Energy efficiency and the law: A multidisciplinary approach

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South Africa is an energy-intensive country. The inefficient use of, mostly, coal-generated energy is the cause of South Africa's per capita contribution to greenhouse gas emissions, pollution and environmental degradation and negative health impacts. The inefficient use of the country's energy also amounts to the injudicious use of natural resources. Improvements in energy efficiency are an important strategy to stabilise the country's energy crisis. Government responded to this challenge by introducing measures such as policies and legislation to change energy consumption patterns by, amongst others, incentivising the transition to improved energy efficiencies. A central tenet underpinning this review is that the law and energy nexus requires a multidisciplinary approach as well as a multi-pronged adoption of diverse policy instruments to effectively transform the country's energy use patterns. Numerous, innovative instruments are introduced by relevant legislation to encourage the transformation of energy generation and consumption patterns of South Africans. One such innovative instrument is the ISO 50001 energy management standard. It is a voluntary instrument, to plan for, measure and verify energy-efficiency improvements. These improvements may also trigger tax concessions. In this paper, the nature and extent of the various policy instruments and legislation that relate to energy efficiency are explored, while the interactions between the law and the voluntary ISO 50001 standard and between the law and the other academic disciplines are highlighted. The introduction of energy-efficiency measures into law requires a multidisciplinary approach, as lawyers may be challenged to address the scientific and technical elements that characterise these legal measures and instruments. Inputs by several other disciplines such as engineering, mathematics or statistics, accounting, environmental management and auditing may be needed. Law is often described as the catalyst for change, building bridges between different academic disciplines, and driving behavioural changes that are not only enforced by government, but that are also voluntarily adopted by the users themselves.

Introduction

Each day South Africans are bombarded with images and messages in printed and electronic media challenging them to reduce their energy consumption and to introduce energy-efficiency measures in their households and workplaces. However, few South Africans realise the complex scientific, technical and multidisciplinary challenges that underpin these calls. Energy efficiency is no longer the sole domain of engineers, as lawyers, auditors, mathematicians, accountants, environmental managers, chemists, economists and many other scientists from the natural and social sciences and humanities alike are involved in attempting to bring about a green economy[1] that includes improved energy efficiencies.

The importance of energy efficiency was again reiterated by the member states at Rio+20 (para 128 & 129)[1] with the following declaration:

> *We recognize that improving energy efficiency, increasing the share of renewable energy and cleaner and energy-efficient technologies are important for sustainable development, including in addressing climate change. ...We also recognize the importance of promoting incentives in favour of, and removing disincentives to, energy efficiency and the diversification of the energy mix, including promoting research and development in all countries, including developing countries.*

The law is one of the disciplines that bridge the divide among the natural sciences, engineering and the other disciplines. It is often also the catalyst to initiate and drive change by providing incentives and disincentives. Environmental and energy law must by necessity be multidisciplinary as it has to translate scientific and engineering principles and knowledge into policy and law. Such law is often underpinned and informed by the sciences and engineering disciplines, while the law often also frames and directs the sciences and engineering disciplines. This symbiotic relationship among the law, the sciences and engineering should not be ignored, especially in complex fields such as energy management and energy efficiency.

Command and control measures (i.e. law and the enforcement thereof) often fail to achieve the desired change. A combination of a number of alternative policy instruments is often deployed in parallel with the law to support the legal instruments and measures to bring about such change. One such alternative policy instrument is voluntary international standards that may be adopted and used by organisations from the public and private sectors alike as a consequence of their corporate fiduciary and social responsibilities.[2-4] These international standards are mostly voluntary requirements, but they are often also included into law, making conformance mandatory as specified.

The South African government has, since 1998, included demand side energy management and energy-efficiency measures in policy documents and legislation. The most recent policy document, the *National Climate Change Response White Paper* of 2011,[5] highlights energy efficiency as one of its principal goals. Both the *National Energy Act 34 of 2008* and the *Electricity Regulation Act 4 of 2006* include measures pertaining to energy efficiency.

Some of these measures apply to government institutions such as municipalities, while others apply to the private sector.

In July 2011, the South African National Standard SANS 50001:2011 (referred to as SANS/ISO 50001) was published. It is a voluntary energy management system (EnMS) standard providing for improvements in the energy performance, efficiency, use and consumption patterns of organisations. The aim of the standard is to 'lead to reduction in greenhouse gas emission and other related environmental impacts and energy cost through systematic management of energy'[2].

