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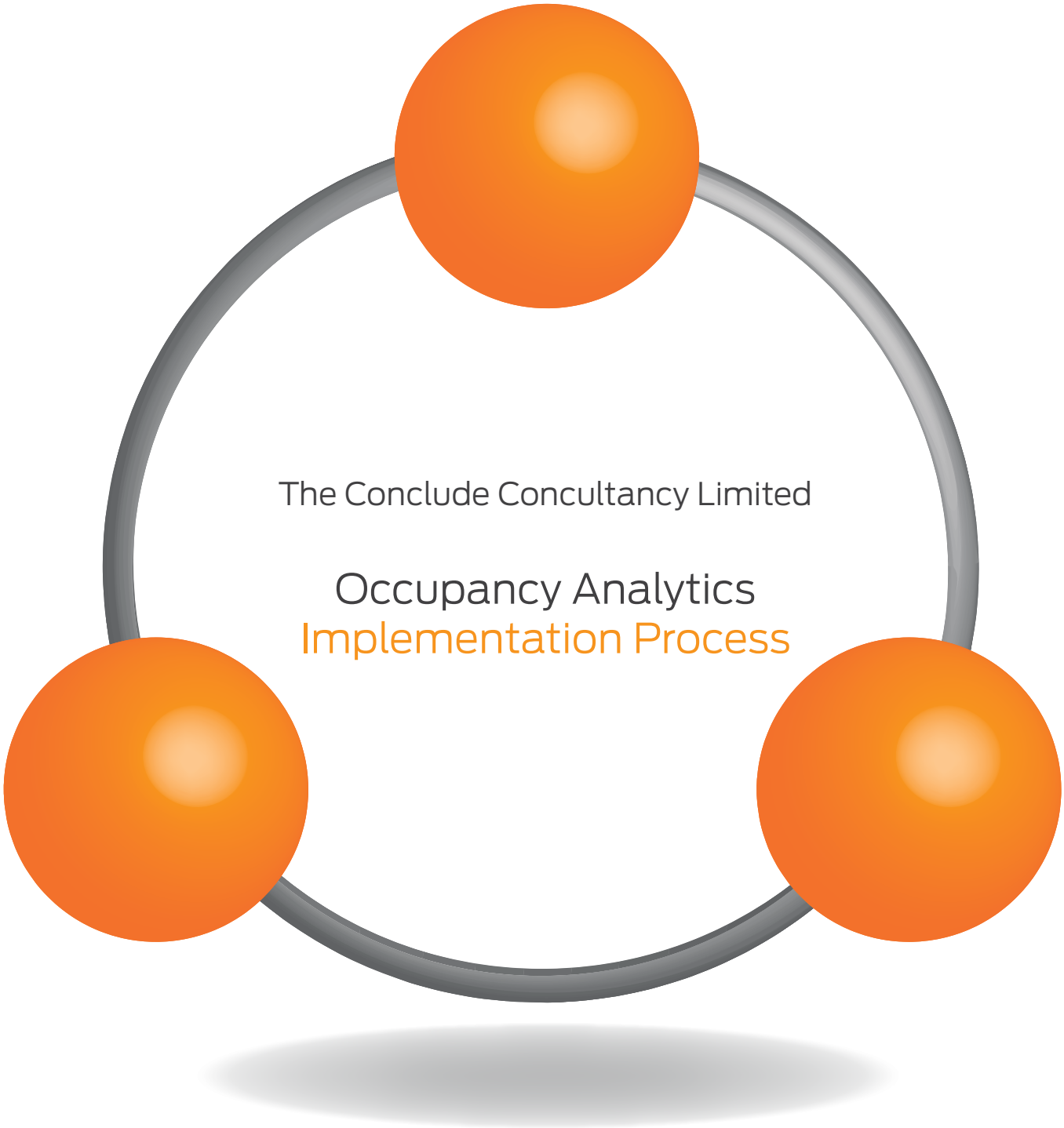

The Conclude Concultancy Limited

Occupancy Analytics
Implementation Process

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Implementation Process: Occupancy Analytics

At what stages of a development process does Occupancy Analytics deliver most value?

