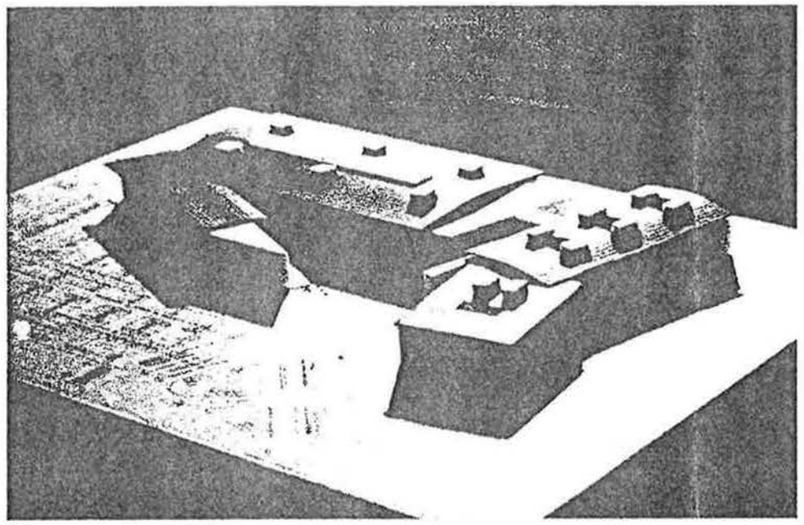

Figure 2. Example of shadow study for 13.00 hours in mid-winter

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RENEWABLE ENERGY

A PROGRAMME FOR THE THERMAL UPGRADING OF THE HOUSING STOCK IN ENGLAND AND WALES TO SAP 65 BY 2010

Peter F Smith, Professor of Architecture at Sheffield Hallam University and Chairman of the Sustainable Futures Committee of the Royal Institute of British Architects

Whilst this paper focusses on problems which are unique to the UK, there are broader implications concerning attitudes which must change if even the modest Kyoto 'agreement' is to be upheld.

In 1974 it was stated by the charity Shelter that in the mid-70s Britain was almost the top of the league in terms of the proportion of GDP spent on its housing. By 1994 it had dropped to near bottom of that league and things are not much better now. Over 7 million households are below the official fuel poverty level. Bad housing has a profound impact on health. In the UK over £1 billion a year is spent by the health service on illnesses directly resulting from cold, damp and mould in housing.

According to the government the official threshold for reasonable energy efficiency is SAP 60. The Standard Assessment Procedure (SAP) is made up of a calculation of the rate of heat loss from a dwelling resulting from its form, thermal properties of its fabric and level of ventilation. This is equated with the cost of making good the heat loss through the heating system and the cost of the fuel used, taking account of any solar gain. It has been criticised for including the fuel price because it is such a variable. Far better to have a system which focusses on the thermal efficiency of the fabric, plus its space and domestic water heating systems. However, it is the official yardstick and will have to suffice.

To repeat, the official base line for energy efficiency is SAP 60 and the average for England alone is SAP 35. This is pushed up by post 1970s housing which had to incorporate insulation. In the private rented sector the SAP average is 21.7 with 26% below SAP 10. A significant number of the <10 group are as low as SAP -25. If Scotland and Wales were included the overall average would drop by a significant margin. All this adds up to a serious deficiency in terms of the quality of the UK housing stock and also explains why 28% of the CO2 emissions for the UK are attributable to housing. If we build the 4.4 million new homes which are said to be needed by 2010, this will add a further 4 million tonnes of carbon to the UK total per year. Incidentally, as our nuclear power stations are decommissioned, if the shortfall is met by gas powered generation this will add another 4 million tonnes to the atmosphere per year; the coal fired alternative would add about 8 million tonnes.

I mention this because the government has made a commitment to reduce our CO2 emissions by 20% by 2010 against 1990 levels. In my opinion, the only way there is any chance of meeting this target is by a radical thermal upgrading programme for the housing stock below SAP 65. Our initial estimate is that this would cut CO2 emissions by 50%, which translates into c.15% reduction of the UK total. In the light of this claim, I and my colleagues have been given research funding by the government to work out how this target could be reached in what seems an impossibly short timescale.

