

## **ENERGY CONSERVATION AND PLANNING**

### **-Guidelines for energy efficient residential developments**

Seminar workshop on Energy efficiency organised by Centre of Environment Technolofgy Development Malaysia (CETDEM) and Malaysia Institute of Planners (MIP) on 12 August 2006 Armada Hotel Petaling Jaya

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#### **Introduction**

Since the Agenda 21 in the Rio summit, Energy efficiency has been recognized as an important consideration in designing building. There is also a growing interest in understanding energy efficient in the planning of city and even at regional level (Breheny, 1992; Nijkamp P. and Perrels A, 1994). This trend is observed in the developed nations where apart from institutional research work, the NGOs and legislation on energy conservation (Energy Act 2004, Sustainable Energy Act 2003, Energy Conservation Act 1996), are also being enforced. Many of the recent publications tend to refer to energy conservation and energy efficient in the discussion of sustainable development. However, many of the developing countries including Malaysia still lack of research in the field of energy efficiency and its application in urban planning. The energy saving may be more substantial if the energy conservation ideas are incorporated at the earlier stage of planning at regional, city or neighbourhood levels. Hence it is important for the Federal Town and Country Planning department to develop energy efficient guidelines for the local planning authorities to implement.

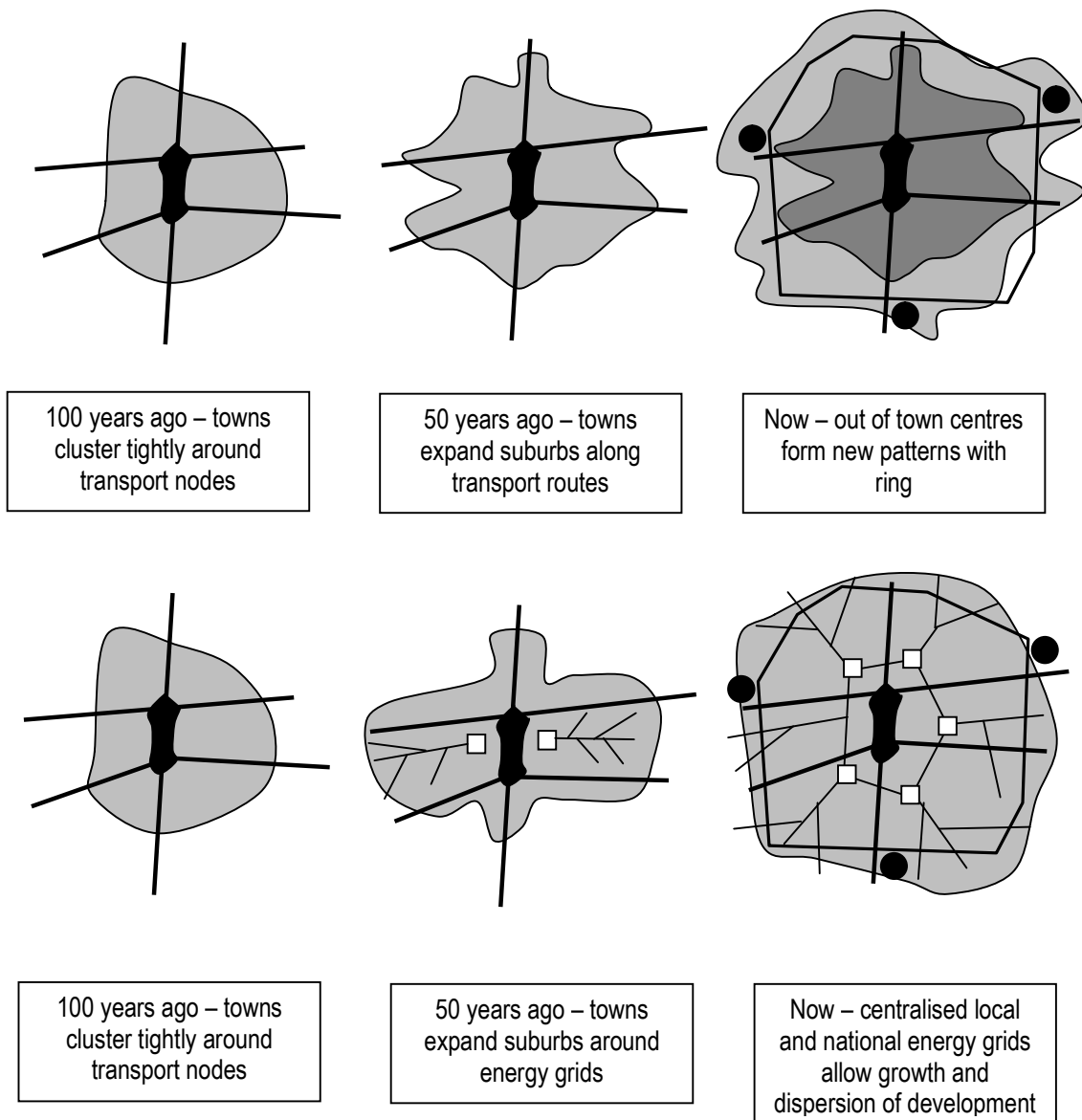
It is the purpose of this paper to examine the current literature on this subject and finally outline broad energy efficient guidelines to relevant authorities such as Federal Town and Country Planning Department and local authorities to consider the aspects of energy conservation into their strategic and physical planning. It is hope that some of the proposals may play the roles as guidelines for planning practitioners at neighbourhood or city level. This paper will focus more at neighbourhood and city levels. The author also recognises that energy efficient home features at building level, should include building orientation, internal room, layout, insulation, ventilation, heat proofing and use of energy efficient appliances.

