Improvement of precast flooring through a structured approach to sustainability

(Hollowcore and pre-stressed beams production)

IPHA Technical Seminar 2005, TU Delft.

Presented by: Hafiz Elhag

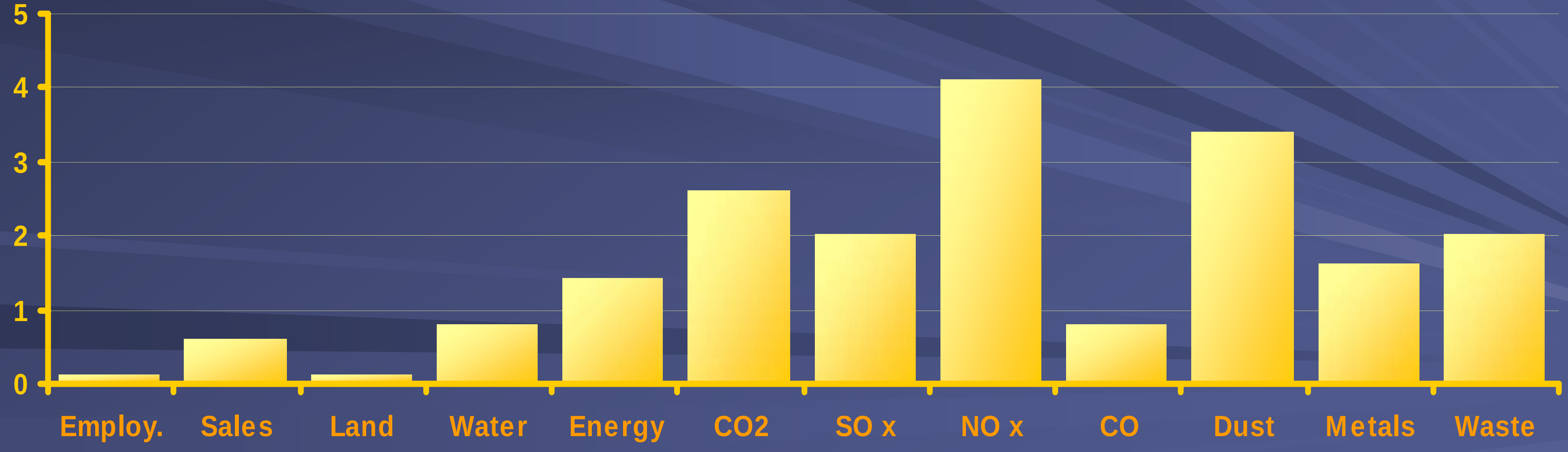
8th November 2005

Loughborough University

BRITISH PRECAST

Sustainability and the precast concrete industry

- Every year, 214 million tonnes of aggregates, 125 million tonnes of cementitious materials, and 35 million tonnes of precast and cast-stone elements are produced.
- Concrete production contributes significantly to UK total economy, consumption, and emissions (%):



Environmental impacts and precast

Main questions raised:

- How can manufacturers maintain their profits and growth without negatively affecting the environment?
- How far should manufacturers go to accommodate sustainability?

