Insulation and Energy Efficiency: Protecting the Environment and Improving Lives

The Most Sustainable Energy is Energy Saved

Executive Summary

Energy efficiency is a fundamental element in our global fight against climate change. It plays a critical role in minimising the societal and environmental impacts of economic growth in developing and developed nations. Energy efficiency also has a crucial role improving every nation's security of energy supply. In addition, these benefits can come without a price tag as is the case for insulation where it is easily possible to get five times your investment back in money saved.

All this is known, yet since discussions on climate change and sustainable development began at the United Nations, millions and millions of tons of oil, coal and gas have been wasted heating poorly insulated homes; thousands have suffered ill health from pollution that was unnecessarily created to power inefficient buildings be they private, business or public, and; people have been left without energy as systems failed to keep-up with demand.

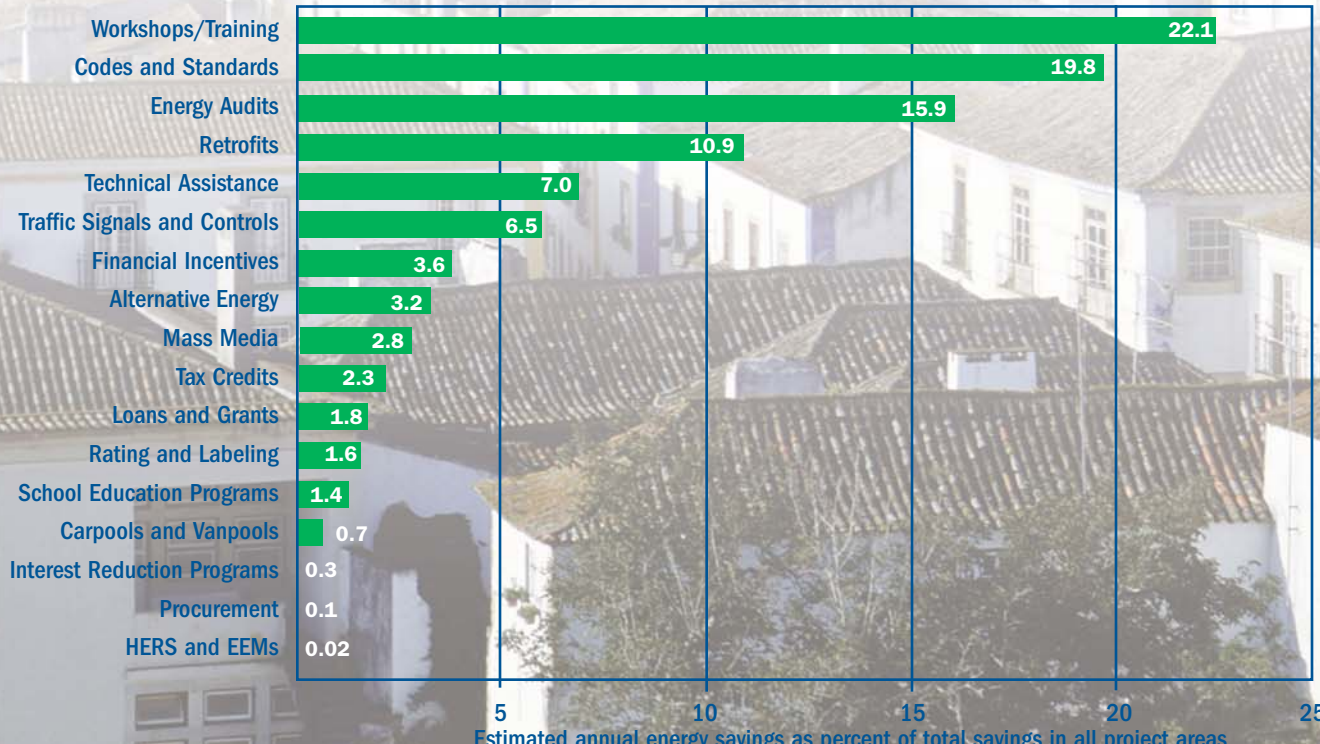
In this document, we will outline the importance of energy efficiency in mitigating climate change and promoting sustainable development, as well as the role of thermal insulation in protecting our people, our environment and Kyoto goals, and our individual and global economies. We will also provide arguments on the need for future discussions to specifically address the need for building and energy codes and global standards.