Natural and social scientists, engineers and developers, for example, should take note of these energy-efficiency measures that are contained in both law and voluntary instruments when designing, developing and implementing new technologies and infrastructure and managing existing processes and facilities. They should take note of the potential interactions between the voluntary standard, as well as policies and legislation to guide and change their behaviour by contributing to an improved energy future. It is therefore the aim of this article to explore the interactions between energy law and the ISO 50001 voluntary instrument for energy management systems to answer the following research question: What are the linkages between and the principal provisions for energy efficiency as provided for in South African energy law and policy and the SANS 50001 standard that should be understood and adopted by scholars and practitioners from diverse academic and technical disciplines in order to support the country's transition to a greener economy and a more sustainable future?

This article is based on a literature survey of the most important literature, laws and policies in the field of energy efficiency. The legal discourse is informed by literature from other disciplines. Kroeze[6] states that 'law is a hermeneutic and professional discipline', which directs the methodologies used, the research questions posed, the assumptions made and the hypotheses postulated. As Areeda[7] states:

> *The needs and purposes of the law are not necessarily the same as the interests and objectives of the expert*[s] *pursuing* [their] *own discipline*...[t]*he proper legal result may turn on statutory interpretation, characteristics of the legal system, or other matters of policy on which* [another] *science has little to contribute. It is for those reasons that outside disciplines are not the law, but only illuminate it.*

According to Kroeze[6] and Areeda[7], lawyers 'borrow' from other disciplines and translate the knowledge acquired from other sciences into law. Subject matter experts from other disciplines often argue that the law is too generic, ignoring the detail and complexities that characterise specific scientific sub-disciplines and their fields of expertise. Areeda[7] comments:

> *While the other disciplines seek truth for its own sake, the law is more skeptical about finding it and uses only as much of it as is helpful to guide our prudential policy choices in this untidy world.*

This article proceeds from the premise that environmental law in general and energy law in particular are complex fields of inquiry requiring a new approach to multidisciplinary research. Lawyers need to progress from mere 'borrowing' scientific knowledge to inform the law, to work in multidisciplinary teams with researchers from a variety of applicable disciplines to generate new law, and implement and enforce existing law in order to address these growing complex systems. Energy efficiency is used to illustrate this complexity.

Energy efficiency, energy use and energy consumption in South Africa

In this section, legal definitions are compared to definitions found in other policy documents and literature to determine whether the legal and scientific definitions correlate. Some statistics with regard to energy consumption in South Africa are also provided and the drivers for the introduction of energy-efficiency measures are discussed.

SANS/ISO 50001:2011[2] defines 'energy efficiency' as the 'ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy' and provides as an example the 'conversion efficiency, energy required or energy used, the output or input; the theoretical energy used to operate or the energy used to operate'. The *National Energy Act 34 of 2008* (section 1) defines 'energy efficiency' as the 'economical and efficient production and utilisation of an energy carrier or resource'. Barton[8] describes it as 'a ratio of function, service, or value provided in relation to the energy converted to provide it' or 'the amount of work done in relation to the energy used'. Xia and Zhang[9] identify four energy efficiency classes, namely technology efficiency, equipment efficiency, operational efficiency and performance efficiency. They describe the 'performance efficiency of an energy system' as being 'determined by external but deterministic system indicators such as production, cost, energy sources, environmental impact and technical indicators'. They also indicate that all of these efficiencies may be affected by 'technical, human and time factors'. Deciding when to use energy may, for example, affect the efficiency of the technology used.[8]

The SANS/ISO and Barton definitions clearly indicate a relationship between the ratio of the output or performance and the input of energy, while the legal definition of energy efficiency focuses mainly on the result that is achieved, namely the economical and efficient utilisation or production. The examples of energy efficiency outcomes provided for in the SANS/ISO document and the four energy efficient elements identified by Xia and Zhang[9] add a dimension which can be used to describe the result as set out in the Act. It may also be necessary to redefine the term 'energy efficiency' in the Act, taking the scientific, engineering and other definitions into account to provide a more comprehensive legal definition. The legal definition should at least relate to the ratio or relationship between the input and output of energy as well as to the outcome or possible outcomes of the input and output ratio.

SANS/ISO 50001:2011 also defines 'energy consumption' as the 'quantity of energy applied', and 'energy use' as the 'manner or kind of application of energy' that may, for example, include 'ventilation; lighting; heating; cooling; transportation; processes; production lines'. 'Significant energy use' refers to 'energy use accounting for substantial energy consumption and/or offering considerable potential for energy performance improvement'[2]. These definitions are not included in the *National Energy Act* or the *Electricity Regulation Act* and if energy-efficiency measures are to be introduced in South Africa, which is the case in relation to tax measures, the question is whether these definitions should not also be included in the legislation.

Energy may also be divided into primary, intermediate and final forms of energy. Primary energy is 'extracted or captured directly from natural resources' and may be renewable or non-renewable. Intermediate energy is 'primary energy converted into other forms and final energy is the one consumers buy or receive in order to carry out desired activities'[10]. Energy efficiency deals with the final energy form. Again this distinction is not made in law.

