EMBODIED ENERGY IN BUILDING MATERIALS.

WHY IS IT IMPORTANT FOR DESIGNERS TO TAKE THIS INTO CONSIDERATION?

We are all familiar with the image of our small green planet, spinning in space. It is this image that has probably done more to bring home to the thinking people of this world our interdependence.
The Earth in fact is one giant living organism. Paradoxically, we would never had this picture without the enormous expenditure in both money and energy on the American & Russian space programs!

In writing this , I have relied heavily on information from several sources:

From the RAIA Environment Design Guide;

1) ' Embodied Energy of Building Materials' Bill Lawson
2) 'The Energy Impact of Windows in Building Design' Peter Lyons
3) 'Assessing the Environmental Impact of Building Materials' Bill Lawson, Harry Partridge, John Gelder.
4) 'Recycling Building Materials' Bill Lawson
5) 'Renewable Resources: An Introduction to Materials' J. Gelder
6) 'Renewable Resources: A Survey of Materials' J. Gelder.

Also;
7)' Its a Matter of Survival' Anita Gordon & David Suzuki
8)' Green Architecture, Design for a sustainable Future' B & R Vale
9)' Dark Nature' Lyall Watson.
10)' Life Cycle Costing for Building Design'
11)' Green Design'

There have of course been other books and reports that I have read on the subject, but these are the ones I have made reference to in this report.

One of the fundamental laws of physics, stated simply is "energy & matter can neither be created nor destroyed (Georgescu-Roegen 1977), what we have is what we've got, and we'd better look after it.

So, why is this particularly of interest to building designers?
A study " *A Building Revolution"* by the **Worldwatch Institute** (Sydney Morning Herald, 8.4.1995) states **"40% of the annual global consumption of materials and energy goes into buildings, which rank alongside the private car as a source of environmental change".**

Our environment is impacted by building materials at every step of the building process, the choices we make as designers affect land degradation, pollution and global warming. Assessing the embodied energy of the materials we choose is but one small factor in the process of choosing the least damaging materials and methods. It is imperfect, sometimes confusing, but still remains one of the most easily *quantified* methods. It is much more difficult to *qualify.*

" In Australia, virtually all the purchased energy consumed is derived from the **finite** stock of fossil fuels. This has significant environmental impacts, including:
* the depletion of finite resources; and
* the liberation of air pollutants such as **carbon dioxide**, various **nitrogen oxides** and various **sulphur oxides** as well as the production of solid wastes such as fly ash, and liquid wastes such as heated or contaminated water."(1)

So, in assessing the embodied energy in any given material, it is important not only to find out the *quantity*, but also the *quality*. That is, if possible, find out the *source* of that energy.

A good example of this is aluminium. Aluminium consumes vast quantities of energy in it's production, especially from the virgin bauxite. As 'energy conscious' designers perhaps we should avoid the use of aluminium ? That would seem to be an obvious assumption. BUT, we then find out that while Alcoa's smelter in Victoria is dependant on coal fired electricity, and therefor very destructive to the environment on a continuing basis, Comalco's smelter in Tasmania is Hydro-electric powered, and while one can argue that flooding valleys to create hydro projects IS destructive to the environment, it is a once off project, with a very localised effect.

To further complicate matters, many building items used are sourced from recycled aluminium, as an example, whereas the embodied energy in a window made from first process aluminium is 8 times that of a softwood framed window, and 12 times that of a hardwood framed window, the embodied energy in an aluminium window, made from recycled aluminium is in fact equal to , or less than ,that in a window with a softwood frame! Curiouser and curiouser.

To complicate things further, when sourcing materials, we must in addition take into consideration how far that item has been transported, and *by what means.* It is most desirable to source materials as close to the point of use as possible.

From Forintek, Canada we have the following figures , expressed in Millejoules per ton of material, per kilometre travelled;

	Canada	UK
Road	1.18	4.5
Rail	0.49	o.60
Ship	0.12	0.25

As you can see, very wide disparity.

And this disparity is multiplied over the entire process. To strictly analyse the embodied or capital energy in any building product, and *it's environmental effect* is a complex process which must take into account

the initial extraction process
the processing
the transportation
the installation or fixing process
the maintenance of the product
the demolition or disassembly
it's potential for re-use or recycling

It must also take into account whether the embodiment of that energy is in fact beneficial to the environment.

The most obvious environmental effect of energy use is the release of carbon dioxide into the atmosphere, and the believed connection of this to depletion of the ozone layer, and global warming.

The production and transport of materials by the use of fossil fuels, releases carbon dioxide that has been locked up for millions of years. The use of timber and similar products locks up carbon dioxide *for the life of that product*. In extending the life of that product by the use of preservatives, paints etc, is to introduce further variables to the energy process. Benefit of locking up that energy is only obtained though, when the trees cut down for it's manufacture are replaced.

The very complexity of trying to analyse these impacts, should not put us off . We need to assess as nearly as we can the effect of our choices. Obviously it would be desirable to have a universal ecolabelling system that took all these factors, plus others of environmental import, into consideration, done by an objective and readily relied on organisation, so that we as designers have the chance to make informed choices. Several systems are under development, and hopefully in the future it will be easier for us to take responsible action. In the meantime, it is important for us, when specifying materials, and brands of materials, to research where possible the quantity, quality and type of embodied energy in the materials chosen, along with whatever other impacts it's use, or design may have.

If the product of our work is the second most important impact on the world environment, then it could be said that we are one of the most important factors in saving the environment. A very heavy responsibility, and one we should take very seriously indeed. We must aim for balance and sustainability, and by assessing embodied energy in the products we choose, we have at least one of the tools we need.