#### **Urban Forms and Structure**

The urban form and structure of city has undergone significant changes due to the rapid urbanization and mode of communication. The main energy source supported this urban expansion through the world irrespective the developed, developing or underdeveloped nations in the last few centuries are the non-renewal fossil fuel. The relatively cheap and accessible source of energy has made many cities becoming more dependent on fossil fuel.

Urban forms and structure of many cities are determined by the transportation network namely the radial and grid pattern which forms the star, finger or ribbon shape of development (Refer Figure 1). Many of these cities expand outward along the transportation route either a road, rail or even river towards the fringe and forms suburbs and some do have sub centres. Apart from the influence of transportation network, electricity also played important roles in the deconcentration of cities. In the early 20th century, there are a number of local stations, which supplied both gas and electricity to surrounding districts. Now, the centralised local stations feed into national grids, which further promote dispersion of development. The “spreading out phenomenon” is not desirable in terms of energy conservation because it tends to have lower energy efficiency because of higher consumption in terms transportation and difficulties to have a critical mass for an optimal production and supply of energy.

**Figure 1: Evolution of Urban Structure with (a) Transport Nodes and (b) Energy Grids**



### Urban Planning and Issue of Energy efficiency

Planning system has strong influence on the energy conservation. Based on GAIA (1996) and Owen (1986), it has been estimated that “overall energy consumption could be one third more in ‘inefficient’ settlement patterns as compared with the efficient ones.

Planning can have effect on energy conservation at the following levels: -

a) Structure plan

Structure plan indicates where development should take place, according to spatial principles of energy efficiency. Green belts, forestation and strategic land use and landscaping all have significance implication on energy conservation.

b) Local plan:

Local Plan is where the government policies and structure plan apply on a site. It is more of a physical plan or design (e.g. specific energy efficiency per area/community) supported with detailed policies relating to energy efficiency, open space, biomass, height controls, layout principles and other detailed physical design.

c) Information dissemination

Negotiation and information dissemination can be improved both by more relevant policy (formal mechanisms) but also through informal mechanisms such as development briefs, improved Continuing Professional development (CPD) and other focus of training.

However, based on Brundtland Report, the Dutch government environmental policy document set out the 5 levels of environmental impact i.e. from global to local level, to be addressed by public agencies. It is usually incorporated with Agenda 21. Figure.2 shows the different levels of environmental policy document.

There are six (6) important aspects to be considered in the achieving the energy conservation.

- i. Strategic Planning
- ii. Local Planning
- iii. Development Control
- iv. Design Guidelines
- v. Implementation
- vi. Public Consultation
- vii. Physical Planning
- viii. Management
- ix. Tools

**i) Strategic Planning**

In Local Agenda 21, government needs to work closely with the local agencies to implement their policies. At the strategic level, reduction in the use of private car and the encouragement of public transport will help to contribute to reduction in the gasoline consumption and level of CO<sub>2</sub> emissions and have impact on human health.

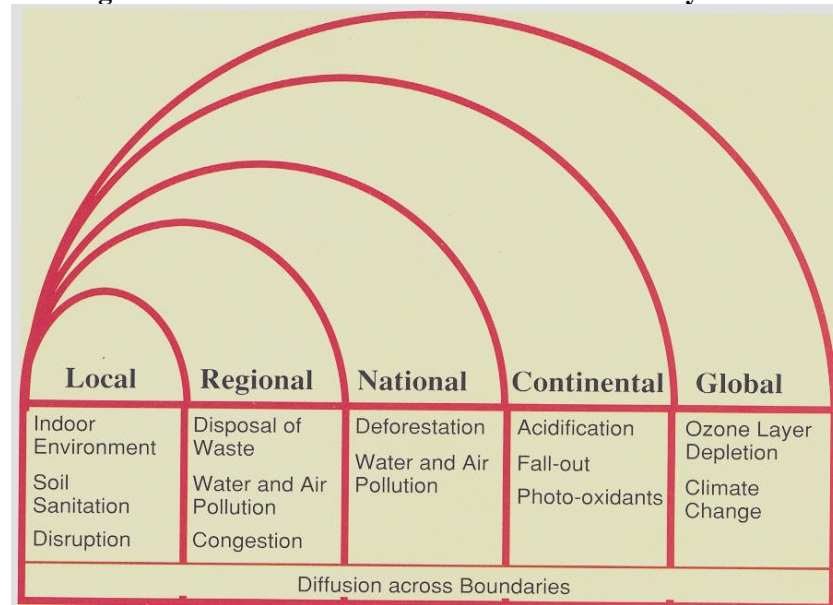
Siting and scale of major development will have impact of energy use. It will have impact on transportation if major development is spread out and also emphasis is not given for public transport and pedestrianization.

**ii) Local Planning**

The planners impact on energy saving is most significant at local planning level. At this level, the planning can influence the urban form; encourage the use of public transport. In

addition the NGO and local authority can play the most effective roles in campaigning on the awareness of energy saving.