Occupancy Analytics adds significant value to nearly every stage of the planning, design, and operational stages of the development process. This is because it provides the interface between those that will use the facilities and those that design and construct them.

From the forgoing it will be appreciated that occupancy forecasts impact every stage of the development process.

1.0 Strategic planning. Right sizing the facility and the systems used to service it. What size should the facility be? What should the CAPEX budget be for the facility and the systems within it?

The answers to these questions will come from an understanding of what capacity the hospital facility needs to provide AND the efficiency which could be expected from a world-class hospital. Processes that encourage patient flow will be far more efficient than those that do not. An efficient hospital will process a greater number of patients per square metre of developed floor space than one that is not. Consequently a smaller facility could be designed, once the forecast patient demand has been agreed.

Establishing the capital cost budget for the engineering systems should be informed by the 'right-sizing' of the systems to match the forecast patient demand. This is where our occupancy analysts working with the engineers provide the strategic advice as to the most appropriate engineering systems strategy for the specific situation.

1.1 Establish targets. At the strategic planning stage it is also ideal to establish an energy and carbon target for the new facility. The Conclude Consultancy is able to provide normalised benchmarking data for such targets built up from departmental performance targets to create a 'composite target'.

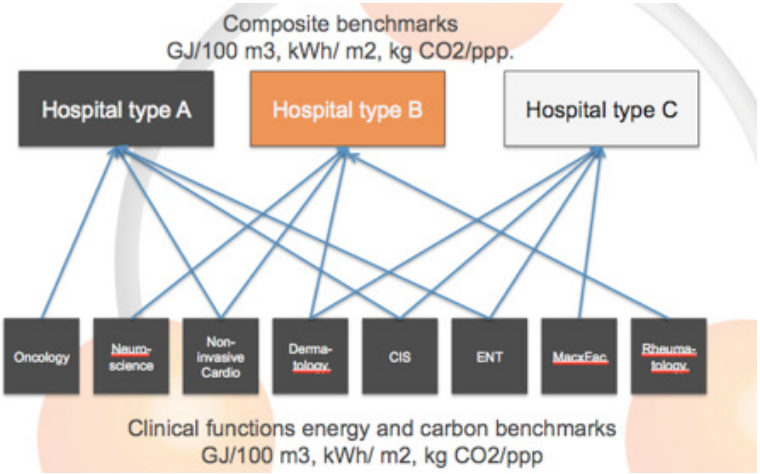

Figure 1 - Hospital facility targets derived from departmental targets.

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1st principle: *The forecast occupancy along with the energy target of the building must be established at the outset of the project, in the strategic planning stage. These two factors will significantly impact the sizing of the building and the budgets for the engineering systems.*

Process Stage	Activity	Comment	Value
1.0 Strategic planning	1.1 Analyse forecast demand and potential impact on rights sizing of facilities.		
	Questions: ▪ What overall occupancy should we plan for?	Occupancy Analytics informs the right sizing of the facility and challenges assumptions concerning the capital provision of plant.	In Europe and the US it is common to over-size hospitals because planning is based on inaccurate assumptions. For every saving of 1000m2 leads to a reduction in European costs of £4.5m.
	▪ What energy and carbon targets should we set for the scheme?	Conclude can provide benchmarking performance data to inform appropriate energy and carbon targets.	Departmental energy targets will enable clinical teams to become accountable for consumption. But they need to be realistic as well as challenging.

2.0 Outline design and Scheme Design. Evolving an informed sustainability strategy for the hospital facility will be most effectively achieved by establishing a dialogue between the potential users and the project team. It is fundamentally important that the design strategy is informed by the operational strategy for the facility, and it is from this understanding that the sustainability strategy should emerge.

2.1 Integration between design and operation. In Europe the lack of integration between design and operation has been described as 'The Great Divide'. It is common for the potential users of the facility not to understand the opportunities presented by different design strategies on the improved operational performance of the facility. Likewise it is common for the designers not to understand the operational impacts on the design. Any mismatch that does arises, means that the facility will fail to perform as the designers expect and the users will be frustrated because the design does not facilitate their working practices. This challenge is illustrated in Figure 2.