The worldwide mineral wool insulation industry believes that we need immediate action on energy efficiency. It is within our means to protect both our standard of living as well as the health of our people and our planet; we must find the political will and tools to do this.

The role of energy efficiency in combating climate change and promoting sustainable development is well understood but it is often forgotten how important this role can be. For example, within the European Union such vast quantities of energy are being lost through roofs and walls alone that Europe's entire Kyoto commitment could be achieved through improving insulation standards. Not only could these reductions be made but recent research into their cost-effectiveness demonstrates that they can be made whilst saving the EU over 8 billion EURO a year by 2010 and creating over 340 000 new jobs.

It is equally concerning that few are even aware of the role that energy efficiency can play in reducing other environmental impacts and protecting quality of life. In the U.S. alone, $5.9 billion[1] could be saved annually in healthcare and economic costs linked to air pollution simply by improving insulation; the improved quality of life being immeasurable.

Figure 1: 2005 Oak Ridge Evaluation on Estimated Annual Energy Savings by Project Area From U.S. State Energy Program (SEP) Funds[2]



Energy efficiency also has a pivotal role in maintaining and increasing standards of living, while at the same time respecting sustainable development. Doing the same or even more with less energy can only be achieved through energy efficiency. As developing nations in particular strive to increase standards of living, ensuring the efficient use of energy will be vital if this growth is to be decoupled from environmental and social degradation. David Sandlow from the Brookings Institute recently argued that protecting the environment is key to preventing conflict since "environmental degradation is often a precursor to violence."[3] Energy efficiency plays a role in both the national security of a region as well as the security of the energy supply.

The worldwide mineral wool insulation industry believes that if we are to be serious about improving energy efficiency, that energy efficiency guidelines, in the form of codes and standards for buildings must be developed for all regions in the world. These guidelines must outline building and energy codes that define clear requirements for individual components of a building and do not simply describe general objectives for buildings. Often there exists a preference to discuss environmental performance of a building, rather than looking at the contributions of individual components and materials. This misses an important step, because the assessment of the components is a necessary part of assessing the overall structure.[4] For example, building and energy codes should prescribe minimum levels of insulation to be used, or acceptable types of window glazing. Anything less is unlikely to be effective. Such codes have proven extremely effective, especially when adapted to local conditions and properly enforced.

Standards refer to those guidelines set forth by the building and engineering industry to ensure that materials and building practices meet certain performance requirements. These serve as the basis for building and energy codes. Building and energy codes then refer to the legislative mandates and voluntary programs, which provide consistency in building practices within a region and ensure worker and occupant safety. Our industry does not advocate a single code or standard, but rather promotes ideal codes and standards for which each region should strive. The combination of codes and standards ensures that all nations take meaningful steps towards reducing emissions through sound building practices and encourages sustainable development.

Thermal insulation is only one material used in buildings that can dramatically affect the energy efficiency and sustainability of that property, but it is one of the few that has no other purpose than to save energy and protect and provide comfort to

occupants. Although many supporters gave voice to the need for energy codes and standards during the early ad hoc intergovernmental meetings of experts on energy and sustainable development at the UN Conference on Sustainable Development, language to this effect was not included in conference reports. The mineral wool insulation industry sees this omission as a fundamental lack of understanding regarding energy efficiency's role in sustainable development. With appropriate codes and standards that specify cost-effective energy saving technologies like insulation, the building industry and its suppliers can bridge the gaps between environmental protection, public health, economic advantages and community development.

Given the benefits for climate change, sustainable development, human health, and security of energy supply that proper insulation can provide at no cost to standard of living, it is surprising that more is not being done to promote insulation worldwide. Resources necessary to ensure our children's futures are being depleted and money is being wasted that could be better spent on healthcare and education.