It is also necessary to define energy management. 'Energy management' in relation to information technology is defined as

> *a set of functions for measuring, modelling, planning, and optimizing networks to ensure that the network elements and attached devices use energy efficiently and* [are] *appropriate for the nature of the application and the cost constraints of the organization.*[11]

While an 'energy management system' relates to

> *a set of systems or procedures upon which organizations can develop and implement an energy policy, set targets, action plans and*

> *take into account legal requirements related to energy use, an EnMS allows organizations to improve energy performance and demonstrate conformity to requirements, standards and/or legal requirements.*[2]

The definition of an EnMS becomes important when such a system is introduced to ensure energy efficiency and to measure its outcomes. South Africa has introduced regulations referring to energy management systems and tax incentives[12] which may necessitate the introduction of this terminology into law. It is important to note that a legal definition often does not correspond with a scientific definition and it is therefore important for scientists to explore legal definitions and for lawyers to explore scientific definitions. A court of law will adhere to a definition in an Act, but if a term is not defined, or is vaguely defined, the court has to refer to other definitions in dictionaries; but as science comes to play a more important role in environmental and energy legislation, the court will soon also have to begin to refer to scholarly articles in scientific journals to find solutions.[13]

Ward and James[14] state that 'through globalization there has been an increasing shift of energy-intensive manufacturing from industrialized countries to developing countries and, with that shift, a shift of emissions'. South Africa's energy is mostly generated by the coal-fired generation utilities of the public supply company Eskom.[15] In 2010, the Department of Energy[16] stated that South Africa has an energy-efficiency potential ranging from 20% to 30% across various segments in the public and private sectors. The end users of electricity at that time included 'the domestic sector (17.2%), agriculture (2.6%), mining (15%), industry (37.7%), commerce (12.6%), transport (2.6%) and other (12.3%)'[16].

What are the drivers to support energy efficiency management by these sectors?[8,17] Economic and cost factors are almost always a key determinant of change, while safety and environmental requirements for pollution control and the reduction of climate change impacts also remain important drivers.[8,18-20] The contribution of the transition to a green economy (referred to above) remains to be determined. Incentives are often also a reliable driver for change, while taxes and the cost of energy may also initiate and drive change.[8,21] The cost of energy will significantly increase should South Africa's proposed carbon tax be introduced at the rate of ZAR120 per tonne CO_2 in 2015.[22] It was estimated in 2011 that, should a carbon tax of ZAR110 per tonne of CO_2 be levied, the increases in costs to a cement factory would translate to an additional ZAR265 per tonne of coal, 28c per litre of diesel and 11c per KWh of electrical energy used. It was estimated that, even without the carbon tax, the cost of energy could increase by 45% in a cement factory as a result of the increase in diesel, coal and electricity-related costs.[23] To stay competitive, the cement industry indicated that it would have to become more energy efficient at an operational level.[23] Barton[8] also identifies energy security (or rather insecurity) as a possible driver.

The International Energy Association introduced 25 Energy Efficiency Recommendations in 2011.[24] (South Africa is not a member of the International Energy Association.) Recommendation 21 states that governments should require large energy-intensive industries to conform to ISO 50001 or an equivalent energy-management protocol and should encourage other industrial energy users to do the same. Governments should expect of industries to report on their energy savings. According to the Recommendation, energy management measures should include[24]:

> *Identifying and assessing energy saving opportunities by benchmarking, measuring and documenting energy consumption;* [i]*mplementing actions to capture identified energy saving opportunities;* [and] [p]*ublicly reporting the energy-saving opportunities identified and the actions taken to capture them.*

A study by the United Nations Environment Programme, the Global Environment Facility and the International Energy Agency indicated that the phasing out of incandescent bulbs alone might result in a reduction of 5% in global electricity consumption and 6% in the output of carbon dioxide, which translates into the 'equivalent of more than 450 coal-fired power plants or more than 122 million mid-sized cars'[24]. Government may also introduce command and control measures such as standards or punitive measures to enforce energy-efficiency measures.[8]

There is therefore a drive towards energy efficiency and a need to implement measures to enforce it. The implementation of such measures may still be a challenge as the legal measures do not necessarily correlate with other scientific literature. It is therefore necessary to determine if a policy framework is in place to introduce energy efficiency.

Policy measures

In 1998 the South African government published a *White Paper on the Energy Policy of the Republic of South Africa,*[25] referring to energy efficiency not only in households but also in the industrial, mining and commercial sectors. At this stage, government had already committed itself to promote improved energy efficiencies by way of 'cleaner energy end-use technologies, environmental performance auditing and incorporating environmental costs' in the end price of energy. The need to address energy efficiency in the transport and agricultural sector has also been referred to.[25] In 2004, the *White Paper on Renewable Energy*[26] indicated a link between energy efficiency and the introduction of renewable energy.

