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Energy Efficient for Heat Exchanger, Refrigeration and Air Conditioning

Dr. A. M. Omer

Energy Research Institute (ERI), Nottingham, United Kingdom.

***Corresponding Author:** *Dr. A. M. Omer, Energy Research Institute (ERI), Nottingham, United Kingdom.*

ABSTRACT

Scientifically, it is difficult to predict the relationship between global temperature and greenhouse gas (GHG) concentrations. The climate system contains many processes that will change if warming occurs. Critical processes include heat transfer by winds and tides, the hydrological cycle involving evaporation, precipitation, runoff and groundwater and the formation of clouds, snow, and ice, all of which display enormous natural variability. The equipment and infrastructure for energy supply and use are designed with long lifetimes, and the premature turnover of capital stock involves significant costs. Economic benefits occur if capital stock is replaced with more efficient equipment in step with its normal replacement cycle. Likewise, if opportunities to reduce future emissions are taken in a timely manner, they should be less costly.

INTRODUCTION

Over millions of years ago plants covered the earth, converting the energy of sunlight into living tissue, some of which was buried in the depths of the earth to produce deposits of coal, oil and natural gas. During the past few decades has found many valuable uses for these complex chemical substances, manufacturing from them plastics, textiles, fertilizers and the various end products of the petrochemical industry. Each decade sees increasing uses for these products. Coal, oil and gas are non-renewable natural resources, which will certainly be of great value to future generations, as they are to ours. The rapid depletion of non-renewable fossil resources need not continue, since it is now or soon will be technically and economically feasible to supply all of man's need from the most abundant energy source of all, the sun. The sunlight is not only inexhaustible; it is the only energy source, which is completely non-polluting (UN, 2001).

Industry's use of fossil fuels has been blamed for our warming climate. When coal, gas and oil are burnt, they release harmful gases, which trap heat in the atmosphere and cause global warming. However, there has been an ongoing debate on this subject, as scientists have struggled to distinguish between changes, which are human induced, and those, which could be put down to natural climate variability. Industrialized countries have the highest emission levels, and must shoulder the greatest responsibility for global warming. However, action must also be taken by developing countries to avoid future increases in emission levels as their economies develop and population grows. Human activities that emit carbon dioxide (CO2), the most significant contributor to potential climate change, occur primarily from fossil fuel production. Consequently, efforts to control CO2 emissions could have serious, negative consequences for economic growth, employment, investment, trade and the standard of living of individuals everywhere. Scientifically, it is difficult to predict the relationship between global temperature and greenhouse gas (GHG) concentrations. The climate system contains many processes that will change if warming occurs. Critical processes include heat transfer by winds and currents, the hydrological cycle involving evaporation, precipitation, runoff and groundwater and the formation of clouds, snow, and ice, all of which display enormous natural variability. The equipment and infrastructure for energy supply and use are designed with long lifetimes, and the premature turnover of capital stock involves significant costs. Economic benefits occur if capital stock is replaced with more efficient equipment in step with its normal replacement cycle. Likewise, if opportunities to reduce future emissions are taken in a timely manner, they should be less costly. Such flexible approaches would allow society to take account of evolving scientific and technological knowledge, and to gain experience in designing policies to address climate change (Rees, 1999).

The World Summit (WS) on Sustainable Development in Johannesburg committed itself to ‘‘encourage and promote the development of renewable energy sources to accelerate the shift towards sustainable consumption and production’’. The WS aimed at breaking the link between resource use and productivity. It is about:

- Trying to ensure economic growth doesn’t cause environmental pollution.
- Improving resource efficiency.
- Examining the whole life-cycle of a product.
- Enabling consumers to receive more information on products and services.
- Examining how taxes, voluntary agreements, subsidies, regulation and information campaigns, can best stimulate innovation and investment to provide cleaner technology.
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The energy conservation scenarios include rational use of energy policies in all economy sectors and use of combined heat and power systems, which are able to add to energy savings from the autonomous power plants. Electricity from renewable energy sources is by definition the environmental green product. Hence, a renewable energy certificate system is an essential basis for all policy systems, independent of the renewable energy support scheme. It is, therefore, important that all parties involved support the renewable energy certificate system in place. Existing renewable energy technologies (RETs) could play a significant mitigating role, but the economic and political climate will have to change first. Climate change is real. It is happening now, and GHGs produced by human activities are significantly contributing to it. The predicted global temperature increase of between 1.5 and 4.5oC could lead to potentially catastrophic environmental impacts. These include sea level rise, increased frequency of extreme weather events, floods, droughts, disease migration from various places and possible stalling of the Gulf Stream.This has led scientists to argue that climate change issues are not ones that politicians can afford to ignore, and policy makers tend to agree (Bos, My, Vu, and Bulatao, 1994). However, reaching international agreements on climate change policies is no trivial task.