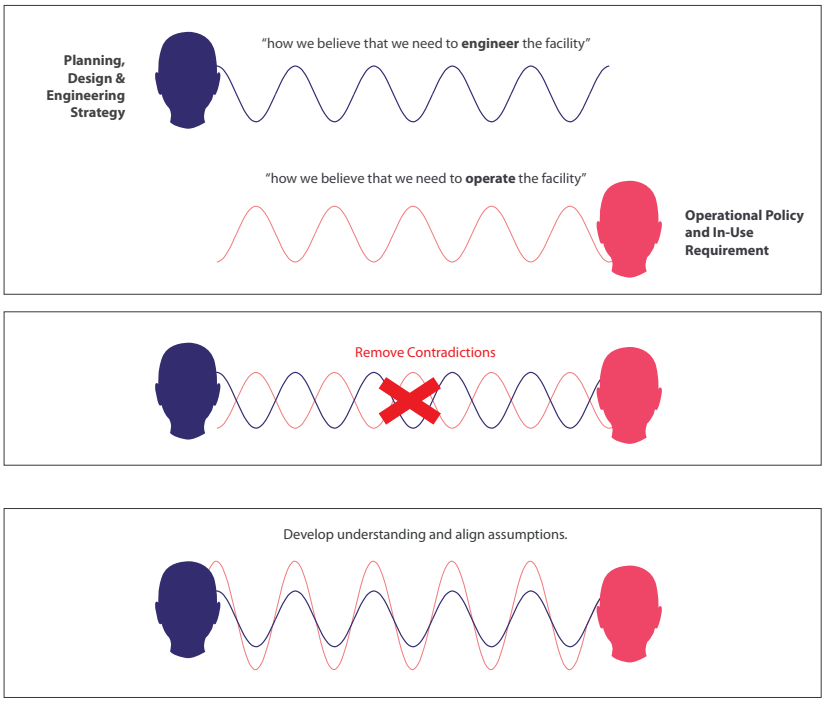

Figure 2 - "Bridging the Great Divide'. (See also www.conclude.org.uk)

The Conclude Consultancy's role in this stage of the project would be to provide the intelligent interface between the project team and the users. If user representatives are not available at this stage then Conclude can provide the expertise to produce draft operational policies to enable the dialogue to develop in this stage of the project. The objective is to achieve optimum alignment between user's requirements and engineering excellence.

From low energy and low carbon perspectives this will be evidenced through a close alignment between operational policy and the design of the engineering control systems. To achieve this alignment The Conclude Consultancy has developed what we refer to as the *'Whole Facility Energy Model'*. Whilst this is founded in a Building Information Model, it uses a thermal simulation engine configured to receive data from the Occupancy Analytics Model so that the energy and carbon impacts of operational policies can be modeled. Conversely where alternative engineering strategies involve a change that could impact facility use, these can be considered with the operational policies and the impacts assessed within the Whole Facility Energy Model. Figure 3, illustrates the integration between occupancy profile and (in this example) a heating controls profile. (This is explained more fully in Section 3).

