## Factsheet

# Total Energy Use in Buildings: Analysis and Evaluation Methods

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**ANNEX 53**

One of the most significant barriers for achieving a substantial improvement of building energy efficiency is a lack of knowledge about the factors determining energy use. In fact, there is often a significant discrepancy between designed and real total energy use in buildings. The reasons for this are generally poorly understood, but are believed to often have more to do with the role of human behaviour than the building design. In fact, building energy use is mainly influenced by six factors:

– Climate
– Building envelope
– Building services and energy systems
– Building operation and maintenance
– Occupants' activities and behaviour
– Indoor environmental quality

In the past, much research focused on the first three factors (climate, building envelope, building services and energy systems). However, the latter three factors related to human behaviour can have an influence at least as significant as the three former ones. Detailed comparative analysis of building energy data covering all six factors would provide essential guidance in identifying energy saving potentials and opportunities. This recently completed project has advanced the understanding of how these six factors combine to influence building energy use, with particular emphasis placed on occupant behaviour.

### ACHIEVEMENTS

The project has greatly improved the treatment of the influencing factors within the building energy field and has more closely related this to the real world. Hence, it has given a better understanding of how to robustly predict total energy use in buildings, so enabling the improved assessment of energy saving measures, policies and techniques. The scope has covered office and residential buildings. Several distinct areas of research have been carried out covering:

– A literature review and a state of the art review: These were incorporated into the Final Report.

– Definitions and energy reporting: These included terminology, indicators and influencing factors for energy use. Definitions were developed for energy boundaries, building energy use terms and conversion factors. Moreover, definitions were developed of the influencing factors and energy performance indicators at three levels of complexity for residential and office buildings, with two case studies used to expound the definitions.

– Case studies and data collection: Case studies were completed including collation of material for four building types for use in simulations.

– Statistical analysis and energy performance evaluation: Guidance has been developed on how to apply statistical and analytical methods as predictive models for total energy use.

– For residential buildings, the particular aspects of occupant behaviour considered relate to use of: heating, cooling, ventilation and windows, domestic hot water, appliances and electric lighting, and cooking.

– The classification of energy-related occupant behaviour in office buildings was on three different levels, namely: individual occupant or manager, zone or office, and the whole building. At each level, occupant and management behaviour is taken into account with respect to electric lighting, equipment, natural or mechanical ventilation, and heating and domestic hot water systems.