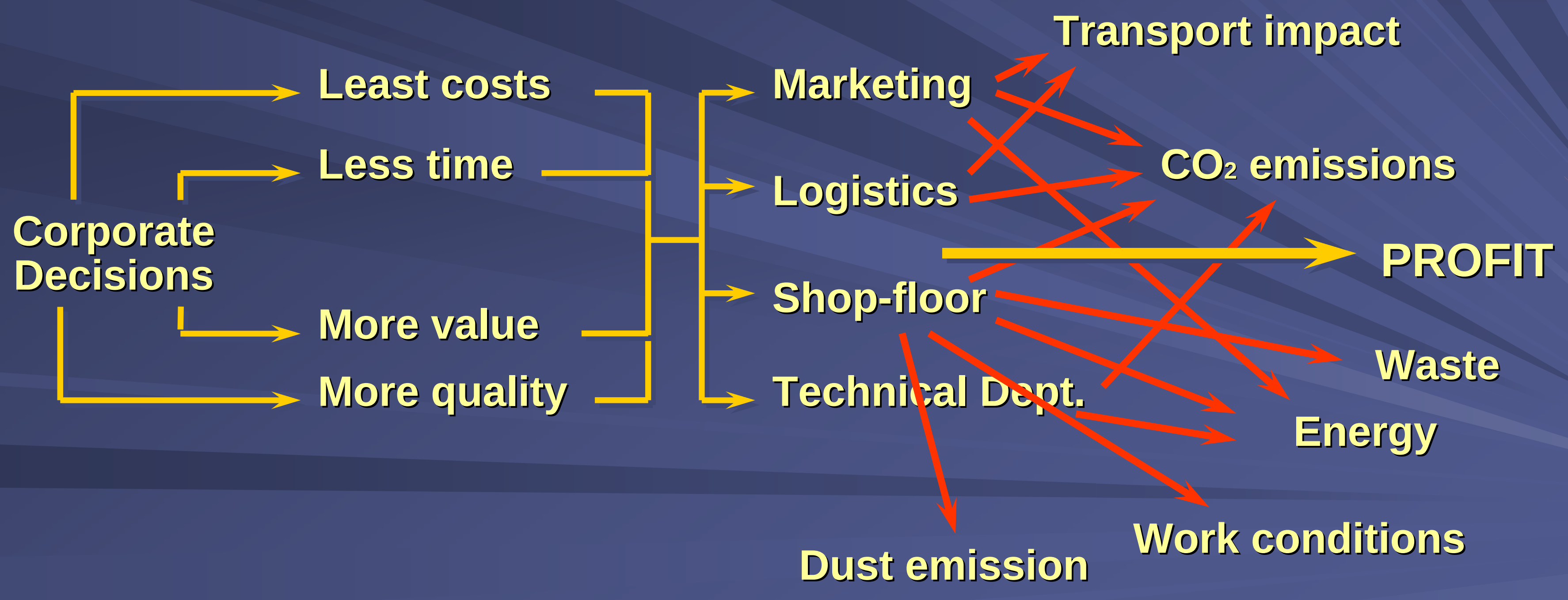
- Answers for such questions are very complicated and will probably entail some compromises.

- Our approach to handle this question is a little bit basic.

- Taking the question to specific decision-makers within the organisation.

Sustainability and the precast industry

- Production systems are designed to manufacture products with high value, high quality, with less cost, and within shorter times.



About the research

- **Aim:** Evaluate effects of sustainable development measures on the business case of precast flooring production (Hollowcore/ pre-stressed beams).

Objectives:

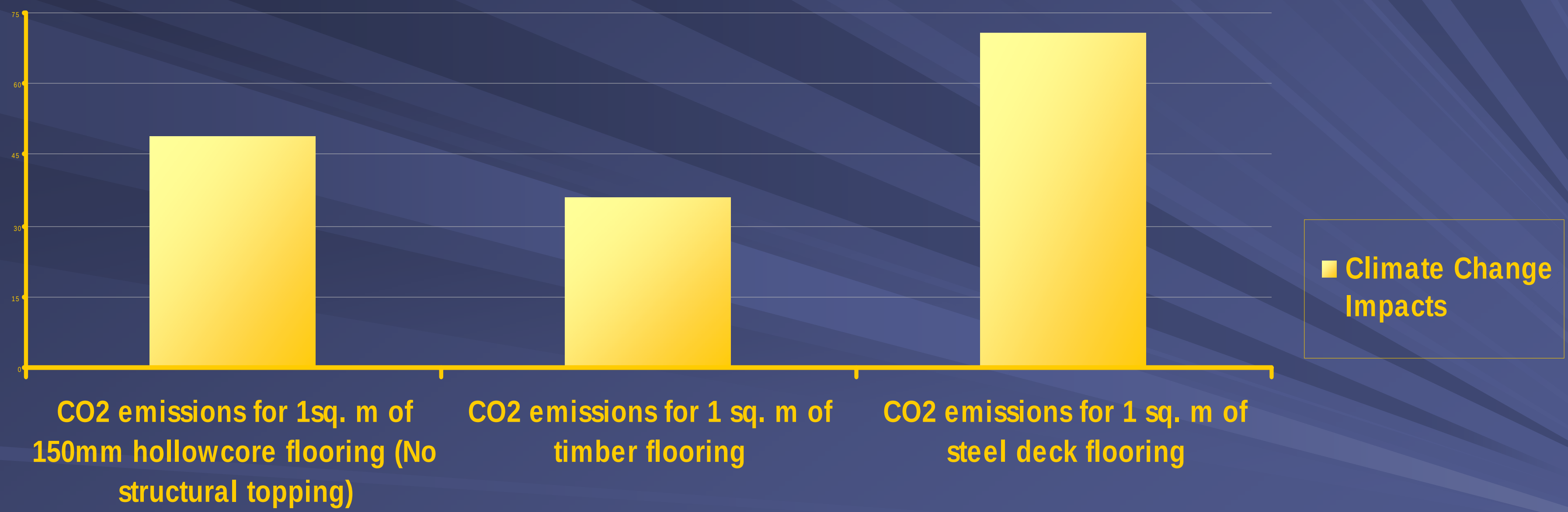
- Evaluate Environmental impacts – using LCA.
- Understand links between environmental impacts and managerial/ technical solutions – using LCA.
- Understand possibility of sustainability implementation and manufacturers' levels of compliance – using focus groups and semi-structured interviews.