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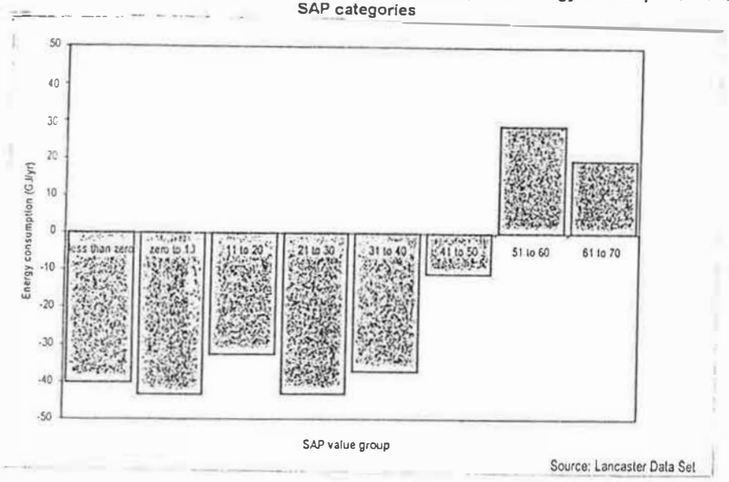
A thermal retrofit strategy

If this target is to be achieved there will have to be a systematic national programme underpinned by government regulation and funding. The present piecemeal approach to energy efficiency with its excessive deference to free market principles has no chance of reaching this 50% CO2 reduction target. The barriers to a systematic programme at present are:

- A high percentage of owner-occupiers, especially in England plus private tenants requiring voluntary participation.
- Under the Home Energy Conservation Act, local authorities are obliged to state how they will raise the energy efficiency of housing within their boundaries by 30%. There are wide variations in methodology and quality of outcome under the terms of the Act.
- The method of accounting employed by the Treasury focusses on capital spending and excludes revenue benefits. It is currently not able to offset capital costs with revenue gains and this distorts the cost effectiveness of capital intensive programmes.
- There are serious discrepancies between official design parameters (ie BREDEM based) for household energy consumption and the actual energy consumption within lower efficiency housing .
- The widening income gap and the rising proportion of the elderly is increasing the rate of fuel poverty. This will get worse as state pensions increasingly decline in real terms.
- There are serious doubts about the capacity of the construction industry to deliver a rapid retrofit programme.
- Where local authorities have undertaken their own retrofit programmes, they have encountered serious problems of quality control.
- The energy regulators' powers are currently confined to keeping down fuel prices and maximising market freedom.

If a national programme is to be successful within a market economy with a high proportion of home owners then it has to offer both short term and long term cash benefits. The long term benefits are no peoblem, especially for low income low SAP households where space heating costs might be reduced by 75-80%. The short term benefit would be achieved where the cost of energy plus repayments for the fabric upgrading would add up to *less* than the previous annual costs of energy alone. The problem here is establishing a benchmark for the real annual energy costs. The standard computer model for the heat regime assumes a living room temperature of 21 deg C and 18 deg C for the rest of the house. *The England House Condition Survey 1991* shows no average temperatures for living rooms reaching this average. (Table A13.3) An intensive localised survey in Lancaster by our research associate Chris Goodacre reveals a similar pattern when focussing on energy consumption and SAP rating. Only when SAP 51 is reached does energy consumption reach the level assumed by the standard heat regime model. Figure 1

Figure 1: Average difference between actual and expected energy consumption within SAP categories



From unpublished PhD thesis by Chris Goodacre

The rationale for a large-scale retrofit programme is that it should represent *realistically calculated* energy savings which will form the base line of a cost-benefit equation. Therefore it is essential that retrofit programmes be based as near as possible on actual energy costs rather than theoretical models. This means assessing costs on an area-sensitive basis, fine tuning them to establish specific yardsticks at neighbourhood level.

Opinion is converging on the belief that the Energy Service Company (ESCO) is the most likely mechanism able to realise the goal of radically improving the national housing stock. The principle behind the ESCO is that it supplies both energy and energy conservation services such as improving the thermal efficiency of the building fabric and providing advice regarding fittings and applicances. The householder would receive a single bill for fuel and repayments for the upgrading costs. A KPMG report of February 1998 offers a commercially viable framework for ESCOs. Estate models have shown that the housing stock requires an average investment of £5000 per dwelling to achieve significant thermal improvements by means of measures such as over-cladding and double glazing. The market rate of return for the ESCO against this cost would be in the region of £800 per year for 14 years. For the householder, this cost would be offset by the cost of saved energy.

