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Implementation of Renewable and Energy Efficiency Interventions in New Government-delivered Metro Housing

Several countries have recognized the importance of including energy efficiency in their building codes. The application of these codes is often initially voluntary, with a stepped mandatory introduction process.

In South Africa, government is currently conducting an investigation into a revision of the national building codes and national Housing Code to include energy efficiency measures. A voluntary green building rating system is also being developed by the Green Building Council.

South African building standards are encoded in the national building code, the SANS 0400. This building code only deals with health and safety issues at present. The National Building Regulations, which refer to SANS 0400 are currently held by the Department of Trade and Industry (DTI). The South African Bureau of Standards (SABS) which is responsible for producing the SANS 0400, falls under the DTI, and acts as the technical advisor to the Minister.

In November 2007, the DTI gave the go ahead to the SABS to prepare a scoping report to assess the viability of including energy efficiency interventions in the building codes. This involves a thorough life cycle cost analysis of each proposed intervention, in order to make a strong case for its inclusion into the codes. This process commenced in January 2008 and is anticipated to take one year. The process of then amending the National Building Regulations will take another 3 years. Therefore it will be four years before any energy efficiency interventions for new buildings will be enforced in South Africa. The draft energy efficiency standards have been completed, and will shortly be gazetted, but these remain voluntary until included in the National Building Regulations.

It is likely that a two tier approach will be adopted with a basic minimum set of criteria to be met from a technical design side (these will be included in the building codes), and a voluntary Green Building Rating System to incentivize good building practice which exceeds building code energy efficiency standards.

As the department responsible for the delivery of state subsidized housing, the Department of Housing has been working to include energy efficiency into the Norms and Standards for housing delivery. To date DoH has submitted to Minmec that some basic, no cost energy efficient interventions be approved for inclusion in the National Housing Code. DoH is working with the National Home Builders Regulatory Council (NBRC) to develop additional energy efficiency codes. Discussions with Treasury for additional funding to support these interventions look promising.

The simple energy efficiency checklist for government-delivered metro housing provided here includes all interventions with proven impact. The list has been developed through:

- extensive modeling of the impacts of each intervention;
- assessment of impacts and consequent prioritising, based on the criteria of financial feasibility (including capital and operational and maintenance costs); environmental impact; user acceptability; established technology; ease of implementation; social impact, and job creation; and
- a review of international best practice.

Detailed modeling of interventions, taking local climatic conditions into account, has been done for most of the metros in South Africa and is available from SEA.

Municipalities leading the way with energy efficiency interventions in new government-delivered metro housing can expect the following benefits:

- A decrease in the rate of future demand for electricity and increased energy security
- Reduction in Greenhouse Gas Emissions
- Reduction in energy poverty
- Poor households spend approximately 20% of their income on meeting their energy needs
- Increased Employment Oportunities
- Renewable energy and energy efficiency technologies have been shown to provide more employment that their fossil fuel counterparts.

Well designed and managed buildings can reduce typical electricity consumption figures by 60%-85%. This can have huge implications for the future when all the housing stock of a country is considered.

The ten point housing checklist

The following list provides a comprehensive outline of renewable and energy efficient interventions that should form part of a minimum energy efficiency and renewable energy Code of Practice which should be adopted by municipalities. Please refer to Intervention Guide for greater detail on each intervention.

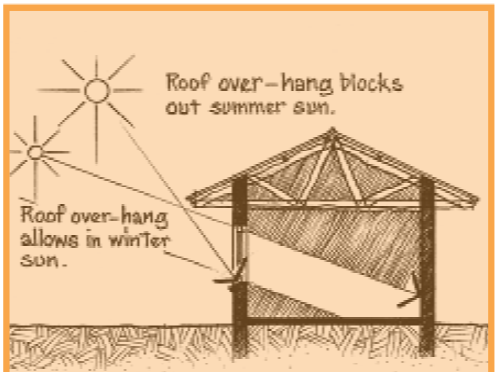
Interventions to be implemented IMMEDIATELY AT NO COST:

1. **Orientation**. Will the building be oriented in such a way that the largest wall and glazing area is faced as close to north as possible?
2. **Concrete Blocks**. Can you use concrete blocks with a central air gap instead of bricks for the wall?
3. **Efficient Lighting**. Has efficient lighting been planned for?
4. **Clay Walls**. Is it feasible to use clay wall construction for this project?
5. **Natural cross ventilation**. Has provision been made on the sides of the building for opening windows to allow for natural cross ventilation?
6. **Solar rights**. Has provision been made that the building will not be constructed so as to infringe on the direct access to sunlight of any adjacent existing buildings?