The lack of commitment to energy codes and standards represents an enormous missed opportunity. Instead of signalling a way in which to bridge the gap between environmental protection, public health and economic development, we are instead reinforcing apathy and lack of action in the field of energy efficiency and insulation standards. This omission must be corrected. The worldwide mineral wool insulation industry, therefore, calls upon heads of state to seize the opportunity presented as nations of the world meet to address sustainable development and climate change, to ensure we send the world the right signals on energy efficiency and the importance of thermal insulation technology in meeting our international goals on emissions reductions.

Role of Insulation in Climate Change and Sustainable Development

Sustainable development has a variety of meanings, most of which centre around three areas: social, economic and environmental. The global insulation industry is in line with the United Nations and others in its view on sustainable development as including:[5]

- A focus on creating prosperity for all, not just profits for a few, and to do this within the bounds of the ecologically possible, and without infringing on basic human rights;
- Foster positive human development and provide people with opportunities for self-actualisation and an acceptable quality of life; and
- Balance between protecting the physical environment and its resources, and using these resources in a way that will allow the earth to continue supporting an acceptable quality of life for human beings.

Insulation touches on each of these core areas. The industry aims its product development and marketing efforts in ways that promote sustainable building practices, and energy efficient design and use. Additionally, the mineral wool industry bases its products on renewable resources and focuses on the whole life costs of its products—from manufacture and product development through transportation to the job site, lifetime performance of the product and waste.

Construction standards, such as the International Energy Conservation Code (IECC) and other regional versions highlight the use of insulation in sound building practice. It is widely accepted that buildings in most countries and climate zones can be heated and cooled with renewable energies, providing the insulation standard corresponds to limits like the German Passivhaus or the Swiss Minergie P. Such buildings typically produce more energy than they consume or at least rely on renewable energy sources for the little energy they require.

While codes and standards focus on new construction, governments should not ignore the importance of retrofitting older building stock. Use of mineral wool insulation to retrofit older buildings in Europe would reduce energy costs and cut carbon emissions by as much as 42 percent.[6]

Ecofys' previous study for EURIMA "Mitigation of CO_2 Emissions from the Building Stock"[7] identified a significant potential for greenhouse gas emission reductions in the building sector. As economics—more than potentials—are of decisive importance, two new Ecofys studies[8] examined the economics of suitable measures for the building sector of the European Union. The studies identify a portfolio of measures and retrofit packages in the European building stock, especially in warm and moderate climates as well as in the new Member States of the EU. The studies also confirm the principles of the Trias Energetica. Following these principles,

Public/Governmental Policies in Key Regions

United States

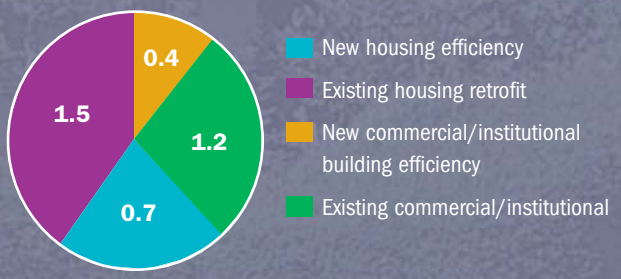
The United States was not a signatory to the Kyoto Protocol; opting instead for voluntary programs it felt better stimulated economic development and competitiveness. An example of these voluntary programs is ENERGY STAR, a strongly branded consumer-oriented effort of the U.S. Department of Energy, which sets standards for homes, appliances, and energy efficient technologies such as insulation and windows. "If existing homes in the U.S. were insulated to ENERGY STAR levels, annual carbon emissions would be 11 percent lower and 29 million fewer tons of carbon would be released into the atmosphere."[19]

Canada

The government of Canada has committed to the success of the Kyoto accord. Federal programs such as "EnerGuide for Houses," "EnergyStar," "One Tonne Challenge" and "Canadian Industry Program for Energy Conservation" (CIPEC) are being delivered as voluntary programs by Natural Resources Canada to encourage nation-wide participation. Environment Canada is also considering legislative measures to ensure a baseline compliance. On the Provincial front, Ontario has committed to, and begun the closure of all coal fired electrical facilities. This action demands a strong conservation effort to maintain services, therefore building energy codes must be updated to achieve improved energy efficiency. The province of British Columbia has removed Provincial Sales Tax from the purchases of energy efficiency products like insulation to spur market change.

