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SHORT RESEARCH AND DISCUSSION ARTICLE

Energy efficiency through integrated environmental management

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Abstract Integrated environmental management became an economic necessity after industrial development proved to be unsustainable without consideration of environmental direct and indirect impacts. Energy dependency and air pollution along with climate change grew into major challenges facing developed and developing countries alike. Thus, a new global market structure emerged and changed the way we do trade. The search intensified for alternatives to petroleum. However, scientists, policy makers, and environmental activists agreed to focus on strategic conservation and optimization of energy use. Environmental concerns will remain partially unaddressed with the current pace of consumption because greenhouse gas emissions will continue to rise with economic growth. This paper discusses energy efficiency, steady integration of alternative sources, and increased use of best available technologies. Energy criteria developed for environmental labeling certification are presented. Our intention is to encourage manufacturers and service providers to supply consumers with less polluting and energy-consuming goods and services, inform consumers of the environmental and energy impacts, and thereby instill sustainable and responsible consumption. As several programs were initiated in developed countries, environmental labeling requirements created barriers to many exports manufactured in developing countries, affecting current world trade and putting more pressure on countries to meet those requirements. Defining an institutional and legal framework of environmental labeling is a key challenge in implementing such programs for critical economic sectors like tourism, textiles, and food production where energy needs are the most important aspect to control. A case study of Tunisia and its experience with eco-labeling is presented.

Keywords Sustainability · Eco-labeling · Energy efficiency · Tourism, textiles, food industry · Environmental management

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Introduction

Rapid economic growth in the 70s resulted in adverse effects on the environment that led experts to seek urgent actions to preserve the future quality of life on earth. The need for sustainable development prompted the creation of several programs in different parts of the world to implement environmental protection policies. And, the concept of sustainable development was born. As defined in 1987 by the Prime Minister of Norway, who chaired the World Commission on Environment and Development, sustainable development is as follows: "A development that meets the needs of the present generations without compromising the ability of future generations to meet theirs." Sustainable development is a concept based on three principals and closely linked pillars: the society, the economy, and the environment (Brundtland Bericht 1987). It is essential to insure a balance between economic growth and the different systems as well as social justice. This will allow developing countries to position themselves fairly in an international and global economy and have improved access to health and education. The Brundtland Report also promoted controlled consumption of energy among other natural resources.

The attitude change, especially in developed countries, was captured by the marketing business sector and applied to convert environmental worries into commercial benefit. A number

of environmental declarations in product advertising emerged. Among others, labels such as "recyclable" or "this product uses less energy" or "this product contains recycled matter" are now commonly seen on many products. This attracted the attention of consumers who were already looking for ways to lessen their impact on the environment through the purchase of greener products. Given the risk of confusion on the consumer side, governmental action established national and regional programs of eco-labeling. Government programs responded to the absence of standards to ensure that such claims by businesses are credible and verifiable. This also aimed to protect the consumer while preserving the environment.

Environmental labeling and its role in energy saving

Environmental programs are developed with each country's specific environmental goals and needs in mind. Environmental labeling indicates manufacturers who produce and market products that are relatively less harmful to the environment and encourages consumers to purchase products labeled as environmentally preferable. It is all done with the hope to encourage other producers to change their manufacturing procedures and reduce environmental harm (USEPA 1998).

Environmental labels are intended to generate environmental benefits through their positive influence on consumers' purchasing decisions. They are great instruments to create a synergy between the different stakeholders in the society. While the consumer recognizes a label or a logo as a selection aid to make greener purchases, at the same time, the manufacturer uses the label to communicate good environmental production practices. Nevertheless, this practice should be accompanied by institutional and regulatory policies to prevent misuse and false claims. This will distinguish sincere environmental claims from fraudulent marketing slogans.

The implementation of such programs will also encourage the use of cleaner production technologies to respond to a more demanding and competitive market while also informing consumers. Furthermore, environmental labeling is seen by many producers and manufacturers as an opportunity to seek value-based distinction over a cost-based one.

The high cost of energy and the increased dependency on foreign supplies have driven most businesses to analyze their energy bills more closely. With prices doubling and tripling in the last few years, businesses are struggling to stay competitive and relentlessly trying to find new ways to improve their bottom line. For many years, energy-intensive industries were exploring new manufacturing technologies along with alternative energy sources.

