ENERGY EFFICIENT BUILDINGS

DISCUSSION FORUM:
RENEWABLE AND SUSTAINABLE ENERGY
UNIVERSITY OF STELLENBOSCH

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SCHOOL OF ARCHITECTURE AND PLANNING, WITS
SEPTEMBER 07, 2007

ENERGY EFFICIENT BUILDINGS

PRESENTATION IN TWO PARTS:

- CONTEXT AND KEY PRINCIPLES: DANIEL

- DESIGN INTERPRETATION AND APPLICATION: ALASTAIR

ENERGY EFFICIENT BUILDINGS

CONTEXT AND KEY PRINCIPLES

CONVENTIONAL INTERPRETATION - BUILDING SYSTEM-FOCUS:

Two complementary components now well recognised in building system:

- (1) Efficient use of energy which contributes to energy conservation which can be expressed as a savings-margin from *X*KWh/m² to *Y*KWh/m² where X > Y and X is the baseline/reference standard practice
  - Passive thermal control, daylighting, energy-efficient air-conditioning systems, energy-saving appliances as the key strategies)
- (2) Integration of Renewable Energy Technologies
  - Daylighting optimisation
  - Solar water heating
  - Wind energy integration
  - Solar electricity (PV-systems)

ENERGY EFFICIENT BUILDINGS

CONTEXT AND KEY PRINCIPLES

THE EMERGING INTERPRETATION – BROADER CONTEXT:

Need to extend scope and depth to indirect energy implications:

- Embodied Energy: Indirect Energy through production and distribution of materials and components
- Settlement and city scale in relation to access by users
  - » Urban land-form and land-use implications
  - » Linkage to transport and commuting (linked to cleaner- and bio-fuels)

ENERGY EFFICIENT BUILDINGS

CONTEXT AND KEY PRINCIPLES

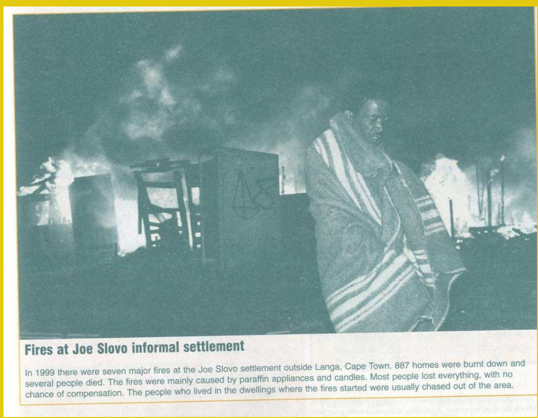
KEY DRIVERS

Developing versus developed country context:

- Energy poverty as a critical socio-economic development issue
- Energy supply constraints versus growing demand in context of a booming economy (local and global constraints)
- Pollution impacts, especially greenhouse gases and climate change
- Diversification of economic/investment opportunities
- Buildings and built environment as key end-user (direct and indirect)

ENERGY POVERTY: HAZARDS

FIRE HAZARDS: COMBUSTIBLE FUELS



Fires at Joe Slovo informal settlement

In 1999 there were seven major fires at the Joe Slovo settlement outside Langa, Cape Town. 887 homes were burnt down and several people died. The fires were mainly caused by paraffin appliances and candles. Most people lost everything, with no chance of compensation. The people who lived in the dwellings where the fires started were usually chased out of the area.

TERI KRUGER
Higher standards will protect consumers from unscrupulous suppliers

pressurised appliances are continuing their operations in the current vacuum of legislative constraints.

Even though the standardisation process has been ongoing for the past three-and-a-half years, Kruger says, the industry is faced with a dearth of compliant alternatives.

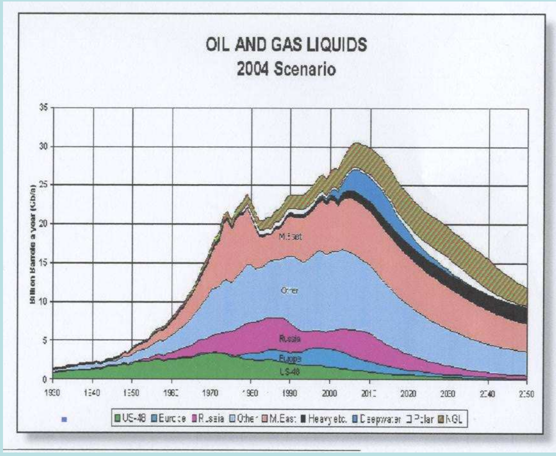
Old, uncertified and unsafe stoves and heaters will only become potentially more dangerous as time passes. Kruger is concerned that with winter approaching and with no other choices commercially available, the health and safety of paraffin users in poor communities will be further compromised in spite of regulatory efforts. "Noncompliant products will be withdrawn but our urgent concern at this stage is that, at the low-cost end of the paraffin market, there are no legal alternatives available."

The Paraffin Safety Association has been campaigning since 2003 to outlaw substandard paraffin-fuelled appliances. In 2004, it provided about R500 000 to fund a competition that would encourage the design of a safe, functional and affordable paraffin stove. "There have been negotiations between competition

PARAFFIN: HOT FACTS

Every day, between 17-million and 20-million South Africans use paraffin appliances. Even those with electricity use the fuel for cooking and heating as it is far more affordable despite the dangers.
It is estimated that there are 50 000 paraffin-related fires a year, which accounts for 3 000 deaths, 50 000 related burns, and an estimated 200 000 homes destroyed.

Key-Driver: Peak-oil scenario



Key-Driver: Eskom Capacity Limits

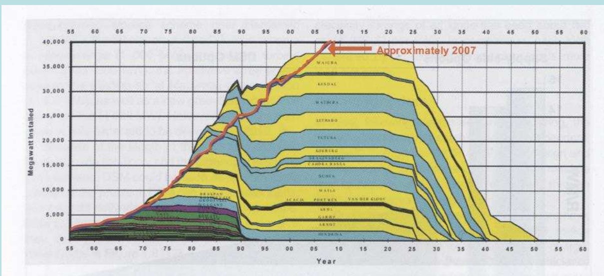
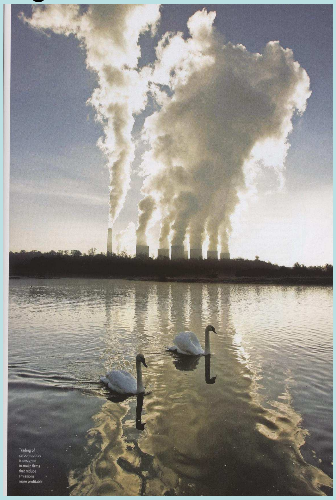


Figure 1.3: Eskom electricity generating capacity as a function of time [11].

Key-Drivers: Pollution impacts

The city and our eco-footprint: Energy – Greenhouse gases and climate change:



Mail&Guardian August 24 to 30 2007

A new report stresses SA's excessive contribution to global warming and suggests remedies

Greener pastures

Kevin Davie

Eskom and Sasol are among the companies that will be reporting under the carbon disclosure project in 2007. South Africa is the first developing nation, alongside Brazil, to participate, says a report by global wildlife fund WWF released this week.

"Eskom will in all likelihood rate as the highest greenhouse gas producing company to report from any country, with 200-million tons of carbon dioxide per year, compared to Shell's 105-million tons.