Life Cycle Assessment (LCA)

- LCA is a decision-support tool used to environmentally map products' impacts throughout its lifecycles.
- The BRE (Building Research Establishment) Environmental profile methodology was used. It accounted for 12 main impact categories (Climate Change, Acid Deposition, Human Air/ Water Toxicity, Ozone Depletion, Mineral Extraction, Waste, etc).
- *Gate-to-gate* environmental profiles developed for five hollowcore & pre-stressed beams members of PFF. Secondary information on upstream *cradle-to-gate* impacts was also used.
- Life Cycle Inventory (LCI) survey in addition to two surveys (factory energy breakdown survey and industrial waste survey).

Life Cycle Assessment (LCA)

- Two main generic environmental profiles were completed (Hollowcore + Pre-stressed beams).
- Comparisons with calculated hardwood timber floorings and steel-deck floors show encouraging results.

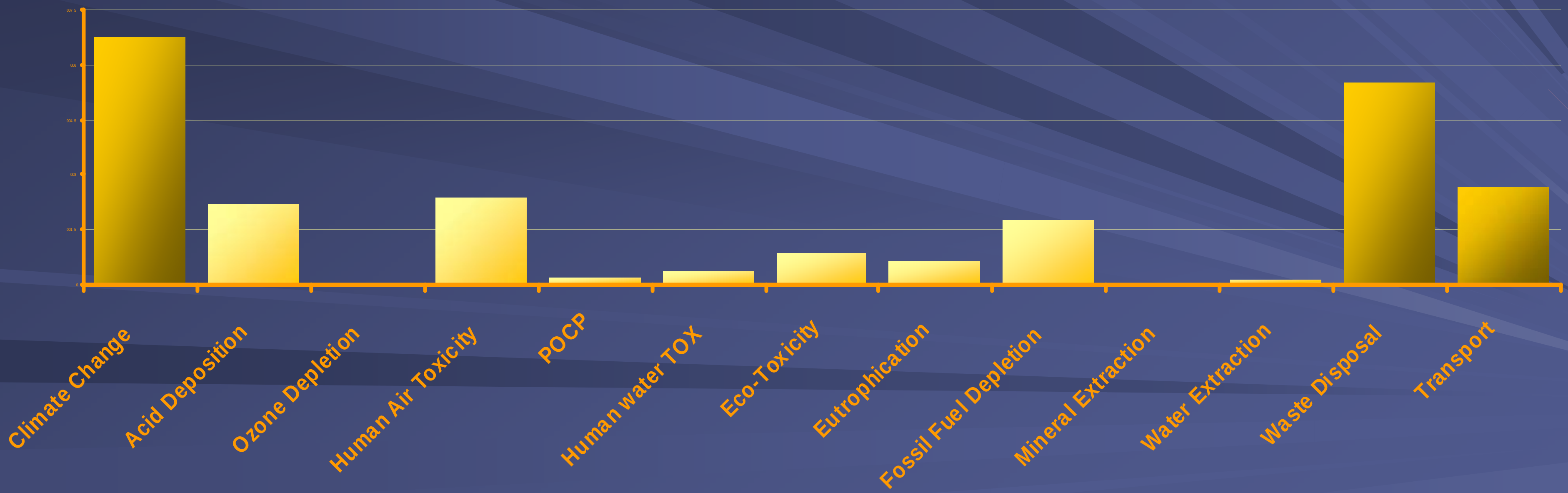


- Comparisons with similar floorings from European studies show similar (or slightly better) results.

Life Cycle Assessment (LCA)

- Using 'Eco-points' helped identifying the main production environmental impacts.

