OPEN ACCESS

Assessing the Sensitivity of Climate Change Targets to Policies of Land Use, Energy Demand, Low Carbon Energy and Population Growth

Author(s)

Douglas Crawford-Brown

ABSTRACT

A reduced scale model of the coupled carbon cycle, population dynamics, energy system and land use characteristics is used to assess the sensitivity of atmospheric carbon to a variety of policies. Policies simulated include reduction of the rate of growth of the population; reduction of the rate of conversion of forested land to cropland; reduction in per capita energy demand in developed nations; reduction in per capita energy demand in developing nations; reduction in the carbon intensity of energy production in developed nations; and reduction in the carbon intensity of energy production in developing nations. For each policy, both the time to onset of the policy and the fractional annual rate of change in the associated model variable are established. Using as a measure of sensitivity the extension in years required for atmospheric carbon to reach the policy ceiling of 1160 BMT, achieved at a policy that introduces a rate of change in each affected model variable of 0.05 per year (a 5% change per year), then the policies in decreasing order of sensitivity are: Developing nations per capita growth (17 years), Developing nations carbon intensity (17 years), Population control (11 years), Developed nations carbon intensity (2.9 years), Developed nations per capita growth (2.8 years) and Land use (1.3 years). These values are all approximately doubled when population is stabilised first. An analysis of the model results also shows a convergence of the developed and developing nations per capita carbon emissions by 2100 when a portfolio of policies is selected to prevent a doubling of the pre-industrial revolution level of atmospheric carbon at any point in the future, consistent with a principle of " contract and converge".

KEYWORDS

Climate Change; Policy; Sensitivity Analysis

Cite this paper

D. Crawford-Brown, "Assessing the Sensitivity of Climate Change Targets to Policies of Land Use, Energy Demand, Low Carbon Energy and Population Growth," *Journal of Environmental Protection*, Vol. 3 No. 12, 2012, pp. 1615-1624. doi: 10.4236/jep.2012.312178.

References

[1]   M. Meinshausen, N. Meinshausen, W. Hare, S. Raper, K. Frieler, R. Knutti, J. Frame and M. Allen, " Green house-Gas Emission Targets for Limiting Global Warming to 2?C," Nature, Vol. 458, No. 7242, 2009, pp. 1158 1162. doi:10.1038/nature08017

[2]   D. Crawford-Brown, " Scientific Models of Human Health Risk Analysis in Legal and Policy Decisions," Law and Contemporary Problems, Vol. 64, No. 4, 2001, pp. 63-81. doi:10.2307/1192291

[3]   A. Stanton, F. Ackerman and R. Bueno, " Reason, Empathy, and Fair Play: The Climate Policy Gap," Department of Economic and Social Affairs Working Paper No. 113, 2012.

[4]   United Nations Development Programme, " One Planet to Share: Sustaining Human Progress in a Changing Climate," United Nations Development Programme Asia Pacific Human Development Report, Routledge, 2012.

[5]   S. Sorrell and S. Dimitropoulos, " The rebound Effect: Microeconomic Definitions, Limitations and

Sponsors, Associates, and Links >>

- The International Conference on Pollution and Treatment Technology (PTT 2013)

Extensions," Ecological Economics, Vol. 65, No. 3, 2008, pp. 636-649. doi:10.1016/j.ecolecon.2007.08.013

[6]   D. Crawford-Brown and S. LaRocca, " Teaching Systems Principles and Policy Applications Using a Reduced Scale Global Warming Model," Journal of Geoscience Education, Vol. 54, No. 3, 2006, pp. 101-120.

[7]   Intergovernmental Panel on Climate Change, " IPCC Fourth Assessment Report: Climate Change," 2007.

[8]   J. Hansen, M. Sato, P. Kharecha, D. Beerling, R. Berner, V. Masson-Delmotte, M. Pagani, M. Raymo, D. Royer and J. Zachos, " Target Atmospheric CO2: Where Should Humanity Aim?" The Open Atmospheric Science Journal, Vol. 2, 2008, pp. 217-231. doi:10.2174/1874282300802010217

[9]   W. Press, B. Flannery, S. Teukolsky and W. Vetterling, " Runge-Kutta Method, Numerical Recipes: The Art of Scientific Computing," 3rd Edition, Cambridge University Press, Cambridge, 2007.

[10]   A. Saltelli and M. Ratto, T. Andres, F. Campolongo, J, Cariboni, D. Gatelli, M. Saisana and S. Tarantola, " Global Sensitivity Analysis: The Primer," John Wiley and Sons, Hoboken, 2008.

[11]   " United Nations Framework Convention on Climate Change, The Kyoto Protocol Mechanisms: International Emissions Trading, Clean Development Mechanism, Joint Implementation," UNFCCC