Renewable energy is the term used to describe a wide range of naturally occurring, replenishing energy sources. The use of renewable energy sources and the rational use of energy are the fundamental inputs for any responsible energy policy. The energy sector is encountering difficulties because increased production and consumption levels entail higher levels of pollution and eventually climate change, with possibly disastrous consequences. Moreover, it is important to secure energy at an acceptable cost in order to avoid negative impacts on economic growth. On the technological side, renewables have an obvious role to play. In general, there is no problem in terms of the technical potential of renewables to deliver energy. Moreover, there are very good opportunities for RETs to play an important role in reducing emissions of GHGs into the atmosphere, certainly far more than have been exploited so far.

However, there are still some technical issues to address in order to cope with the intermittency of some renewables, particularly wind and solar. Yet, the biggest problem with relying on renewables to deliver the necessary cuts in GHG emissions is more to do with politics and policy issues than with technical ones (Bos, My, Vu, and Bulatao, 1994). The single most important step governments could take to promote and increase the use of renewables is to improve access for renewables to the energy market. This access to the market would need to be under favourable conditions and, possibly, under favourable economic rates as well. One move that could help, or at least justify, better market access would be to acknowledge that there are environmental costs associated with other energy supply options and that these costs are not currently internalized within the market price of electricity or fuels. This could make a significant difference, particularly if appropriate subsidies were applied to renewable energy in recognition of the environmental benefits it offers. Similarly, cutting energy consumption through end-use efficiency is absolutely essential. This suggests that issues of end-use consumption of energy will have to come into the discussion in the foreseeable future.

Energy And Population Growth

Throughout the world urban areas have increased in size during recent decades. About 50% of the world's population and approximately 7.6% in more developed countries are urban dwellers. Even though there is evidence to suggest that in many 'advanced' industrialized countries there has been a reversal in the rural-to-urban shift of populations, virtually all population growth expected between 2000 and 2030 will be concentrated in urban areas of the world. With an expected annual growth of 1.8%, the world's urban population will double in 38 years (UN, 2001).

With increasing urbanization in the world, cities are growing in number, population and complexity. At present, 2% of the world's land surface is covered by cities, yet the people living in them consume 75% of the resources consumed by mankind (Rees, 1999). Indeed, the ecological footprint of cities is many times larger than the areas they physically occupy. Economic and social imperatives often dictate that cities must become more concentrated, making it necessary to increase the density to accommodate the people, to reduce the cost of public services, and to achieve required social cohesiveness. The reality of modern urbanization inevitably leads to higher densities than in traditional settlements and this trend is particularly notable in developing countries.

The world population is rising rapidly, notably in the developing countries. Historical trends suggest that increased annual energy use per capita is a good surrogate for the standard of living factors, which promote a decrease in population growth rate. If these trends continue, the stabilization of the world's population will require the increased use of all sources of energy, particularly as cheap oil and gas are depleted. The improved efficiency of energy use and renewable energy sources will, therefore, be essential in stabilizing population, while providing a decent standard of living all over the world (Bos, My, Vu, and Bulatao, 1994). Moreover, energy is the vital input for economic and social development of any country. With an increase in industrial and agricultural activities the demand for energy is also rising. It is a well-accepted fact that commercial energy use has to be minimized. This is because of the environmental effects and the availability problems. The focus has now shifted to non-commercial energy resources, which are renewable in nature. This is found to have less environmental effects and also the availability is guaranteed. Even though the ideal situation will be to enthuse people to use renewable energy resources, there are many practical difficulties, which need to be tackled. The people groups who are using the non-commercial energy resources, like urban communities, are now becoming more demanding and wish to have commercial energy resources made available for their use. This is attributed to the increased awareness, improved literacy level and changing culture (Bos, My, Vu, and Bulatao, 1994). The quality of life practiced by people is usually represented as being proportional to the per capita energy use of that particular country. It is not surprising that people want to improve their quality of life. Consequently, it is expected that the demand for commercial energy resources will increase at a greater rate in the years to come (Bos, My, Vu, and Bulatao, 1994). Because of this emerging situation, the policy makers are left with two options: either concentrate on renewable energy resources and have them as substitutes for commercial energy resources or have a dual approach in which renewable energy resources will contribute to meet a significant portion of the demand whereas the conventional commercial energy resources would be used with caution whenever necessary. Even though the first option is the ideal one, the second approach will be more appropriate for a smooth transition (Bos, My, Vu, and Bulatao, 1994). Worldwide, renewable energy contributes as much as 20% of the global energy supplies (Duchin, 1995). Over two thirds of this comes from biomass use, mostly in developing countries, some of it unsustainable. Yet, the potential for energy from sustainable technologies is huge.