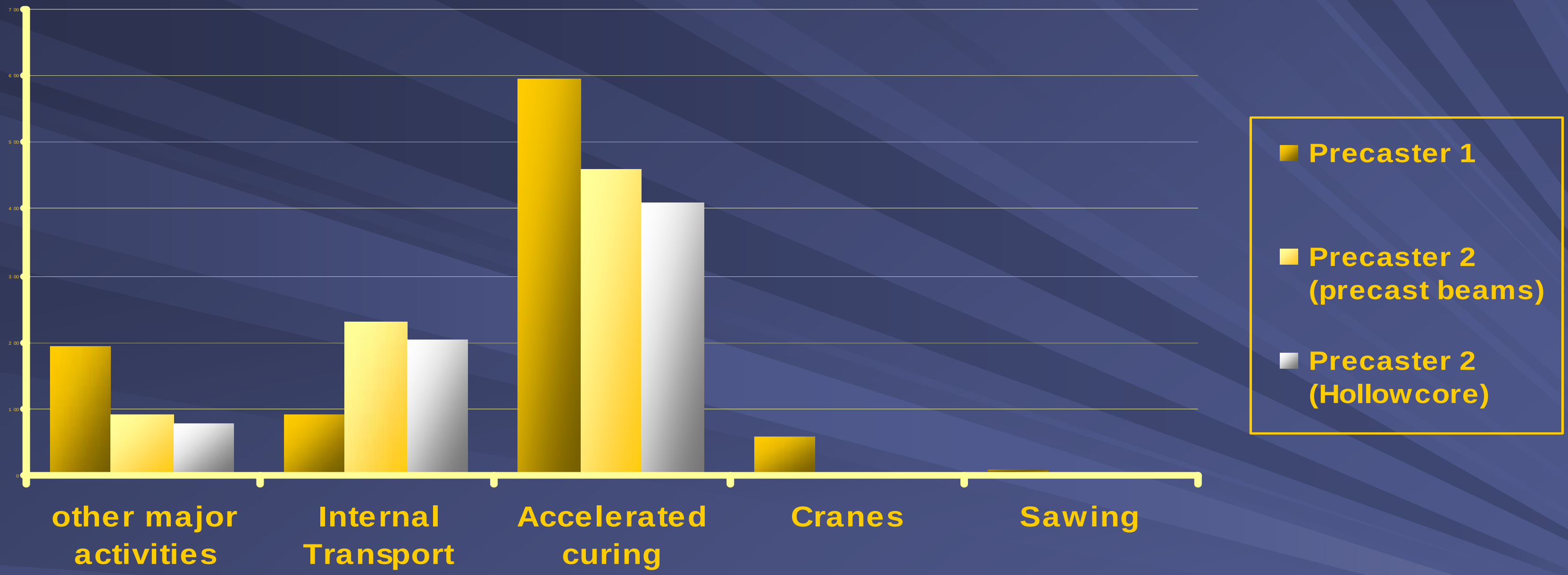
Cement Content (from cement production) 0.4666	Waste 0.0547	Energy impacts & climate change 0.0172+ 0.1135	Transportation (raw mat. only) 0.0266



Eco-point scores (Mineral Extraction not included – being 75% of the total score)

Major impacts (energy)

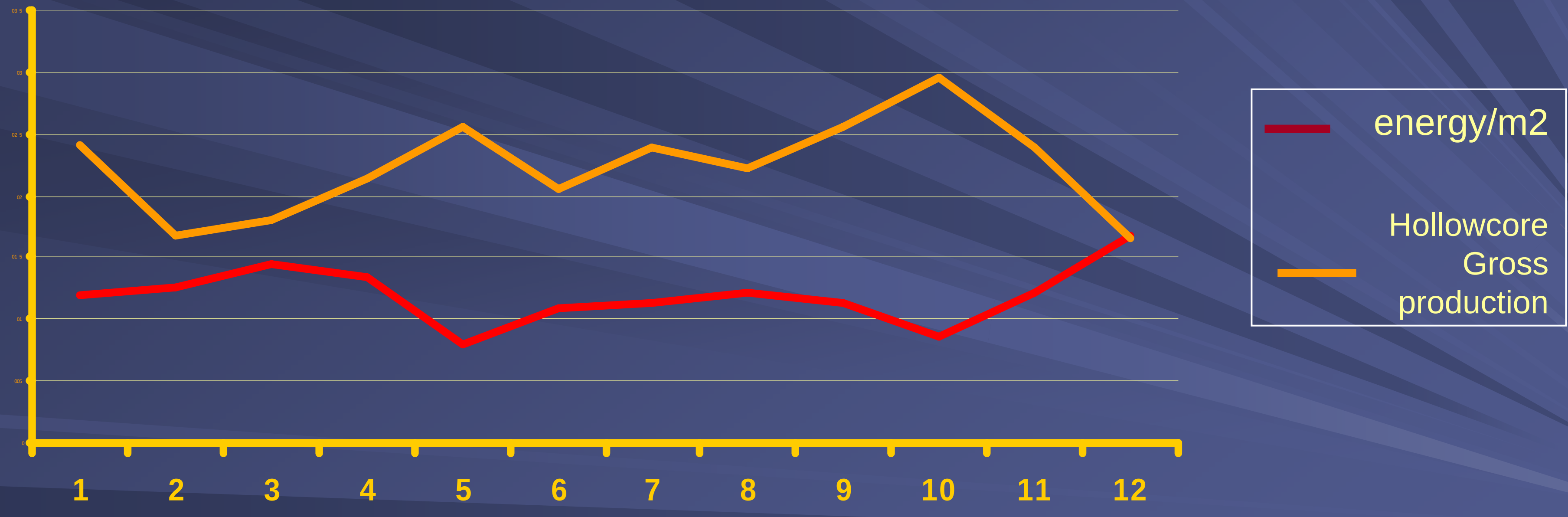
- Precast factories energy breakdown shows the major activities affecting levels and patterns of energy consumption



