Development of marginal abatement cost curves for the building sector in Armenia and Georgia

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ABSTRACT

Armenia and Georgia are taking climate change agenda seriously and contributing to efforts for mitigating global climate change through various ways including preparation of low carbon development strategies for their future economic growth. The improvement of energy efficiency is one of the key elements of the low carbon development strategies. This study develops a methodology to estimate marginal abatement cost (MAC) curve for energy efficiency measures and apply in the building sector in both countries. The study finds that among the various energy efficiency measures considered, the replacement of energy inefficient light bulbs (i.e., incandescent lamps) with efficient light bulbs is the most cost effective measure in saving energy and reducing greenhouse gas (GHG) emissions from the building sector. Most energy efficiency improvement options considered in the study would produce net economic benefits even if the value of reduced carbon is not taken into account. While the MAC analysis conducted demonstrates the cost competitiveness of various energy efficiency measures in Armenia and Georgia, the study also offers a caution to policy makers to have supplemental analysis before prioritizing the implementation of these measures or introducing policies to support them.

1. Introduction

1.1. Background

Armenia and Georgia are small countries in the Caucasus region located between the Black Sea, Russia, Turkey, Azerbaijan and Iran thereby connecting Eastern Europe to Western Asia. Both countries are currently developing low carbon strategies\textsuperscript{1} for their economic development while promoting economic growth and prosperity. The strategies aim to reduce the growth of greenhouse gas (GHG) emissions. The low carbon strategies are also important because both countries depend on imports for their oil and gas supply. Both countries submitted their Intended Nationally Determined Contributions (INDCs)\textsuperscript{2} in response to the decision made by the UNFCCC in its 19th Conference of Parties in Warsaw, Poland in 2013 (UNFCCC, 2013). The Paris Agreement reached at the 19th Conference of Parties in Paris in December 2015 (UNFCCC, 2015) implies that these countries will take actions to implement their INDCs. In the past, both countries provided an indicative list of options to reduce GHG emissions in their National Communications (NCs) to UNFCCC, and also in preparation of nationally appropriate mitigation actions (also referred to NAMAs\textsuperscript{3}) in accordance with an agreement made in the 16th Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) in Cancun, Mexico in 2011 (UNFCCC, 2011).

The low carbon strategies, NAMAs, NC and INDC all present list of potential options that could be implemented to reduce GHG emissions. While various approaches could be adopted to prioritize GHG mitiga-
tion options, the tool often used in low carbon strategies, these issues. The methodology is then implemented to calculate
the marginal abatement cost (MAC) curves. Energy efficiency
options are the most common GHG mitigation options identified in a
MAC curve analysis. These options are often found as the cheapest ones
with negative costs of GHG abatement in most existing literature on
green growth and low carbon strategies (see e.g., World Bank, 2014;
2013; Cervigni et al., 2013; de Gouvello et al., 2010; Johnson et al.,
2009; McKinsey and Company, 2009, 2010, 2011). However, the
economies of energy efficiency vary across countries depending on
the rate at which future energy consumption is expected to increase,
the current level of inefficiency and awareness of the availability of the
best practice technologies to improve energy efficiency.

The concept of MAC curves has been used in the literature for a
long time in determining potential for GHG mitigation from various
options in different economic sectors (production sectors, buildings,
transportation sectors). Examples of early studies using MAC curves
include UNEP (1992), Jackson, (1991, 1995), Timilsina and Lefevre
(1999), Timilsina et al. (2000). Apart from academia, private compa-
nies, such as McKinsey & Company (McKinsey and Company, 2009,
2010, 2011), Bloomberg (Bloomberg, 2010); and international insti-
tutions, such as World Bank (World Bank, 2014; World Bank, 2013;
Cervigni et al., 2013; de Gouvello et al., 2010; Johnson et al., 2009)
have been widely using the concept the MAC curve to prioritize climate
change mitigation options/technologies in various countries.

1.2. Knowledge gap in literature

In this sub-section, we briefly discuss literature review on MAC
curves. Since in-depth review of literature on the strengths and
weaknesses of MAC approach is already available. For example, Kuik
et al. (2009) presents a meta analysis on MAC approach. Similarly,
Kesicki and Strachan (2011)and Ekins et al. (2011) critically assess the
MAC approach. Our study focusses on some technical issues embodied
in methodologies in MAC. For example, should an MAC curve analysis
compare potential GHG mitigation options in a static fashion as if all
mitigation potential of an option can be exploited now, or should the
MAC curve be based on analysis over a time period in which the GHG
mitigation option, such as improvement of energy efficiency, is
implemented gradually? The latter approach can be interpreted as a
dynamic MAC curve analysis and it would be more realistic because it
is impractical to assume that the full GHG mitigation potential of a
measure is ready for exploitation in a short interval of time. Another
issue is: if the investment costs of GHG mitigation be the same when:
(i) an energy inefficient device or process already installed in an
existing facility be replaced with new energy efficient device or process
and (ii) when consumers face a choice between energy efficient and
inefficient device/process to install in a new facility (e.g., choice of roof
and window insulations in a building to be built). Further, what
assumptions are to be made regarding the penetration of a GHG
mitigation measure in the baseline where no policy measures are
introduced to incentivize the implementation of the measure?

Existing studies have used different approaches to address these
issues. Most existing studies do not differentiate between the existing
and new facilities while developing MAC curves and thus use the same
opportunity costs in both cases. Therefore, MAC curves produced by
various studies are not comparable and the use of the same opportunity
costs is misleading. Moreover, existing studies use different assump-
tions on penetration rate of GHG mitigation measures in baseline as
well as climate change mitigation scenarios. This also leads to different
calculations of GHG mitigation potential of the same measure.

This paper aims to present a methodology to contribute in resolving

6 Please see Timilsina et al. (2016) for quantification of energy efficiency barriers in
Ukraine.

5 The differentiation between existing and new buildings and also between existing
stock of appliances and new stock of appliances has different implications. This is
because some existing buildings might have already adopted new stock of appliances, if
that is the case those new stock of appliances would be part of baseline. On the other
hand, some new buildings could still use inefficient appliances. Thus, a baseline
could include not only existing buildings but also new buildings depending upon whether or
not the buildings use inefficient or efficient appliances. The same logic is applicable for
the mitigation scenario as well.
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