The RETs have the benefit of being environmentally benign when developed in a sensitive and appropriate way with the full involvement of local communities. In addition, they are diverse, secure, locally based and abundant. In spite of the enormous potential and the multiple benefits, the contribution from renewable energy still lags behind the ambitious claims for it due to the initially high development costs, concerns about local impacts, lack of research funding and poor institutional and economic arrangements (Duchin, 1995).

An approach is needed to integrate renewable energies in a way to meet high building performance. However, because renewable energy sources are stochastic and geographically diffuse, their ability to match demand is determined by adoption of one of the following two approaches (EUO, 2000): the utilization of a capture area greater than that occupied by the community to be supplied, or the reduction of the community's energy demands to a level commensurate with the locally available renewable resources.

ENERGY SAVING IN BUILDINGS

The prospects for development in power engineering are, at present, closely related to ecological problems. Power engineering has harmful effects on the environment, as it discharges toxic gases into atmosphere and also oil-contaminated and saline waters into rivers, while polluting the soil with ash and slag and having adverse effects on living things on account of electromagnetic fields and so on. There is thus an urgent need for new approaches to provide an ecologically safe strategy. Substantial economic and ecological effects for thermal power projects (TPPs) can be achieved by improvement, upgrading the efficiency of the existing equipment, reduction of electricity loss, saving of fuel, and optimization of its operating conditions and service life.

Improving access for rural and urban low-income areas in developing countries through energy efficiency and renewable energies is important. Sustainable energy is a prerequisite for development. Energy-based living standards in developing countries, however, are clearly below standards in developed countries. Low levels of access to affordable and environmentally sound energy in both rural and urban low-income areas are therefore a predominant issue in developing countries. In recent years many programmes for development aid or technical assistance have been focusing on improving access to sustainable energy, many of them with impressive results. Apart from success stories, however, experience also shows that positive appraisals of many projects evaporate after completion and vanishing of the implementation expert team. Altogether, the diffusion of sustainable technologies such as energy efficiency and renewable energies for cooking, heating, lighting, electrical appliances and building insulation in developing countries has been slow. Energy efficiency and renewable energy programmes could be more sustainable and pilot studies more effective and pulse releasing if the entire policy and implementation process was considered and redesigned from the outset. New financing and implementation processes are needed which allow reallocating financial resources and thus enabling countries themselves to achieve a sustainable energy infrastructure. The links between the energy policy framework, financing and implementation of renewable energy and energy efficiency projects have to be strengthened and capacity building efforts are required.

The admission of daylight into buildings alone does not guarantee that the design will be energy efficient in terms of lighting. In fact, the design for increased daylight can often raise concerns relating to visual comfort (glare) and thermal comfort (increased solar gain in the summer and heat losses in the winter from larger apertures). Such issues will clearly need to be addressed in the design of the window openings, blinds, shading devices, heating system, etc. In order for a building to benefit from daylight energy terms, it is a prerequisite that lights are switched off when sufficient daylight is available. The nature of the switching regime; manual or automated, centralized or local, switched, stepped or dimmed, will determine the energy performance. Simple techniques can be implemented to increase the probability that lights are switched off (Givoni, 1998).

These include:

- Making switches conspicuous.
- Loading switches appropriately in relation to the lights.
- Switching banks of lights independently.
- Switching banks of lights parallel to the main window wall.

There are also a number of methods, which help reduce the lighting energy use, which, in turn, relate to the type of occupancy pattern of the building (Givoni, 1998). The light switching options include:

- Centralized timed off (or stepped)/manual on.
- Photoelectric off (or stepped)/manual on.
- Photoelectric and on (or stepped), photoelectric dimming.
- Occupant sensor (stepped) on/off (movement or noise sensor).

