UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

Overlapping Climate Policies

EPRG Working Paper 2034

Cambridge Working Paper in Economics 20111

Grischa Perino, Robert A. Ritz and Arthur A. van Benthem

The world is under increasing pressure to deliver on the ambition of the 2015 Paris Climate Agreement, and over 60 national and sub-national jurisdictions are putting a price on carbon emissions. Two features of the carbon-pricing landscape are striking. First, by using hybrid designs that combine elements of price and quantity regulation, practice has run far ahead of the simple carbon tax and cap-and-trade policies emphasised by textbook economics. North American carbon markets—such as the Regional Greenhouse Gas Initiative (RGGI)—use price floors and ceilings to contain the variability of the allowance price. Since its 2018 reform, the European Union's Emissions Trading System (EU ETS) features a complex allowance cancellation mechanism. Second, major carbon-pricing systems involve multiple jurisdictions: the EU ETS covers 27 member states plus linked countries like Norway and the UK while RGGI involves ten states in the northeastern United States.

Individual jurisdictions, in turn, often pursue unilateral climate initiatives that overlap with the wider carbon-pricing system. The EU is a classic example, with individual countries "doing more" than what is centrally provided by the EU ETS. The UK in 2013 introduced a carbon fee that adds £18/tCO_2 to the allowance price faced by its power generators under the EU ETS; the Netherlands are committed to introducing a similar unilateral carbon price floor for electricity and industrial sectors. There is a plethora of national policies to support renewable energy (notably solar and wind), and an increasing number of countries are legislating to phase out coal-fired power and impose additional carbon taxes on air travel. These examples share a common feature: they are policies by an individual jurisdiction that operate alongside a wider carbon-pricing system.

Our question in this paper is simple: What is the climate benefit of such overlapping policies? As it is a global public good, any mitigation of climate change will be driven solely by changes in aggregate emissions. For a cap-and-trade system with a fixed emissions cap, like the pre-2018 EU ETS, the answer is clear: if an overlapping policy reduces EU-wide emissions demand (say, from power generation)

Contact Robert Ritz – rar36@cam.ac.uk
Publication November 2020
Funding Perino: DFG (German Research Foundation) cluster EXC 2037 "Climate, Climatic Change, and Society" (project 390683824) and ARIADNE (BMBF project 03SFK5S0)
Van Benthem: National Science Foundation (award SES1530494), Kleinman Center for Energy Policy, Analytics at Wharton Data Science and Business Analytics Fund

by 1 ton of CO2, this will be precisely offset by increased demand of 1 tCO_2 elsewhere in the system—the "waterbed effect" is 100%. At the opposite end, a simple carbon tax does not have an emissions cap and so the waterbed effect is zero. Our main interest, therefore, is in real-world hybrid carbon-market designs which typically feature dynamic "punctured" waterbeds that lie between these two extremes. A punctured waterbed enables overlapping policies to have a global climate benefit.

Yet this chain of reasoning still has a missing link which we refer to as "internal carbon leakage". Suppose that a unilateral Dutch carbon price on power generation reduces its domestic emissions demand by 1 tCO_2 but, within an integrated European electricity market, this leads to an increase in Dutch electricity imports which in turn raises emissions demand by 1 tCO_2 in other EU ETS countries. This overlapping policy has no climate benefit either: its rate of internal carbon leakage is 100%. This conclusion, in turn, applies irrespective of the extent of the waterbed effect. In sum, the answer to our question must be driven by a combination of the waterbed effect and internal leakage.

This paper provides a novel integrated approach through which to understand and quantify the overall emissions impact of an overlapping policy that applies only to part of a multi-jurisdiction carbon-pricing system. We present a model-independent conceptual framework that provides a mapping from the "local" emissions reduction the overlapping policy achieves to its "global" impact which includes any knock-on effects elsewhere in the system. Internal carbon leakage captures emissions displacement within the system (e.g., greater product imports from a neighbouring country) for a given system-wide carbon price. The waterbed effect endogenises the policy's interaction with the displacement between different jurisdictions in the same sector.

We also illustrate the empirical usefulness of the modelling framework by deriving values for internal leakage and the waterbed effect using a combination of simple formulae from our theory results and prior empirical work. We cover overlapping policies in Europe and in North American carbon-pricing systems such as RGGI, the California-Quebec carbon market, and Canada's new federal minimum carbon price. Our findings illustrate how a policy's overall climate benefit varies widely depending on its design, location and timing.

We hope that our analysis, by providing practical guidance on the climate benefits of 25 different combinations of overlapping policy instruments and types of carbon-pricing designs, will be of value to policymakers trying "in real time" to gauge the attractiveness of domestic climate initiatives. A hybrid carbon-market design raises the stakes for what are often termed "complementary" policies: some are truly complementary in the sense that they induce further emissions reductions elsewhere while others can backfire by raising aggregate emissions.