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Minimising Life Cycle Cost and Energy Use Emissions in PFI Projects

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"Delivering Sustainable
Construction"**

The PFI Mantra - Value for Money

PFI Overview

- Major Procurement Method
 - Schools
 - Hospitals
 - Prisons
 - Government Departments, etc.
- Duration 20 to 35 Years plus
- PFI Mantra - Best “Value for Money”

PFI = Sustainability?

- The Broad Themes of Sustainability are:
 - Environment
 - Economic
 - Social

Can the optimum response to environmental matters equate to the optimum economic solution?

PFI Incentives

- Estimate the full cost of constructing and maintaining built assets, as they cannot be recovered.
- Complete the building at the earliest, as payments do not start until the service is being delivered.
- Achieve good quality construction, as it is obliged to maintain the building to agreed standards.

How has PFI fared?

Decisions made on economic grounds

Relate to duration of agreement

Minimise first cost

Goal – Lowest unitary payment

Whole Life Costing:

Not related to choice of sustainable materials

Nor minimum lifetime energy use

Energy a “Pass Through” cost

Pass-through Energy Cost and Use

- Result— Lowest first cost solution
- PFI in its present form does not lead to sustainability

PFI Lifetime Energy Use

- Initial Embodied Energy
- Operating energy
 - Maintaining the internal environment
 - Energy for Processes
- Recurring Embodied Energy
 - Building Service Repair/Replacement
 - Maintenance of Fabric, Interior fit-outs etc.
- Dilapidations/Demolition

Initial Embodied Energy

The *embodied energy* of a building is the energy used to acquire raw materials and manufacture, transport and install building products in the initial construction of a building.



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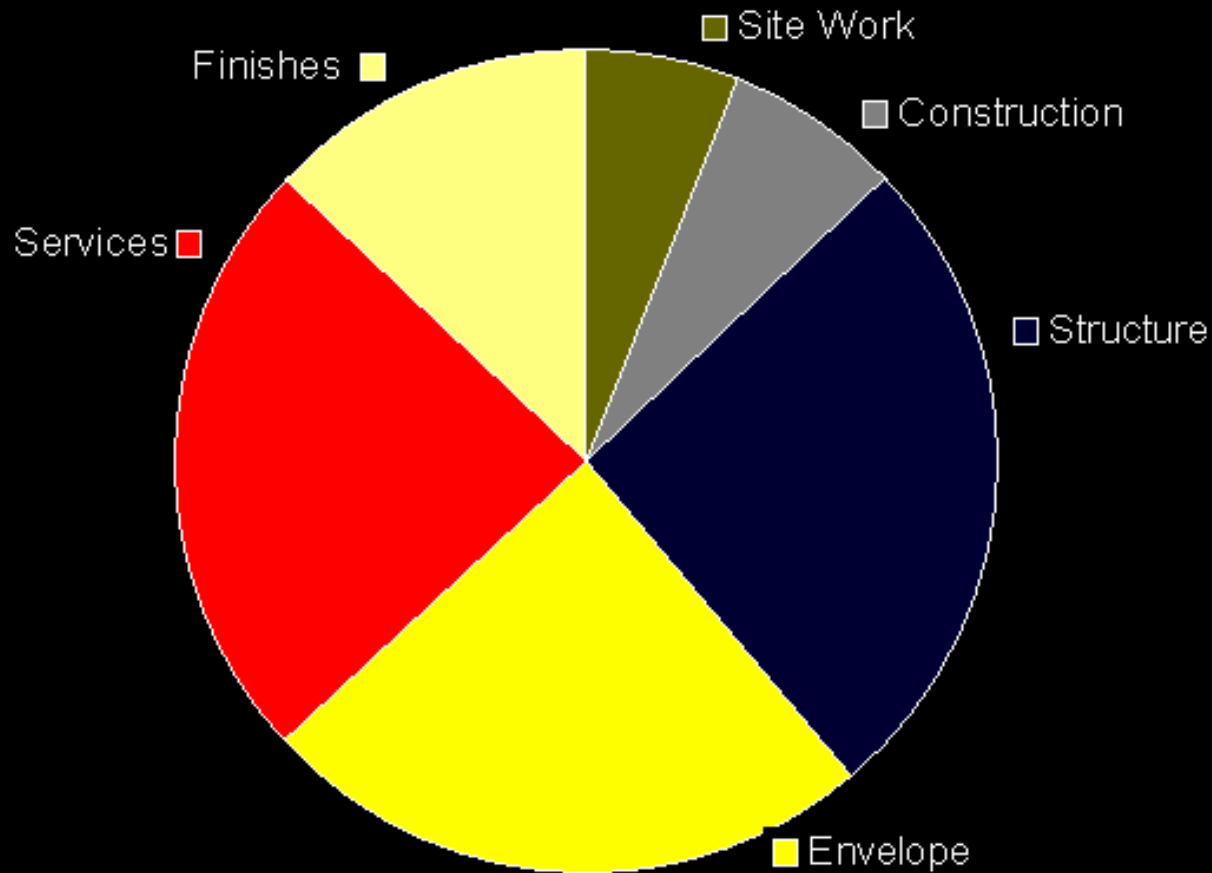


