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Predicting the quantifiable impacts of ISO 50001 on climate change mitigation

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ABSTRACT

Energy consumption in the industrial and commercial (service) sectors accounts for nearly 40% of global greenhouse gas emissions. Reducing this energy consumption will be critical for countries to achieve their national greenhouse gas reduction commitments. The ISO 50001-Energy management standard provides a continual improvement framework for organizations to reduce their consumption. Several national policies already support ISO 50001; however, there is no transparent, consistent process to estimate the potential impacts of its implementation.

This paper presents the ISO 50001 Impacts Methodology, an internationally-developed methodology to calculate these impacts at a national, regional, or global scale suitable for use by policymakers. The recently-formed ISO 50001 Global Impacts Research Network provides a forum for policymakers to refine and encourage use of the methodology.

Using this methodology, a scenario with 50% of projected global industrial and service sector energy consumption under ISO 50001 management by 2030 would generate cumulative primary energy savings of approximately 105 EJ, cost savings of nearly US $700 billion (discounted to 2016 net present value), and 6500 million metric tons (Mt) of avoided CO_2 emissions. The avoided annual CO_2 emissions in 2030 alone are equivalent to removing 210 million passenger vehicles from the road.

Abbreviations: ATPEC, Adjusted total projected energy consumption; CES, Cumulative energy savings; CSI%, Continual savings improvement percentage; CIES, Continual improvement of energy savings; ECUM, Energy consumption under management; ES, Energy savings; k, Steepness of the logistic function (function growth rate); L, Logistic function maximum value (upper asymptote); L_0, Logistic function initial value (lower asymptote); NAES, New annual energy savings; PV, Present value; *r*, Interest rate based on a 10 year US treasury bond yield rate; $t_{current}$, Present year to which the annual savings are being discounted; t, The year at which the cost savings are observed; t_{pmg}, The year at which the logistic function reaches a point of maximum growth; TAES, Total annual energy savings; TPEC, Total projected energy consumption; TNAES, Total new annual energy savings

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1. Introduction

For the 197 countries who are convention parties to the United Nations Conference on Climate Change 2015 Paris Agreement, achieving their GHG reduction targets will require an unprecedented focus on effective policies, international coordination, and engagement with key stakeholders, especially in the private sector. Because energy consumption in the industrial and commercial sectors accounts for nearly 40% of global GHG emissions (Fischedick et al., 2014; Lucon et al., 2014), reducing energy consumption in these sectors is critical for countries working to achieve their GHG reduction targets. Although the energy savings potential in the industrial and commercial sectors is significant, barriers remain to achieving these savings. According to the Intergovernmental Panel on Climate Change, "a lack of human and institutional capacities to encourage management decisions is a primary barrier for energy efficiency that must be removed for the industrial sector to realize its mitigation potential" (Fischedick et al., 2014).

The systematic management of energy has been identified as a pathway to overcome a number of these barriers and improve energy efficiency in organizations while maintaining productivity (EMWG, 2014). The International Organization for Standardization (ISO) 50001 - *Energy management systems – Requirements with guidance for use* provides a continual improvement framework to guide organizations in making energy performance improvement an ongoing part of normal business operations, rather than focusing on individual efficiency projects (McKane et al., 2009). Through its dual emphasis on an energy management system (EnMS) and continual improvement of energy performance, ISO 50001 assists organizations in reducing industrial and commercial energy consumption, managing energy costs, and avoiding GHG emissions. Therkelsen et al. (2015) have shown that the implementation of an ISO 50001-certified EnMS results in more than four times the energy savings achieved under a business as usual scenario, with a payback of under 1.5 years for medium to large industrial facilities.

Organizations around the world are implementing ISO 50001 on their own initiative and in response to national and regional policies and programs. Facilities that implement ISO 50001 can choose to demonstrate their conformance to the standard through validation by an external certification body. An ISO-maintained database of these certifications reports that nearly 12000 ISO 50001 certificates were issued worldwide in 2015, up from nearly 7000 in 2014 (ISO, 2015). While the number of ISO 50001 certificates issued continues to increase, accelerated uptake is needed to significantly impact global GHG emissions. To support this acceleration, policymakers need to be able to transparently assign, evaluate, and communicate the value of ISO 50001 adoption on a national, regional, and global scale. In addition, policymakers would greatly benefit from opportunities to share information on the relative efficacy of ISO 50001-enabling policies in a range of regulatory contexts.