The *Climate Change Response White Paper*[5] provides for mitigation and adaptation responses. The government proposed the introduction of a few Near-term Flagship Programmes to address some of the climate change challenges. An Inter-Ministerial Committee and Intergovernmental Climate Change Committee were to be established to oversee and implement the programmes. The adaptation programmes include the introduction of 'regulatory measures, market-based instruments, tax incentives and fiscal subsidies, information and awareness initiatives'[5]. The regulatory measures include, for example, energy efficiency targets 'complemented by appropriate standards'[5]. The Renewable Energy Flagship Programme (para 8.3) is another driver to enhance the introduction of locally produced renewable technologies. The Energy Efficiency and Energy Demand Management Flagship Programme (para 8.4) foresees a more aggressive implementation of green building construction in both the commercial and residential sectors, for example, by setting standards for controlled ventilation and using recycled materials and solar power. All government buildings and facilities are to be audited to set indicators and benchmarks. The White Paper states that regulatory measures will be introduced in all spheres of government – national, provincial and local. Government must also review their legislation and policies to align them with the White Paper.

In December 2010, the Department of National Treasury published a Discussion Paper on Reducing Greenhouse Gas Emissions: The Carbon Tax Option. In this paper, the Department acknowledges that although South Africa is a non-annex 1 developing country in terms of the Kyoto Protocol, it is ranked as 'among the top 20 countries measured by absolute carbon dioxide (CO_2) emissions'[27]. In 2009, South Africa announced that it will reduce its greenhouse gas emissions by 34% by 2020 and 42% by 2025.[27] In May 2013, the National Treasury published an updated version of the *Carbon Tax Policy Paper*[22] for public discussion. The paper indicates that one of the outcomes of carbon taxes should be the introduction of more energy-efficiency measures. The policy document favours a 'carrot-and-stick' approach as it introduces tax measures (punitive measures) as well as tax incentives for energy-efficiency measures and the introduction of renewable energy. On 1 January 2014, a carbon tax was to be introduced at ZAR120 per tonne CO_2-eq, and provision was to be made for tax-free thresholds and offsets. The tax would have been introduced for 'emissions that result directly from fuel combustion and gasification, and from non-energy industrial processes ...[including] carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulphur hexafluoride'. The tax would have been increased at a rate of 10c per annum until 31 December 2019, with a new tax regime to be introduced on 1 January 2020. The gradual increases in carbon taxes should have allowed large intensive energy users to reduce their scope 2 energy emissions (indirect emissions resulting from the

use of purchased electricity, heat or steam) and to introduce more energy-efficiency measures. The introduction of the proposed carbon tax measures was again postponed for further consultation until 2016.[28] In addition to the carbon tax in 2012 the National Treasury proposed the introduction of an electricity levy on non-renewable sources to fund energy-efficiency initiatives.[29]

The Department of Energy's *Policy to Support the Energy Efficiency and Demand Side Management Programme for the Electricity Sector through the Standard Offer Incentive Scheme* of May 2010[16] proposes various tools or measures to ensure energy efficiency, such as an Energy Conservation Scheme. According to this Scheme, certain key industrial electricity customers with a monthly consumption above 100 GWh per annum per site were required to submit their 'historical baseline consumption profile…in Gwh points spread over one year over any 12-month period'[16] to the licencee by June 2010. The licencee negotiates a baseline with the customer and the baseline is ratified by the National Energy Regulator of South Africa (NERSA). The Minister of Energy then sets a reduction target for each industrial sector. NERSA accordingly determines a tariff on a punitive scale using the baseline information as its point of departure. If less energy than the baseline is consumed then a standard rebate would be offered.

Policies are not enforceable. They are political statements of intention of what government would like to introduce. From the discussion it is clear that the policies are in place and that government is committed towards introducing measures to enforce energy efficiency. It is therefore necessary to determine whether the legal framework sufficiently provides for measures to regulate the introduction of energy efficiency.

Legislation

South Africa's legislation already makes provision for the possibility of introducing energy-efficiency measures. One of the aims of the *Electricity Regulation Act 4 of 2006* is to promote energy efficiency. In section 15(1)(u), the Act allows NERSA to place conditions in licences dealing with energy-efficiency standards and demand-side management. NERSA may also place energy-efficiency conditions on the licencee and may amend them from time to time to adapt to national energy priorities as set out in policies. In terms of GN R721 of 2009,[30] energy efficiency must be taken into account when an integrated resource plan is developed. The Integrated Resource Plan 2010–2030 was published in 2010 and introduced, amongst other things, an energy efficiency and demand-side management financial incentive scheme (a standard offer).[31,32] It is also foreseen that public facilities and housing programmes introduced by government should be energy efficient (by making use of insulation, efficient lighting, motion sensors, for example).[33] Measures will also be introduced for 'commercial buildings (offices, hotels and the hospitality industry, employee compounds at mines, refineries, power stations)'. Government has subsequently introduced green building standards on a local government level and incentives for installing solar-water heating.[34]