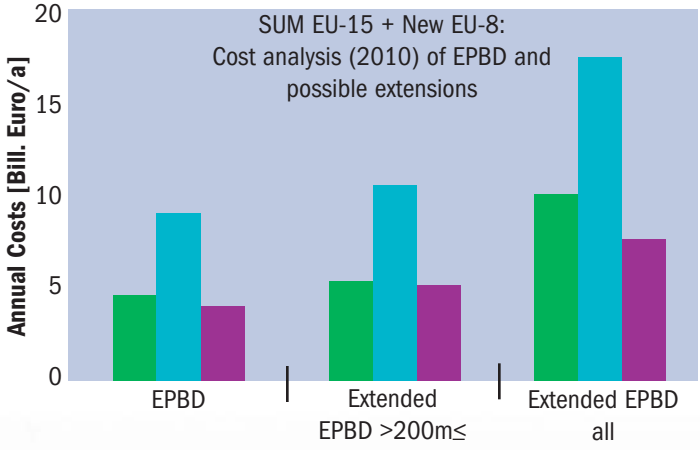
Residential and commercial buildings in Canada represent approximately 10 percent of total GHG emissions and up to 40 percent of all energy used. The government recognizes that promoting energy efficiency of existing building stock is key to reaching its Kyoto commitments. Canada plans to do this by "providing incentives to accelerate retrofits on existing buildings so that one-fifth of the entire housing stock is upgraded by 2010."[20] For this and new construction, Canada is encouraging homeowners and builders to meet EnerGuide 80 classification by 2010.

Canadian Housing and Commercial/Institutional Building Programs: Expected Emissions Reductions



Climate Change: Plan for Canada

Economic impact of the EPBD on EU-15 + New EU-8 building stock



	EPBD	Extended EPBD >200m≤	Extended EPBD all
Total Capital Costs	4,3	5,8	9,7
Energy Cost-Savings	8,3	10,5	17,6
Total Cost-Savings	4,0	4,7	7,9

Source: Ecofys 2005

unnecessary energy losses have to be avoided first, followed by generating the remaining demand from renewable resources or using fossil fuels as efficiently as possible. Transferring these principles to the building stock means that a good insulation standard is a pre-requisite for sustainable buildings.

Applying the identified retrofit packages on the existing EU-25 building stock leads to the conclusion that the large CO_2-saving potential of the building stock can be tapped in a cost effective way if energy saving measures are combined with the standard renovation cycle. In comparison to other instruments of national and EU climate policy this study's measures for the building sector are highly competitive. On the other hand it proves that each renovation without energy saving measures is a missed chance to reduce the CO_2-emissions of the building stock and does not recur before the next renovation cycle 30-50 years later. Implementing the Energy Performance of Buildings Directive, the annual cost savings for Europe would total 4 billion EURO by 2010, rising to 8 billion EURO if the scope of the Directive were extended to all buildings.

Despite the efforts of Kyoto and Johannesburg, the UN warns that industrialised nations are likely to see their greenhouse gas emissions rise by as much as 17 percent by the end of this decade.[9]

The use of thermal insulation can help reduce air emissions, while at the same time, promote sustainable development and economic growth, and improve public health. In a report titled Green and Clean researchers found that insulation currently in place in residential, commercial, and industrial facilities throughout the United States saves 23.5 quadrillion BTU, $177 billion U.S., and prevents 403 million short tons (365,595,450 metric tonnes) of carbon emissions annually.[10] Similarly, an estimation of possible CO_2 reductions for detached and multi-unit housing in Japan found that 16 billion pounds (7.5 billion kg/year) of CO_2 emissions could be saved each year through improvements in thermal insulation.[11] Clearly, energy efficiency through thermal insulation is a critical component of sustainable construction and mitigating climate change.

