SUSTAINABILITY IN REFRIGERATION AND AIR CONDITIONING

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ABSTRACT

As an introduction to the conference (IIR, 2010), this paper considers sustainability in refrigeration and air conditioning generally, and then specifically in the cold chain. Sustainable growth in refrigeration and air conditioning should provide the maximum growth of benefits with the minimisation of other impacts**.** Areas of research and development which may to lead to more sustainable outcomes are listed.

1 WHAT IS SUSTAINABILITY AND HOW IS IT TO BE OBTAINED?

Sustainability is the ability to keep going continuously. How this is to be interpreted will depend on the application. In some applications it means continuing to do the same, for example continuing to grow food crops without depleting the ability of the land to give good yields. But in other applications we must consider the somewhat difficult concept of sustainable growth – by definition impossible in the long term, but possible within certain limits. Sustainable growth has been defined as doing what we do today in a way which ensures that future generations are able to do what they need to do tomorrow, or more briefly, not cheating on our grandchildren.

To achieve sustainable growth in any technology, there are two fundamental requirements; the ability to improve systems and applications so that they are in some sense more efficient, and the ability to demonstrate this improvement by some sort of life cycle assessment. This assessment could be simple, such as primary energy use, water use, food miles, or cost. It could be more complex, such as carbon footprint, or a more complex ecological footprint such as land area required to maintain production and use. The type of assessment chosen will affect the outcome, and inevitably no one assessment can fully balance all the relevant factors, so there is a danger that such assessments become politically or ideologically biased. In addition, the boundaries of the assessment can be controversial – do we have to allow for the production of the food to feed the worker who made the equipment, for example, and if not, why not?

Perhaps one of the greatest needs at the present time is to define sustainability assessment methods appropriate for particular applications, and to have these agreed internationally in a form which is useable without the need for complex ISO standards such as ISO 14064 (ISO, 2007).

2 REFRIGERATION AND AIR CONDITIONING

Refrigeration and air conditioning provide benefits to society. Those attending this conference will be aware of the many domestic, commercial and industrial applications of refrigeration and their many benefits. To mention just two of these, refrigeration provides food safety and security through the cold chain, and air conditioning makes possible the use of the data centres on which so much of a modern developed country is dependent. It follows that, for our industry, sustainable growth must mean **the maximum growth of benefits with the minimisation of other impacts**, until such time as the benefits are available to all who need them.

As an industry, we need to consider the most appropriate life cycle assessment type. Given the issues of ODP and GWP and leakage of refrigerants, it could be that TEWI is the most practical, but thought must be given to carbon footprint and ecological footprint measures also. Oversimplified and misleading assessments, such as food miles, or use of GWP with no relation to leakage rates or energy efficiency, must be avoided. A combination of several assessment techniques may be required to give a fair picture.

Always, the first priority should be minimising the need; using insulation, free cooling, and good controls so that no more than is necessary is provided (IIR, 2008). Only then should alternative systems and components

be considered. But this leaves a great deal of scope for research and development on topics which can lead to improved sustainability. Some of these are listed below.

2.1 Refrigeration Systems

Systems to be considered in the search for sustainability include the following:

- Integrated systems; combined heating and cooling, or tri-generation of heating, cooling and power,
- Air and ground source heat pumps, either reversible or for heating only,
- Thermosyphon systems,
- Cascade and multi-stage systems,
- Solar or heat-powered cooling,
- Absorption and adsorption systems,
- Air cycle,
- Magnetic or electrocaloric refrigeration.

2.2 Applications and components

There are many areas needing further development and application, and this conference will highlight current progress. Important areas include:

- Refrigerant leakage reduction,
- Energy efficiency,
- Use of alternative refrigerants,
- Heat recovery,
- Fan efficiency,
- Micro tube heat transfer,
- Controls,

And not least,

- Education and training of technicians/engineers,
- Education of end users.

3 SUSTAINABILITY IN THE COLD CHAIN

This is particularly important because of the impact on food supplies. In 2006 about 52% by value of food products traded worldwide had refrigerated transport requirements (UNCTAD, 2007). In addition large quantities of locally used food required temperature control, which was not always available. For the Beijing Congress, it was calculated that the costs of setting up proper cold chain networks in China over ten years would be no more than the value of foodstuffs lost in the absence of such facilities – such conclusions must apply in many developing countries (Heap, 2007).

Sustainability issues for the cold chain include many of the general ones in section 2 above. Cleland (2010) provides a detailed study in his keynote paper, and concludes that cold chain sustainability involves a complex trade-off between environmental, social and economic factors.

Market forces align well with sustainability objectives – less energy use, less refrigerant leakage and less waste all represent better margins for producers and carriers. The important thing is to use lifetime financial assessments, not short-term capital costs, in choosing equipment. Not always easy in a time of economic recession.

This all emphasises the continuing need for innovative technical and scientific responses to the challenges being faced. Much good work has been done by the IIR and by SIRAC. The ideas being put forward by our presenters this week will help us move forward towards our objective of obtaining maximum growth of benefits with minimisation of other impacts, for a more sustainable future.

REFERENCES

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