**Figure 2: Dutch Government Environmental Policy Document**



\*This figure is adapted from the Dutch government's environmental policy document, which followed the Brundtland Report and sets out the range of levels of environmental impact, which will have to be addressed by public agencies. Since the adoption of Agenda 21, all these scales of concern are within the ambit of planning. It is acknowledged that some decisions require to be taken internationally, hence the need for Agenda 21 itself.

### iii) Development Control

Development control deals with the routine day to day functions of local planning authority in approving planning application. It may range from small project of minor change of land use or even building use such as approval of detached house to a large township development. The use of guidelines and planning standards as a parking standards, road width, density, appropriateness land use or even adherence of energy saving principles will directly influence the energy conservation. Larger projects of more than 100ha of land may require fairly detailed assessments of energy demand and also potential use of renewable energy source.

### iv) Design Guidelines

Design guidelines will contain advice on location, layout, and the use of landscape, orientation, built form and so on. In UK, guidelines such as Environmental Code of Practice for Buildings and their Services by BSRIA are example of guidelines with energy conservation content.

Best practice guidelines will help to provide a better picture of what to be achieved. Different type of location may need different actions for instance a densely built up areas will have different needs to a newly planned new town.

**v) Implementation**

Feedback system has to be in placed so that the information can be used as basis for effective future action. One of the effective implementation measures suggested by the Central Research Unit in United Kingdom is that feedback to be included in the cycle of continuing professional development (CPD) so that professionals may be able to gradually aware and improve the energy conservation aspect in planning.

**vi) Public Consultation**

In order to ensure effective implementation, community participation and involvement are important to ensure ownership and commitment of the community. Table 5.1 shows the relationship of planning issues by sector and level of planning actions.

**vii) Physical planning**

Physical planning will have influenced over the form of development, promotion of mixed use, transportation planning, optimizing compactness and regeneration.

Since the shape of development will affect the way that it uses energy and also the amount of energy used to create it, layout planning and built form has to be energy conscious in the process of design.

Transportation sector consumes about 25% of the total energy consumption, it is also important for planner to rethink ways of reducing the dependence on private transport. Encouragement of public transport and walking by providing adequate pedestrian amenities and public transport facilities are important consideration in physical planning.

Based on the compact city argument, compact settlement is the most efficient form of energy consumption. It can either be in form of compact around a point as in a sub-centre or compact along a line as in corridor development.

Regeneration and brown field development are new trend and form of sustainable development. This form of development will help to capitalize on the embodied energy of existing environment and limit new development.

**viii) Management**

To ensure effective energy saving cities, management aspect in terms of coordination, energy partnership and the use of local centres to coordinate information are important.

The management concerns with the coordination of public agencies and energy providers such as TNB, Petronas and other renewal sources of energy suppliers to work together to further energy conservation. In many cases, private and public buildings and activities can look into possibilities to share energy and make it more effective. At the same time,

NGO and other local centres may play the roles to coordinate local strategies and disseminate information. This will also help to implement local programs of actions.

#### ix) Tools

Planning tools used to promote more energy efficient cities include education and perception as well as auditing. It is important to promote and educate planners and community at large to appreciate and emphasize energy conservation and also methods of achieving it. At the same time, method on energy auditing is needed in the planning system to assess development.

**Table 1: Planning Issues and Level of Actions for Energy Conservation Policies**

<b>Level</b>	<b>Settlement pattern</b>	<b>Land use planning</b>	<b>Site layout and built form</b>	<b>Transport And infrastructure</b>	<b>Education and Perception</b>
Strategic Planning	Encourage Compact settlement	Overall distribution of housing and employment centres. Declaration of traffic free zones Strategic energy audit	General statement of principles	Disposition of Road nets and energy grids	National and regional policies
Local planning	Encourage energy efficient forms Sitting base on micro climate	Encouragement of mixed use Strategic landscape distribution	Disposition of uses to energy appropriate sites Consideration of microclimate	Interface with new energy efficient systems Encouragement of public transport	Identify energy conservation as critical material factor Use local knowledge
Development Control	Use of planting and optimum sitting	Greater flexibility of use mix. Interface with building control of environmental health. Control of densities.	House type and orientation Interface with building control and environmental health. Density control	Provision of public transport, cycling facilities, parking standards, interface with traffic calming	Working with developers Required written statement of how development proposal use energy conservation principles
Design Guidelines	Energy rule for site selection,	Strategic landscape Shelter belts	Design guideline and design	Traffic calming Encouragement of walking ,	Publications

	building type, layout		brief	cycling and public transport	
Implementation	Town centre project for energy conservation	Promote energy conscious mixes Develop CHP schemes	Promote energy conscious schemes	Car free scheme Park and Ride Traffic calming	RTPI/PAM/MIP CPD courses
Public Consultation	Energy conservation as an issue in local and strategic plans & major project	Energy conservation as an issue in local planning and practical project	Publications for respective developers	Transportation review. Car pools	Demonstration

### **Towards formulation of Design guidelines for energy efficient development**

Three (3) main aspects relevant to energy are:-

- a) Landscape and Landform
- b) Layout
- c) Built Form

These aspects will affect the orientation of site, layout and individual buildings which have an effect on overall energy use and potential for the sun as an energy source. The other aspect influence the energy use is the flow of air around and through the site and the temperature of that air flow will affect energy use.