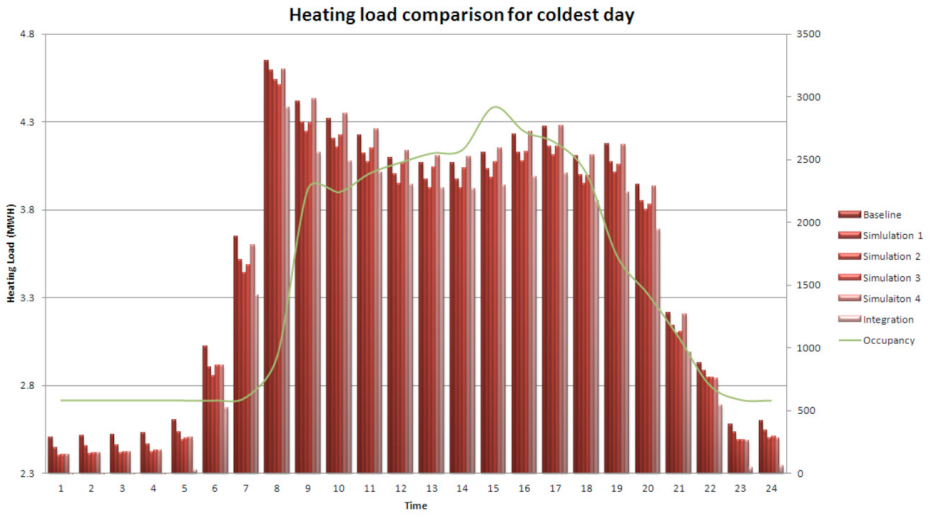

Figure 3 - The occupancy profile aligned to the heating controls profile

2.2 Peak Load Smoothing. Another very important concept developed by The Conclude Consultancy Limited is called *'Peak Load Smoothing'*. This is where we set out to control the operational policies such that the coincidence of the scheduling of departmental activities is coordinated to avoid peaks of peaks of occupancy ands imaging equipment use– in other words to *smooth* them.

The importance of *'Peak Load Smoothing'* is that it has significant impact on the sizing of engineering systems and imaging equipment, because they are sized according to a diversified peak[1]. By reducing the diversified peak we can substantially reduce capital cost of the systems and equipment.

To put this potential benefit into context, our studies show that a typical engineering analysis in Europe over-estimates occupancy by as much as 300%. This leads to substantial over-sizing of engineering systems. The difference arises because engineers typically assume the occupancy of hospital facilities and we have never found any evidence to calculate it, other that what we have set out to achieve in The Conclude Consultancy.

In peak load smoothing studies we have demonstrated how it is possible to reduce actual peak occupancy by between 19-23%.

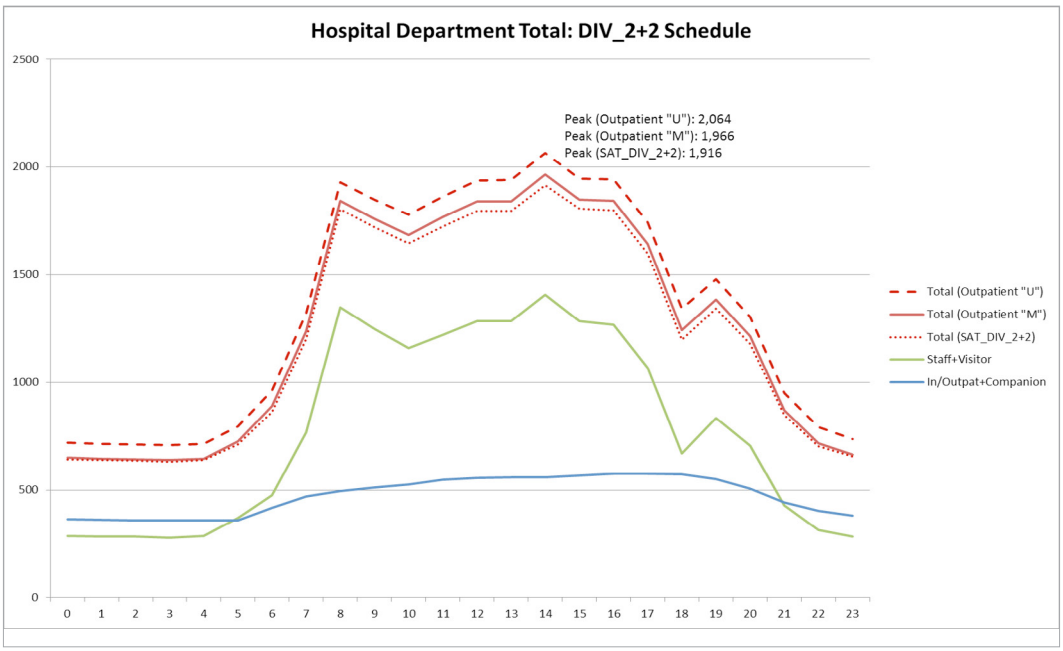

Figure 4 - Peak Load Smoothing

2nd principle: *If the team wishes to control energy consumption and carbon emissions then the means by which this needs to be achieved is through the alignment of operational policies and engineering system design.*

2.3 Enhanced briefing. Arising from the forgoing will be the need to translate the users requirements into requirements that can be assimilated by the project team. The Conclude Consultancy are experts in this process. The requirements that emerge from it are processed from the Occupancy Analytics work and the Whole Facility Energy Model studies. Theses processes produce new knowledge, which is documented in what we refer to as the 'Enhanced Brief'. The importance of this document cannot be under-estimated because it provides design critical data for the project team, which they would otherwise have to make assumptions about, as was described earlier.