- Main variables affecting energy levels are curing, casting, and other production systems employed, machinery used, factory's layout, and shapes of products manufactured.

Major impacts (energy)

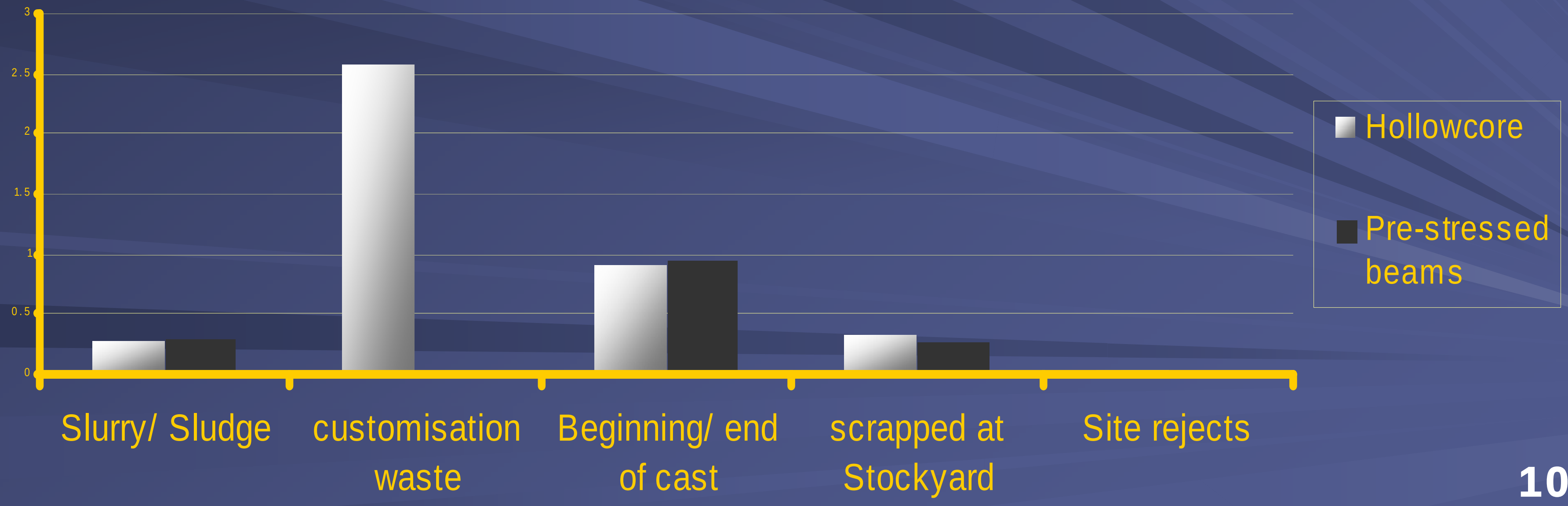
- **Operational variables** affecting energy levels and performance on a day-to-day basis, these include: economies of scale; nature, size, and flow of jobs coming to the shop-floor; and climate (ambient temperature, etc.).