#### **a) Landscape and Landform**

The preliminary siting of development is a major determinant of its energy performance. In cold countries siting of building consider surface exposed to cold air flows and sunlight to optimize the thermal comfort and energy saving. However, in tropical countries, the concern is more on the heat and cooling effect of winds and shade.

Landscape is an effective means of energy conservation measures in providing shelter. Planting of dense tree will affect wind speeds and provide shade against hot sun. Hence it will reduce potential heat loss or heat gain to building. Other functions of landscaping include the aesthetic and functions as contributor to sustainable development and renewal fuel systems through coppicing, and ethanol production.

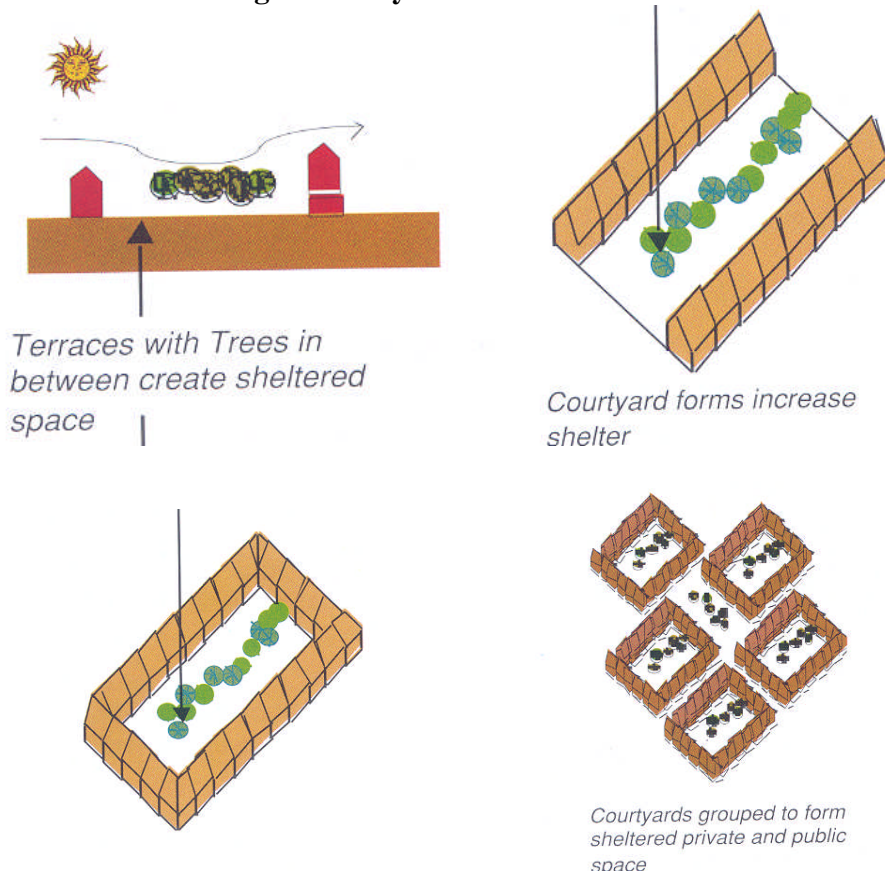
#### **b) Layout**

Layout has impact on energy use patterns in the following situation

- i) Orienting building to optimize shade or maximising solar energy production..
- ii) Reduction of roads and other services which will reduce the embodied energy content of the layout.



**Figure 3: Layout and Orientation**



Source : GAIA Planning (1996)

**c) Built Form**

In the case Scotland, Building standard & guideline are seen as building control bye laws. Built forms issues are also affected and influenced by Local plan and development control directives from time to time.

**Figure 4: Built form**



**Action:**

- Carefully consider the location of development in terms of exposure, orientation, shelter, cold air flow etc.
- Encourage compact forms of development at medium to high density to reduce external surfaces and provide shelter.
- use landscape treatment to provide shelter for developments, combined with landforms to maximise the effect
- encourage building forms and materials that minimise the whole spectrum of energy loss - including embodied energy.

Source : GAIA Planning (1996)

Policy actions related to built forms are:-

- i) Ensure good location of development in terms of exposure, orientation, shelter, cold/ hot air flow etc.
- ii) Promote compact form of development at medium to high density to reduce external surfaces and provide shelter.
- iii) Enhance the use of landscape to provide shelter for development.
- iv) Consider building forms and material that minimize energy loss, including embodied energy.

**d) Mixed Land Use**

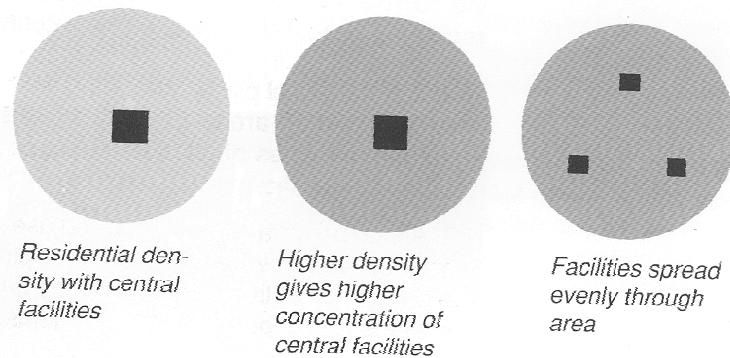
Strict zoning of single use has impact on the energy consumption. The separation of land use to ensure compatibility of activities and health reason has been accepted as a norm to separate place of work from living areas. The availability of relatively cheap fossil fuel in 1960s and motorization era have further contributed to the urban suburbanization process in many countries. Figure 5.shows the evolution of city from small centre to large city with centralization of function and then follows by decentralization with concentration at the sub-centres. Many cities have grown from small centre into a city of higher density

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which gives rise to concentration of central facilities. Due to the congestion problems and inner city decay, the central facilities are then distributed to the sub-centres.