Assuming an energy saving of 50%, this would mean a cost saving of:

owner occupier	375
private rented	309
council tenants	260
housing assoc tenants	230
Average for all households	330 - 1991 prices £s stirling.

derived from the English House Condition Survey 1991 DOE

In order to provide an incentive to participate in the programme, householders should be assured of a c.10% saving in real annual costs embracing energy and energy services. The difference of c.£500 per year should be met in the early years by government subsidy. If retrofit repayments were reduced at the outset but designed to track inflation, then government subsidy would taper and eventually disappear. In times of severe economic constraint, there would have to be a rigorous appraisal of the balance between costs and revenue. At a recent debate (May 1998) Lord Ezra, past Chairman of the Coal Board, argued strongly in favour of retaining the levy on electricity, the Non-Fossil Fuel Obligation (NFFO). In effect this was a carbon tax which has largely been channelled into nuclear energy. The 10% levy should continue to operate since it is a tax to which consumers are accustomed but in future embracing all fossil fuels. It should be ring-fenced to contribute to the year-on-year subsidy for the home upgrading programme. The government has shied away from overt carbon taxes for fear of electoral penalties. In a MORI poll conducted in October 1996, 66% of the British public supported the continuance of the NFFO with most believing it should be exclusively devoted to environmental causes. Such a programme will produce a steady increase in revenue benefits which will include:

- a boost to the construction industry. One new skilled job is created for every £30-35,000 spent on retrofitting buildings. Added to this will be up to one job for every £60,000 due to the respend factor. The support industries will also experience a significant increase in turnover. Within an industry with a high unemployment rate, this will have the added benefit of replacing unemployment benefit with tax and social security revenue.

- The £1 billion annual health costs attributed to poor housing should taper off and there should be a marked reduction in deaths due to hypothermia

- As less personal income is consumed by energy, this may well have an impact on the social benefits burden.

- There will be extra disposable income through the cost of saved energy providing a further boost to the economy.

- The capital value of the stock is significantly increased, with benefits both to the individual owner and the national stock value.

- Improved housing will mean a longer life expectancy with the effect of reducing the environmental costs associated with demolition and replacement.

- According to the Oxford University Environmental Change Unit the final outcome of the balance between costs and revenue gains will be a net profit to the Exchequer. One of the facets of our research is to test this hypothesis.

Operation and management

For a scheme on a national scale the operational structure will need to be centrally imposed. An existing quasi-government agency exists in the form of the Energy Saving Trust (EST). It would make sense for the Trust to be enhanced to provide oversight of the system and be accountable directly to government for the efficient operation of the scheme. The obvious next tier is the local authority. LAs would be

responsible for delivering the target SAP within their boundary within the defined timescale and for achieving a minimum of, say, 75% uptake across all households. A member of the EST might be positioned within each LA for the duration of the operation. The government agency to which that EST person would report would be the regional office of the Department of Environment, Transport and the Regions (DETR).

The operational responsibility should be vested with specialised project management companies who have demonstrated their capability in this sphere. They would be responsible to the LA for completing the work to specification and on time.

The LAs would be required:

- to assess the *real* costs of energy to households as the median between highest and lowest within a given neighbourhood

- building on data gathered under the terms of the Home Energy Conservation Act (HECA) to assess the work needed within contract boundaries to raise the minimum SAP to 65. The work would be based on nationally agreed specification standards

- to identify ESCOs which would be willing to tender within the LA area. These would be checked for in-house expertise etc.

- to select a short list of project management companies

- to publicise the programme within their area and obtain a sample of likely uptake rate from owner occupiers, private tenants and housing association tenants. LA tenants would automatically be included.

The LAs would then seek tenders from approved ESCOs which would include:

- the cost of electricity and gas fixed for the duration of the contract unless the market dropped by over,say, 5% in which case the ESCO price would track the rate of reduction; increases in price would not be passed on to consumers.

- the cost of upgrading individual properties according to the specification provided by the LA and to a standard of at least SAP 65

- the duration of the contract, including penalties for delays

- guarantees of security of supply of energy.

Once the contract terms had been agreed, the LA would appoint the accepted project management company tenderer.

The way forward

For this strategy to be possible a number of things will need to happen. First there will have to be changes in the regulations governing the primary responsibilities of the fuel regulators if ESCOs are to function effectively. At present consumers have a statutory right to change energy suppliers at 28 days notice. Since the supply of energy and energy efficiency services would be offered as a single package it will be necessary for consumers to agree to be locked-in to the ESCO for the duration of the

contract. This degree of market stability together with economies through long-term financing packages will enable the ESCO to offer a highly competitive energy price at the outset.