The *National Energy Act 34 of 2008* defines 'energy efficiency' as the 'economical and efficient production and utilisation of an energy carrier or resource' and also allows the Minister to issue regulations pertaining to energy efficiency, including (section 19(f)-(n)) measures dealing with minimum levels of energy efficiency in each sector of the economy; the steps and procedures necessary for the application of energy efficiency technologies and procedures; and measures for the labelling of household appliances, devices and motor vehicles indicating their energy-efficiency levels. The Minister may also prohibit the manufacture, importation or sale of electrical and electronic products and fuel-burning appliances for reasons of less than expected energy efficiency and publish standards and specifications for energy carriers as well as energy efficiency standards for specific technologies, processes, appliances, devices, motor vehicles and buildings. He or she may introduce energy conservation measures during energy shortages, 'which may include but [are] not limited to the amount of energy to be saved, the duration for such measures and penalties associated with non-compliance to such measures'. The Minister has not issued regulations dealing with energy efficiency yet. The Minister has, however, issued regulations in terms of the *Electricity Regulation Act 4 of 2009*. In terms of this Act, the Minister may make regulations on the types of energy sources from which electricity must be generated, and the percentages of electricity that must be generated from different energy sources (section 35(4)(k)-(l)).[34] The *National Environmental Management: Air Quality Act 39 of 2004* may further be used to set national, provincial and local standards for air quality, priority areas, controlled emitters and energy carriers. The legislation does not regulate the detail of energy efficiency but allows the Minister to deal with the specifics in regulations which will need the inputs of various specialists.

Other market-based measures (economic incentives) have also been introduced to address environmental issues and may be regarded as measures that address climate change.[5,35] They include 'the electricity generation levy, motor fuel levy, motor vehicle emissions tax, the levy on incandescent light bulbs, tax incentives supporting renewable energy measures (biofuels, solar panels etc.) [and the] Cleaner Development Mechanism projects'[5]. In 2013, the Department of Energy introduced Regulations on the Allowance for Energy Efficiency Savings in terms of section 19 of the *National Energy Act 34 of 2008*.[12] In terms of the regulation, a person (including an industry) may claim a tax allowance in terms of section 12L(5) of the *Income Tax Act 58 of 1962* for energy-efficiency savings. The person must register with SANEDI (the South African National Energy Development Institute established in terms of section 7 of the *National Energy Act*) in respect of any energy-efficiency savings he or she may want to claim (regulation 2(1)). The person must also appoint a measurement and verification (measurement and verification as applied in terms of ISO 50001, para 4.6.1)[12] professional to compile a report containing the energy-efficiency savings for the year for which the allowance is claimed. A measurement and verification professional is someone who acts under the auspices of a measurement and verification body that is accredited by the South African National Standards (SANS) and who may inspect, measure, report and verify energy-efficiency savings (regulation 1 – a body accredited in terms of section 22 of the *Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act 19 of 2006*). This report must be submitted to a committee of SANEDI (appointed in terms of regulation 3). This committee may obtain independent professional advice to confirm that the report complies with SANS 50010:2011 and that it is a true reflection of the energy savings that are claimed (regulation 3(3)-(4)). SANEDI must then issue a certificate (regulation 3(2)) containing 'the baseline at the beginning of the year of assessment for which the allowance is claimed, derived and adjusted in accordance with regulation 5 and determined in accordance with' ISO 50001 (regulation 4). The baseline calculation must be made in accordance with regulation 5 and in accordance with the methodology in ISO 50001. The study must also refer to the energy used at the end of the year, the annual energy savings expressed in kilowatt hours determined in accordance with ISO 50001, the name of the measurement and verification body that certified the professional who conducted the report, etc. (regulation 4). The tax measures are seen as an incentive for industry to introduce energy efficiency practices.

Gunningham[36] foresees that market-based instruments/economic incentives may be 'one component of a broader mix of energy policy initiatives'. However, economic measures alone will not achieve energy-efficiency targets. It is necessary, as indicated above, to introduce voluntary measures such as ISO 50001[2,8] as well as legal and policy measures to effectively change behaviour.

In order to implement and enforce these regulations, various specialists (for example, engineers, economists, energy management specialists, auditors and lawyers) would need to be involved as indicated. As ISO 50001 has been introduced as part of the law, it is necessary to understand how it came about and what it entails.