In terms of energy efficiency, the mixing of use would lead to less movement between different use zones. Many of the movement involve home to workplace journey. Therefore it is important to ensure mixing workplace and home as well as facilities. As a result, the local authority may have to consider auditing of energy demand and efficiency factor in approving a retail, industry or leisure development. The use of Use Classes Order in the planning system allows complementary activities in a given zoning. Local plan may play an important role in remixing of land use in the implementation of a more efficient energy saving policy. Although the mixing of land use does promote energy saving but the primary objective of planning should be amenity, compatibility, safety and health as the main over-riding factor.

**Figure. 5: Evolution of Small Cities to Larger Cities**



Based on the above argument, actions outline for the promotion of mixed use should adopt a more flexible approach to reduce the need to travel are as follow:-

- i) Promote concentrations of mixed development at energy nodes
- ii) Discourage dispersed, car dependent and mono activity development
- iii) Promote compact, diverse and non motorized (foot and bicycle) development

#### **e) Transport**

Transport sector is not only a visible form of energy consumption but also posed problems to planners in the form of congestion pollution and global warming. The problems are more acute because of the high growth in car ownership and continuous dependence on fossil fuel. Table 2 shows that about 27% of total consumption by the transport sector. The greatest contribution to global warming comes from CO<sub>2</sub> which make up 50% of the gases which are held to cause this effect. 20% of the total CO<sub>2</sub> emissions are from transport. Other than CO<sub>2</sub>, the main toxic emissions are CO, NO<sub>x</sub> benzene, formaldehyde, lead, pyrene, and soot.

**Table 2: Total Fuel Consumption by Sector**

Sector	Consumption	% of Scot Total	CO <sub>2</sub> Emissions (Tonnes)
Transport	153,750,000	27.28	12,880,047
Industry	181,300,000	32.17	14,399,358
Services	88,490,000	15.70	6,986,991
Domestic	140,000,000	24.84	10,045,704
Total	563,540,000	100.00	44,312,100

*(NB – these figures include emissions from generation of electricity and other intermediate uses necessary to supply each sector)*

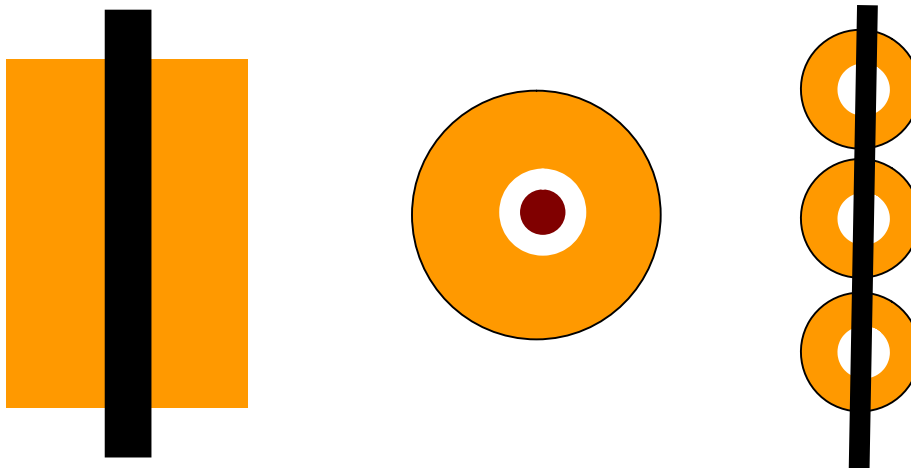
Policy actions related to transport are:-

- i) Promote schemes to reduce private vehicle use in town centres and encourage public transport, cycling and walking, and
- ii) Enhance land use that reduce shorten journey length in preference to allocations which encourage private car use.

**f) Optimum Compactness**

Many discussions have focused on the advantages in terms of energy saving of compact city in achieving sustainable development. The obvious advantages are in the reduction of travel distances and also the concentration may brings benefits in terms of urban form such as terrace, courtyard and medium to high density development that will make energy efficient. Having higher density and compactness, there is also a greater opportunity to share energy through energy partnership. (refer figure 6)

**Figure 6: Compactness can be done in a Point or along a Line.**



The criteria to be used for compactness or density are:-

- i) appropriateness of site choice
- ii) sheltering by the landscape

- iii) minimizing the form of the buildings to reduce the external heat losing envelope (e.g. low wall to floor ratio)
- iv) reduction of infrastructure (e.g. shorter road layout)
- v) full use of space (daily and annual cycles)

CRC (1996) discussed on compactness will lead to the problem of town cramming against the lowering of quality of environment and greenness of urban areas. It suggested that compactness along a line (a public transport) is a better option than compactness about a point. The energy efficient city concept should have a clearer justification in terms of reducing the need to travel, greater heat retention in urban areas and better used of fixed infrastructure.