Initial Embodied Energy

The *embodied energy* of a building is the energy used to acquire raw materials and manufacture, transport and install building products in the initial construction of a building.



Typical figures for initial embodied energy of office buildings range from 4 to 12GJ/m²



Distribution of Initial Embedded Energy

Operating energy

Energy to operate the building – i.e. the energy required to condition (heat, cool and ventilate) and light the interior spaces and to power equipment and other services.

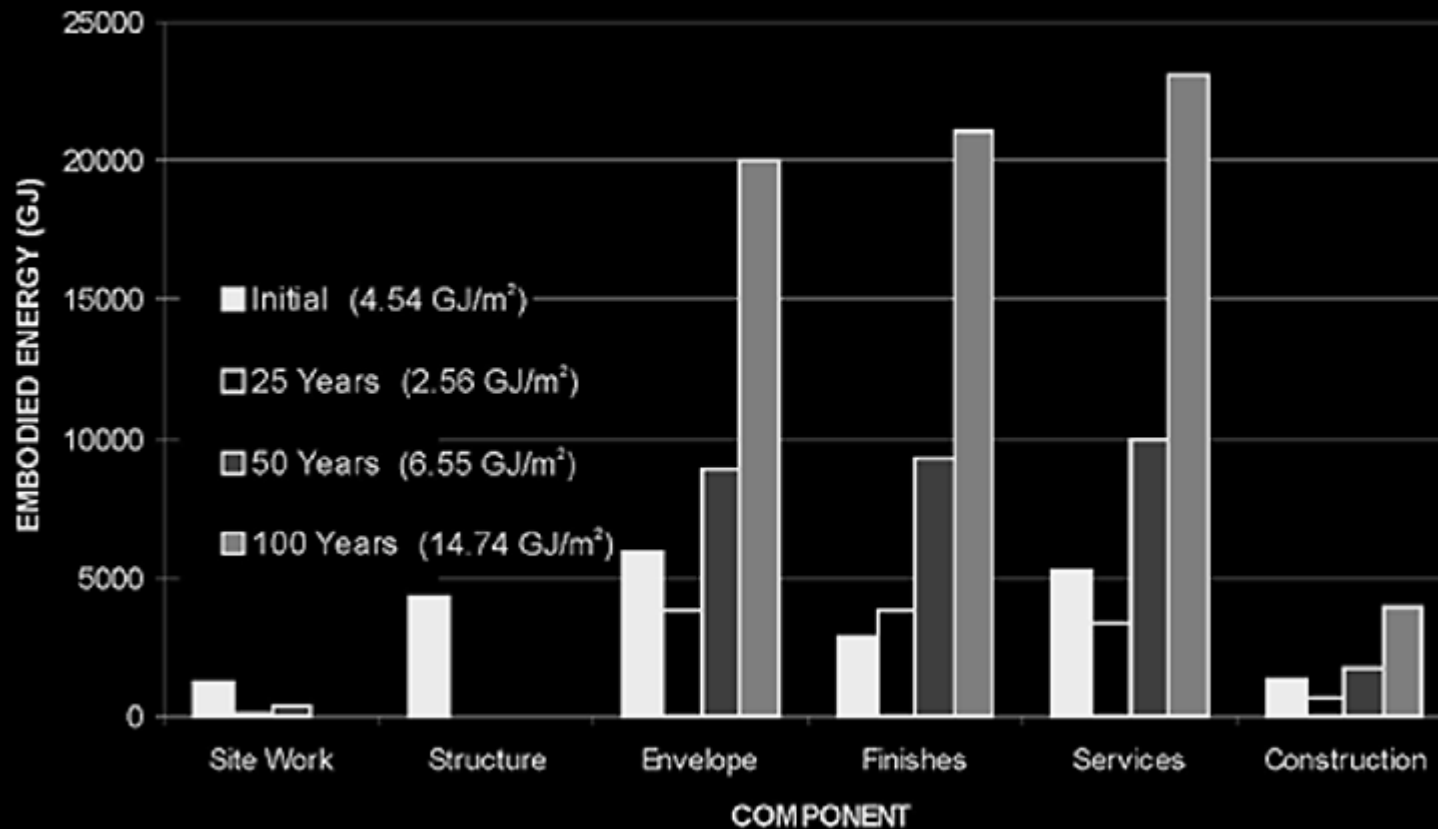
Recurring Embodied Energy

Regular maintenance, repair and replacement of building services and other equipment.

Fit-outs e.g. internal partitions and doors, floor, wall and ceiling finishes and mechanical and electrical services. Occur more often than replacement of structural and envelope elements and use greater proportions of energy intensive materials, e.g. plastics, copper, etc.

For a current typical building life of, say, 50 years, the recurring embodied energy (between 6.5 and 6.8 GJ/m²) is equivalent to the initial embodied energy of the building.

Embodied Energy and Building Life



Estimating Embodied Energy

Steel recycled	9 MJ/kg
Steel	32
Steel Reinforcing	40
Steel Pipe	56
Concrete block	1
Concrete poured	1.3
Concrete pre-cast	2
Copper	71
Copper Cable	110
Aluminium	227

1,000 kW Chiller

- Steel 9,000 kg