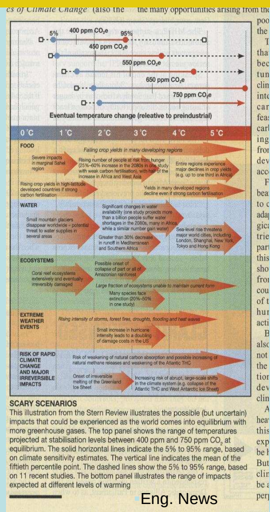
"Sasol will report about 70-million tons a year. Its Secunda coal-to-liquids plant is the largest single point source of greenhouse gas emissions in the world, according to a recent submission to the South African Cabinet by the department of environmental affairs and tourism," says the WWF.

The report, *Re-thinking Investment*, was released this week at a function hosted by the department of trade and industry, which announced it was setting up a desk to promote environmental goods and services. It highlights South Africa's disproportionate contribution to global warm-

Sasol's Secunda plant is the largest single point source of greenhouse gas emissions in the world

simpl[illegible] additional revenues generated by the tax being applied to reducing taxes on consumer goods, personal

Mail & Guardian

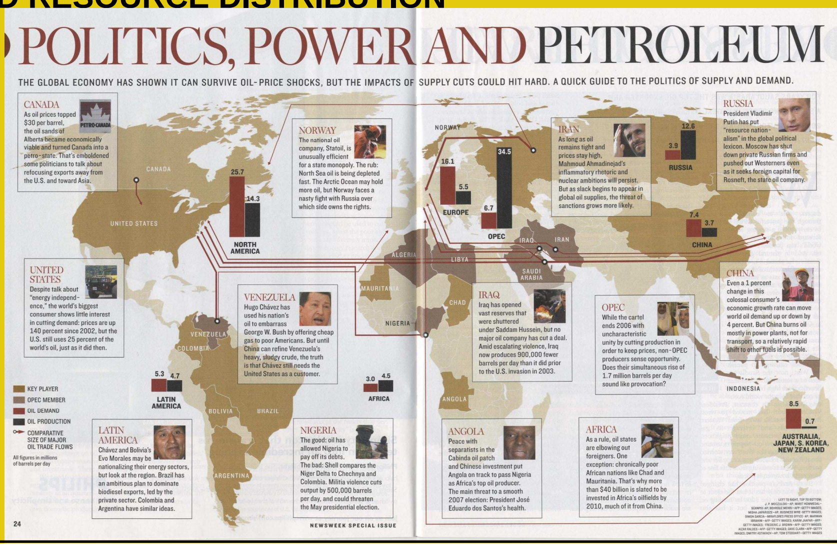


SCARY SCENARIOS
This illustration from the Stern Review illustrates the possible (but uncertain) impacts that could be experienced as the world comes into equilibrium with more greenhouse gases. The top panel shows the range of temperatures projected at stabilisation levels between 400 ppm and 750 ppm CO_2 at equilibrium. The solid horizontal lines indicate the 5% to 95% range, based on climate sensitivity estimates. The vertical line indicates the mean of the fiftieth percentile point. The dashed lines show the 5% to 95% range, based on 11 recent studies. The bottom panel illustrates the range of impacts expected at different levels of warming

Eng. News

Key Drivers: Dependency/vulnerability

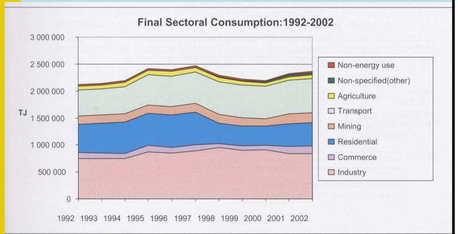
THE GLOBAL CHALLENGE: FOSSIL FUEL DEPENDENCY AND RESOURCE DISTRIBUTION

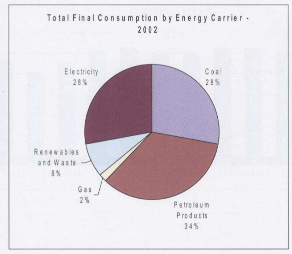


Key Drivers: Built Environment End-User

BETWEEN 50% TO 70% ENERGY CONSUMPTION LINKED TO BUILT ENVIRONMENT

- Critical end-user of energy
- Industry as key consumer and processing of building materials critical (cement, steel, glass etc)
- Transport second largest consumer: building materials heavy and bulky. Commuting a major factor in petroleum consumption
- Residential buildings third largest
- Commercial buildings fourth largest

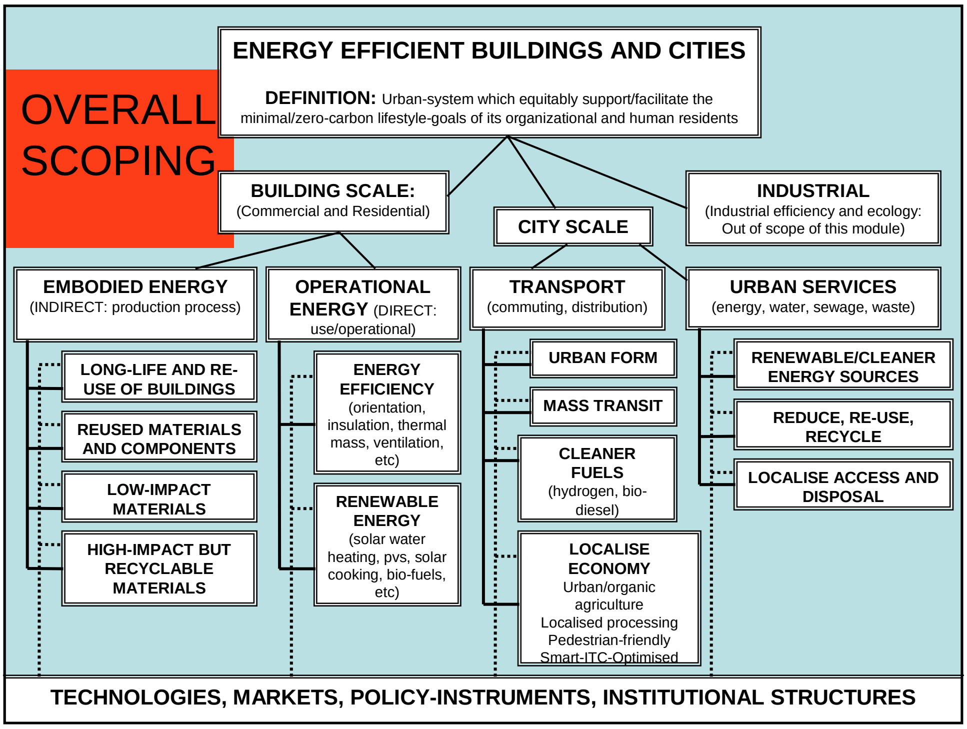




ENERGY EFFICIENT BUILDINGS

BUILT ENVIRONMENT:

- Critical end-user of energy
- Offers great opportunities for efficiency and renewable energy interventions
- Ranges in scale from city-wide to building/site specific interventions
- Challenges a multiple range of role-players to act/contribute in various roles



