

## Executive Summary for “Efficient and Equitable Policy Design: Taxing Energy Use or Promoting Energy Savings?”

### *Introduction and motivation*

Fossil-based energy use generates environmental externalities. Should such energy use be lowered using taxes or through promoting and mandating energy savings? The choice and design of regulatory instruments is a crucial environmental policy decision. The toolkit of instruments comprises two fundamental categories. Market-based instruments (MBIs)—such as, for example, emissions taxes, tradable emissions allowances, and subsidies for pollution abatement—harness and channel the power of the market towards achieving environmental goals through an economic incentives approach to regulation. Command-and-control (CaC) instruments—such as, for example, technology mandates and performance standards—impose requirements on production processes or outputs of firms. In evaluating alternative regulatory strategies, economists have tended to focus on efficiency, or its close relative, cost-effectiveness. The public acceptance of a policy, however, often critically depends on its distribution of costs and benefits in society. While recent work has assessed the distributional impacts of MBIs, surprisingly little is known about the household-level incidence of CaC regulation and potential trade-offs with efficiency at the aggregate economy level. In particular, this is surprising as CaC approaches are ubiquitous in real-world environmental policies in many countries and, in fact, often seem to be the preferred choice over market-based regulation.

### *Focus and contribution*

This paper contributes by providing insights into the efficiency and distributional impacts of alternative policy designs aimed at lowering energy use and carbon dioxide (CO<sub>2</sub>) emissions. We focus on comparing two fundamentally different paradigms of environmental regulation: (1) a Steering approach that exploits economic incentives arising from taxes on energy use; and (2) a Promotion approach that builds on promoting and mandating measures for saving energy through the use of CaC measures as well as sector-specific subsidy programs. We contribute to the sparse literature on assessing the distributional impacts of non-tax regulation. Specifically, our Promotion scenario comprises a detailed representation of emissions standards for new passenger vehicles, efficiency standards for electrical appliances, and targeted subsidies to promote energy-saving investments for buildings and industrial electricity use. While our analysis is motivated by and focuses on climate and energy policy in Switzerland, it offers general insights into the fundamental theme of policy instrument choice and design for efficient and equitable environmental regulation.

### *Research methodology*

Our analysis of assessing the economic efficiency and the incidence among heterogeneous households of various MBIs and CaC measures to reduce energy use is two-pronged. We begin by briefly reviewing the basic conceptual considerations for policy instrument choice and design focusing on describing the channels through which regulation affect economic outcomes. The main contribution of the paper, however, lies in going beyond a mere qualitative understanding of the effects of alternative regulatory measures by providing a quantitative assessment to gauge the importance of the different channels affecting instrument performance in the context of the real economy. We develop a quantitative framework which integrates a detailed micro-household simulation analysis into a numerical multi-commodity general equilibrium framework. Our quantitative framework captures the policy-induced economic responses which determine the efficiency and equity of environmental regulation at the aggregate economy and household level. Specifically, our model features an economy-wide representation of sectoral production and

consumption activities—including detail on the supply and use of energy—while capturing cross-market effects as well as aggregate economy resource (income) constraints. Importantly, the models incorporates all 9'734 households from a representative sample of the Swiss household population as individual economic agents, thus enabling us to analyze in rich detail the heterogeneous behavioral responses to and welfare impacts of alternative regulatory designs at the household level in a general equilibrium framework.

### *Main findings*

First, devising cost-effective regulation requires considering instrument choice and instrument design. We find that the promotion-based regulation entails costs on the order of five times higher than the costs of broad-based tax regulation. On the one hand, this is due to that fact that promotion-based instruments render energy services too inexpensive by either explicitly subsidizing energy-saving capital (e.g., in the case of buildings programs) or working as implicit output subsidies on specific energy services combined with an implicit tax on polluting ways of generating those services (e.g., through emissions standards for passenger vehicles and efficiency standards for electrical appliances). On the other hand, promotion-based regulation, according to our scenario, reduces emissions too strongly in the transport sector.

Second, tax-based regulation leads to a substantial variation in household-level impacts whereas different household types are similarly affected under a promotion-based approach. The reason is that tax-based regulation leads to substantial changes in both output prices for energy and non-energy goods and factor prices (wages and capital) while under a promotion-based regulation prices are largely unaffected. Given the large the heterogeneity of consumers in terms of preferences (expenditure patterns) and endowments (income sources), the price changes under tax-based regulation bring about highly dispersed impacts at the household level. A related insight born out by our analysis is that focusing on mean impacts for specific socio-economic groups (e.g., income deciles) obscures substantial within-group variation of impacts. This is particularly important as the within-group variation of impacts swamps the variation in mean impacts across groups.

Third, while tax-based regulation leads to more a dispersed distribution of household-level impacts, a large fraction of households (about 36%) gain under tax-based regulation (with rebating of carbon tax revenues) while almost all households are worse off under a promotion-based policy. In particular, we show that the cost of promotion-based regulation largely materializes through the need to finance energy subsidies but is “hidden” to the extent that output and factor price impacts are small. Households that gain under tax-based regulation are those with relatively small expenditure shares on energy goods, high shares of income derived from (inflation-indexed) government transfers, and low overall income, who thus disproportionately benefit from per-capita rebates. The incidence across income deciles under tax-based regulation, however, depends importantly on how the tax revenues are recycled: it is progressive with per-capita rebates and yields a regressive outcome if rebates are proportional to income.

Fourth, grouping households according to socio-economic characteristics other than income, we find that under tax-based regulation retired households experience small welfare gains, house owners are more negatively affected than renters, and rural households are relatively worse off than households living in urban and agglomeration areas. In contrast, under promotion-based regulation all of these household groups incur substantial welfare losses, although the variation in impacts across groups is much smaller. Overall, our analysis thus expounds important trade-offs between efficiency and equity for environmental policy design.