Likewise, energy savings from the avoidance of air conditioning can be very substantial. Whilst day-lighting strategies need to be integrated with artificial lighting systems in order to become beneficial in terms of energy use, reductions in overall energy consumption levels by employment of a sustained programme of energy consumption strategies and measures would have considerable benefits within the buildings sector. The perception is often given however is that rigorous energy conservation as an end in itself imposes a style on building design resulting in a restricted aesthetic solution. It would perhaps be better to support a climate sensitive design approach, which encompassed some elements of the pure conservation strategy together with strategies, which work with the local ambient conditions making use of energy technology systems, such as solar energy, where feasible. In practice, low energy environments are achieved through a combination of measures that include:

- The application of environmental regulations and policy.
- The application of environmental science and best practice.
- Mathematical modeling and simulation.
- Environmental design and engineering.
- Construction and commissioning.
- Management and modifications of environments in use.

While the overriding intention of passive solar energy design is to achieve a reduction in purchased energy consumption, the attainment of significant savings is in doubt. The non-realization of potential energy benefits is mainly due to the neglect of the consideration of post-occupancy user and management behavior by energy scientists and designers alike. Buildings consume energy mainly for cooling, heating and lighting. The energy consumption was based on the assumption that the building operates within ASHRAE-thermal comfort zone during the cooling and heating periods (ASHRAE, 1993). Most of the buildings incorporate energy efficient passive cooling, solar control, photovoltaic, lighting and day lighting, and integrated energy systems. It is well known that thermal mass with night ventilation can reduce the maximum indoor temperature in buildings in summer (Kammerud, Ceballos, Curtis, Place, and Anderson, 1984). Hence, comfort temperatures may be achieved by proper application of passive cooling systems. However, energy can also be saved if an air conditioning unit is used (Shaviv, 1989). The reason for this is that in summer, heavy external walls delay the heat transfer from the outside into the inside spaces. Moreover, if the building has a lot of internal mass the increase in the air temperature is slow. This is because the penetrating heat raises the air temperature as well as the temperature of the heavy thermal mass. The result is a slow heating of the building in summer as the maximal inside temperature is reached only during the late hours when the outside air temperature is already low. The heat flowing from the inside heavy walls can be removed with good ventilation in the evening and night. The capacity to store energy also helps in winter, since energy can be stored in walls from one sunny winter day to the next cloudy one.

ENERGY USE IN AGRICULTURE

The land area required to provide all our energy is a small fraction of the land area required to produce our food, and the land best suited for collecting solar energy (rooftops and deserts) is the land least suited for other purposes. The economical utilization of solar energy in all its varied forms- photovoltaic, direct solar thermal, renewable fuels, ocean-thermal, and wind can offer the world the technology, then can conserve valuable non-renewable fossil resources for future generations to enjoy, and all can live in a world of abundant energy without pollution (Wu, and Boggess, 1999).

Energy in agriculture is important in terms of crop production and agro-processing for value adding. Human, animal and mechanical energy is extensively used for crop production in agriculture. Energy requirements in agriculture are divided into two groups being direct and indirect (Duffie, and Beckman, 1980; Sivkov, 1964a; Sivkov, 1964b; Barabaro, Coppolino, Leone, and Sinagra, 1978).

Direct energy is required to perform various tasks related to crop production processes such as land preparation, irrigation, interculture, threshing, harvesting and transportation of agricultural inputs and farm produce (Pernille, 2004). It is seen that direct energy is directly used at farms and on fields. Indirect energy, on the other hand, consists of the energy used in the manufacture, packing and transport of fertilizers, pesticides and farm machinery. As the name implies, indirect energy is not directly used on the farm. Major items for indirect energy are fertilizers, seeds, machinery production and pesticides.

Calculating energy inputs in agricultural production is more difficult in comparison to the industry sector due to the high number of factors affecting agricultural production. However, considerable studies have been conducted in different countries on energy use in agriculture (Singh, 2000; CAEEDAC, 2000; Yaldiz, Ozturk, Zeren, 1993; Dutt, 1982; Baruah, 1995; Thakur, Mistra, 1993).