- Copper 1,000
- Refrigerant, 270
- Oil 40
- Misc. 25



Embodied energy 534,000 MJ (1,922,000 kWh)

Recycled materials 300,000 MJ (1,080,000 kWh)

How can we improve PFI sustainability?

- Ensure initial selection of system, plant, materials, and operation minimise life cycle energy use.
- Ensure plant selected can be repaired rather than replaced – adequate space.
- Analyse design on a life cycle energy use as well as cost.

Selection of Materials

- Cellulose 0.6 MJ
- Mineral wool 3.1
- Fibreglass 4.8
- Polyiso 15.1
- EPS 19.0

Selection of Plant (Chillers)

- HFC vs Natural Refrigerant Chillers
- Chillers vs Chillers
- Life cycle costing
 - Energy use estimates (**Incentivisation**)
 - Efficiency at part load
 - Maintenance costs
 - Replacement prediction

Summary

Minimising life cycle energy use of services can be included in PFI projects without compromising “Value for Money”. Minimising the Initial and Recurring Embedded Energy of building services needs to be considered at the Design stage in the selection of systems, equipment, materials and maintenance space.

Estimating the Recurring Embedded Energy is not an Exact Science but its significance will continue to increase as buildings continue to use less energy.

Building services should be designed to be maintained and repaired and only replaced when there are real and tangible benefits to the energy life cycle.