Interventions with capital costs but financially feasible in light of substantial, social, environmental and economic benefit as articulated in national and local government goals:

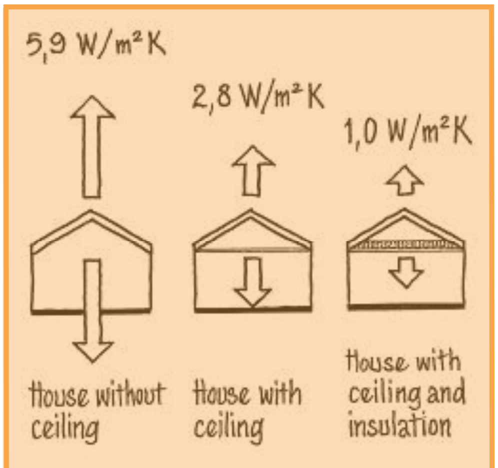
7. **Ceilings.** Have ceilings been included in design? Minimum requirements for these (based on retention values) can be found in the South African National Standard: Energy Efficiency in Naturally Ventilated Buildings, shortly to be gazetted by Standards South Africa.
8. **Thermal Insulation.** Has reflective or bulk insulation been included in the building design? Minimum requirements for these (based on retention values) can be found in the South African National Standard: Energy Efficiency in Naturally Ventilated Buildings, shortly to be gazetted by Standards South Africa.
9. **Cavity Walls.** Is it possible to include cavity walls in the building design?
10. **Solar Water Heaters.** Is it feasible to incorporate a Solar Water Heater into the building? If so, does it meet the following standards?

#	SANS Number	Description/ Title
1	SANS 1307:2005 (SABS 1307)	Residential solar water heaters
2	SANS 6210:1992 (SABS SM 1210)	Residential solar water heaters - Mechanical qualification tests
3	SANS 6211-1: (or part 2) 2003	Residential solar water heaters Part 1: Thermal performance using an outdoor test method (part 2 is an indoor test method)
5	SANS 60335-2:2000	Household and similar electrical appliances - Safety Part 1: General requirements
6	SANS 151	Fixed Electrical storage water heaters



A roof over-hang on the north side of the house should let in winter sun and shade rooms from summer sun.

This diagram applies to houses south of the



Heat resistance gained by ceiling and insulation material.

INTERVENTIONS GUIDE

Orientation of structure

Orientation of a building is one of the most fundamental no cost interventions one can implement. To optimize passive thermal design, the house should be north facing. This means that most of the wall area of the building should be facing north and south, with most living areas positioned on the northern side of the house. The reason for this is that the smaller east and west walls receive the most intense solar radiation, ensuring that the house is kept as cool as possible.

Building orientation should be considered as early on in the planning phase as possible. Ideally the road infrastructure in a new development should run east-west and north-south to allow the plots to lie similarly.

Adequate roof overhang and window position

Roof overhangs on the north wall in houses south of the Tropic of Capricorn can keep the higher summer sun out and let the lower winter sun in. Roof overhangs on the south wall in houses north of the tropic will keep summer sun out, while no shading on the north will allow winter sun through. Windows can be optimized to allow in maximum winter sun and daylight. Shading did not prove hugely beneficial in modeling.

Ceiling and/or insulation use

Insulation is one of the most effective ways to make a house more energy efficient. A well insulated house ensures that the flow of heat through the building envelope is minimized. This means that keeping the building cool in summer and warm in winter will require significantly less energy when compared to an uninsulated building. Good insulators are materials that are poor conductors of heat, and are often rated with an R-value (resistivity). Another excellent form of insulation is reflective aluminium foil, which reflects radiated heat from the roof before it reaches the ceiling cavity. As most heat is lost and gained in a simple building through its roof, ceilings and roof insulation are two of the most cost effective techniques to make it more energy efficient. Air is a good insulator too. Leaving an airgap between roof and ceiling will further enhance insulation concrete blocks with central airgap or two skin walls with an airgap between the bricks acting as good wall insulation. Clay walls can perform better than brick and has a lower embodied energy.

Colour of roof and walls

Especially in hot climates, having a light exterior wall and roof colour to reflect the sun's radiation can have a large effect on reducing internal temperatures. However, this did not prove hugely beneficial in modeling.