Energy use in the agricultural sector depends on the size of the population engaged in agriculture, the amount of arable land and the level of mechanization. To calculate the energy used in agricultural production or repair of machinery, the following formula is used:

$$ME = (G \times E) / (T \times C_a) \quad (1)$$

Where:

ME is the machine energy (MJ/ha)

G is the weight of tractor (kg)

E is the constant that is taken 158.3 MJ/kg for tractor

T is the economic life of tractor (h)

C_a is the effective field capacity (ha/h)

For calculation of C_a, the following equation is used:

$$C_a = (S \times W \times E_f) / 10 \quad (2)$$

Where:

C_a is the effective field capacity (ha/h)

W is the working width (m)

S is the working speed (km/h)

E_f is the field efficiency (%)

Agricultural greenhouses have a very poor efficiency of thermal conversion of the received solar energy (Pernille, 2004). This is particularly evident in Europe, where, in a cycle of 24 h, and in winter period, the following constraints are observed:

- During the day to maintain through ventilation, an inside temperature at a level lower than the excessive temperatures, harmful for the growth and the development of the cultures.
- At night to assure, by a supply of heating energy, an optional temperature higher than the crucial level of the culture.

This low thermal efficiency is due to the fact that, in a classic greenhouse, the only usable thermal support is the greenhouse soil, which has a weak thermal inertia. Storage of most of the daily excess energy, in order to reuse it during the night where the temperature is low, is therefore impossible. Among other climatic factors contributing in the development of greenhouse cultivation, the inside air temperature, in contact with the aerial part of the plant, constitutes a dominant representative factor (David, 2002).

The impact of heating on the increase of the inside air temperature is very important, because a significant increase of agronomic efficiency in the experimental greenhouse.

RENEWABLE ENERGY TECHNOLOGIES

Sustainable energy is energy that, in its production or consumption, has minimal negative impacts on human health and the healthy functioning of vital ecological systems, including the global environment. It is an accepted fact that renewable energy is a sustainable form of energy, which has attracted more attention during recent years. A great amount of renewable energy potential, environmental interest, as well as economic consideration of fossil fuel consumption and high emphasis of sustainable development for the future will be needed. Nearly a fifth of all global power is generated by renewable energy sources, according to a new book published by the OECD/IEA (OECD/IEA, 2004). Renewables for power generation: status and prospects claims that renewables are the second largest power source after coal (39%) and ahead of nuclear (17%), natural gas (17%) and oil (8%). From 1973-2000 renewables grew at 9.3% a year, and the authors predict this will increase 10.4% a year to 2010 (IHA, 2003). Wind power grew fastest at 52% and will multiply by seven times to 2010, overtaking biopower. Reducing GHGs by production of environmental technology (wind, solar, fuel cells, etc.). The challenge is to match leadership in GHG reduction and production of renewable energy with developing a major research and manufacturing capacity in environmental technologies (EWEA, 2003).

More than 50% of world's area is classified as arid, representing the rural and desert part, which lack electricity and water networks. The inhabitants of such areas obtain water from borehole wells by means of water pumps, which are driven by diesel engines. The diesel motors are associated with maintenance problems, high running cost, and environmental pollution. Alternative methods are pumping by photovoltaic (PV) or wind systems. Renewable sources of energy are regional and site specific. It has to be integrated in the regional development plans (Steele, 1997).

It has been known for a long time that urban centers have mean temperatures higher than their less developed surroundings. The urban heat increases the average and peak air temperatures, which in turn affect the demand for heating and cooling. Higher temperatures can be beneficial in the heating season, lowering fuel use, but they exacerbate the energy demand for cooling in the summer times. In temperate climates neither heating nor cooling may dominate the fuel use in a building, and the balance of the effect of the heat is less. As the provision of cooling is expensive with higher environmental cost, ways of using innovative alternative systems like mop fan will be appreciated. The solar gains would effect energy consumption (Sitarz, 1992). Therefore, lower or higher percentage of glazing, or incorporating of shading devices might affect the balance between annual heating and cooling load. In addition to conditioning energy, the fan energy needed to provide mechanical ventilation can make a significant further contribution to energy demand. Much depends on the efficiency of design, both in relation to the performance of fans themselves and to the resistance to flow arising from the associated ductwork. Figure 1 illustrates the typical fan and thermal conditioning needs for a variety of ventilation rates and climate conditions (John, and James, 1989).