CITY-SCALE CHALLENGES AND OPPORTUNITIES

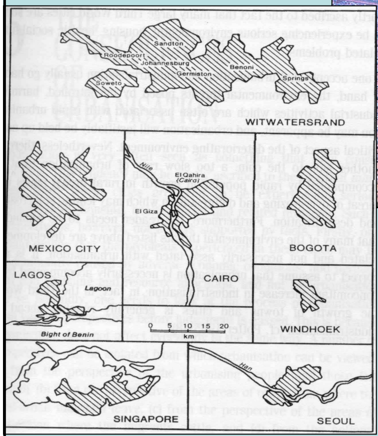
RELATIONSHIP BETWEEN CITY/BUILT FORMS, LIFESTYLES AND CARBON-FOOTPRINT

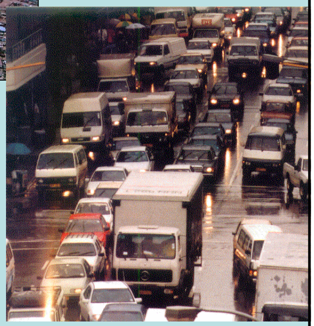
- Density, city-form and commuting: the urban-form legacy of apartheid
- Densification strategies and incentives
- Cleaner-fuels and bio-fuels in transport
- Localising the economy: food production and other supplies
- ICT as localisation strategy (commuting/trips and equitable access to services/supplies)

URBAN FORM, DENSITY AND COMMUTING

COMPACT VERSUS SPRAWL CITY DEBATE: OPPORTUNITIES AND TRADE-OFFS

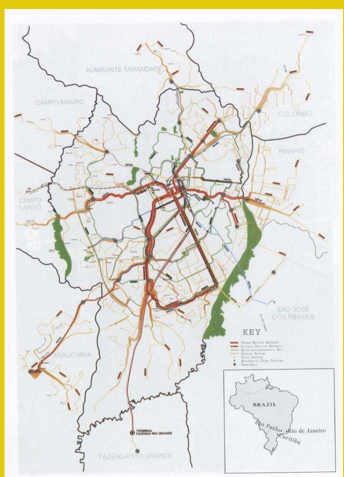
- Practice of functional zoning and motorised transport: dormitory function of townships and suburbs
- Inadequate capacity to sustain mixed-use and public transport
- Generates trips, necessitates private passenger vehicle and peak/low traffic cycles





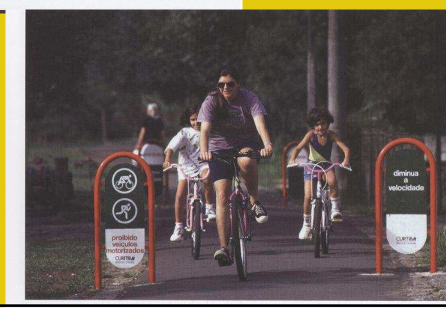
ENERGY EFFICIENT CITIES

GOOD PRACTICE CASE STUDIES: CURITIBA, BRAZIL



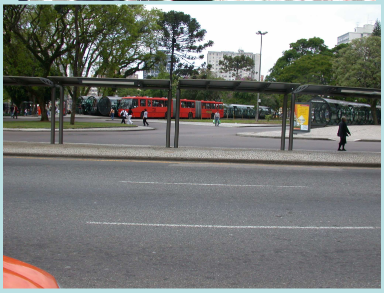
1. *Curitiba's Public Transit System (with insert of Brazil).* Courtesy of IPPUC.

14. *Bus with platforms extended to tubular passenger loading point:* Wright Collection



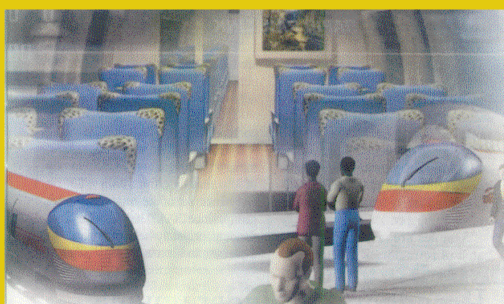
URBAN FORM, DENSITY AND COMMUTING

GOOD PRACTICE CASE STUDY:



ENERGY EFFICIENT CITIES

LOCAL ATTEMPTS AT PUBLIC TRANSPORT: BUT WEAK DENSIFICATION STRATEGY



ENERGY EFFICIENT CITIES

LOCALISING THE ECONOMY TO REDUCE CARBON-FOOTPRINT:URBAN AGRICULTURE

The complexities of **carbon friendly** Shopping

Tesco-like decisions to count the carbon footprint of products on their shelves sound like a simple and positive move. But what is their impact on developing countries? **Words: Patrick Burnett**

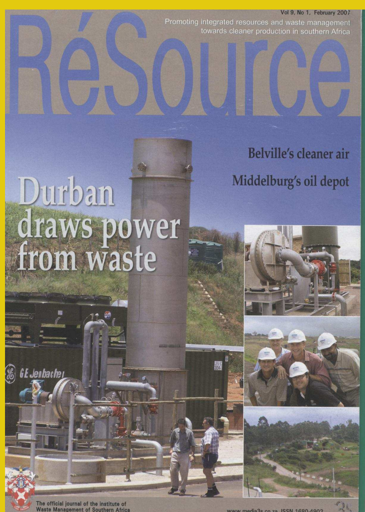
Tesco, the giant United Kingdom supermarket chain, sparked a furious debate about green shopping in February when they announced planned 'carbon friendly' measures such as restrictions on the stocking of air freighted produce and the introduction of carbon count- the debate has centred around 'food miles', underpinned by the logic that long distance air freighted produce carries a high carbon footprint because of noxious carbon dioxide emissions given off by air transport.

But although laudable in its attempts to tackle the pressing issue of climate change, the an-

"With the deepest respect, the

ENERGY EFFICIENT CITIES

TRANSFORMATION TO CLEANER AND BIO-FUELS



ENERGY USE IN BUILDINGS

ENERGY USE IN BUILDINGS

KEY BUILDING CATEGORIES

- Residential (high, middle and low-income)
- Commercial (offices, retail and warehousing)
- Institutional (schools, universities, hospitals)

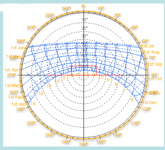
KEY ENERGY USES

- Lighting
- Thermal control (heating and cooling)
- Appliances (refrigeration, ICT, entertainment, cooking, water-heating)