The impact of economies of scale on curing energy

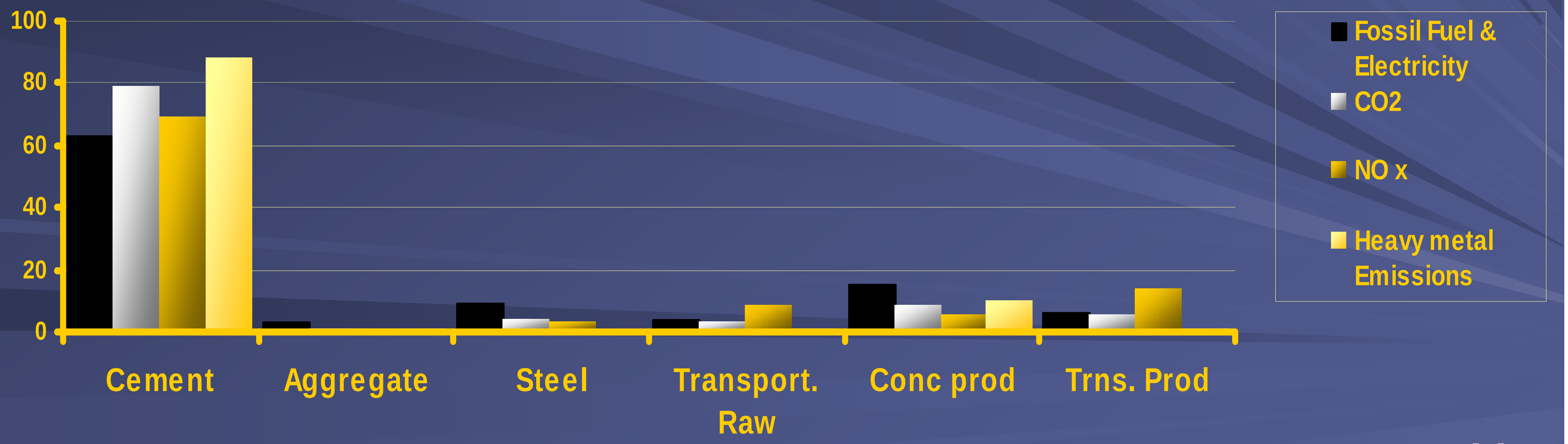
Major impacts (waste)

- A **survey** was organised to identify the causes of concrete waste generation and the main waste streams in precast flooring production.
- **Main variables** affecting concrete waste levels are customisation, production systems used (mainly casting systems), nature of the jobs, length of beds, faults and accidents, and climate



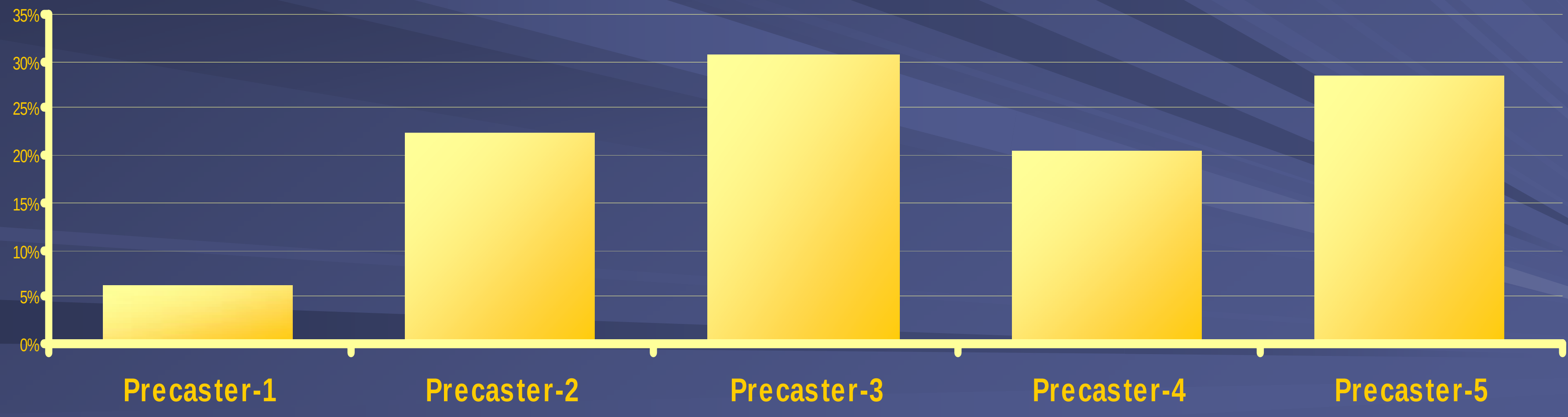
Major impacts (cement content)

- No quantified links between cement content in mix and duration of concrete curing process/ accelerated curing energy.
- Cement production generates 24 times more CO_2 (per tonne of production) than precast flooring manufacture (including accelerated curing processes).



Major impacts (transport)

- Affects six main environmental impact categories including: Climate Change, Acid Deposition, Human Air and Water Toxicity, Photochemical Ozone Creation Potential, and Fossil Fuel Depletion.
- **Depends mainly on:** factory location, suppliers' choice, concrete mixes employed, proportions of raw materials used, and means of transport utilised.