Industries are not always open to change, especially when those changes require additional investment spending. It is, however, believed that environmental labeling programs may foster the use of innovative available technologies offering cleaner and more sustainable production. In fact, these programs calling for compliance with environmental regulations are also indirectly integrating conservation or more specifically optimization of natural resource use. Energy and water availability, cost, and end-use impacts are often key concerns for business, and conservation and control will not only improve the bottom line and competitiveness but will also lower emissions and reduce pollution. The environmental benefit is a net improvement that will, in the long run, help reduce or eliminate remediation costs.

Energy criteria in environmental programs

As shown in Table 1, several programs emerged in recent years to respond to pressing environmental issues. Even though the primary objective of environmental labeling is to improve global environmental welfare, the driving force was to protect both consumers and industries from false claims. In fact environmental labeling evolved from self-claimed information by some manufacturers, to a third party certification by an accredited organization and a board of eco-labeling in an eco-labeling program by ISO 14024 Directives in 1999.

Table 1 Selected international eco-labeling programs

Designation	EU, Flower	German, Blue Angel	Japan, Eco Mark	Canadian, TerraChoice	USA, Green Seal	Tunisia Ecolabel
Year of Creation	1992	1977	1989	1988	1992	2006
Logo						

TerraChoice in Canada is one example of labeling intended to reduce stress on the environment. Another common goal is to educate consumers and increase environmental awareness. It is believed that visible labels will educate consumers and disseminate information about environmentally sound products. Similarly, Japan's EcoMark and Singapore's GreenLabel specifically stress green consumerism and environmental awareness.

Germany's Blue Angel has led the international effort in eco-labels. It was initiated in the 70s by the German Agency of Environmental Protection. This agency succeeded in educating consumers about their "Right to Know," and their role in protecting the environment. Many eco-labeling programs in other countries followed, but rarely with such success (Loewe and Lichtl 2004). This is likely due to the lack of financial and human resources allocated to the programs in some cases and a lack of authority to enforce regulatory environmental policy in others. Reasons that may well explain why it took Tunisia, as a developing country, much longer to initiate its own label in 2006 with the help of the European Commission Environmental Program.

In the midst of the creation of several eco-labels, the need for standardization emerged and we are currently witnessing a harmonization trend aimed at understanding/unifying international trade issues. A great example is the European Union, EU, eco-label to bring harmony across different eco-labeling programs in a unified program called the European Flower. The Flower is playing an information dissemination-leading role in formulating a consensus standard across the EU markets (EPA 1998).

Eco-labeling programs covered various industrial sectors, taking into consideration market trends to make sure the message resonates with a large enough number of consumers in order to create a meaningful market demand. In fact, textiles and the tourism industries fit well in these programs given the wide exposure that consumers have with their products and services. In many countries, these sectors comprise the heart of the economy and do have major environmental impacts. Such sectors are also energy intensive and depend heavily on foreign resources. A clear link between pollution prevention and energy efficiency is then established. Energy efficiency has become the main criterion common to all eco-labeling programs. Several initiatives were devoted to emphasize energy efficiency as a way to promote not only environmental protection but also foster economic prosperity through energy good practices' information on buildings, utilities, industry, and transportation. This is often paralleled with innovative designs based on new and advanced technologies. Even though the technology-driven change may be costly, in the long term, energy efficiency will make up for reduced energy use and therefore results in reduced cost and pollution.[1]

[1] Costs are generally calculated in two terms: short and long terms. While it may be costly to make changes by adopting new and improved technologies, in the long term, savings in cost will be greater because of reduction in energy use or use of alternative energy that is less polluting and will result in less control.

Energy criteria are different from one program to another and depend on available technologies and the opportunity to acquire them. These criteria are flexible and take into account improvements observed from 1 year to another. Table 2 illustrates indirect savings observed as a result of the EU program within and outside the EU. It is, however, essential to state that energy efficiency minimum requirements are set up to be met at the time of eco-labeling certification.