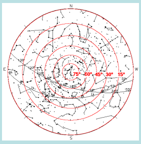
SUSTAINABLE DESIGN: FACTORS TO CONSIDER

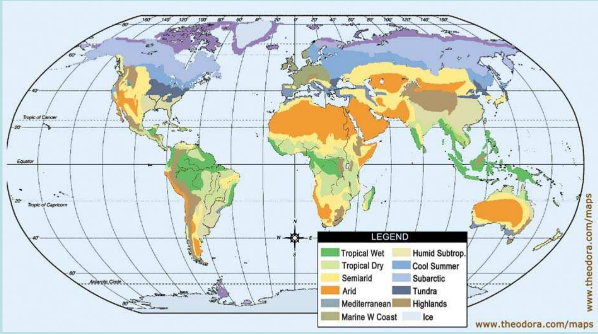
PLACE SPECIFIC
- climate
- sun angles

Azimuth

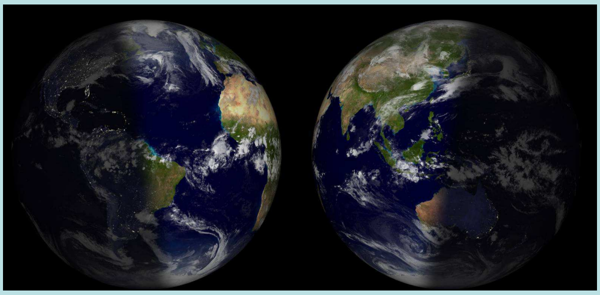


Altitude



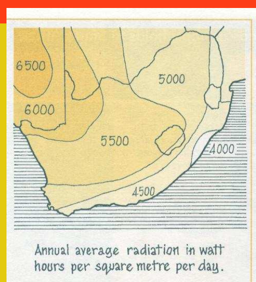


TIME SPECIFIC
-day light hours
- seasonal

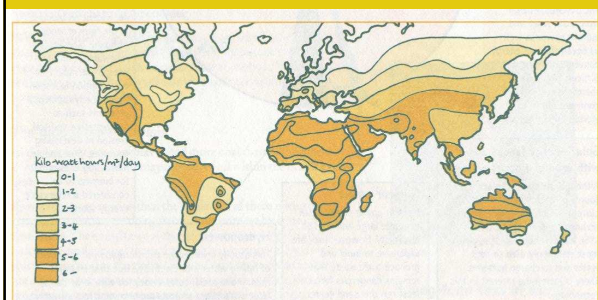


ENERGY USE IN BUILDINGS

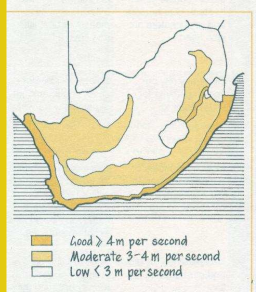
THE GLOBAL AND NATIONAL SOLAR RESOURCE



Solar potential in South Africa



Solar map of the world



Wind power potential in South Africa

ENERGY USE IN BUILDINGS

THERMAL COMFORT: ANALYSIS AND STRATEGIES

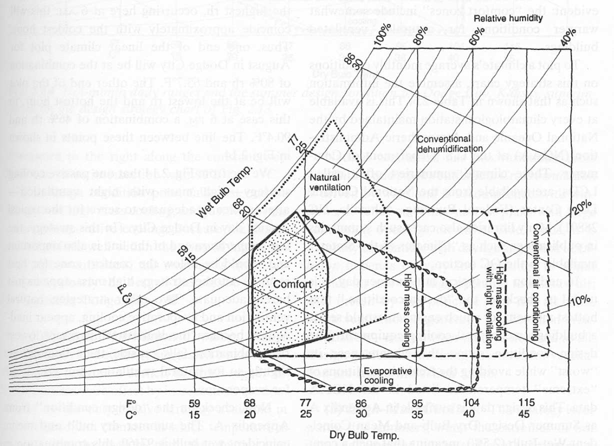


Fig. 2.13 Passive cooling design strategies by climate. Buildings usually contain sources of heat. The more heat that is generated within the building, the more an artificially warmer *climate is created. Thus, after plotting the outdoor climate data on this chart, consider how* shifting *these plots would affect your design strategy. The more* solar gains allowed inside, electric lights, and business machines, etc., *the further your plots shift to the right. The more* people, cooking, bathing, and other heat-plus-moisture sources, *the further your plots move both upward and to the right. (Based on Milne and Givoni, 1979.)*

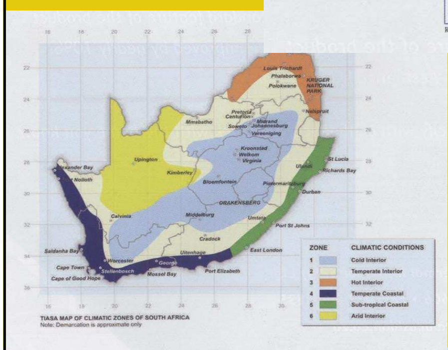
ENERGY USE IN BUILDINGS

CLIMATIC ANALYSIS AND DESIGN RESPONSE

Table 9.1
Energy measures will vary from location to location. The deemed-to-satisfy provisions are based on climate zones, including dry bulb temperatures, thermal neutrality, humidity and southern coastal condensation risk. The climatic zone map has six climatic zones as shown.

Climate Zone	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Description	Cold Interior	Temperate Interior	Hot Interior	Temperate Coastal	Sub-Tropical Coastal	Arid Interior
Climate	Warm summer Cold winter	Warm summer Cool winter	Hot dry summer Temperate winter	Warm humid summer Cold wet winter	High humidity summer Warm winter	Hot dry summer Moderate winter
Average January maximum temperature°C	30.7	30.7	31.9	26.1	27.8	35.5
Average July mean temperature°C	7.8	12.2	17.4	12.2	16.6	12.5
Average July minimum temperature°C	-1.8	3.6	10.2	7.0	10.5	4.1

Reference: D.Holm, H.M.Murray, C.J. Pauw, A.S van Niekerk (Temperatures obtained from Nova Project - climatic information).



ENERGY USE IN BUILDINGS

ENERGY EFFICIENCY:

PASSIVE HEATING AND COOLING:

- Heat exchange in buildings: conduction through envelope, convection through openings, direct radiation through glass
- Indoor versus outdoor temperature cycles
- Heating/cooling strategies: Direct gain – Orientation and glazing
- Heating/cooling: Indirect gain – Thermal-mass, Trombe wall
- Heating/cooling: Ventilation

ENERGY USE IN BUILDINGS

PASSIVE HEATING AND COOLING: CEILING INSULATION

Deemed-to-satisfy rule for energy efficiency in roof and ceiling construction (Table 9.2)

Climate zones	1	2	3	4	5	6
Minimum required Total R-Value (for roof solar absorptance of more than 0.55)	3.2	2.7	2.2	3.2	2.2	3.0
Direction of heat flow	Upwards	Upwards	Downwards and Upwards	Upwards	Downwards	Upwards

Climate zones	1	2	3	4	5	6

Flat roof and cathedral ceiling – ceiling lining under rafters (Table 9.2a)

Tiled roof	Total R-Value of roof and ceiling materials	0.38	0.38	0.38	0.38	0.37	0.38
	Minimum added R-Value of insulation	2.82	2.32	1.82	2.82	1.83	2.62
Metal roof	Total R-Value of roof and ceiling materials	0.36	0.36	0.36	0.36	0.36	0.36
	Minimum added R-Value of insulation	2.84	2.34	1.84	2.84	1.85	2.64

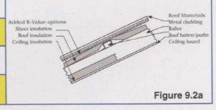


Figure 9.2a

Flat roof and cathedral ceiling – ceiling lining on top of rafters (exposed rafters (Table 9.2b)

Tiled roof	Total R-Value of roof and ceiling materials	0.38					
	Minimum added R-Value of insulation	2.82	2.32	1.82	2.82	1.82	2.62
Metal roof	Total R-Value of roof and ceiling materials	0.36	0.36	0.36	0.36	0.34	0.36
	Minimum added R-Value of insulation	2.84	2.34	1.84	2.84	1.86	2.64

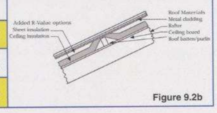


Figure 9.2b

ENERGY USE IN BUILDINGS

PASSIVE HEATING AND COOLING: CEILING INSULATION

Pitched roof with flat ceiling – metal roof (Table 9.2c)

Total R-Value of roof and ceiling materials	0.32					
Minimum added R-Value of insulation	2.88	2.38	1.88	2.88	1.88	2.68

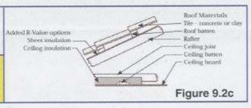


Figure 9.2c

Pitched roof with flat ceiling – tile roof (Table 9.2d)

Total R-Value of roof and ceiling materials	0.37	0.37	0.37	0.37	0.47	0.37
Minimum added R-Value of insulation	2.83	2.33	1.83	2.83	1.73	2.63

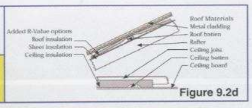


Figure 9.2d

NOTE: The deemed-to-satisfy provisions and the proposals described in this brochure are based on climatic zones.