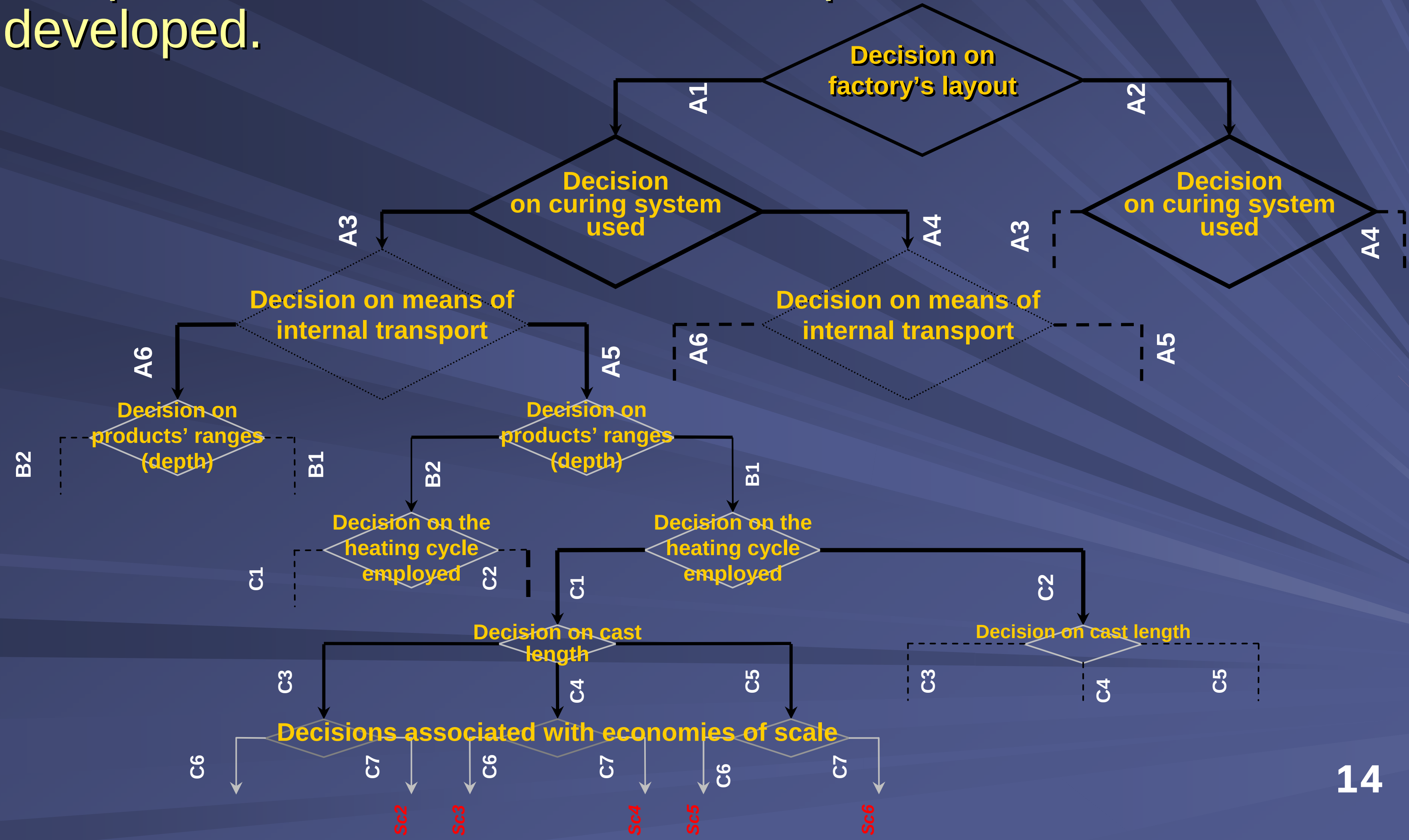
Carbon Dioxide Emissions associated with raw materials transportation

Linking environmental impacts to departmental decisions

- **Strategic decisions** associated with transportation, energy consumption and waste impacts.
- **Technical decisions** affecting upstream impacts (cement use), curing energy, and transportation.
- **Marketing decisions** affecting waste levels, product mix impacts.
- **Design and project-specific decisions** affecting energy consumption rates, waste levels.
- **Operational shop-floor and planning decisions** affecting curing and internal transport energy levels.

Environmental impact scenarios.

- Using data on different production systems, operations, and policies, 219 environmental impact scenarios were developed.