Annual Benefits from Increased Residential Insulation Levels in U.S. Existing Homes, Harvard, 2002 and 2004

- 8 x 10^{14} BTU Saved
- 3,100 Tons of $PM_{2.5}$ Reduced
- 100,000 Tons of NO_x Reduced
- 190,000 Tons of SO_2 Reduced
- 62M metric tons of GHG would be avoided
- 240 Fewer Premature Deaths
- 6,500 Fewer Asthma Attacks
- 110,000 Fewer Restricted Activity Days
- The Health Benefits Correspond to $1.3 Billion Per Year in Externalities Averted, Compared With $5.9 Billion U.S. Per Year in Economic Savings

Synergies Between Energy Efficiency, Public Health and Economic Development

Beyond protecting our environment, energy efficiency plays a critical role in both improved public health and quality of life. The European Environmental Bureau (EEB)[12] estimated that "some 800,000 deaths per year are due to air pollution, with 80 percent of these deaths occurring in developing countries. A working group convened by the World Health Organisation (WHO) and the World Resources Institute (WRI) estimates that by 2020, about 700,000 of these premature deaths (largely due to particulate exposure) would be prevented annually if moderate greenhouse gas emission reduction policies were implemented." The reduction of air pollution through energy efficiency measures, such as the use of thermal insulation, will have dramatic effects on the health of the people occupying those regions.

The Harvard University School of Public Health recently documented the potential effects of increased insulation on air emissions. In two studies, researchers looked at the probable effects of increasing levels of insulation in new and existing homes in the United States. If the 46 million under-insulated existing U.S. homes were retrofitted with insulation to meet the modest levels outlined in the 2000 IECC, the annual benefits would be a significant decrease in air emissions and the resulting health effects of poor air quality, including respira-

tory disease and death.[13] If the decrease in emissions, which is estimated at 800 TBTUs (234,456,888 Kilowatt hours) were translated into oil used to heat those homes, this modest increase in insulation could save enough to fill more than 76 supertankers. This level of savings supports energy security as well.

Given the impressive effects of increasing insulation, the researchers urged lawmakers to implement incentives such as tax credits to encourage homeowners to increase insulation levels. Similar results were found when looking at increasing insulation in new homes, which could lead to a reduction each year in greenhouse gas emissions by more than 400,000 tons.[14] Lower air pollution is a result of the decrease in energy usage that stems from energy efficiency. Not to be overlooked are the healthcare and economic costs averted through the reduction of air pollution—more than $5.9 Billion U.S. annually according to Harvard. This is money that developing and developed nations can better spend in other areas. Additionally, insulation and energy efficiency helps to preserve fossil fuels used in energy, thereby prolonging the life of these finite resources.

Occupational health is also of concern to the mineral wool industry. Companies and associations in this industry have worked together to establish codes of work practices that strengthen WHO and International Labour Organisation (ILO) programs to reduce occupational risk of injury and illness. Fibre glass and rock and slag wool products have been extensively studied and evaluated as to the potential health effects on workers and consumers by the International Agency of Research on Cancer (IARC) and the WHO and were found to be safe to manufacture, install and use.

Finally, insulation is key to increasing comfort and quality of life through its thermal properties, its role as a passive fire resistor, and its acoustical benefits, especially in schools, homes and businesses. We must not overlook quality of life as we aim to protect our environment.

Beyond protecting occupants of buildings, the promotion of sound building practices, manifested in codes and standards, will support growth in construction jobs and an educated workforce that supports the codes and standards process,

European Union

The European Insulation Manufacturers Association (EURIMA) found that upgrading the insulation standards of older European Buildings would prevent the emission of 460 million tonnes of CO_2 annually, which is more that the entire EU reduction effort needed to meet its Kyoto commitment.

New European legislation on the Energy Performance of Buildings[21] goes some way to capturing this potential, by requiring member countries to develop minimum requirements on the energy performance of new buildings and large existing buildings. According to two new studies carried out on behalf of Eurima[22], these rules will only capture about ten percent of the overall potential (i.e. 39 million tonnes). These studies also demonstrate that a simple extension of these rules to include all existing buildings could more than double these emissions reductions (i.e. 83 million tonnes) by 2010.

Even with such an extension, much of the potential would still be left untapped. Moreover, recent evidence suggests that to capture these emission savings would lead to substantial cost savings for the European Union as a whole and for its citizens. In fact, capturing the total CO_2 potential could lead to a net annual cost saving for the EU-25 of 57 billion EURO, if the investments were made during the normal retrofit cycle. Moreover, these are simply the cost savings from less energy use and do not include the substantial co-benefits derived from reduced climate events and air pollution. With this in mind, EURIMA will be working with the EU, to develop further policies that can lead to further cost-effective emission reductions.