Acknowledgement : Energy Efficiency Provisions for BCA Volume 2 (Australia) 2005

Regulatory Proposal – Revised Energy Efficiency Provisions – Australian Government – November 2004

Notes:

1. The Total R-Value of the roof and ceiling materials may need to be adjusted if other building elements such as sarking are also installed.
2. Required insulation can be installed in the roof, the ceiling or a combination of both.
3. The Total R-Value in Figure 9.2c is based on there being natural ventilation of the roof space through the gaps in the roof tiles. However Figures 1(a), (b) and (d) assume that there is no ventilation of the roof space through the metal roofing.
4. Where the solar absorptance of the roof upper surface is less than or equal to 0.55, the minimum added R-Value of insulation may be reduced by 0.5 to account for the lower minimum Total R-Values specified in Table 9.2 for climate zones 3 and 5.
5. The direction of heat flow in Table 9.2 is considered to be the predominant direction of heat flow for the hours of occupation of the building. It takes into account the higher rate of occupancy of houses at night time rather than day time.

ENERGY USE IN BUILDINGS

PASSIVE HEATING AND COOLING: WALL INSULATION

Deemed-to-satisfy rule for energy efficiency in wall constructions (Table 9.3)

Climate zones	1	4	6	2	3	5
Minimum required Total R-Value for walls	1.7			1.4		

Typical wall construction R-Values (Table 9.3a)

Climate zones		1, 4, 6	2, 3, 5
Cavity clay masonry (minimum 110 mm external, minimum 90 mm internal)	Total R-Value of wall materials	0.66	0.66
	Minimum added R-Value of insulation	1.04	0.74
Concrete blockwork masonry (minimum 140 mm masonry)	Total R-Value of wall materials	0.51	0.51
	Minimum added R-Value of insulation	1.19	0.89

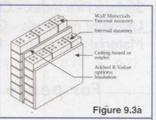


Figure 9.3a

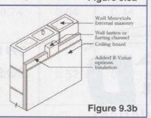
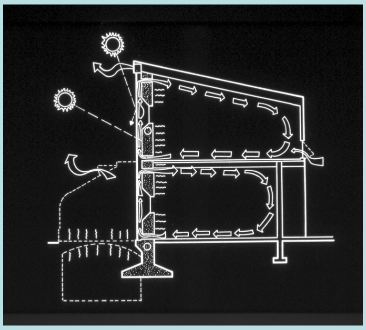
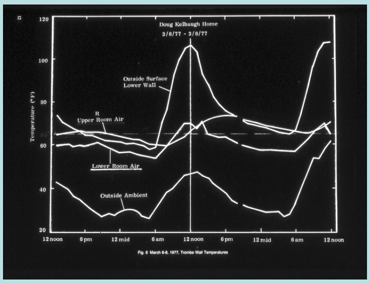


Figure 9.3b

"Insulate before you insolate"

- Orientation to winter sun is an important first step
- In a direct gain building, the windows admit both heat and daylight
- The building envelope needs to conserve the solar heat collected by the windows, and to help distribute the daylight
- Windows can be fitted with thermal shades or shutters for heat conservation by night

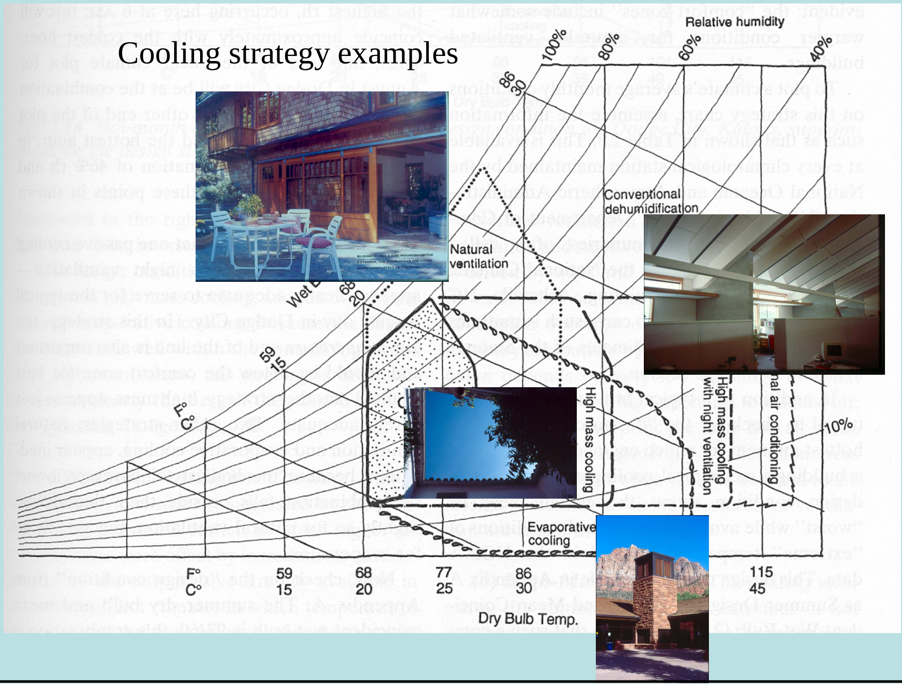




The Trombe wall delays the arrival of solar heat, while the sunspace and direct gain openings allow morning warm-up.

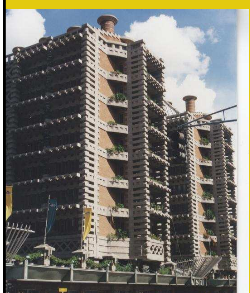
Temperatures are for a sunny winter day.