Energy criteria for the tourism sector

In many parts of the world, the sustainability of the tourism sector is at risk. Energy consumption patterns of tourist attractions are known to consume a considerable amount of any nation's energy resources. For example, in New Zealand, tourism was found to contribute considerably to the country's energy bill, particularly when motorized travel is involved, such as scenic flights or jet boating where consumption varies from (344 MJ/flight) to (255 MJ/ride), on a per capita basis. It is quite high when compared to less energy intensive tourist attractions, such as museums (10 MJ/visit) (Becken and Simmons 2002).

In less developed areas of the world, increased tourist activities can easily increase national energy expenses. The lack of integrated environmental management in the design of the buildings, the choice of equipment, and appliances can result in increased demand in electricity given the increased flow of tourists for these relatively less costly destinations. Some promising ecotourism resorts, for example, in Tunisia are being developed. The Green Hill Resort, in Beni M'Tir village in the northwestern region, was proposed in 2011 as an energy-efficient hotel that will produce the energy it needs to operate. While Tunisia has minimal domestic energy resources and imports most of its energy, building a hotel that does not contribute further to energy consumption is notably progressive. The resort is based on three components: bioclimatic architecture, geothermal elements, and solar energy according to MED-ENEC (energy efficiency in EU construction

Table 2 European Union Flower Indirect Benefits (2006)

Designation	Average savings per year		
	Within EU	Outside EU	Units
Money	763	–	Million Euros
Energy	43	2.9	Terawatt-hour
CO_2	27	1.9	Million tons
Reduced air pollution	49	3.5	Thousand tons

Given the voluntary nature of the participation in the flower eco-labeling program, details on the data provided are available and the total savings may reflect more categories than the one presented in this table. It is therefore not possible to give the percent of energy saving with comparison to the overall realized savings in the whole region

regional program). The project is still under development, but will likely set a precedent for sustainable tourism development in Tunisia. Meanwhile, the United Nation Environmental Program (UNEP) asserted that reductions of up to 44 % in energy use are possible with green tourism (UNEP 2015).

Environmental auditing has become an important tool to assess environmental performance in many businesses, and tourism is no exception (Goodall 1995). In established hotels, it has become a standard practice to identify energy-saving measures to reduce operating costs and improve the bottom line given the stiff competition. In Canada, for example, hotel energy-efficiency measures were sufficient to cut costs by 20 %. Major expenditures included lighting for guest rooms and common areas, heating, and ventilation as well as air conditioning and motorized equipment such as elevators (ORHMA 2006).[2] This is also in line with the USA, where in 2003, the percentage of average energy consumption for water heating and lighting in hotels was about 60 %. Space heating was about 5 % in 2003 compared to 18 % in 1995 of the total cost thanks to similar programs as one can see in Fig. 1 (USEIA 2003).[3] The Alliance to Save Energy website[4] lists a number of measures that can assist hotels and resorts in improving their overall energy management, identify source energy-efficiency technologies and service providers, and benchmark energy use data in several countries.

Environmental labeling programs focus on improving energy conservation in several areas, for example, controlling costs by avoiding wasteful consumption and making use of alternative energy sources—in particular local renewable technologies such as solar or wind power. Many of these programs pay close attention to energy audits and advise their customers to seek energy efficiency measures to make sure systems are optimized.

Energy criteria for the textiles sector

The textiles industry has witnessed drastic changes in energy consumption practices. With stiff competition worldwide and low labor costs, manufacturers are driven to research different ways of cutting costs and maximize profits. Energy is one critical area where tremendous improvements have been made and record cost savings were realized in the last decade. However, the nature of the textiles industry with its highly fragmented manufacturing processes and heterogeneity have made it a challenge for this sector to take advantage of and benefit from available cost-effective technologies. Several options, such as use of electronic roving end break stop-motion detectors instead of pneumatic systems during preparatory processes, or installation of energy-efficient motors in ring frames, or installation of variable frequency drives on autoconer machines in the finishing processes, could save a considerable amount of energy and the recovery of capital costs can occur in 1- to 4-year timeframe. Most textile firms are small to medium businesses and may need incentives to help bear the cost burden. Several programs were implemented in developed countries, and energy-efficient guidelines for this sector are readily available (EOLBNL 2010). For example, in Canada, the textile industry enhanced its energy intensity by 44.0 % and cut its actual energy use by 39.7 % between 1995 and 2002 (Office of Energy Efficiency—Annual Report 2002–2003).