The government seems to be creating a political climate in which it would be acceptable to override the duties of the regulators to maximise market freedom where ESCOs are involved in large-scale retrofit programmes. At the same time the regulators would have powers to ensure that ESCOs did not take advantage of locked-in customers. A recent government Green Paper appears to be creating the regulatory space to allow ESCOs to operate:

"Where Ministers wish to implement social or environmental measures, including energy efficiency measures, which have significant financial implications for consumers...these should be decided by Government and implemented through new, specific legal provision rather than through guidance to the regulatory"
(A Fair Deal for Consumers, Department of Trade and Industry Proposal 2.3)

Where necessary an LA should provide temporary accommodation for households for whom the disruption would impose an unacceptable burden on an inhabitant, such as the elderly and chronically sick.

Reference was made earlier to the skills shortage within the construction industry. This is especially acute in the sphere of retrofit energy efficiency technologies. It will be necessary to embark on a national crash programme of education and training to ensure that there is a qualified workforce which increases in parallel with the demands of the industry. We could learn from the Swedish government's 2 year intensive training programme in advance of the introduction of SBN 80 which ensured that there were sufficient expert operatives to cope with the rigours of the greatly enhanced thermal building regulations.

Conclusion

Upgrading the housing stock in certain countries will be the most effective way of achieving significant CO2 reductions by 2010 whilst also realising social and economic benefits. There must also be radical changes in the supply side with much more resource targeted at renewable energy and CHP. However, the central message of this paper is this. If we are to stem the onward march of global warming and climate change then we must be prepared to carry the costs and to accept limits to our individual freedom. The strategy I have described will only work if people accept that their freedom to play the energy market at short notice would be suspended during the period of an ESCO retrofit programme. Surely this is not too much to ask, especially as householders will experience immediate benefits. Yet this small problem symbolises the global dilemma. All the economic trends are in the direction of the free market and deregulation whilst the environmental thrust is towards regulating the market so that it contributes to the security of the planet. The security is especially threatened by the failure so far to halt the rise in CO2 emissions. The simple truth is that saving the planet in the long term is not compatible with free market economics. From the market perspective, saving the planet is not cost-effective.

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RENEWABLE ENERGY

FROM A SCHOLAR CITY TO A SOLAR CITY

Arq. Dania González Couret. Ph.D. Arq. Amy Hevia Santos. M.Sc.
Arq. Irina Dacosta Calheiros. Arq. Luis Vladimir Vega Céspedes.

Faculty of Architecture. ISPJAE. 127 and 114. CUJAE. Marianao. Havana City. Telephone: (537) 20-6997/ 206903. Fax: (537) 27-2429/27-2964. e.mail: arquitectura@ispjae.cujae.edu.cu

ABSTRACT

Located on "Bartolomé Masó" municipality on the north part of "Sierra Maestra" in "Granma" province, the Scholar City "Camilo Cienfuegos", represents a paradigm of the real ideals of the Cuban Revolution related to education. The paper presents the results of a work developed by a team of professors and students of the Faculty of Architecture and Mechanic Engineering in the Polytechnic University of Havana (ISPJAE) in 1997, which includes a diagnosis of its current situation as a consequence of its historical development, and an strategy for its transformation into a sustainable city.

The proposed strategy deals with economic and social sustainability, preservation of natural resources, energy conservation, and appropriate technology, considered in 3 main concepts: *Habitat city*, *Cultural city*, and *Sustainable city*, which are finally integrated into a *Solar City* as a symbolic term. As part of the proposal, a Master Plan, urban and architectural design criteria and steps for the future development are presented

KEYWORDS

Sustainable human settlements; sustainable development; sustainable strategies; sustainability.

THE SCHOLAR CITY "CAMILO CIENFUEGOS"

The local government has called for help to recover the Scholar City "Camilo Cienfuegos" (a paradigmatic example of the architecture and ideals of the Revolution) and Cubasolar is looking for financial support and working on strategies and projects based on a sustainable approach. Thus, the aim of this paper is to present the main ideas applied on the strategy for the sustainable renewal of the Scholar City "Camilo Cienfuegos".

Antecedents

According to a sustainable approach, very advanced at that time, this Scholar City was conceived by the leaders of the Revolution since the very days of the insurrectionist struggle. It would be a scholar city for 20 000 students from the region, composed of 35 units unit, each of which should be for 576 students, containing classrooms, bedrooms and dining rooms. With an extension of 500 "caballerías", it would also include 42 industries, 105 sports fields (with swimming pools and one big stadium), a zoo park, a hospital, a theatre, an airport for tourists going to "Sierra Maestra", and also settlements for the teachers and other workers on the city (Cardoso, O.J., 1981).

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