Optimum compactness can be seen in the following situations:-

- i) Inner Urban
- ii) Outer urban and suburban
- iii) Rural area
- iv) Appropriateness of site
- v) Development of site

In terms of policy actions related to optimum compactness are:-

- i) To minimize dispersion in order to facilitate opportunity for shared energy scheme, optimum use of existing infrastructure, saving of energy through reduction in travel in planning of new settlements.
- ii) Promotion of compactness along energy lines and also around energy nodes.
- iii) Opportunities can be found in existing settlement fabric to allow the development of compact nodes.

**g) Regeneration**

Regeneration of whole area of a town is related to the reuse and conservation of building material at a larger scale. It results in the conservation of the energy capital already expended and embodied energy. Embodied energy is the energy that has been expended to manufacture, transport and build the various man-made elements of our environment. It includes the energy to extract and process the raw materials and extend beyond the life span of the building. Promotion of Brownfield sites against Greenfield sites is due to the increasing tendency for these to be polluted.

**Figure 7: Recycling Protocol**

“The Recycling Protocol”
<ul style="list-style-type: none"> <li>1. “Mend the Urban Fabric</li> <li>1. Reuse Building</li> <li>2. Reuse Elements</li> <li>3. Recycle</li> <li>4. Use for Fuel</li> <li>5. Dump</li> </ul>

Policy actions include:-

- i) Encourage the increase use of embodied energy material in building
- ii) Promote more retention of existing buildings on the grounds of embodied energy rather than historic value or financial expediency
- iii) Enable the establishment of transfer stations to encourage the availability and display of reusable products and materials.

#### **h) Coordinated Agencies**

In order to implement energy conscious policies, coordination of policies and activities of all relevant public agencies should be carried out. Among the relevant departments and agencies are environmental health, transportation and roads, building control, building and landscape and lighting, cleansing and drainage. Other departments that may help to promote awareness and participation of general public are education, community education and social work as well as NGOs.

Policy actions to promote coordination of agencies are:-

- i) Planning department may play the lead role in coordinating the formation of partnership and joint action on local energy conservation measures.
- ii) Encourage targeted projects as demonstrations of joint working and monitoring of data for future work.

#### **i) Energy Partnership**

There is still a need for balancing the demand and supply of energy at national level as well as at the local level. Planning department has the information and important role seek to identify, encourage and assist in the formation of mutually beneficial local energy partnerships. Common examples where heat rejected from one can be taken by its neighbour is ice rink to a swimming pool, power station to horticulture glasshouses and Combined Heat Power (CHP) scheme. Other schemes such as shared atrium space (covered street to reduce heat loss from building facades, community transport pool, or even office space timeshare scheme (shift work in offices on graded rentals)..

In this way, planners at local authority functions like a 'matchmaker', identifying where communities, businesses or developers might work together for mutual energy benefit.

Policy actions to encourage energy partnership are as follow:

- i) To bring together groups of residents and business people to consider ways to reduce energy consumption
- ii) Local authority provides basic information to the public explaining the ways in forming energy partnership.

#### **j) Local Centres**

Local centres in the form of Combined Heat and Power (CHP), District heating (DH), refuse as fuel, neighbourhood transport etc and eco station will operate as a focal point.



The encouragement on the use of DH and CHP can be further supported in both the Structure Plan and Local Plans.

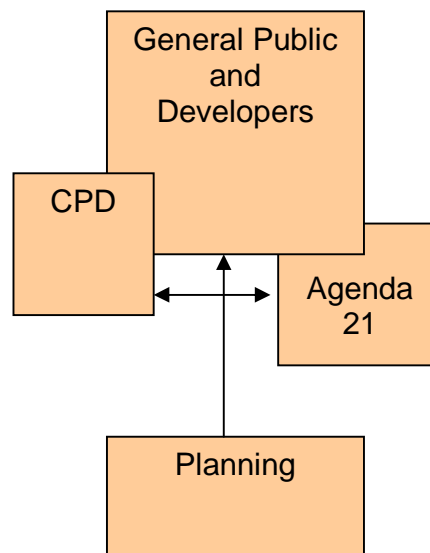
Policy actions on the promotion of local centres are

- i) To study the possibilities of creating local infrastructural scheme of energy sharing and conservation.
- ii) To examine the establishment of neighbourhood encystations that provides information, expertise and encouragement for local people to take conservation measures.

#### k) Education and Perception

Education is important for the users and implementers. Many of the local authorities organized their own programmers on environment and energy issues often relate to the Local agenda 21. General education on sustainability for primary and secondary school Children will also bring awareness of energy efficient conscious at the school going population. Similarly the education of planners themselves should also be given priority. Urban Planning curriculum on should also be reviewed to incorporate energy saving aspect. In addition, the continuing education of planning and related professional should also reflect a concern of energy conservation.

**Figure 8: Education and Perception**



Planning could coordinate information and advice to professionals, field workers, the general public and developers.

The policy actions in relation to education and perceptions are:-

- i) Planning system can assist the process in the use of clear terminology in plans
- ii) Provide training planning staff as well as related professionals such as architect and surveyors
- iii) Planning system should also encourage informed public discussion of issues and assist the environmental education for schools and community groups.

#### **l) Auditing**

It is important to have a consistent measurement of energy efficiency and carbon emission for auditing. Policy on energy related and environmental issues require research information and not on mere opinion. The establishment of target is important as in Kyoto Protocol on carbon emission.

