CORRESPONDENCE:

Emission effects of the Chinese–Russian gas deal

To the Editor — In May 2014, Russia and China signed an agreement according to which Russia will supply approximately 38 billion cubic metres of gas to China annually over 30 years via the Power of Siberia pipeline[1]. This additional gas could support the Chinese government's plan to reduce local air pollution and CO_2 emissions by reducing coal consumption.

Dong *et al.*[2] argued that this gas deal between Russia and China would lead to an annual reduction in Chinese CO_2 emissions of 41.7 million tonnes (or 46 million short tons). But this relies on a number of optimistic assumptions about fuel displacement. We show that when potential market responses are considered, the impact of the gas deal on Chinese CO_2 emissions could be less optimistic than expected.

The estimate of Dong *et al.* relies on the assumption that all the additionally imported gas from Russia is used to substitute coal. Indeed, this might be the case if additional gas is used by state-run companies, which are not necessarily exposed to market incentives in the same way as private companies are. In free markets, however, this estimate might be too optimistic as potential market effects are not taken into consideration. This is of particular importance since recent price reforms by the Chinese government aim to liberalize the energy sector in the long term[3], and market effects resulting from the implementation of the gas deal become crucial.

While domestic and imported gas is easily substitutable, energy inputs such as gas, coal and oil tend to be imperfect substitutes in consumption. In addition, China does not face a shortage of gas supplies as the portfolio of gas imports is quite diversified. Thus, more gas from Russia in China's energy market could crowd out more expensive gas imported from other countries and make the overall increase in demand for gas in China less pronounced. Furthermore, the additional gas supply may lower the average energy price in China, inducing additional consumption of energy and related CO_2 emissions.

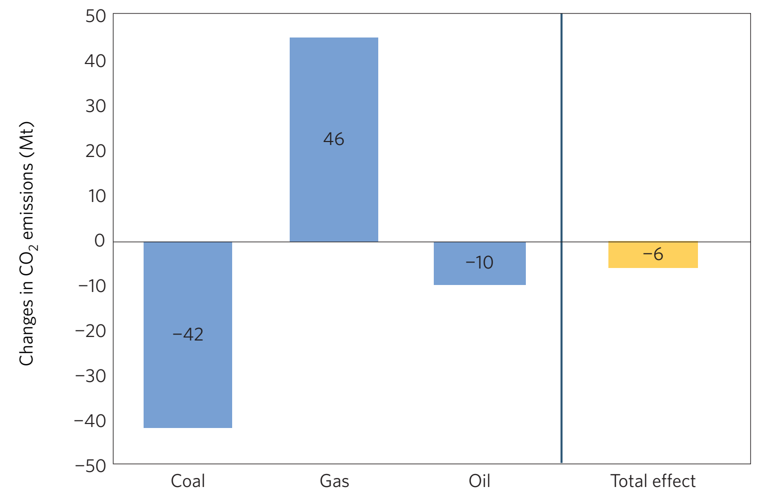

Figure 1 | Average yearly changes of CO_2 emissions in China by energy carrier in millions of tonnes (Mt), induced by the Chinese–Russian gas deal. Calculated in comparison with a business-as-usual-scenario.

Our model shows that total consumption of gas in China could increase by approximately 20 million tonnes of oil equivalent annually, and that CO_2 emissions are only moderately reduced by 6 million tonnes annually, on average (see Fig. 1 and Supplementary Information for details). This suggests that to exploit the full potential of CO_2 emission mitigation, the Chinese–Russian gas deal needs to be complemented by policy measures encouraging substitution from coal towards gas. ❐

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Additional information

Supplementary information is available in the online version of the paper.

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Reply to 'Emission effects of the Chinese-Russian gas deal'

Dong *et al.* reply — Orlov *et al.*[1] suggest that, unless policy changes, economic factors will mean that only a small fraction of Russian gas will be substituted for coal consumption in China as a consequence of a pipeline agreement, contrasting with results from our research[2]. We agree that is so. But policy trends do suggest a drive towards cleaner forms of energy.

Global efforts to mitigate climate change rely on moving away from 'business as usual', as pursuing the cheapest energy option in the short-term will lead to catastrophic environmental damage in the longer run. Furthermore, there is strong evidence that Chinese policy is already driving the market towards cleaner energy, largely because of popular demand for cleaner air, which cannot be met by keeping energy production dominated by abundant and cheap coal.

The policy impacts of this 'war on pollution' include targets for industrialized Chinese provinces to reduce their particulate matter (PM) 2.5 levels by 15–25% by 2017 (by 25% in Beijing)[3]; corresponding targets for coal consumption and heavy industry capacity reductions in key provinces; structural re-rating of coal prices and coal-related companies by financial markets; the Twelfth Five Year Plan (2011–2015) that contains strong measures to prevent economic growth at the expense of the environment[4]; China–US bilateral targets on carbon emissions[5]; and the promotion of the clean energy sector agreed at the Asia Pacific Economic Cooperation meeting in November 2014[6].

In the first four months of 2015, coal consumption declined by approximately 8% year-on-year, led by a precipitous fall in coal use in the power sector[7]. Chinese coal share prices from January 2014 to March 2015 kept pace with the Hang Seng index, while renewables' shares soared by 25 times that amount, largely as a result of the public response to the vastly popular, independent, documentary film, *Under the Dome* (the film has now been censored[8]). Furthermore, PM2.5 data suggest that air quality has significantly improved in 2015 compared with previous years, and not because of wind and humidity weather factors.

Given the immediate success of these policies, we believe it is inconceivable that China will not continue to drive the energy market towards cleaner fuels than coal, and hence we expect a far greater degree of gas for coal substitution than simulated by Orlov *et al.* Thus the actual reduction in carbon emissions resulting from the Russian gas deal will be essentially driven by policy decisions of the Chinese government. ❒

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CORRESPONDENCE:

Subnational socio-economic dataset availability

To the Editor — In their *Nature Climate Change* Commentary, Otto *et al.*[1] highlight the data divide between natural and social sciences. Where the former has successfully entered the cosmopolitan age (that is, data without borders), the production of socio-economic data is mostly framed according to national boundaries. The authors rightly point out the need for subnational socio-economic datasets and call for a "new paradigm in data gathering".

We agree with the authors, but note that access to detailed socio-economic data has improved steadily over the past 15 years thanks in part to multilateral donors, government bodies, and international alliances, such as CGIAR (a global agricultural research partnership of 15 research centres worldwide), increasingly investing in open data policies, cross-country standards, online catalogues, and data-visualization platforms. As of writing, 154 countries have online data portals with ample economic statistics at subnational level[2]. Scientists have established consortia and communities of practice to study the effects of climate change at scale with a strong focus on improving data standardization and interoperability across domains[3]. Spatially explicit, harmonized socio-economic data products are increasingly available to the public, such as population and poverty grids[4], microdata derived from national household surveys[5], and rasterized socio-demographic indicators[6]. While these products are often overlooked in the economic literature, they are well suited to the study of climate's impact on human geography across scales.

In their concluding remarks, Otto *et al.* call for "bottom-up and crowd data pooling initiatives" and point to household surveys as potentially rich sources of subnational socio-economic data. By overlaying spatially explicit socio-economic and health indicators on environmental and biophysical data layers, it is possible to investigate complex relationships between, for example, population and the environment across relevant geographical boundaries (watersheds, farming systems and climatic zones, for example). To illustrate such already ongoing analyses, we present a series of maps that integrate biophysical datasets with bottom-up data pooled from georeferenced household surveys (Fig. 1 and Supplementary Fig. 1a,b) with data openly sourced from HarvestChoice[6] and Demographic and