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COMMENTARY

Carbon pricing: a win-win environmental and public health policy

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Abstract
Carbon pricing is an important tool for mitigating climate change. Carbon pricing can have significant health co-benefits. Air pollution from fossil fuels leads to detrimental health effects, including premature mortality, heart attacks, hospitalization from cardiorespiratory conditions, stroke, asthma exacerbations, and absenteeism from school and work, and may also be linked to autism spectrum disorder and Alzheimer's disease. Reduction in fossil fuel combustion through a carbon price can lead to improvements in all these areas of health. It can also improve health by encouraging active transportation choices and improving ecosystems. Furthermore, it can promote health equity in society and improve overall societal health where the revenue from carbon pricing is used as a progressive redistribution mechanism for low-income households. Hence, carbon pricing is a win-win environmental and public health policy and an important step toward achieving Canada's emission target by 2030. However, carbon pricing has several potential pitfalls which need to be considered in the design and implementation of any such policy. As Canada moves ahead with mandatory carbon pricing this fall, it is important to monitor its impact, evaluate it objectively, and modify and complement as necessary with policies and regulations.

Résumé
La tarification du carbone est un important outil d'atténuation des changements climatiques. Elle peut aussi présenter des avantages conjoints considérables sur le plan de la santé. La pollution de l'air due aux combustibles fossiles a des effets nuisibles sur la santé, dont la mortalité précoce, les crises cardiaques, les hospitalisations pour troubles respiratoires, les accidents vasculaires cérébraux, l'exacerbation de l'asthme et l'absentéisme à l'école et au travail; elle pourrait aussi être liée au trouble du spectre autistique et à la maladie d'Alzheimer. La réduction de la combustion des combustibles fossiles par le prix du carbone peut donc conduire à des améliorations de tous ces aspects de la santé. Elle peut aussi améliorer la santé encourageant les options de transport actif et en améliorant les écosystèmes. De plus, elle peut favoriser l'équité en santé dans la société et améliorer la santé sociétale globale lorsque les recettes de la tarification du carbone servent de mécanisme de redistribution progressif vers les ménages à faible revenu. La tarification du carbone est donc une formule gagnante sur le plan de l'environnement et de la santé publique, ainsi qu'un pas important pour respecter les cibles d'émission du Canada d'ici 2030. Par contre, une telle politique recèle plusieurs pièges dont il faut tenir compte dans sa conception et sa mise en œuvre. Comme le Canada va de l'avant avec la tarification obligatoire du carbone à l'automne 2018, il est important d'en surveiller les incidences, d'en faire une évaluation objective, et de la modifier ou de la compléter par les politiques et la réglementation nécessaires.

Keywords Carbon pricing · Carbon levy · Air pollution · Health co-benefits · Carbon tax pitfalls

Mots-clés Tarification du carbone · Pollution de l'air · Avantages conjoints pour la santé · Pièges de la taxe sur le carbone

Introduction

A central component of The Pan Canadian Framework on Clean Growth and Climate Change to meet Canada's 2030 emissions target is the pricing of carbon pollution. Carbon pricing policies currently cover 80% of the Canadian population, either explicit price-based systems like in British Columbia (BC), a hybrid approach composed of a carbon levy and an output-based pricing system in Alberta, or a cap-and-trade

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system in Quebec and Ontario. New federal legislation will apply to provinces without existing policies by September 2018. The price on carbon pollution will start at \$10/t and increase to \$50/t by 2022. The federal carbon pollution pricing backstop includes a carbon levy applied to fossil fuels, and an output-based pricing system for industrial facilities that emit above a threshold. The fossil fuels covered include liquid fuels (e.g., gasoline, diesel fuel, and aviation fuel), gaseous fuels (e.g., natural gas), and solid fuels (e.g., coal and coke) (Government of Canada 2018). Though the primary aim is to impact climate change, this policy can also have important public health benefits. The policy can lead to health benefits in local communities after emission reductions occur, making them more salient than the long-term and widespread benefits of mitigating climate change.

Combustion of fossil fuels leads to air pollution which has adverse health effects. Fossil fuel combustion emits greenhouse gases (GHGs) and pollutants, including particulate matter (PM), nitrogen oxides, volatile organic compounds (VOCs), and sulfur dioxide, into ambient air (Mannucci et al. 2015). Although all components are harmful, the most severe effects are from ambient PM, particularly $PM_{2.5}$ (particles with aerodynamic diameter of 2.5 μm or less). Upon inhalation, $PM_{2.5}$ goes deep into lung alveoli, even the bloodstream. Evidence for harm from PM exists worldwide, and from short-term and long-term exposure (Mannucci et al. 2015). In Canada, the age-standardized mortality rate in 2012 attributable to ambient air pollution was 37 deaths per 100,000 (WHO 2016). Each 10 $\mu g/m^3$ increase in annual average $PM_{2.5}$ exposure leads to a 3% to 20% increase in all-cause mortality (Roman et al. 2008). Regional and local variation in $PM_{2.5}$ concentrations leads to differential distributional impacts of air pollution on populations.