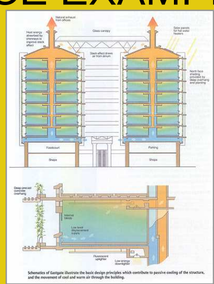
Cooling strategy examples



ENERGY USE IN BUILDINGS

GOOD-PRACTICE EXAMPLE: EASTGATE

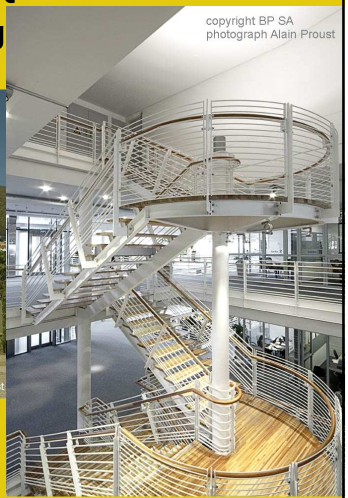




ENERGY USE IN BUILDINGS

GOOD-PRACTICE EXAMPLE: BP HEADQUARTERS

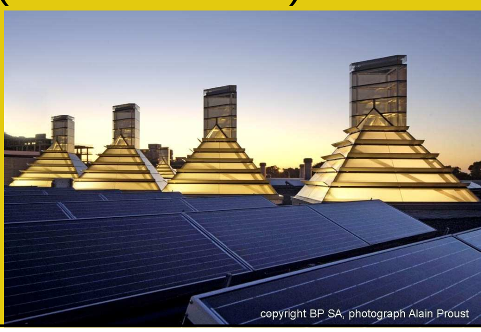
Façade design for enhanced daylighting

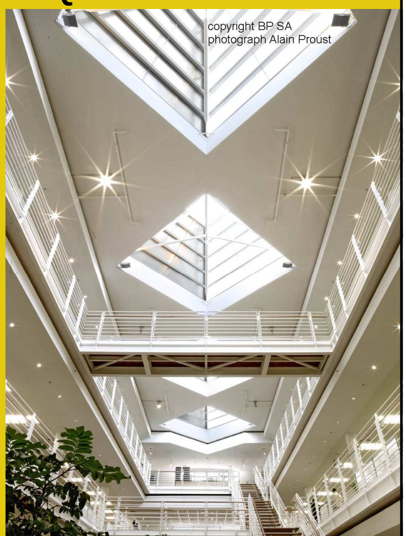


ENERGY USE IN BUILDINGS

GOOD-PRACTICE EXAMPLE: BP HEADQUARTERS

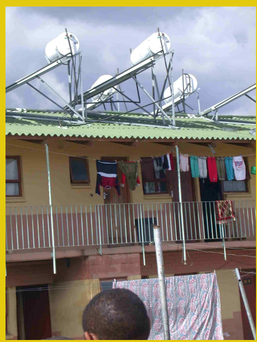
- **Internal "feel/balance" of** daylight and artificial light
- Integration of PV (not cost-driven)

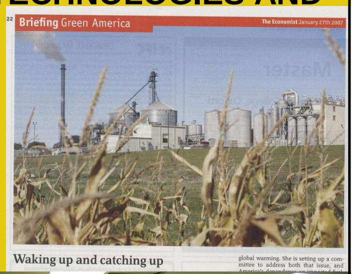




ENERGY USE IN BUILDINGS

INTEGRATING RENEWABLE ENERGY TECHNOLOGIES AND BIO-FUELS IN BUILDINGS





ENERGY EFFICIENT BUILDINGS

ENERGY LABELLING OF BUILDINGS

- **Information strategy to inform stakeholders of energy-consumption levels of building**
- **Can be mandatory or voluntary**
- **Can be in isolation or with back-up of incentives and rewards**
- **Requires a broad support system for stakeholders (both in terms of expertise and web-based information)**

ENERGY USE IN BUILDINGS

ENERGY EFFICIENCY AND RENEWABLE ENERGY IN BUILDINGS: KEY BARRIERS OF INTEGRATION

- Historically “cheap” electricity
- Absence of supportive policies and building regulations
- Inadequate industry-preparedness: leads to high costs (eg solar water heaters and double glazing)
- Weak local expertise: related professionals and trades not adequately developed

ENERGY USE IN BUILDINGS

GLOBAL INITIATIVE IN SUPPORT OF ENERGY EFFICIENCY AND RENEWABLE ENERGY IN BUILDINGS

NEWSNETWORK

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United States | news | climate | 2007-05-20 | printable |
Source: Environmental Finance

Cities offered $5bn to 'green' old buildings

Former US president Bill Clinton yesterday announced a $5 billion programme to retrofit buildings in 15 cities around the world to make them more energy efficient. Under the programme, public buildings such as fire stations, as well as commercial buildings owned by the private sector, will be able to apply for funding to install energy efficiency improvements. The plan is a joint effort of the Clinton Climate Initiative and C40, a group of mayors from various global cities, chaired by London's mayor Ken Livingstone.

Announcing the programme at a C40 conference in New York, Clinton said: "The businesses, banks and cities partnering with my foundation are addressing the issue of global warming because it's the right thing to do, but also because it's good for their bottom line. They're going to save money, make money, create jobs and have a tremendous collective impact on climate change all at once."

Four major energy service companies – Honeywell, Johnson Controls, Siemens and Trane – will conduct energy audits on the buildings, perform the retrofits, alongside local contractors, and also guarantee the expected energy savings.

The firms have agreed to scale up their operations in the first 15 cities to participate in the scheme: London, New York, Bangkok, Berlin, Chicago, Houston, Johannesburg, Karachi, Melbourne, Mexico City, Rome, Sao Paulo, Seoul, Tokyo and Toronto.

Financing will be provided by ABN Amro, Citigroup, Deutsche Bank, JPMorgan Chase and UBS, who have agreed to arrange $5 billion between them to pay for the programme.

Livingstone said the programme would help meet his own target of reducing emissions from public buildings owned by the Greater London Authority by 20% in the next three years. "But the full opportunity is much larger – nothing less than to 'green' London's entire major building stock – commercial and public sector. If every building in London were to take advantage of this offer we would cut 5 million tonnes of carbon from London's 44 million-tonne annual carbon footprint," he added.

Michael Bloomberg, mayor of New York, said: "Mayors are responsible for coming up with pragmatic solutions and implementing them effectively – and this programme will allow us to do that."

Gary Page, head of global markets at ABN Amro, which has agreed to arrange $1 billion, said: "Buildings consume 40% of the world's energy and account for one third of greenhouse gases. Increasing the energy efficiency of their facilities can make a significant impact, both to an organisation's carbon footprint and its bottom line."

ENERGY USE IN BUILDINGS

RECENT INITIATIVES IN SUPPORT OF ENERGY EFFICIENCY AND RENEWABLE ENERGY IN BUILDINGS

Day dawning for new low-power lamps as Eskom tallies up potential for saving electricity capacity and CEF plans southern African factory

Lights are going out on old bulbs

SAMANTHA ENSLIN-PAYNE

Durban – The Central Energy Fund (CEF) and UK multinational Philips are in talks to make energy saving light bulbs in sc… would dovetai… ment's plans t… incandescent b…

The facility … pact fluorescen… probably be in … to be operatin… year, Luc Escou… ager for Philip… yesterday. He de…

Barry Bredenkamp, the acting operations manager for the National Energy Efficiency Agency (NEEA), said on Friday that South Africa wanted to eradicate incandescent

initiatives come in the face of an electricity supply crisis that saw demand soar to a record 35 981 megawatts two weeks ago in icy weather.

Eskom's margin is about 8 per-

putting tremendous pressure on the already tight supply system, Eskom warned yesterday.

It said it was managing the demand by using available generating

Africa used CFLs, demand could be reduced by 1 000MW. To build 1 000MW of new generating capacity could cost about R17 billion, based on the cost of Eskom's new Medupi … bulbs are … be done on … initial pur… households. … s or CFLs … power con… e, but cost … of CFLs at … R17.59 to … the brand

and watts. An incandescent bu… costs between R3.75 and R4.25.

Etzinger said the cost of CF… could decline if they were produce… locally as a portion of the cost we… to transport. Both CFLs and inca… descent light bulbs are importe… from Indonesia and China.

Even if the price did not fall su… stantially, it would still be viable f… households to make this investmen… particularly given above-inflatio… electricity price hikes that were du… to be implemented over the next fe… years, Etzinger said.

Light bulb ban, Page

The Star WEDNESDAY APRIL 4 2007

Advertisement Feature in The Star, Pretoria News, Daily News and Cape Arhus

Writer: Lorraine Tulleken
Advertising: Special Projects

UNDP CEF (Pty) Ltd

Special Projects Division
Feature

Summit highlights importance of solar water heating to South Africa

Solar water heating (SWH) is part of the solution as, with rapidly increasing demands on our local and regional electricity infrastructure, government has the challenging task of using our resources as best as possible.