[1] A 'diversified peak' is one where the design team has estimated that not all rooms will be used all of the time. The variation in room usage is referred to a 'diversity of use'. The aggregate occupancy is assumed as the 'diversified peak'.

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3rd principle: *Users (or user representatives) must be engaged in the design process such that their operational needs can be translated into briefing requirements for assimilation by the project team. To avoid having to make major assumptions concerning use, these requirements need to be documented in the Enhanced Brief.*

Process Stage	Activity	Comment	Value
2.0 Outline and Scheme Design	2.1 Develop dialogue with users where possible. Identify a User Reference Group. Should this not be possible then Conclude would propose Operational Policies to be used as the basis of 'Best Practice.'	A key element of the strategy is to engage users in the process, so that the facility design reflects the proposed working practices.	This avoids many assumptions having to be made by the project team.
	Develop Level 1 Occupancy Analytics study for the whole facility. Forecast probability of occupancy profiles.	This work is central to the optimisation of space and engineering design. Numerous studies in Europe and the US clearly demonstrate that assumptions in the Basis of Design lead to substantial over-design.	The work will enable the hospital project team to understand the factors that would influence capacity and future flexibility.
	2.2 Establish energy targets for each function in the hospital. Develop Peak Load Smoothing (PLS)	This work can be postponed from this stage if a User Reference Group is not available. PLS will enable peak energy loads to be managed such that plant sizing can be reduced.	Correlating energy and carbon emissions with working practices is the ideal situation.
	2.3 Develop the 'Enhanced Brief'. This document will include the Basis of Design to be used by the planners, architects and engineers.	Targets will be correlated to Operational Policies, which we could develop or assist in the development of.	The project team will be informed by data that will enable them to develop the planning and engineering design without having to make substantial assumptions.

3.0 Detail design and procurement. During this stage of the process the detailed accommodation requirements are being planned. The challenge for the occupancy analytics team during this stage is to develop a 'Level 2' analysis for each department. This will provide the core data used in the design of the engineering controls strategy.

In the Level 2 analysis we model the occupancy flows within each department. We develop an analysis based on similar functional uses, and it is this analysis that is used to inform the controls strategy. The Conclude Consultancy firmly believes that users must be engaged in the decision making process concerning how the engineering systems in the facility would be controlled. Experience in Europe has shown that successful low energy and low carbon performance will be achieved where there is strong engagement between the project team and the users.

The assumptions often made by designers in terms of occupancy strongly impact the controls systems design. Invariably the controls strategy results in spaces being serviced to a level not required by the occupancy of the space being served. This is best illustrated in Figure 5.