In terms of policy actions, planning have to develop energy auditing that:-

- i) feed into decision making at local level
- ii) are clear to developers so that they are used in proposals
- iii) are recognized at appeal
- iv) are simple to use.

### **Conclusion**

Energy use in and carbon emissions from the residential sector constitute 20-30% of the national total. With the growing population in Malaysia and increasing affluence lifestyle, the rapid increase in housing stock will further aggravate the energy issue in Malaysia. In planning neighbourhood and city in tropical country like Malaysia, we should take advantage of the natural heat from the sunlight and cooling breezes to reduce energy use in heating and cooling of home.

Policies strategies of local authorities on energy conservation and planning are more common in developed countries as compared with developing countries. Development plans outline spatial structure of the planned area with land use zoning clearly defines the separation of activities. This segregation imposes constrain on mobility and density or “compactness” of use which will have direct impact on energy demand pattern. Hence it is important for local authorities to plan compact city with mixed land use to reduce energy demand in terms of transportation. These policies should also be equipped with supporting policies such as education, design guidelines, regeneration and information support.

### **References**

Anderson Victor (1993). *Energy Efficiency Policies*, Routledge, London.



Batty, Sue (2001). Politics of Sustainable Development - *An Overview* in Simin Daoudi, Antonia Layard and Sue Batty (ed.) *Planning for Sustainable future*, London, Spon.

Blowers, Andrew (1994). *Planning for a Sustainable Environment*, A Report by the Town and Country Planning Association, Earthscan.London

Breheny M. J. (1996). Centrist, Decentrists and Compromisers: Views on the Future of Urban Form in Jenk, M, Burton E and Williams K, edit (1996). *The Compact City: A Sustainable Urban Form?* London E & FN Spon

Byrne J. and Rich D. (ed.) (1985). *Energy and Cities, Energy Policy Studies: Volume 2*, New Jersey.

Cope D. R., Peter Hills and Peter James (ed) (1984). *Energy Policy and Land use planning: An international Perspective*, Pergamon Press, Exeter.

Dantzig G. and Saaty T. (1973). *Compact city: a Plan for a Livable Urban environment*, Freeman, San Francisco.

De La Barra T, Rickaby PA ,(1987) 'A Hierarchical Land Use Transport Model for Energy Evaluation. in *Energy and Built Environment Form*. D U Hawkes J Owers, PA Rikaby,J P Steadman. (eds) Butterworth, Sevenoaks, Kent.

De La Barra T, Perez B, Vera N,(1984). *TRANUS-J: Putting Large Models into Small Computers*. Environment and Planning B: Planning and Design 11 pp 87-101.

Department of Environment, Transport and Regions (1999). *Revision of Planning Policy Guidance Note 12 ( PPG12) : Development Plans*. Public consultation draft, London DETR. London DETR

Department of Environment, Transport and Regions (1994). *Planning Policy Guideline (PPG) 13 (1994) on Transport*. London DETR

Department of Environment, Transport and Regions (1993). *Planning Policy Guideline (PPG) 22 (1993) on Renewal Energy*. London DETR

ECOTEC (1993). *Reducing Transport Emissions through Planning*, HMSO, London.

Elkin, T., Mc Laren, D. and Hillman M. (1991). *Reviving the City: Towards Sustainable Urban development*. Friends and Earth, London.

Fels M. F. and Munson M. J. (1975). *Energy Thrift in Urban Transportation: Options for Future*, The Energy conservation Papers; a report to energy project of the Ford foundation Ed. R H Williams (Ballinger, Cambridge, MA)

Government Consultation Paper (March 1999) *New and Renewable Energy: Prospects for the 21<sup>st</sup> Century*

Gilbert Gorman and Dajani J. S. (1974). *Energy, Urban Form and Transportation Policy*. Transportation Research 8 (September) 267-275.

Girardet Hebert (1996). *Getting London in shape for 2000*, London First.

Girardet Hebert (1999). *Creating Sustainable Cities*. Schumacher Briefing, Green Books, Bristol.

GAIA planning (1996). *Energy Conservation and Planning*, Scottish Office Central Research Unit. Edinburgh

Habitat (1996) *Habitat Agenda*, United Nation, New York.

Halkan Falk (2004). Available at [http// www. energysavingnow.com](http://www.energysavingnow.com)

Hall D. (1991). *Altogether Misguided and Dangerous: A Review of Newman and Kenworthy* (1989) *Town and Country Planning* 60 (11/12) pp350-351

Haughton, G and Hunter, C (1994) *Sustainable Cities*, Jessica Kingley Publishers, London.

Hughes P (1991) *The Role Passenger Transport in CO<sub>2</sub> Reduction Strategies*, *Energy Policy* 19(2) pp 149-160

International Energy Agency (IEA) (1991). *Energy Efficiency and the Environment*. Organisation For Economic Cooperation and Development. Paris

Jenk, Mike, Burton Elizabeth and Williams K, edit (1996). *The Compact City: A Sustainable Urban Form?* London E & FN Spon

K Steemer (2003). *Energy and the City: Density, Buildings and Transport*, *Energy and Buildings* 35(2003) 3-14, Elsevier.  
*Policy* 4, pp108-116.

Lamm Johan O (1986) *Energy in Physical Planning: A method for Developing the Municipality Master Plan with regards to Energy Criteria*, Swedish Council for Building Research, Stockholm, Sweden.