SANS/ISO 50001:2011

The USA and Denmark developed energy management standards in 2000. Sweden followed in 2003, the Netherlands in 2004, Ireland in 2007, and Korea and Thailand in 2008. In 2009, China had a draft standard.[37] The voluntary programmes targeted large industrial plants

with the idea of recognising outstanding performers. Financial incentives and training were provided.

Driven by the debate around climate change, the idea of an international energy management system standard was suggested by the United Nations Industrial Development Organization to the International Organization for Standardization secretariat in 2007.[38] Discussions were held between developed and developing countries. The ISO Technical Management Board approved the project to generate the ISO 50001 standard in February 2008, and it was finally introduced in June 2011. The ISO Committee is also developing ISO standards on Energy Baseline General Principles and Guidance; Guidance for the Implementation, Maintenance and Improvement of an EnMS; Monitoring, Measurement, Analysis and Verification of Organizational Energy Performance, Energy audits, Energy management system audits and auditor competency; and Energy Performance Indicators, General Principles and Guidance.[39]

The South African SANS/ISO 50001:2011 standard is based on ISO 50001 drafted by the ISO/PC 242, the Energy Management Technical Project Committee of the International Organisation for Standardisation. The South African standard was approved in June 2011. In the introduction[2] it is stated that '[t]his International Standard is applicable to all types and sizes of organizations, irrespective of geographical, cultural or social conditions' as well as any type of energy user.[2] Like the ISO 14001:2004 Environmental Management Standard, the ISO 50001:2011 standard is based on the Deming management Plan-Do-Check-Act model.[10,39]

SANS/ISO 50001:2001 correlates with the other ISO management system standards and can be integrated, for example, with environmental or occupational health systems as well as general quality systems. Annexure B of SANS/ISO 50001:2011 indicates, for example, the correlations between the different standards: ISO 50001:2011 (Energy Efficiency Management Systems); ISO 9001:2008 (Quality Management Systems); ISO 14001:2004 (Environmental Management Systems) and ISO 22000:2005 (Food Safety Management Systems). An organisation may use the standard in order to obtain certification from ISO or may register with ISO. It may also use the standard to ensure and declare that the organisation's practices conform to the international standard. The organisation commits to its own energy policy as well as to its obligation to comply with legal and other requirements.

As in other management systems, the main requirements of the energy management system include general requirements, the responsibility of management, the formulation of an energy policy, energy planning, implementation and operation, and checking and review.[2] In this review, the focus is on indicating where legal requirements play a role in the energy management system process and therefore on the linkages between law, science, engineering and energy management.

According to the standard[2], an organisation must 'establish, document, implement, maintain and improve an energy management system in accordance with the international standard'. It must 'define and document the scope and boundaries of its energy management system' and 'determine how it will meet the requirements' of SANS/ISO 50001:2011 in order to '…achieve continual improvement of its energy performance and of its environmental management system'.[2] ('Energy performance' is defined as 'measurable results related to energy efficiency, energy use and energy consumption' – para 3.12.) The 'boundaries' of the organisation are the 'physical or site limits and/or organizational limits', which may include, for example, 'a process, a group of processes, a site, an entire organization, [or] multiple sites under control of an organization', while 'scope' refers to the 'extent of the activities, facilities, decisions that the organization addresses through an environmental management system, which can include several boundaries'. It may for example refer to 'energy related to transport' (para 3.1 and 3.26). The boundaries and the scope of the organisation will determine the legal obligations to which the organisation must adhere and which will form the bottom line for certification.[40]

Top management must truly commit to the energy management system and ensure that the necessary resources are available, otherwise the system will fail (para 4.2.1). To ensure effective implementation of the energy management system, an organisation must appoint a management representative with the necessary skills and competence (para 4.2.2.). Hilliard and Jamieson[41] describe the skills such a person should have as 'technical and analytical abilities which should include knowledge of power electrics, thermodynamics, and statistics, with an aptitude for modelling and analysis'; business literacy that includes the ability to 'concisely and authoritatively contribute to management decision-making for assessing EM investment', and 'social skills and agreeability'.

Top management must draft an energy policy stating the organisation's commitment to achieve energy performance improvement. This policy must be 'appropriate to the nature and scale of the organisation's energy use and consumption' and must amongst other things include 'a commitment to comply with applicable legal requirements and other requirements to which the organisation subscribes related to its energy use, consumption and efficiency' (para 4.3(a) and (d)).

The organisation must further 'conduct and document an energy planning process' which coincides with its energy policy. The energy planning process includes the identification of all legal and other requirements that may be applicable to the organisation (para 4.2.1). The organisation must determine 'how these requirements apply to its energy use, consumption and efficiency and shall ensure that these legal requirements and other requirements to which it subscribes are considered in establishing, implementing and maintaining' the energy management system (para 4.2.2). It is interesting that the standard does not refer to legal compliance as such, but only to the commitment of the organisation to comply with the laws.