The Energy Management Working Group (EMWG) of the Clean Energy Ministerial provides an international forum for member governments to collaborate on activities to accelerate broad use of EnMS in industry and commercial buildings worldwide (EMWG, 2016a). The EMWG identified the need for an internationally-developed, transparent, and adaptable methodology to estimate the impacts of ISO 50001 and subsequently established the ISO 50001 Global Impacts Research Network (Impacts Network). Membership of the Impacts Network includes international academics, researchers, and policymakers, who collectively are tasked with providing input on the development of the methodology and facilitating discussion of policy drivers for energy management.

This paper describes the ISO 50001 Impacts Methodology as set forth in the ISO 50001 Impacts Estimator Tool (IET 50001) and presents estimates of the potential global energy, energy cost, and carbon dioxide (CO_2) emissions savings associated with ISO 50001 uptake. The IET 50001 software is designed to help global policymakers estimate the impact of implementing ISO 50001 in a country or region. The Impacts Network has provided comments and expert guidance in shaping and refining the methodology presented in this paper. To provide a policy context, the Impacts Network experts have also contributed several examples of national and regional ISO 50001 implementation plans, actions, and impacts, which are included in Appendix A.

2. Background

Reducing energy consumption in the industrial and commercial sectors presents a significant opportunity for countries to achieve the GHG reduction targets outlined in the COP21 INDCs. The industrial sector[1] contributes 30% of total GHG emissions, of which 85% are CO_2 (Fischedick et al., 2014). Based on Lucon et al. (2014), the commercial sector accounts for 7% of global GHG emissions. The bulk of commercial-sector emissions are indirect CO_2 emissions from the consumption of electricity in buildings.

In recent decades there have been improvements in energy intensity (a measure of the energy used per unit of output) in the industrial sector, but the progress has been more than offset by growth in production (IIP, 2012). Looking forward, energy demand in both the industrial and service sectors is expected to steadily grow (EIA, 2013; Fischedick et al., 2014), making it particularly important for governments and businesses to work towards achieving greater improvements in energy performance to limit climate impacts.

Improved energy efficiency has been identified as a low-cost option to reduce CO_2 emissions from organizations while maintaining or improving productivity levels (IEA, 2015a; UNIDO, 2011). Substantial energy savings are available in the industrial and service sectors from both technological and operational improvements (UNIDO, 2011). Cost savings potentials in the service sector from high-performance envelope and higher-efficiency equipment are between 35% and 50%, and retrofits can achieve 25–70% savings in total energy use (Lucon et al., 2014).

Although best available technologies are approaching technical limits for some sectors, there remain many energy-efficiency opportunities in optimizing the operation of industrial processes and the configuration and operation of industrial and service sector systems, especially for less energy-intensive industries. For example, motor-driven equipment consumes about 60% of electricity in manufacturing, and while replacing motors can deliver between 2% and 5% in energy savings, optimizing the motor system, made up of multiple components, can achieve savings between 20% and 30% (UNIDO, 2010). The emissions mitigation potential associated with industrial efficiency improvements is higher in developing countries than in developed ones (UNIDO, 2011), offering substantial opportunity to incorporate energy efficiency improvements into new facility design and to sustain these efficiencies through effective energy management.

Despite the significant potential for efficiency improvements and emissions reductions, barriers continue to limit uptake of these measures including: management focus on production rather than energy; lack of energy use and consumption data; lack of understanding of financial and other non-energy benefits from reducing energy use; a shortage of technical skills for identifying, developing, and implementing energy efficiency measures; a disconnect between capital costs and operating costs, and limited upfront capital (DOE, 2015; McKane et al., 2009; Sorrell et al., 2011). Energy management systems provide an organizational structure for overcoming these barriers.

[1] For the purposes of this paper the industrial sector includes manufacturing, mining, and construction.