Russia

The decision by Russia to ratify the Kyoto protocol means that the Kyoto Protocol will now enter into force. Although the most obvious impact is that it makes both the commitments undertaken and the instruments created under the protocol legally binding, it is perhaps the moral boost to fighting climate change globally that is most important. This achievement reinforces the need to act and to capture the potential for reducing emissions from buildings.

such as building scientists, engineers, architects and others. In many countries, the construction industry consumes more raw materials by weight than any other industrial sector. The built environment typically accounts for a large percentage of all greenhouse gas emissions. By weight, construction can produce much of a nation's waste. Obviously, this industry has a significant effect on the environment. Equally as important is the role construction plays in economic expansion:

"Employment in construction brings with it significant social and economic impacts. As economic activity and investment expands, construction activities create considerable employment opportunities. Moreover, the multiplier effect is such that one job in construction gives rise to two further jobs in the economy as a whole."[15]

New research from Australia shows that these standards not only produce environmental and health benefits but can increase economic growth. Setting building standards and codes at the highest level of stringency that still leads to growth should therefore be a high priority for all governments. An expert workshop by the Insulation Council of Australia and New Zealand (ICANZ) concluded that the overall economic benefits of energy efficient buildings are up to 400% higher than traditional government modelling of direct benefits to consumers alone.

So, while at first glance, energy efficiency may seem unrelated to larger societal issues, this discussion demonstrates that it is a significant driver for improving both public health and economic development.

The Role of Energy Codes and Standards

With an understanding of the role insulation plays in sustainable development, the question arises: How to encourage increased use of insulation regionally and worldwide? The answer lies in the adoption and enforcement of regulations and guidelines, under the general heading of codes and standards, which promote the spread of energy efficiency. In 2002 the Business Council for Sustainable Energy, in which the global insulation industry participates, provided this commentary to the World Summit on Sustainable Development (WSSD) in Johannesburg: "Increasing levels of energy consumption and production have raised concerns about the impact of globalisation on the environment. Sustainable development will be difficult without the cooperation of industry and an international agreement in support of energy efficient codes and standards. Energy efficiency standards and guidelines will add transparency and a level of minimum efficiency that can be used as a means of calculating environmental emissions impacts of projects on a comparable global basis. We believe that appropriate energy efficiency codes and standards along with capacity building should be based on a suitable economic analysis for the jurisdiction in question."[16]

A 2005 Oak Ridge National Laboratory study in the U.S. found that approximately one-fifth of the total energy savings funded with State Energy Program (SEP) funds from the Federal Government resulted from the adoption of codes and standards. Oak Ridge has stated that "codes and standards are a cost-effective way to reach energy efficiency, especially in areas with substantial building activity because the adoption of codes and standards is relatively inexpensive while the results, which typically apply to entire states, are wide reaching."[17]

Implementation of energy codes, which include insulation, makes sense for the economy and for the public good, and supports the WSSD's sustainability plan. Ideally these codes will continue to be developed at the international level, as in the case of the International Code Council's IECC, and be interpreted and enforced locally to ensure success.

Market Based Programs

Codes and standards are a basic building block to achieving the minimum in energy efficiency. These are best supported through market based and governmental programs, which encourage participants to go above the minimum code requirements to save energy.

Many regions have long histories with market-based programs to reduce emissions and encourage energy efficiency. Cap and trade programs are an efficient means to lower the cost of reducing CO_2 emissions. The use of government-sponsored incentive programs has shown success in encouraging energy efficiency in both residential and industrial facilities. The same Oak Ridge study cited earlier also found that each $1 U.S. of total SEP funding resulted in annual energy savings of 1.03M source BTU and a cost savings on $7.22 U.S. for

programs that could be measured. Market-based systems that reward investment in existing energy efficiency technologies in buildings and industry will provide the maximum results at the lowest cost.