Leach G., Lewis, C., Romig, F., Buren, A van and Foley, G (1979). *A Low Energy Strategy for the United Kingdom*. Science Reviews Ltd London.

Le Corbusier (1976). *The Radiant City: Elements of a Doctrine of Urbanism to be Used as the Basis of Our Machine-Age Civilization*. NYC: Orion Press, 1967.

Seminar workshop on Energy efficiency organised by Centre of Environment Technolofgy Development 18 Malaysia (CETDEM) and Malaysia Institute of Planners (MIP) on 12 August 2006 Armada Hotel Petaling Jaya

Local Government Management Board (LGMB) (1992). *Environmental Practice in Local Government*, London.

Newman PWG, Kenworthy JR (1989) *Gasoline Consumption and Cities: A Comparison of US cities with Global Survey*. American Planning Association Journal 55 pp24-37

Newman PWG, Kenworthy JR (1992) *Is there a Role for Physical Planners?* Journal of American Planner association 58, 353-62

Nikamp P (1983), *Regional Dimensions of Energy Scarcity, Environment and Planning*. Government and Policy Vol1 pp 178-192

Nijkamp, Peter and Perrels Adraian (1994), *Sustainable Cities in Europe*, Earthscan, London .

Odum H T and Odum E (1976) *Energy as a basic for Human and Nature*. NewYork, NY: McGraw Hill

Office of the Deputy Prime Minister (2003). *Consultation on the New Planning Policy Statement 22 (PPS 22) Renewal Energy*. Available at [http:// www.odpm.gov.uk](http://www.odpm.gov.uk).

Owens S. E. (1984). Energy Demand and spatial structure in Energy Policy and Land Use Planning in D R Cope, P R Hills, P James (eds.) Pergamon Press, Oxford) pp 215-240

Owens S. E. (1986a). *Energy, Planning and Urban Forms*. Peon, London.

Owens S. E. (1986b). *Strategic Planning and Energy Conservation*. Town Planning Review 57, pp 69-86

Owens S. E. (1987). The Urban Future: Does Energy really matter? in Dean Hawkes, Janet Owers, Peter Rickaby and Philip Steadman, *Energy and Built Form*, Martin centre of Architectural and Urban studies, University of Cambridge. Butterworths. London.

Owens S. E. (1990). Land Use Planning for Energy Efficiency in JB Cullingworth (ed.) *Energy, Land and Public Policy*, (Transactions Publishers, Centre for Energy and Urban Policy Research, University of Delaware, Newark) pp 53-98

Owens S. E. (1994). Energy, Environmental sustainability and land use planning in Breheny M. J.(ed.) *Sustainable Development and Urban Form*, European research in regional science.

RERC (1974). *The Cost of Sprawl: Environmental and Economic Costs of Alternative Residential Development Patterns at the Urban Fringe*, Real estate research corporation (US Government Printing Office, Washing, DC).

Seminar workshop on Energy efficiency organised by Centre of Environment Technolofgy Development 19 Malaysia (CETDEM) and Malaysia Institute of Planners (MIP) on 12 August 2006 Armada Hotel Petaling Jaya

Rickaby Peter (1987). *Six Settlement Patterns Compared*. Environmental and Planning B: Planning and Design 14, pp193-223

Rickaby P.A., Steadman J. P. and Barret M. (1992). *Pattern of City in English Towns, Implications for Energy Use and Carbon Dioxide Emission* in Breheny M. J. (eds.) *Sustainable Development and Urban Form*. Pion Ltd , London.

Robinson I M (1985) Energy and Urban Form: Relationships between Energy Conservation, Transportation and Spatial structures in Byrne J and Rich D (ed.)(1985), *Energy and Cities*, Energy Policy Studies Volume 2 , New Jersey.

Roth, U (1977) The impact of settlement patterns on low temperature heating supply systems, transportation and environment in papers and proceeding of the *International Congress of Technology*". Den Haag International Federation of Housing and Planning (IFHP)

Simin Daoudi and Antonia Layard (2001). Sustainable Development and Planning: An Overview in Simin Daoudi, Antonia Layard and Sue Batty (ed.) *Planning for Sustainable Future*, London Spon

Steadman P. (1980), *Configurations of Land Uses, Transport Networks and Their Relationship to Energy Use*, Centre of Configuration Studies, Open University, Milton Keynes, MK7 6AA.

UK Government, *Energy Act 2004*.

UK Government, *Sustainable Energy Act 2003*,

UK Government. *Energy Conservation Act 1996*

UK Government. *Town and Country planning Act 1990*, HMSO, London.

United Nations Environmental Programme (1999). *Global Environmental Outlook*, Earthscan Publications , London.

United Nations Human Settlements Programme (Habitat 2001). *Cities in Globalizing world: Global Report on Human Settlement*. Earthscan, London.

Wakernagel, Mathis and Rees, William (1996), *Our Ecological Footprint*, New Society Gabriola Island, British Columbia..

World Commission on Environment and Development (1987). *Our Common Future*, Oxford University Press. London.

Seminar workshop on Energy efficiency organised by Centre of Environment Technology Development 20 Malaysia (CETDEM) and Malaysia Institute of Planners (MIP) on 12 August 2006 Armada Hotel Petaling Jaya

Zuchetto J. and Jansson A. M. (1979). *Integrated Regional Energy Analysis for the Island of Gotland Sweden*, Environment and Planning A, Vol. 11 pp919-942.