SWH is also key to ensuring continued and sustainable growth for Africa's future.

An increased use of solar water heating (SWH) will provide the hot water required for our homes and, therefore, also for the economy.

Increased utilisation of solar water heating will facilitate job creation and enable demand side management, a reduction in carbon dioxide emissions, as well as a reduction in the reliance on the electricity network.

This became clear as more than 100 delegates from Europe, Australia, Brazil and Southern African countries met at a recent Solar Water Heating Summit to share their insights, experience and financing models in the solar water heating arena.

The event was hosted by the Southern African Renewable Energy and Energy Efficiency Partnership (REEEP).

Participants and speakers represented South Africa, Namibia, Malawi, Kenya, Swaziland, Australia and Brazil, from all three tiers of government as well as academic institutions and non-governmental organisations within Southern Africa.

REEEP is an international initiative backed by more than 200 national governments, businesses, development banks and NGOs, to enhance the levels of integration of renewable energy and energy efficient systems into national and global energy systems

Five years ago, Southern African delegates met in Pretoria to launch the REEP secretariat, to consider the energy needs of the region and lament the lack of interest, finance and commitment.

DOWN TO BUSINESS: delegates at this year's solar water heating conference concentrated on work already done, and on budgets already approved, rather than on plans and proposals.

Last week, delegates were far more practical.

They presented project report-backs rather than proposals, and considered budgets spent rather than budgets sought.

Particularly impressive was the work being done in Kenya, Namibia and Botswana through a national commitment in those countries to roll out the use of renewable energy as a mechanism for sustainable growth in this energy crisis.

The major aims of the summit were to:

- stimulate discussion and capacity to engage government in the uptake of solar water heating;
- to present the results of research relating to the uptake of solar water heating, and consider the lessons southern Africa can learn; and
- to showcase solar water heating technologies and applications to the public sector.

International speakers included David Rossiter from the Australian Renewable Energy Regulator, who discussed the successes and failures of the large-scale implementation of SWH through using renewable energy certificates.

Delcio Rodrigues of the Vitae Civilis Institute, Sao Paulo, discussed the successes and failures of related bylaws in Brazil, and the SWH sale-of-energy model.

And Jared Atiang of the African Energy Policy Research Network in Kenya, spoke about the importance of sustainable growth through an energy crisis, with a focus on cities.

The presentations are available on www.reeep-sa.org/summit or www.reeep.org.

For more info contact Carmen Armstrong, REEEP Southern Africa Manager, on 021-881-3282, 082-492-8654 or carmen.armstrong@reeep.org

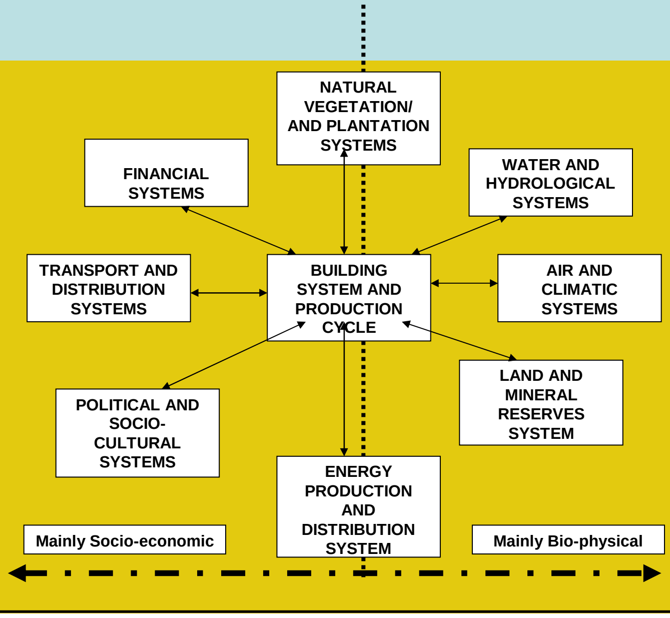
ENERGY EFFICIENT BUILDINGS

EMBODIED ENERGY AND ITS IMPLICATIONS IN ENERGY EFFICIENT BUILDINGS:

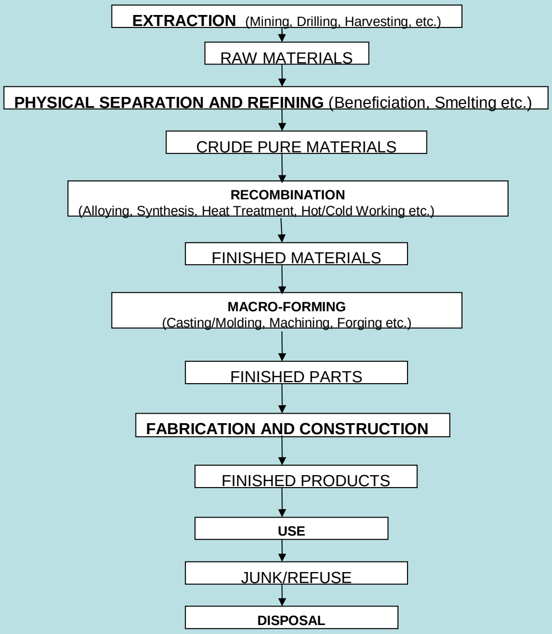
EMBODIED ENERGY

- Introduction: Buildings as open systems
- Life-cycle analysis and industrial ecology
- Embodied energy in building production
- Key methods in embodied-energy analysis
- Embodied energy and key sectors in South Africa's construction
- Interventions for embodied-energy conservation

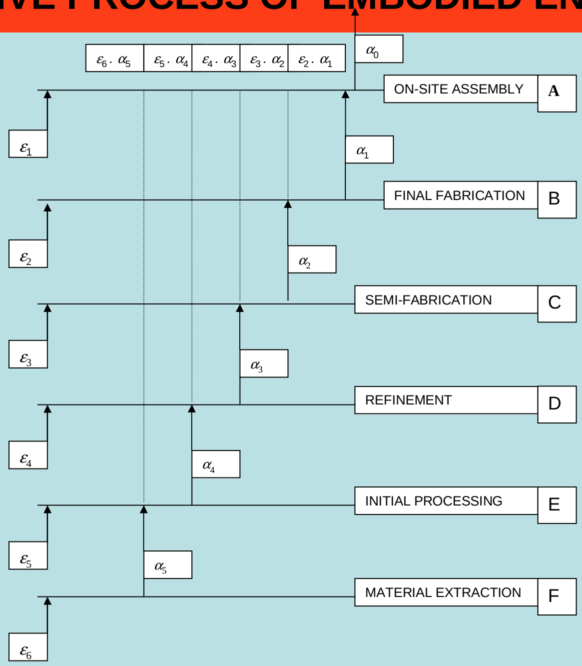
BUILDINGS AS OPEN SYSTEMS



LIFE-CYCLE ANALYSIS AND INDUSTRIAL ECOLOGY OF PRODUCTS



CUMULATIVE PROCESS OF EMBODIED ENERGY



KEY METHODS OF DERIVING EMBODIED ENERGY INTENSITIES

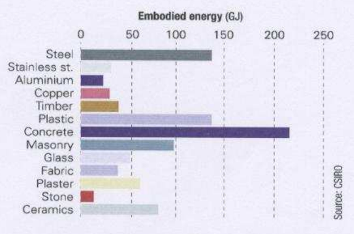
- STATISTICAL METHOD: ENERGY INPUT DIVIDED BY MONETARY VALUE OR PHYSICAL QUANTITY OF OUTPUT
- ENERGY AUDITS: STAGE-BY-STAGE AUDIT OF ENERGY INPUT AND PRODUCT OUTPUT
- INPUT-OUTPUT ANALYSIS: ENERGY STATISTICS, I-O ANALYSIS TABLES