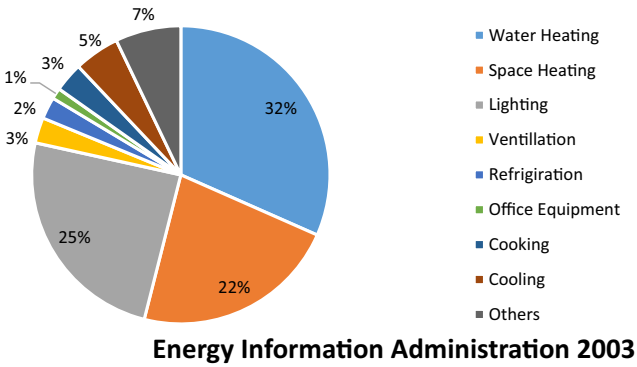

Fig. 1 Average distribution of hospitality energy use in USA

The Textiles Sector Task Force in Canada committed to an energy intensity reduction target of 1 % per year through 2010 to meet Kyoto Protocol goals. The challenge however is to involve more companies in the program, as well as industrial energy innovators. To make further advances in energy efficiency, companies must adopt benchmarking and best-practice approaches to energy management as a part of their ongoing business management strategies (Office of Energy Efficiency—Annual Report 2002–2003).

Another very important area of interest is technological advance. Even though capital costs may rise in the short term, companies should be more open to new and cleaner ways of production, often with lower operating costs over the longer term. For example, the insulative coating product known as Nansulate High Heat has been proven to conserve energy when applied to high surface temperature equipment in textile plants where Nansulate High Heat applied to heat exchangers caused a 25 % decrease in the amount of time necessary to heat water to 110°C for one of the company's customers (Bilgin 2006).

Many textiles manufacturing operations rely on wet processing techniques. These techniques involve an aqueous solution or bath to apply chemicals to a textile substrate, fixing

[2] More detailed information can be found under the Canadian office of energy efficiency, Improving Energy Performance in Canada—Report to Parliament Under the *Energy Efficiency Act* For the Fiscal Year 2010–2011 at this link: http://oee.nrcan.gc.ca/publications/statistics/parliament10-11/chapter1.cfm?attr%3D0.

[3] More information on lodging and other sectors' energy consumption is available through Commercial Buildings Energy Consumption Survey (CBECS) at this link: http://www.eia.gov/consumption/commercial/reports/2012/preliminary/index.cfm.

[4] The Alliance to Save Energy website: www.ase.org.

the chemicals to the fiber, scouring or washing to remove free chemicals and drying to produce a finished fabric or garment. Heating and then water evaporation make these wet processes very energy intensive. Industry experts estimate that wet processes use approximately 60 % of the energy consumed in the textile industry. Switching from wet to dry spinning processes, for example, could be an alternative, where a polymer dissolved in a volatile solvent is introduced into a heated drying chamber and the solvent is evaporated to reach a solid fiber. This process may be used in lieu of the wet process to save energy and reduce water pollution. This is only one promising area to save on energy consumption in this sector.

Energy criteria for the food processing industry

Health and safety issues are the main drivers in food production control, and many labels have been created to track the origin and ingredients in food products. Very little has been done about the food production process itself as long as costs can be included in the consumer price. Potential energy savings in the food processing industry are found in almost every facet of operations. Processes used to manufacture, package, and process food are key areas where energy could be saved. Emerging technologies in efficiency and productivity design are available and could be found in newer or recently upgraded commercial-scale food industry facilities. Several case studies related to dairy and poultry demonstrated that new insulation materials as well as automated ventilation processes are considerably more efficient in air conditioning and result in reduced costs. However, lack of incentives discouraged the agricultural sector from seeking these technologies despite proven reliability and capability through research and prototype testing. For example, partnerships to help farmers are currently available through the STAR program at the USEPA as an initiative to support this sector. Potential benefits were also proven in the food-processing sector from distributed generation of energy on-site instead of off-site energy transmission lines. Numerous farming businesses are currently generating their own energy through composting and other means. Combined heat and power, solar, and wind power are among several technologies that could be used in food processing.