Air pollution is linked to cardiovascular complications (increased coronary artery disease, higher risk of hospitalization, and death from heart failure), respiratory complications (increased risk of chronic obstructive pulmonary disease exacerbations/hospitalizations, lung cancer, and a deleterious effect on lung function, respiratory tract infections, and asthma episodes among children), and neurological complications (higher risk of stroke) (Mannucci et al. 2015). Air pollution has also been linked to absenteeism from school and work, premature birth and low birth weight, autism spectrum disorder (Raz et al. 2015), and Alzheimer's disease (Jung et al. 2015; Chen et al. 2017).

Fossil fuel extraction and consumption have other disruptive health effects. Oil sand development in Alberta has led to outcry over water pollution and damage to surrounding ecosystems and wildlife, which is particularly felt by the Indigenous communities who share these ecosystems. The sour gas industry contributes to air pollution through the release of hydrogen sulfide, an extremely poisonous, corrosive, explosive, colourless, and foul-smelling gas. Hydraulic fracturing used to access oil and gas deposits in shale and other tight formations in Alberta and BC emits VOCs and methane to air, and causes water pollution from the fracturing and flowback fluid.

Limiting fossil fuel use through carbon pricing may reduce these adverse health outcomes. Modeling analyses across the world demonstrate that reducing carbon emissions by reducing fossil fuel use has health benefits (Watts et al. 2015). A proposed carbon fee in Massachusetts is estimated to save 340 lives between 2017 and 2040, health benefits valued at \$2.9 billion USD (Buonocore et al. 2017). BC introduced a revenue-neutral carbon tax in 2008 covering 70% of their GHG emissions. Despite an 8.1% increase in population, the province has seen a 5.5% decrease in its emissions from 2007 to 2014 (Government of BC 2017). Australia's short-term carbon price over two years showed a reduction between 11 and 17 million tonnes cumulatively attributable to the carbon tax (O'Gorman and Jotzo 2014).

Carbon pricing may lead to broader public health benefits. Higher cost of transportation from higher fuel prices can encourage people to walk when possible or use public transportation. A carbon price may also increase the cost of foods with high GHG emissions, particularly animal-based products. Increased costs of animal-based products may lead consumers to replace them with vegetarian products, which can improve health (Aleksandrowicz et al. 2016). Reducing GHG emissions through carbon pricing can improve our physical environment and agricultural sustainability, since other pollutants from fossil fuel combustion also contribute to acid rain, impair crop and timber productivity, and damage ecosystems (Watts et al. 2015). Redistributing revenue can promote health equity through economic equity. Improvement in air quality can improve the health of all populations but particularly vulnerable populations, including the elderly, infants, children, pregnant women, and people with comorbidities, consequently improving health equity (Mannucci et al. 2015). While climate change aggravates existing inequalities, and disproportionately affects the most vulnerable subpopulations within and across countries, a price on carbon can mitigate climate change and help close existing inequities by protecting vulnerable subpopulations who would have been disproportionately impacted by climate change (Watts et al. 2015).

Carbon pricing has potential pitfalls. The environmental and public health benefits of carbon pricing depend on its success in reducing fossil fuel consumption. Concerns with carbon pricing have led to public and business resistance to carbon pricing. This has often led to a complete refusal or compromised institutionalization of carbon pricing. In Canada, Saskatchewan has threatened to go to court to fight the federal government's proposed plan. In Australia, a carbon tax was implemented and then removed shortly after.

Carbon pricing is often viewed as a tax grab, particularly when carbon revenues are used for general government spending. This leads to a variety of economic concerns, including negative impacts on Canada's competitiveness to attract and retain capital. It could disproportionately impact lower income households harder, since energy and food costs are quite inelastic and may impact their ability to travel and afford nutritious meals. Carbon pricing can be difficult to implement due to the need for administrative infrastructure and regulatory institutions for monitoring, reporting, and verification of GHG emissions. This reduces economic efficiency from informational asymmetry, if emitters can "game the system" since they know more about their emissions than regulators. Canada's current decentralized approach contributes to complexity in implementation, particularly given the difficulty in measuring the provincial cap-and-trade systems against federal benchmarks. The threat of a rising carbon price may lead to the "green paradox"—a short-term acceleration of carbon-intensive production, suppressing prices and boosting short-term consumption. "Carbon leakage" is also a risk, when carbon-intensive processes move to countries with less stringent carbon policies, like the US and China. With geographic and social class variation in air pollution, reduction of GHG emissions means not all areas and sections of population will benefit equally (or at all).

