTOIDs in which one bTOID contains a single premises corresponding to the company renting the space. In such a case the bTOID would be defined as a separate building. Three questions arise: how often this happens, how much it matters, and whether a modification to the definition of an SCU could fix the problem.

On the first point, no examples have been seen as yet, though the data have not been studied in depth. On the second, the indications are that any problems would be minor. Party walls with other SCUs would still be treated as such, and the treatment of differences in temperatures on opposite sides of the wall would be dealt with as correctly as the physical modelling allowed. So the matter is mainly one of convenience: more calculation would be carried out and more SCUs represented than strictly necessary, but other than that there are no obvious disadvantages. In view of this finding, changes to the SCU definition seem unnecessary.

An interesting outcome of the application of the SCU concept to the data for Leicester was that the number of SCUs is similar to the number of premises. This does not seem unreasonable but there is no obvious reason why they should be similar: some buildings (e.g. office blocks) will contain several premises while some premises will extend over several buildings (e.g. hospitals). So the similarity may simply be accidental.

Problems and issues

The most significant issue with the new approach is its dependence on the, presumably manual, work carried out by Council staff to link premises to bTOIDs for the LLPG. Obviously this work was not done specifically to provide the basis for the present work, and it is possible that variations or errors which are minor in the context of the intended outcome could have a more significant effect on the deductions about SCUs.

In this context, it is worth mentioning that further analysis of the Class 4 Groups defined earlier provide possible opportunities for quality checks – but this is not directly relevant to the present work. On a similar

note, the consistency between local authorities of the linking methods used will have an impact on the applicability of the SCU concept across the UK.

Limitations of the method include its restriction to the UK because it requires digital mapping data, business taxation data and the links between them. Further limitations arise as a result of the relatively volatile nature of the taxation data. Changes in the existence or extent of business premises will have an impact on the related SCUs. In particular, if a business ceases to exist, resulting in its disappearance from the VOA database, the corresponding SCU will no longer be defined. This represents a clear difference between the SCU and the building it purports to represent. There is no obvious solution to this problem, although retaining historical VOA entries to ensure the SCU definition continues seems a reasonable approach provided the building is tagged as empty and is modelled as such.

Next steps

The modelling process following successful definition of SCUs will introduce a further set of challenges, mainly relating to the availability and quality of data. In order to minimize such issues a reduced data set approach will probably be used, although the SCU concept should be valid for any physical modelling method. Even so, obtaining the required data will not be straightforward. Internal gains could be derived from the work of Liddiard (2012) while approximate methods will be required for properties of the building fabric, such as the glazing fraction correlations of Gakovic (2000) and the derivations from building age of Smith (2009), assuming age data can be obtained or estimated.

The intended outcome of the modelling of Leicester's non-domestic stock is an understanding of the impact on CO_2 emissions of a range of interventions such as wall insulation, improved glazing and shading devices, more efficient electrical lighting, connection to district heating and provision of local renewable energy generation (Lomas et al 2010).

CONCLUSIONS

- A new definition of space in the urban built environment, the self-contained unit (SCU), can be derived automatically from the LLPG and equates reasonably well to the concept of building. Its use allows the possibility of city-scale modelling based on the characteristics of individual buildings. When applied to the city of Leicester, reasonable results were obtained, making possible for the first time an estimate of the number of non-domestic buildings in the city of just over 10,000. This represents a significant advance and further work will be required to demonstrate the power of the approach fully. It must be recognised that the complexity of the urban environment and the data relating to it mean that inevitably there will be caveats, but these are not expected to seriously undermine the usefulness of this new concept in urban scale energy modelling;

- It cannot be applied to shopping centres and similar structures which must therefore be dealt with as special cases;

- The SCU depends in a non-audited way on the work carried out to create the LLPG;

- An SCU cannot be defined if a building is unoccupied;

- The concept of SCU is only usable where an LLPG (and its supporting data sources) exists and therefore only applies to the UK.

NOMENCLATURE

bTOID	Building TOID, a polygon representing the base of a building or part of one in an Ordnance Survey MasterMap Digital Map.
Class	A category of Group (q.v.) dependent on the nature of the links between the included bTOIDs and premises.
Group	A collection of records from the LLPG which are interlinked but have no connections to any other records.
LLPG	Local Land and Property Gazetteer, a database describing the land and buildings in the area for which a local authority is responsible. The National Land and Property Gazetteer (NLPG) comprises all the LLPGs in the country.
OS	Ordnance Survey, the UK mapping authority.
Premises	(Strictly, "hereditament"). Property attracting business taxation.
SCU	Self-Contained Unit, a collection of contiguous bTOIDs with shared premises
TOID	Topological Identifier, an element of an OS digital map.
VOA	Valuation Office Agency, the government agency responsible for business taxation.

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