On the other hand, producers looking to market their products may discover that what appears on the outside of the package is as critical as what they put inside. Hence, they discovered early enough in this industry what does "eco-label" tell about their products and used labeling to increase sales (Lockeretz and Merrigan 2005). In a Nutrition Today article on eco-labels, William Lockeretz and Kathleen Merrigan, at the Friedman School of Nutrition Science and Policy at Tufts University, note that the "organic sector has been growing at an annual rate of 20 % for the past decade… [and] Eco-Labels could soon move into the mainstream."

The International Organization for Standardization (ISO) has developed ISO 14020 and ISO 14024 that defined principles and procedures for environmental labels and declarations. For an eco-label, this means an indication that a food has been produced in a way that is considered environmentally friendly (e.g., certifies that the label follows the ISO standards). There is a broad range of labels that fall under the eco-label category, including "various fair trade claims" farm animal welfare, decent treatment of farm workers, and authenticity of a product are among those claims according to Lockeretz and Merrigan. But, which eco-labels are to be trusted? EuropGap has gained interest in the business field around the world. But, very little has been done at the consumer level. In contrast, "organic" labels are growing at a steady pace. Nevertheless, they both lack the rationale behind eco-labeling life cycle approach. It is therefore essential to demonstrate how well eco-labeled products can help small farms and small food companies to compete in today's food retailing environment, which favors larger suppliers who can better afford to pay labeling and certification fees. Nevertheless, the effort of implementing these programs faces various international trade issues such as free trade that could favor richer countries with relatively higher consumers' awareness about labels and what they mean (Dawkins 1996).

This brings us to the main purpose of this paper, namely, addressing how an eco-labeling program that aims at raising consumer awareness can at the same time encourage industry to use integrated environmental management systems, both of which could help a developing country compete in the current global market. Eco-label programs help policy makers enforce environmental protection programs that encourage the use of new energy-efficient technologies for manufacturing and pollution prevention.

Case study: Tunisia—an eco-labeling experience

Project initiative

Access of Tunisian products to European markets is highly dependent on compliance with stringent European environmental directives and requirements. Environmental labeling of Tunisian products is an initiative taken by the International Center of Environmental Technologies of Tunisia (CITET) to encourage manufacturers and service providers to supply consumers with less polluting goods and services and instill more sustainable and responsible consumption. It is also an effort to brand Tunisian products in order to meet the challenges of a globalized market by giving a boost to the products quality. The project of eco-labeling included technical studies and contribution from national and international experts. The objective was to evaluate social, economic, and environmental conditions to set up the legal,

regulatory, and institutional framework along with the development of criteria for certification.

Regulatory framework and incentives

Tunisia is well aware of the potential energy problems it faces. It is committed to undertaking action and building a culture of energy conservation. In 1985, a national agency for renewable energies was created to play that role and several actions were documented in its summary report of 20 years of activities (ANME 2006). The Ministries of Trade and the Industry and Energy made a commendable effort jointly, in order to enforce mandatory labeling of equipment and electric appliances (Law no. 2004–72, August 2004, and its Decree no. 2004–2145 of Application, September 2004).

A government initiative was established to allow competition for sensible use of energy and promotion of renewable alternatives of energy (Decree no. 2006–1394, May 2006). The immediate impact of this program was the promulgation of the legal documents that introduced the availability of the eco-labeling program and its credibility. It also provided the incentive for participating manufacturers to have an integrated environmental management system where all aspects from energy to water to raw materials were taken into consideration as an integral part of daily business management. The reinforced capacity of these companies was critical to the access of Tunisia's manufactured products in the European free exchange market and its preparedness to compete in a global market.

Recommendations

Regardless of what lies behind eco-labels use, a well-implemented program will ensure that the basic certification requirements are met. A proper legal framework is a key element to the enforcement of such practices. Eco-labeling has addressed the area of energy efficiency as an essential requirement given its potential to realize not only environmental protection but also cost savings, which caught the attention of manufacturers in different industries. It is essential to acknowledge that the most successful programs are the ones initiated by governmental authorities, given the scale of human and financial resources involved as well as governmental capacity in enforcing their application through legal actions and financial incentives. Moreover, from a policy maker's perspective, it is recommended to help establish environmental policy that promotes cleaner production and the transfer of innovative technologies.