Carbon pricing may not be the sine qua non of the fight against climate change. Clean-energy regulations and investments may work better as they impose a higher implicit price than any politically practicable explicit carbon tax (Green and Denniss 2018). Places with carbon pricing systems often have complementary strategies, making it difficult to attribute the reduction in fossil fuel use to carbon pricing alone (Green and Denniss 2018). BC has a renewable fuel regulation along with a low carbon fuel standard; Alberta launched a coal phase-out, renewable electricity standards, and caps on oil sands and certain oil-well emissions; Ontario phased out coal-fired power and subsidizes renewable energy; Nova Scotia reduced emissions from 2005 solely through regulations and subsidies. Sweden, which has an existing carbon tax, used regulations on district heat providers to encourage fuel switching to reduce carbon emissions. Restrictive supply-side climate policies can complement demand side restrictions via carbon pricing, since they discourage high levels of investment in the development of GHG-intensive projects.

Conclusion

In conclusion, a well-designed carbon pricing system is a step in the right direction. A well-designed carbon pricing system proactively shapes markets, making it an important component of climate change strategy along with appropriate policies, regulatory reforms, and investment in renewable energy (Green and Denniss 2018). Disruptions can be minimized if the system is predictable, has minimal exemptions, is administratively simple, minimizes carbon leakage, and has stakeholder support. A revenue-neutral design, where revenue feeds back into the economy through rebates, clean-energy research, and development, can mitigate economic harms and improve the fairness of the policy (Green and Denniss 2018). The rebates can be preferentially given to low and middle-income families to offset the cost of the fee, making the policy economically progressive, along with improving the environment and public health. However, the outcomes of such a policy need to be closely monitored for potential pitfalls. Success in achieving Canada's target GHG emissions for 2030 will most likely need additional policies, although a price on carbon pollution is a significant start.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

Aleksandrowicz, L., Green, R., Joy, E. J., Smith, P., & Haines, A. (2016). The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: a systematic review. *PLoS One, 11*(11), e0165797. https://doi.org/10.1371/journal.pone.0165797.

Buonocore, J. J., Guinto, R. R., Levy, J. I., Nystrom, S., Brown, C., & Bernstein, A. S. (2017). *Air quality and health co-benefits of a carbon fee-and-rebate bill in Massachusetts* (p. 27). Boston: Harvard T.H. Chan School of Public Health.

Chen, H., Kwong, J. C., Copes, R., Tu, K., Villeneuve, P. J., van Donkelaar, A., et al. (2017). Living near major roads and the incidence of dementia, Parkinson's disease, and multiple sclerosis: a population-based cohort study. *Lancet, 389*(10070), 718–726. https://doi.org/10.1016/s0140-6736(16)32399-6.

Government of B.C (2017). British Columbia's revenue-neutral carbon tax http://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax. Accessed 13 Oct 2017.

Government of Canada (2018). Technical paper: federal carbon pricing backstop. https://www.canada.ca/en/services/environment/weather/climatechange/technical-paper-federal-carbon-pricing-backstop.html. Accessed 26 April 2018.

Green, F., & Denniss, R. (2018). Cutting with both arms of the scissors: the economic and political case for restrictive supply-side climate policies. *Climatic Change*. https://doi.org/10.1007/s10584-018-2162-x.

Jung, C. R., Lin, Y. T., & Hwang, B. F. (2015). Ozone, particulate matter, and newly diagnosed Alzheimer's disease: a population-based cohort study in Taiwan. *Journal of Alzheimer's Disease, 44*(2), 573–584. https://doi.org/10.3233/jad-140855.

Mannucci, P. M., Harari, S., Martinelli, I., & Franchini, M. (2015). Effects on health of air pollution: a narrative review. *Internal and Emergency Medicine, 10*(6), 657–662. https://doi.org/10.1007/s11739-015-1276-7.

O'Gorman, M., & Jotzo, F. (2014). *Impact of the Carbon Price on Australia's electricity demand, supply and emissions* (p. 69). Australia: Crawford School of Public Policy, the Australian National University.

Raz, R., Roberts, A. L., Lyall, K., Hart, J. E., Just, A. C., Laden, F., et al. (2015). Autism spectrum disorder and particulate matter air pollution before, during, and after pregnancy: a nested case-control analysis within the Nurses' Health Study II Cohort. *Environmental Health Perspectives, 123*(3), 264–270. https://doi.org/10.1289/ehp.1408133.

Roman, H. A., Walker, K. D., Walsh, T. L., Conner, L., Richmond, H. M., Hubbell, B. J., et al. (2008). Expert judgment assessment of the mortality impact of changes in ambient fine particulate matter in the U.S. *Environmental Science & Technology, 42*(7), 2268–2274.

Watts, N., Adger, W. N., Agnolucci, P., Blackstock, J., Byass, P., Cai, W., et al. (2015). Health and climate change: policy responses to protect public health. *Lancet, 386*(10006), 1861–1914. https://doi.org/10.1016/s0140-6736(15)60854-6.

WHO. (2016). *Ambient air pollution: a global assessment of exposure and burden of disease* (p. 121). Geneva: WHO Press.