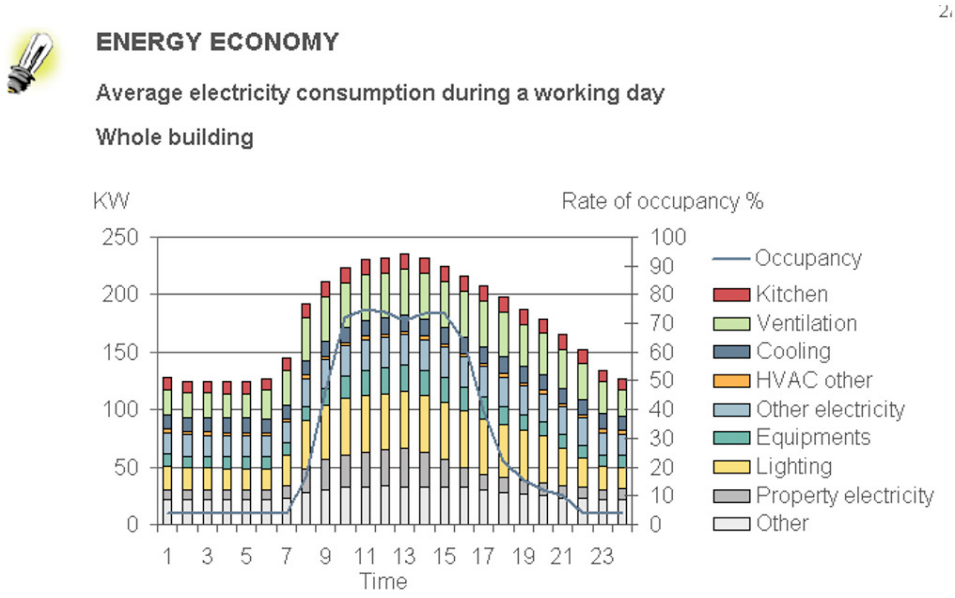

Figure 5 - Example of mis-alignment between controls and occupancy

3.1 Controls strategy. During the detailed design stage The Conclude Consultancy would work between the users and the project team's engineering controls specialists to design a controls strategy that would enable the energy and carbon performance of the facility to be optimised for use. The work would enable the user representatives to understand the potential of the engineering system design in terms of how users could modify their working practices to make use of the engineering potential in latest system design and control. Likewise the controls engineers would appreciate where operational imperatives would impact the design. Figure 3, referenced earlier is an example of how such an alignment can be achieved.

4th principle: *Users (or user representatives) must be engaged in the design process such that their operational needs can be translated an appropriate engineering controls strategy.*

3.2 In-Use database. An In-use database is an essential requirement for a hospital facility where energy and carbon performance are to be optimised over the life-cycle. The database is designed to harvest data from the controls system and is used by both engineers and users in change management process. Through the work in 3.1, the users requirements will have been understood and from this work, so too will the performance metrics required for each part of the facility. These metrics will also be used in activity 3.3 for the finalisation of departmental energy budgets.

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The Conclude Consultancy would specify the data required for the In-Use database. This will be provided as a specification to the controls engineers so that the systems that they design will produce the data required for the In-Use database.

A significant new concept here is to use the Occupancy Analytics Model and The Whole Facility Energy Model as the essential tools for Facility Engineers to use in the optimisation of facility performance with the user representatives. The Conclude Consultancy has designed a Change management Process to facilitate this dialogue.

3.3 Finalise departmental targets. Initial energy and carbon targets will have been established during Scheme Design stage. With the development of detailed operational policies that are coordinated with 1:50 scale room design schedules, it will be possible to finalise departmental energy targets. Policies will be established with the User Reference Group so that those responsible for and those accountable for performance will be engaged in the process. Their information and reporting requirements will be discussed and agreed and this knowledge will be used to inform the In-Use database design.

5th principle: *To achieve on-going performance improvements in energy and carbon, users must be fully engaged in performance with the facility engineers. Targets must be demanding, and users must receive the information that they require so that they are able to manage performance.*

Process Stage	Activity	Comment	Value
3.0 Detailed design and procurement.	3.1 Work with User Reference Group and the Engineering Controls specialists to develop a controls strategy that incorporates users needs.	This work will help to prevent a situation where space s are being controlled within the facility regardless of the needs of occupancy.	Optimised facility performance with full engagement with the users.
	3.2 Model alternative controls strategy. Report on impacts within the Whole Facility Energy Model.		Without such an alignment it would mean that energy would be needlessly consumed. This is the key means by which OPEX costs are reduced.
	2.3 Develop the 'Enhanced Brief'. This document will include the Basis of Design to be used by the planners, architects and engineers.		By ensuring that staff become responsible for energy consumption, and managers are accountable ownership of these there will be ownership of these targets.

4.0 In-Use. During this stage the Occupancy Analytics and Whole Facility Energy models are installed in the facility alongside the In-Use database. The In-Use database is connected to the Engineering controls system database, and the reporting is configured as specified in 3.3.