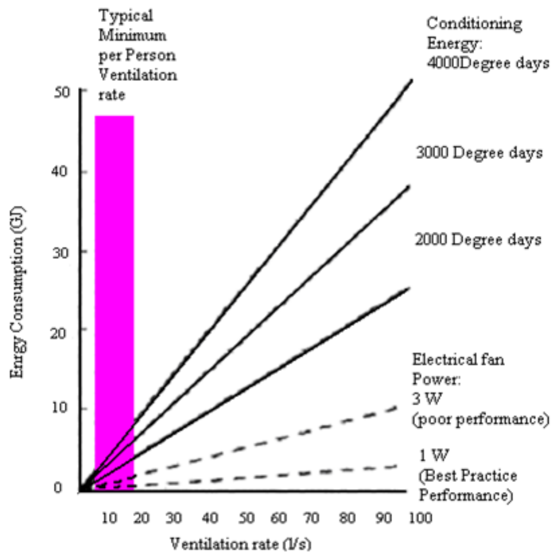

Figure1. *Energy impact of ventilation.*

Recommendations

- Launching of public awareness campaigns among local investors particularly small-scale entrepreneurs and end users of RET to highlight the importance and benefits of renewable, particularly solar, wind, and biomass energies.
- Amendment of the encouragement of investment act, to include furthers concessions, facilities, tax holidays, and preferential treatment to attract national and foreign capital investment.
- Allocation of a specific percentage of soft loans and grants obtained by governments to augment budgets of R&D related to manufacturing and commercialization of RET.
- Governments should give incentives to encourage the household sector to use renewable energy instead of conventional energy.
- Execute joint investments between the private sector and the financing entities to disseminate the renewable with technical support from the research and development entities.
- Availing of training opportunities to personnel at different levels in donor countries and other developing countries to make use of their wide experience in application and commercialization of RET particularly renewable energy.
- The governments should play a leading role in adopting renewable energy devices in public institutions e.g., schools, hospitals, government departments, police stations etc. for lighting, water pumping, water heating, communication and refrigeration.
- To encourage the private sector to assemble, install, repair and manufacture renewable energy devices via investment encouragement, more flexible licensing procedures.

Conclusion

There is strong scientific evidence that the average temperature of the earth's surface is rising. This was a result of the increased concentration of carbon dioxide and other GHGs in the atmosphere as released by burning fossil fuels. This global warming will eventually lead to substantial changes in the world's climate, which will, in turn, have a major impact on human life and the built environment. Therefore, effort has to be made to reduce fossil energy use and to promote green energies, particularly in the building sector. Energy use reductions can be achieved by minimizing the energy demand, by rational energy use, by recovering heat and the use of more green energies.

The study was a step towards achieving this goal. The adoption of green or sustainable approaches to the way in which society is run is seen as an important strategy in finding a solution to the energy problem. The key factors to reducing and controlling CO2, which is the major contributor to global warming, are the use of alternative approaches to energy generation and the exploration of how these alternatives are used today and may be used in the future as green energy sources. Even with modest assumptions about the availability of land, comprehensive fuel-wood farming programmes offer significant energy, economic and environmental benefits. These benefits would be dispersed in rural areas where they are greatly needed and can serve as linkages for further rural economic development. The nations as a whole would benefit from savings in foreign exchange, improved energy security, and socio-economic improvements. With a nine-fold increase in forest – plantation cover, the nation's resource base would be greatly improved.

The international community would benefit from pollution reduction, climate mitigation, and the increased trading opportunities that arise from new income sources. The non-technical issues, which have recently gained attention, include:

- Environmental and ecological factors e.g., carbon sequestration, reforestation and revegetation.
- Renewables as a CO2 neutral replacement for fossil fuels.
- Greater recognition of the importance of renewable energy, particularly modern biomass energy carriers, at the policy and planning levels.
- Greater recognition of the difficulties of gathering good and reliable renewable energy data, and efforts to improve it.
- Studies on the detrimental health efforts of biomass energy particularly from traditional energy users.

REFERENCES

[1] ASHRAE. (1993). *Energy efficient design of new building except new low-rise residential buildings*. BSRIASHRAE proposed standards 90-2P-1993, alternative GA. American Society of Heating, Refrigerating, and Air Conditioning Engineers Inc., USA. 1993.

[2] Barabaro S., Coppolino S., Leone C., and Sinagra E. (1978). Global solar radiation in Italy. *Solar Energy* 1978; 20: 431-38.

