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GLOBAL CLIMATE CHANGE MITIGATION: WHAT IS THE ROLE OF DEMAND REDUCTION?

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Abstract

Though world leaders did not reach any agreement in Copenhagen in setting CO_2 reduction targets for individual countries or for major emitters, politicians agreed that inaction makes its consequences more irreversible and there must be substantial cuts in CO_2 emission. Global atmospheric CO_2 concentration increased rapidly in recent decades. The primary source of the increased atmospheric concentration of CO_2 since the pre-industrial period results from fossil fuel use (IPCC 2007), emitted by burning carbon intensive fuel in the supply side especially in the power sector as well as consumption in the demand side in order to meet the energy services demands. There are different options to reduce CO_2 emissions: efficiency improvement, low carbon alternative fuels, sequestration (carbon capture and storage) and demand reduction. This paper investigates the role of demand reduction in meeting global CO_2 reduction targets using elastic demand version of the TIAM-UCL global model under different long-term low carbon energy scenarios during 2005-2100. The role of demand reduction is analysed at regional level (developed vs. developing countries) and sector level. The contribution of demand reduction in meeting the CO_2 reduction target is calculated using decomposition analysis technique.

Under fixed energy services demand in the standard TIAM-UCL global model, CO_2 reduction is achieved by shifting to efficient technologies, alternative fuels (low/zero carbon fuels) and sequestration. In the elastic demand version of the partial equilibrium model, energy services demands will respond to price changes. The reference prices are generated in the non-mitigation scenario where fixed energy services demands are met in a least cost manner. In addition to shifting to efficient technologies, low carbon fuels and sequestration, demand reduction also plays a role in reducing CO_2 emissions in the elastic demand version of the TIAM-UCL model. Demand reduction depends on the price elasticity of demand and incremental costs of alternative options available to meet the energy services demand. The elasticities used in TIAM-UCL model are long-run elasticities and are the same as used in the ETSAP-TIAM model. It is important to note the aggregate nature and sparse empirical basis for the price elasticities of energy service demands, so that sensitivity analysis around the elasticities becomes important.

A key issue in climate change mitigation is to find a way to engage developing countries while ensuring the participation of developed countries. One of the ways to involve developing countries is carbon trading on the basis of a trade in rights to emit which are allocated or auctioned (cap-and-trade) (Stern, 2008). In cap-and-trade system, model generates CO_2 prices (shadow prices) at the set CO_2 reduction target. Price of CO_2 will be

lower in the elastic demand version of the model at the set target as part of the target is achieved by demand reduction.

The role of demand reduction in global CO_2 mitigation is analysed under a cap-and-trade policy using the elastic demand version of the TIAM-UCL global model. The low carbon scenarios are analysed under the assumption that cap-and-trade is in effect—any country can buy emissions from other countries in order to meet their target. There are three different scenarios defined for this analysis: the first is the Reference Case (REF) where CO_2 emissions are not constrained. The other two are the Low Carbon Scenarios, in which annual CO_2 emissions are constrained for both developed as well as developing countries to meet the atmospheric CO_2 concentration targets (Table 1). In addition to these scenarios, sensitivity analysis on elasticities will be carried out in order to better understand the role of demand reduction.

Table 1: Scenario definition

Scenario	**Reduction target compared to 2005 emission level**					
	Annex I		**China and India**		**Other regions**	
	2050	**2100**	**2050**	**2100**	**2050**	**2100**
Reference Case (REF)	-	-	-	-	-	-
LCS540: Low Carbon Scenario 540 ppm	-50%	-80%	+300%*	0%	-	-
LCS450: Low Carbon Scenario 450 ppm	-80%	-80%	-30%	-30%	+30%*	+30%*

*emits more than 2005 emission

Results of the decomposition analysis indicate that the contribution of demand reduction to overall CO_2 reduction, when comparing the elastic demand low carbon scenarios with the base case, is in both scenarios around 5%. While the contribution of demand reduction tends to be highest in early periods (2020-230) with up to 8% due to the lack of cost-efficient low-carbon technologies, the demand share decreases to half of the share towards the end of the 21st century. This can be explained with the greater availability of low-carbon technologies. Demand reduction can play a significant role within a limited scope next to more important measures, in particular structural shifts towards carbon-free energy technologies. CO_2 reduction target is met by greater contribution of sequestration for which the technology has not been proved yet. Sensitivity analysis will be carried out with limited/delayed availability of sequestration options. Though demand reduction is one of the cost effective options it needs a behaviour changes as well as it cost the society in terms of welfare losses due to the un-served energy services demand. Welfare loses due to demand reduction will be analysed in the paper. TIAM-UCL provides marginal CO_2 abatement cost (MAC). Analyses show that the demand reduction (elastic demand version of the model) reduces MACs compared to the standard version by up to 15% in the LCS540 and up to 24% in the LCS450 during 2030-2100.

References:

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