The organisation must conduct an energy review, which may include an analysis of the current energy sources and energy use and consumption. The organisation will have to be able to demonstrate an improvement in energy efficiency, which means it will have to quantify its improvements – a task that a lawyer will not be able to perform. Various models have been developed to assist organisations in this regard.[8,42] In relation to the energy baseline, ISO 50001:2011 (A 4.4) states[2]:

> [A] *suitable data period means the organisation accounts for regulatory requirements or variables that affect the energy use and consumption. Variables can include weather, seasons, business activity cycles and other conditions.*

This information (compiled by energy specialists, engineers, accountants, etc.) will form an energy baseline against which future energy use and consumption could be measured (A 4.4).[2] The review must also include an identification of the facilities, equipment, systems, processes and personnel (e.g. contractors, part-time personnel and temporary staff) that may significantly affect energy use and consumption and an estimation of future energy use and consumption (A 4.3).[2] The energy use and consumption may be prescribed by legislation or may be defined by the organisation itself.[43] The main aim of the review should be to 'define areas of significant energy use and to identify opportunities for improving energy performance'[2] (A 4.3). One should provide for human error in the interpretation of data. Timescales may also influence the interpretation of the data and the interpretation may be influenced by the loss of institutional memory. The model that is used for capturing energy data should not only be cost effective but should also correlate with human understanding: 'Energy models with finer data may be more useful but a model that few understand is dangerous and a model that falls out-of-date is worthless.'[41]

The organisation must establish energy performance indicators 'appropriate for monitoring and measuring its energy performance'. According to SANS/ISO 50001:2011 (A 4.5), an energy performance indicator could be a simple ratio or a complex model such as 'consumption per time, energy consumption per unit or production, or multi-variable models'[44]. The organisation must record and review the methodology used to determine these indicators (para 4.4.5). In addition, the organisation must 'establish, implement and maintain documented

energy objectives and targets at the relevant functions, levels, processes or facilities of the organisation'. The objectives and targets must coincide with the energy policy and the objectives with the targets. The targets must be linked with a time frame. SANS/ISO 50001:2011 states clearly that legal and other requirements, amongst others, must be considered when the objectives and targets are considered. The legal requirements may include international, national and provincial laws and bylaws. Other requirements may include voluntary principles or codes of practice or voluntary practices to which the organisation subscribes (A 4.2).[2] The views of interested parties must also be considered. The objectives and targets must be translated into an action plan (para 4.4.6).

In order to ensure implementation of the action plan, the organisation must employ skilled people and train them in the importance of conformity to the energy policy, procedures and requirements of the energy management system. The employees must also be aware of their roles and responsibilities in terms of the energy management standard and must understand what the impact and consequences of their activities and behaviour are, or could be, on energy use and consumption as well as on the energy objectives and targets set (para 4.5.2).

The organisation must communicate internally on its energy performance and may decide to communicate externally on its energy policy and performance (para 4.5.3). The communication could include non-compliance with legislation, although compliance is not an explicit requirement. The organisation must have a proper document control system in place, which must include objectives, targets and action plans. However, in most instances it will be necessary to document the legal requirements as well, and to review and update them regularly (para 4.5.4.1 and 4.5.4.2).[2] The organisation must ensure that the correct version of the legal requirement is available. The organisation must also identify those operations and activities that are related to its significant energy uses and ensure that they are carried out under the specified conditions. These operations include emergency and contingency plans (para 4.5.5).

In the design of new, modified or renovated facilities, equipment, systems and processes, an organisation must consider energy-performance opportunities if such a facility, equipment, system or process may have a significant impact on its energy performance. The result must be incorporated into the 'specification, design and procurement activities of projects' and recorded (para 5.4.6).

The organisation must when it obtains energy services, equipment or products inform suppliers that procurement is evaluated on the basis of energy performance. If the legislation does not provide specific criteria, the organisation must establish and implement criteria to assess energy use, consumption and efficiency 'over the planned or expected operating lifetime when procuring energy products, equipment and services which are expected to have a significant impact on the organisation's energy performance' (para 4.5.7). ISO 50001 could be used to ensure that procurement is used to 'improve energy performance through the use of more efficient products and services. It is also an opportunity to work with the supply chain and influence its energy behaviour' (A 5.7).[2]

An important aspect of the energy management system is checking (para 4.6). One of the components of checking is the evaluation of compliance with legal requirements and other requirements (para 4.6.2). The results of such evaluations have to be documented. A procedure must be available to ensure that the documents are retained, easily identifiable and retrievable (para 4.5.6).