Natural ventilation systems

Cross ventilation – designing a building with windows which will allow fresh air from prevailing summer winds to flow through it.

Daylighting

Daylighting is an approach which places windows at strategic points in a building to optimize the amount of natural light entering into it. This can substantially reduce costs from artificial. In addition to energy savings, daylighting generally improves occupant satisfaction and comfort. Windows also provide visual relief, a contact with nature, time orientation, the possibility of ventilation, and emergency exits.

Daylighting windows should be positioned to capture reflected and not direct sunlight, thereby minimizing the heating effect of extra window area. Very little additional mechanical cooling will be required to compensate for the additional light. Light coloured, reflective internal walls and ceilings will also enhance internal light space.

Solar Water Heaters

Solar water heaters (SWHs) are one of the most viable renewable energy technologies currently available on the market. They replace the conventional electric water heater (EWH), by capturing the heat of the sun to heat water for commercial and residential applications. In countries such as South Africa which have a good solar radiation, SWHs can reduce household electricity use by typically 20-30%. Although they have a relatively high capital cost, a solar water heater in a typical 'average' South African household will pay for itself in electricity saved in approximately 5 years.

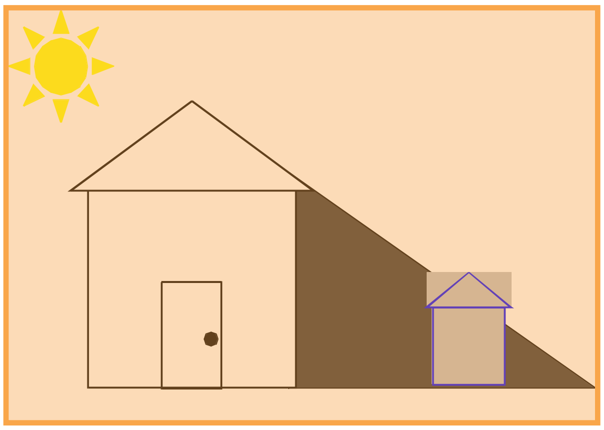
Solar water heaters are a proven technology and if maintained will continue to work for up to 25 years. Care should be given that well made systems from reputable manufacturers are used in any mass rollout scheme. Eskom has a list of accredited suppliers who meet SABS Standards.

Efficient lighting

The following table gives some typical embodied energy figures:

Material		KJ/kg
Metal	Steel	20
	Steel Recycled	3.6-5.5
	Aluminium	167
	Aluminium Recycled	4.7
	Zinc	46-52
Plastics	Polythene	138
	Polypropylene	145
	PVC	103
	Polystyrene	45
Other	Cement	13
	Glass	14-18
	Tiles	4
	Clay Brick	4

Embodied energy figures for typical building materials



A new building should not be allowed to infringe on the solar rights of another

Compact fluorescent light bulbs: A CFL is 80% more efficient than an incandescent bulb. This means that the same amount of light can be generated using 1/5 of the power. Over the lifetime of one 18W CFL (the equivalent of a 100W incandescent) which is approximately 10 000 hours, a saving of 800kWhrs of electricity will be achieved amounting to R480 of electricity saved per CFL (using today's rates).

Embodied energy in building materials

Every manufactured item of building material requires a certain amount of energy to produce it. This energy is called the embodied energy of the material. For warmer southern climates, the embodied energy of a house is approximately the equivalent of 15 to 20 years its operational energy. For a house lasting 100 years, this is approximately 10 percent of its total energy costs.

Some materials such as aluminium require hugely energy intensive processes to manufacture, and therefore have a relatively high embodied energy. Others such as tiles and clay brick require low energy processes to manufacture, and therefore have a relatively low embodied energy.

Another point to consider is the energy required to transport the material to a building site. Locally sourced materials will have a far lower transport embodied energy component compared to internationally sourced materials.

Solar / Thermal Rights

Solar or thermal rights is the concept that any new building should not encroach on a neighbouring building's access to direct sunlight. As roof area will in the future be utilized increasingly for solar water heating and electricity generation, the right of homeowners to access direct sunlight on their roofs will become increasingly more important. Also windows which are used for daylighting purposes can be affected. To date no legal precedent has been set in South Africa to support this principle. It does however make sense to make provision for this eventuality in city bylaws, or in the building codes.