Between 1978 and 1985, 30.5 million Americans lowered their tax bill an average of $143.44 through a federal energy efficiency incentive program. In those eight years, over $4.3B U.S. in tax incentives were redeemed. The dollars returned to consumers' pockets helped fuel an era of growth and prosperity.[18] In August 2005, the U.S. passed an Energy Bill that includes tax incentives to increase the energy efficiency of new and existing residential, manufactured and commercial buildings. Also included was funding for a wide variety of programs and public education efforts designed to improve energy efficiency and advance energy efficient building codes.

Conclusion

Key to improving the environment and enhancing sustainable development is the creation of programs that reduce energy usage and associated air emissions while strengthening the local and global economies and creating jobs. These programs can increase the opportunities for developing nations to participate in the global economy. Part of this effort must be the establishment of processes that include minimum energy efficiency codes and standards in both new and existing buildings and incentive programs that provide for accelerated energy efficiency and reduced emissions.

Thermal insulation helps meet the goals of energy savings, emissions reductions, air quality improvement, sustainable development and growth. It is a low-cost, widely available, proven technology that begins saving energy and money, and reducing emissions the moment it is installed. It is easy to implement in any nation regardless of its developed status, and continues saving energy and money for the life of the building. As nations of the world address climate change and implement policies that promote sustainability, increased usage of fibre glass and rock and slag wool insulations, along with strong energy codes and standards, should be standard elements in this effort. We must address the origin of problems that lead to climate change and work against sustainable construction, rather than focusing primarily on measures that lessen its effects.

United Kingdom

The UK Department of Trade and Industry (DTI) reports that the UK is on track to meet Kyoto GHG targets and its domestic goal of reducing carbon dioxide (CO2). DTI said GHG emissions in the UK decreased three and a half percent last year, which is in line with the trend needed to ensure the UK meet its Kyoto target to reduce (GHGs) to 12.5 percent below 1990 levels by 2012.[23]

Mexico

In Mexico in 1995, a group of manufacturers, builders, power plant owners and others led the effort to pass an industrial energy code that would encourage increased industrial energy efficiency and reduced environmental emissions. It was estimated that if every plant in the country had energy efficient levels of insulation installed on pipes and equipment, the total savings would be 8 million barrels of oil equivalent and 8 million tonnes of emissions into the atmosphere. In 1999, the Mexican Energy Department stated that, in newly built plants alone, the energy code resulted in 40 million cubic meters of savings in natural gas.

South America

A recent study from Brazil shows that the country has the potential to save 900,000 barrels of oil per year with correct industrial insulation thickness. Another 900,000 barrels can be saved with the insulation of fittings and valves.

Japan

A study conducted by the Glass Fiber Association of Japan found a steady rise in the use of thermal insulation, with a peak occurring in the late 1990s. Taking into account the energy used in producing the products, the primary energy consumption annualised over the lifecycle of the building was found to decrease between 6,700 - 7,484 MJ/dwelling unit/year based on glass or slag wool insulations. Carbon dioxide emissions were reduced using that same formula between 270.4 - 323.7 kg/dwelling unit/year.[24]

Australia

Governments worldwide have approached the need to reduce greenhouse gas emissions with some reluctance as it is feared it will have a negative impact on economic growth. New research conducted by the Australian government shows that saving household energy, in fact, promotes economic growth. When costs and savings from a range of residential building energy efficiency measures were input to a model of the Australian economy, projected results showed the Australian GDP was increased by up to $1 billion with 2600 jobs created. This growth was achieved through the transfer of resources from the capital intensive energy sector to the more labour intensive energy efficiency sector. Each dollar spent saving energy creates more employment than the same dollar spent on producing energy.

Saving energy improves security of energy supply, but it also reduces peak loads on energy infrastructure which has been shown to have a range of additional benefits. Peak electricity is more expensive for energy retailers to buy from energy generators. In Australia the highest 0.2% of peak loads represents 16% of the cost of electricity. Saving energy will therefore not only extend the life of energy resources and defer the need for new power stations it will help to reduce the cost of energy for all consumers. Savings are also achieved in reduced maintenance costs when the peak loads on the electricity grid are reduced.

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PUB.#N019
11/05