EMBODIED ENERGY AND KEY SECTORS LINKED TO BUILDING PRODUCTION

MATERIAL	PER EMBODIED ENERGY MJ/kg
Kiln dried sawn softwood	3.4
Kiln dried sawn hardwood	2.0
Air dried sawn hardwood	0.5
Hardboard	24.2
Particleboard	8.0
MDF	11.3
Plywood	10.4
Glue-laminated timber	11.0
Laminated veneer lumber	11.0
Plastics - general	90
PVC	80.0
Synthetic rubber	110.0
Acrylic paint	61.5
Stabilised earth	0.7
Imported dimension granite	13.9
Local dimension granite	5.9
Gypsum plaster	2.9
Plasterboard	4.4
Fibre cement	4.8*
Cement	5.6
Insitu Concrete	1.9
Precast steam-cured concrete	2.0
Precast tilt-up concrete	1.9
Clay bricks	2.5
Concrete blocks	1.5
AAC	3.6
Glass	12.7
Aluminium	170
Copper	100
Galvanised steel	38

Embodied energy per material.

(Lawson 1996)



Embodied energy as per amounts used in a completed building. (www.dbce.csiro.au)

COMPARATIVE FRAMEWORK FOR MATERIAL SELECTION

- INADEQUACY OF CONVENTIONAL INTENSITIES (MONETARY, PHYSICAL OR TRADE UNITS)
- NEED FOR INTEGRATION OF PERFORMANCE CONSIDERATIONS
- USE-INTENSITY AS A CRITICAL FACTOR
- COMBINING ENERGY- AND USE-INTENSITIES
- DERIVING EMBODIED-ENERGY IMPACT COEFFICIENTS FOR COMPARISON AT THE LEVEL OF THE ECONOMY

LISTING OF MATERIALS ACCORDING TO EMBODIED-ENERGY IMPACT COEFFICIENTS (IN REFERENCE TO PREVIOUS TWO TABLES)

- PRODUCTS OF CONSTRUCTION 1.27MJ/Rc
- BRICKS AND TILES 0.68MJ/Rc
- STRUCTURAL METALS (INCLUDING IRON AND STEEL) 0.54MJ/Rc
- TRANSPORT, STORAGE, WHOLESALE DISTRIBUTION 0.46MJ/Rc
- CEMENT 0.30MJ/Rc
- WOOD AND WOOD PRODUCTS 0.17MJ/Rc
- PETROLEUM PRODUCTS 0.10MJ/Rc
- ELECTRICITY AND GAS 0.10MJ/Rc
- PAINTS AND VARNISHES 0.09MJ/Rc
- GLASS GLASS PRODUCTS 0.08MJ/Rc

EMBODIED-ENERGY CONSERVATION INTERVENTIONS: LOW IMPACT MATERIALS

TLHOLEGO EARTH CONSTRUCTION: RUSTERNBURG

NEW GOURNA: SUN-DRIED EARTH BRICK CONSTRUCTION

EMBODIED-ENERGY CONSERVATION INTERVENTIONS: REUSE OF BUILDINGS

DOUGLAS ROOMS: JOHANNESBURG: FOURTH CYCLE OF REUSE IN OVER 100 YEARS LIFE SPAN

EMBODIED-ENERGY CONSERVATION INTERVENTIONS: REUSE OF CONSTRUCTION MATERIALS AND COMPONENTS

SORTING OF DEMOLITION WASTE FOR REUSE OF COMPONENTS: TIMBER AND STEEL

EMBODIED-ENERGY CONSERVATION INTERVENTIONS: REUSE OF CONSTRUCTION MATERIALS AND COMPONENTS

REUSE OF COMPONENTS IN FORMAL AND INFORMAL CONSTRUCTION: SHACK AND STUDIO IN PRETORIA

EMBODIED-ENERGY CONSERVATION INTERVENTIONS: DEMOLITION WASTE:

CEMENT AND STEEL IN REINFORCED CONCRETE

EMBODIED-ENERGY CONSERVATION INTERVENTIONS: :

FROM DEMOLITION WASTE CEMENT BRICKS: CAPE BRICK

EMBODIED-ENERGY CONSERVATION INTERVENTIONS:

FROM FLY-ASH AND WASTE-FIBRE TO BRICKS: NEOLITE INDUSTRIES

ENERGY EFFICIENCY IN CONSTRUCTION, PRODUCTION AND DISTRIBUTION OF MATERIALS

- ENERGY EFFICIENCY IN PRODUCTION (CLEAN TECHNOLOGIES PARADIGM: ISO 14000 CERTIFICATIONS AND UPSTREAM-TO-DOWNSTREAM CONSIDERATIONS OF IMPACTS)
- ENERGY-EFFICIENT PLANT AND EQUIPMENT ON SITE
- SHORTER DISTRIBUTION NETWORKS
- RAIL RATHER THAN ROAD TRANSPORT
- LABOUR INTENSIVE CONSTRUCTION (CRITICAL FOR DEVELOPING COUNTRIES WHERE CREATION OF JOBS AND SKILLS OPPORTUNITIES IS REQUIRED)

CONCLUSION

- BUILDING AS OPEN SYSTEM IS A VALUABLE FRAMEWORK FOR ESTABLISHING RELEVANCE IN SUSTAINABLE ARCHITECTURE AND BUILDINGS
- BUILDING PRODUCTION AS KEY SECTOR IN THE ECONOMY AND CONSEQUENT IMPACTS
- EMBODIED ENERGY ANALYSIS CAN BE DERIVED THROUGH STATISTICAL, AUDIT OR I-O METHODS
- USE-INTENSITY IS CRITICAL IN IDENTIFYING CRITICAL MATERIALS AND COMPONENTS FOR EMBODIED ENERGY CONSERVATION
- CONSERVATION THROUGH A CRADLE-TO-CRADLE APPROACH ESSENTIAL (LOW-IMPACT MATERIALS, REUSE OF BUILDINGS AND COMPONENTS, RECYCLE OF CONSTRUCTION WASTE
- DESIGN TEAM SPECIFYING MATERIALS/COMPONENTS FROM “CLEAN TECHNOLOGY” SUPPLIERS/MANUFACTURERS
- FACILITATION THROUGH DATA CAPTURE AND GREEN LABELING SCHEMMES ESSENTIAL

TWO RELATED FOLLOW-UP EVENTS

- **SECOND PREA-WORKSHOP (Promoting Renewable Energy in Africa: Socio-economic priorities in renewable and sustainable energy in the built environment)**
  - DATE: OCTOBER 11 – 13, 2007
  - VENUE – SUSTAINABILITY INSTITUTE, LYNEDOCH, STELLENBOSCH
  - DETAILS: http://web.wits.ac.za/Conferences/PREA/
- **PEAK-OIL SOUTH AFRICA CONFERENCE**
  - DATE: NOVEMBER 8 – 9, 2007
  - VENUE: GALLAGHER ESTATE, MIDRAND
  - DETAILS: Www.oildepletion.co.za

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- THANK YOU