An energy audit is the first step toward a comprehensive energy management plan. It provides information and insight into how the business uses energy. This requirement is found in all eco-labeling programs and applies to all industries.

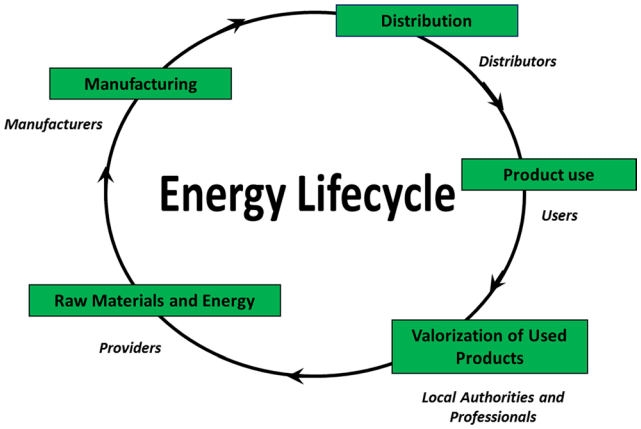

Fig. 2 Product energy lifecycle recommended for consideration

However, eco-labeling goes beyond energy and resource handling. It addresses the lifecycle of the product from raw materials and their handling to the waste generated at the end of the product's use and its possible valorization. Figure 2 illustrates the different steps in the product lifecycle where energy-saving opportunities are sought. While energy resources are a priority in performing an audit, all other resources including water and other materials used in the process of making a product or proving a service should be carefully considered as well.

Conclusions

The underlying principle behind environmental labeling is commendable. Eco-labels are valuable tools to reach integrated environmental management and also as one way to improve the image of how business is run. Moreover, criteria that are established for these labeling programs are not limited to energy resources, but also extend to other resources—natural or human—that may be applied in the process of providing products and services. Other equally important aspects such as environmental justice are a key component of a well-managed and holistic environmental program that will help employees feel that they are vital partners in integrating and enforcing energy saving procedures. Healthier and well-compensated employees are more likely to care about the energy bill among other manufacturing costs.

With the rapid growth of labels have come several important questions: How credible are they? How can a consumer distinguish labeling initiatives motivated by real environmental concern from those that use eco-labeling just as a marketing tactic? Do consumers understand what these labels mean, or are they just "information overload"? The answer to all these questions is going to depend on whether the program's implementation will succeed in capturing the key elements: transparency, verifiability, and non-discriminative or misleading consumer's information tools.

Some economists as well as green critics continue to challenge the idea that improving energy efficiency will lower energy prices, arguing instead that increased energy efficiency will make products more affordable and hence lead to greater consumption and therefore higher energy costs overall (Greening et al. 2000). This assumption means that more consumption will result in increased energy use and as a consequence more pollution. Therefore, they insist on switching to alternatives to fossil fuels, such as renewable energies and greater energy conservation (Herring 2000). A successful eco-labeling program should strike a balance between economic growth and pollution prevention. Therefore, it must be practiced in a profitable economic environment for businesses while respecting environmental policies. It should be in accordance with market dynamics and must be able to adjust quickly and promptly to technological changes as well as the economics of the global market. Thus, periodic examinations of labeling programs are needed to update the criteria of certification and take into account technological advances and newly approved standards.

While the developed world has taken advantage of such programs to help businesses stay competitive by adding labels that distinguish their products and services in a highly globalized market, the voluntary nature of environmental labeling has made it less appealing to the developing world because of the resources needed to implement such programs. Nonetheless, countries like Tunisia, while struggling to remain afloat in an ever changing and more challenging business environment, have come to realize both the benefit of implementing such programs to help boost the sales of their products, and also the necessity of adopting new requirements governing trade to help the international penetration of those products. Many other developing countries have seen their exports restricted because of environmental trade policies which has led the United Nation Environmental Program to develop to come to their assistance and promote a 10-year framework of programs in support of regional and national initiatives focusing on the needs of developing countries to improve their trade opportunities while preserving the quality of the environment and promoting the sustainable use of natural resources including energy.

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