The organisation may conduct an internal audit to determine whether the organisation complies with the environmental management standard's objectives and targets and whether the environmental management plan is implemented and maintained. The auditor must also establish if the energy management standard improved energy performance (para 4.6.3). On 12 May 2012 it was decided that the Southern African Auditor and Training Certification Association (SAATCA) accreditation processes for lead auditors will apply to energy management system auditors as well.[45] The criteria for SAATCA EnMS start-up auditors were also discussed. Records must be kept of the audit report. The organisation must address all actual and potential non-conformities. These non-conformities may include non-compliance with legal requirements. The preventative steps must also be documented. The effectiveness of the corrective action must also be reviewed. If need be, the energy management standard must be amended.

From time to time, top management must review the energy management standard to determine its 'suitability, adequacy and effectiveness'. The management review must include, for instance, a review of the 'results of the evaluation of compliance with legal requirements and changes in legal requirements and other requirements to which the organisation subscribes' (para 4.7.2). The output of the management review may, for example, include an amendment to the energy policy, objectives and targets or energy performance indicators (para 4.7.3).

Why do companies introduce or not introduce energy management systems? According to Pandolfo[10], organisations will invest money if immediate cost reductions are visible. In the case of energy consumption, the immediate cost reduction cannot be predicted and the benefits cannot be identified. Steele[46] is of the opinion that the benefit of adhering to a management system standard is its voluntary nature and that it was developed by the users themselves, that it provides performance-based solutions, that costs could be reduced, that organisations can participate in markets that were previously closed to them, that it ensures legal compliance, that it reduces risks and ensures continuous improvement, and that it is at least a step taken towards implementing best practice. It also ensures that the organisation is competitive, socially responsible and environmentally friendly by reducing its dependence on natural resources and its carbon footprint.[10] It may be easier for larger companies to effect energy management with the appointment of energy managers. Smaller organisations cannot always afford to attract people with the necessary expertise.[40] Pandolfo[10] found that it is easier for a site with ISO 14001 certification to implement ISO 50001:2011 than for one starting from scratch. In her study she indicated that such a site already complies with 70% of the ISO 50001:2001 requirements. Management must, however, commit to the introduction of an energy-management system to ensure its effective implementation and must be prepared to fund the expenses.[47] The most challenging aspect is to determine the baseline energy consumption, for which determination is not required by ISO 14001:2004. It is important that organisations share information on best practice, energy-efficiency technologies and the results of case studies.[47] Some countries have incentives to stimulate the introduction of energy-efficiency technology and investment.[47] The introduction of a voluntary mechanism such as an ISO standard as an incentive is less well known from a legal perspective.

Conclusion and recommendations

In a recent article, Thopil and Pouris[21] indicated the need for differential pricing of electricity as 'a technique that offers flexibility within the context of the country's economic, social, industrial and environmental policies' and the need to force energy-intensive industries to use energy more wisely. Such a market-based instrument is but one of many instruments that can be employed to drive energy efficiency. In this article it has been established that there is a link between energy-efficiency policy, legislation and the voluntary mechanism SANS/ISO 50001. One regulation already includes ISO 50001 measurement standards into its regulatory procedures, coupling them with tax measures, while the ISO 50001 standard refers to legal requirements. It has also become clear that several laws and policies refer to energy efficiency as a tool to reduce energy use and consumption. The legislation does not explicitly indicate how these measures should be introduced. Policies and laws need to be implemented. The only regulation that provides clear guidelines is the one providing tax incentives for the implementation of energy-efficiency measures. Energy efficiency is, however, not a goal that can be achieved by practitioners schooled in a single discipline. It has become apparent that an interdisciplinary approach will be needed to implement and enforce not only the statutory measures but also voluntary standards. Lawyers will not be able to work in this field without the input of scientists such as engineers, energy specialists, tax specialists, architects, accountants and environmental managers,

among others. Similarly, engineers and other scientists will not be able to implement these measures without legal input. Scientists and lawyers will have to work together to develop norms and standards for energy-efficiency practices.

Climate- and environment-related issues have become an important feature of every person's daily life. As stated above, law is one of the disciplines that is able to integrate natural science, engineering, mathematics, social sciences and other disciplines by providing incentives and disincentives. Science needs to be translated into policy and law. The law cannot ignore the rest of the scientific world. It needs its input, especially in complex fields such as energy and energy efficiency.

The need for improvement of energy efficiency and to reduce the energy intensity of the economy was reiterated in the Draft 2012 Integrated Planning Report that was published in July 2013.[48] Command and control measures (i.e. measures enforced by government) frequently fail to efficiently and effectively drive transitions towards energy efficiency and legal compliance. It is noted that energy efficiency performance by the private sector is in some instances driven rather by international market demands than by command and control measures. It is therefore necessary to move away from a silo-based approach towards science to an integrated approach in which the natural sciences, humanities and social sciences approach issues such as climate change and the environment in a holistic manner.

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