[3] Baruah, D. (1995). Utilisation pattern of human and fuel energy in the plantation. *Journal of Agriculture and Soil Science* 1995; 8(2): 189-92.

[4] Bos, E., My, T., Vu, E. and Bulatao R. (1994). *World population projection: 1994-95.* Baltimore and London: World Bank by the John Hopkins University Press; 1994.

[5] CAEEDAC. (2000). A descriptive analysis of energy consumption in agriculture and food sector in Canada. *Final Report*, February 2000.

[6] D'Apote, S.L. (1998). IEA biomass energy analysis and projections. In: *Proceedings of Biomass Energy Conference: Data, analysis and Trends*, Paris: OECD; 23-24 March, 1998.

[7] David, J.M. (2002). Developing hydrogen and fuel cell products. *Energy World* 2002; 303: 16-17.

[8] Duchin, F. (1995). *Global scenarios about lifestyle and technology, the sustainable future of the global system*. Tokyo: United Nations University; 1995.

[9] Duffie J.A. and Beckman W.A. (1980). *Solar Engineering of Thermal Processes*. New York: J. Wiley and Sons; 1980.

[10] Dutt, B. (1982). Comparative efficiency of energy use in rice production. *Energy* 1982; 6:25.

[11] Energy Use in Offices (EUO). (2000). *Energy Consumption Guide* 19 (ECG019). Energy efficiency best practice programme. UK Government, 2000.

[12] EWEA. (2003). *Wind force* 12. Brussels, 2003.

[13] Givoni B. (1998). *Climate consideration in building and urban design*. New York: Van Nostrand Reinhold; 1998.

[14] Hall O. and Scrase J. (1998). Will biomass be the environmentally friendly fuel of the future? *Biomass and Bioenergy* 1998: 15: 357-67.

[15] IHA. (2003). World Atlas & Industry Guide. *The International Journal Hydropower & Dams*, United Kingdom, 2003.

[16] John, A., and James, S. (1989). *The power of place: bringing together geographical and sociological imaginations*, 1989.

[17] Kammerud R., Ceballos E., Curtis B., Place W., and Anderson B. (1984). Ventilation cooling of residential buildings. *ASHRAE Trans: 90 Part 1B*, 1984.

[18] OECD/IEA. (2004). *Renewables for power generation: status and prospect*. UK, 2004.

[19] Pernille, M. (2004). Feature: Danish lessons on district heating. *Energy Resource Sustainable Management and Environmental March/April* 2004: 16-17.

[20] Rees W.E. (1999). The built environment and the ecosphere: a global perspective. *Building Research and information* 1999; 27(4): 206-20.

[21] Shaviv E. (1989). The influence of the thermal mass on the thermal performance of buildings in summer and winter. In: Steemers TC, Palz W., editors. *Science and Technology at the service of architecture*. Dordrecht: Kluwer Academic Publishers, 1989. p. 470-2.

[22] Singh, J. (2000). On farm energy use pattern in different cropping systems in Haryana, India. Germany: International Institute of Management-University of Flensburg, Sustainable Energy Systems and Management, *Master of Science*; 2000.

[23] Sitarz D, (1992). editor. *Agenda 21: The Earth Summit Strategy to save our planet*. Boulder, CO: Earth Press; 1992.

[24] Sivkov S.I. (1964a). To the methods of computing possible radiation in Italy. Trans. *Main Geophys. Obs*. 1964; 160.

[25] Sivkov S.I. (1964b). On the computation of the possible and relative duration of sunshine. *Trans. Main Geophys Obs* 160. 1964.

[26] Steele J. (1997). *Sustainable architecture: principles, paradigms, and case studies*. New York: McGraw-Hill Inc; 1997.

[27] Thakur, C. Mistra, B. (1993). Energy requirements and energy gaps for production of major crops in India. *Agricultural Situation of India* 1993; 48: 665-89.

[28] United Nations (UN). (2001). World urbanisation project: the 1999 revision. New York: The United Nations Population Division.

[29] Wu, J. and Boggess, W. (1999). The optimal allocation of conservation funds. *Journal Environmental Economic Management*. 1999; 38.

[30] Yaldiz, O., Ozturk, H., Zeren, Y. (1993). Energy usage in production of field crops in Turkey. In: *5th International Congress on Mechanisation and Energy Use in Agriculture*. Turkey: Kusadasi; 11-14 October 1993.

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