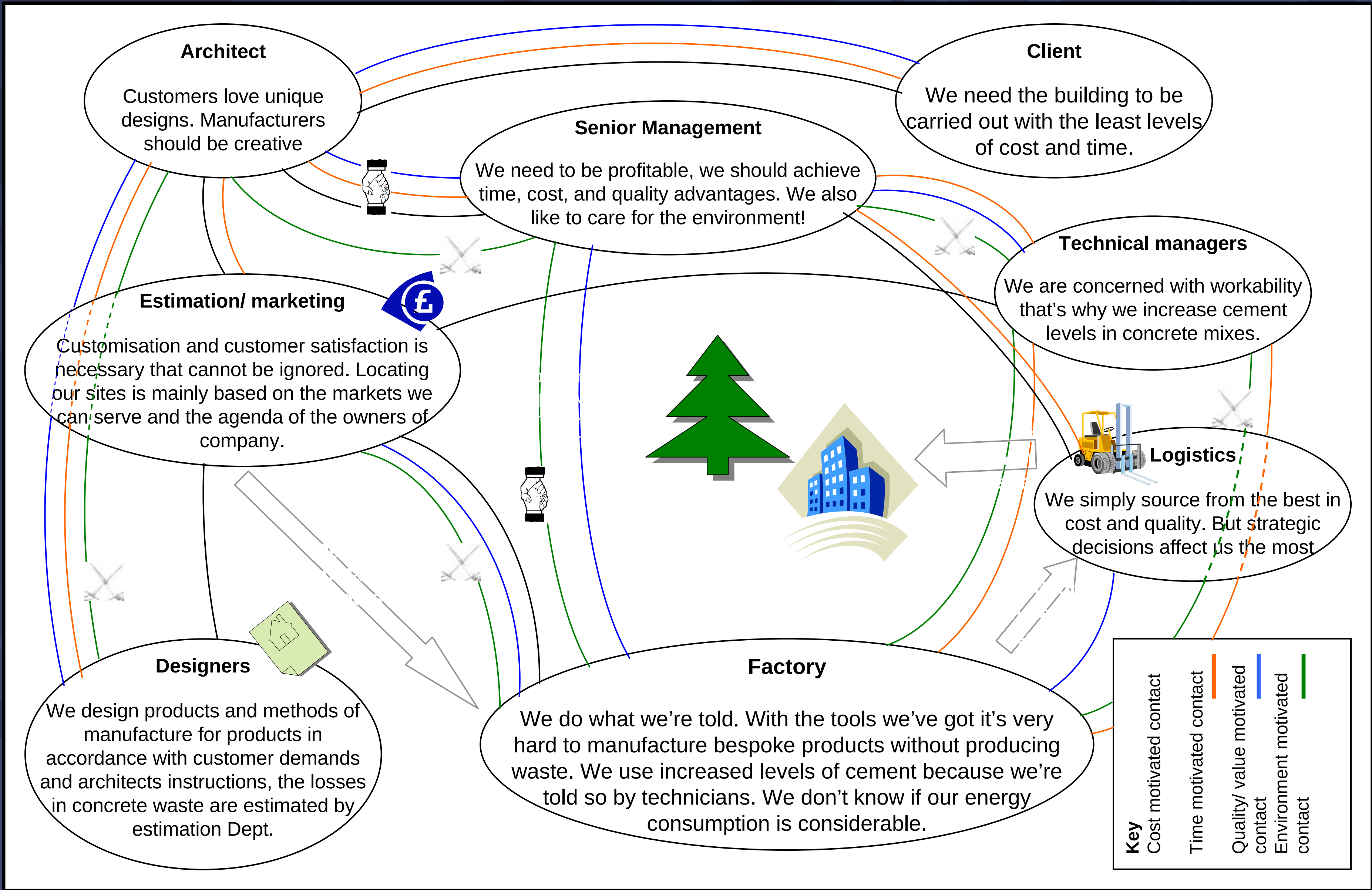


Focus Groups (interrogating results)

- Focus groups used to understand qualitative decision-making aspects behind environmental impacts.
- Invaluable information collected on crucial **business case** objectives.
- Information obtained on manufacturers' **perceptions** of sustainability.
- **Boundaries** between business needs and sustainability needs were evaluated and redefined.

- 'Soft systems' techniques (including rich pictures) used to analyse – understand dimensions of the problem by acknowledging its complexity.

Focus Groups ('rich pictures')



Semi-structured interviews

- Semi-structured interviews with decision-makers in different management levels.

- Being used to search for solutions and technologies (specifying 19 principal solutions).

1. Identifying nature of different decisions.
2. Identifying chances of sustainability applications.
3. Levels of awareness, possibility of amending decisions.

- Initial results support and expand upon focus group findings.

Conclusions

- Results and findings of the study will help manufacturers:

1. Address the main issues and elements affecting their environmental profiles and performance.
2. Link Key Environmental impacts to conventional gains and losses in the business: addressing the potential conflict between sustainability and business objectives.
3. Recognise the quantitative and qualitative complexity of the problem, and identify the most effective solutions and appropriate problem solving mechanisms to tackle sustainability.

- Research is due for completion in Spring 2006.

Thank You

Any questions?

email: hke@britishprecast.org