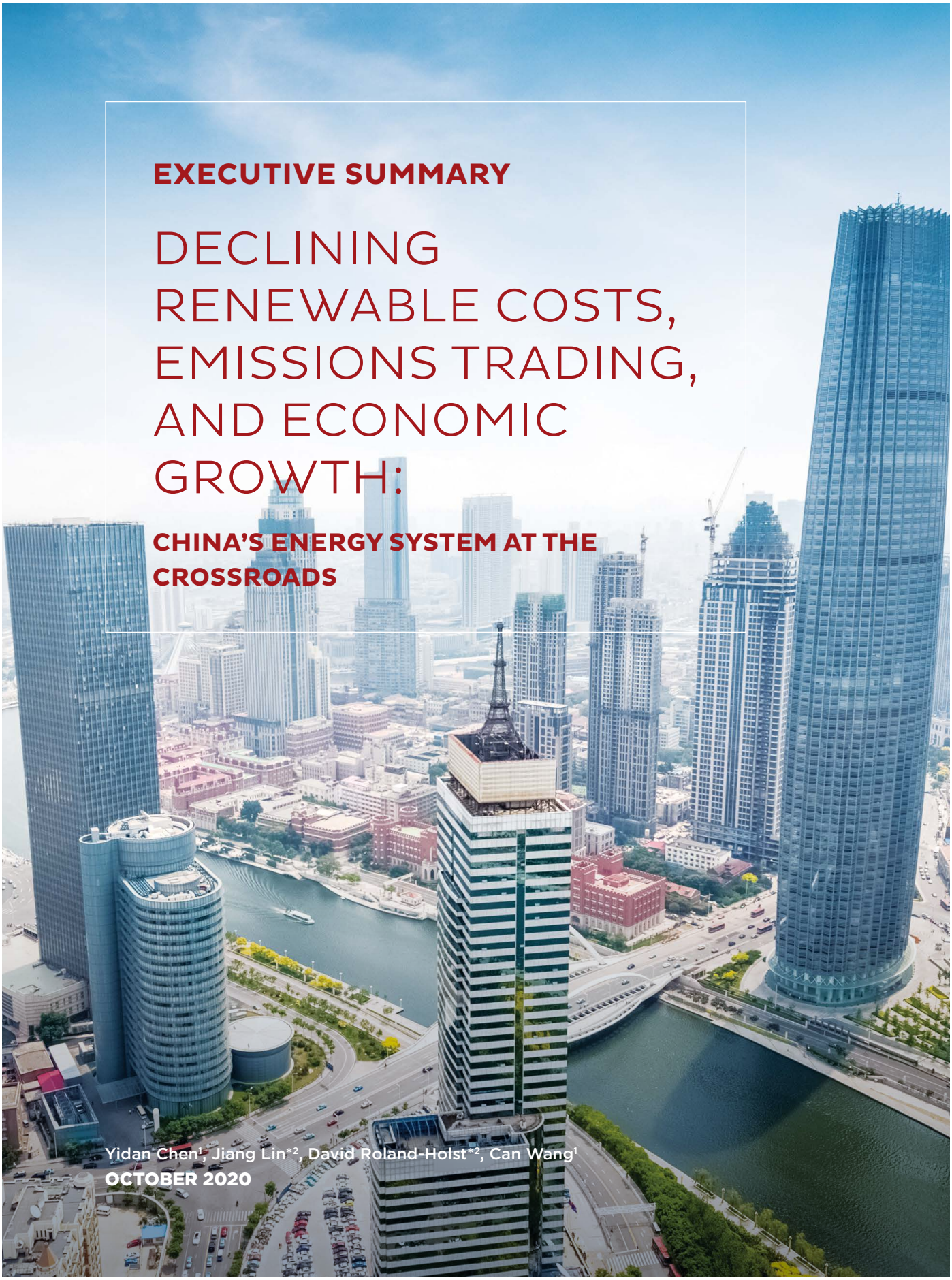

EXECUTIVE SUMMARY

DECLINING RENEWABLE COSTS, EMISSIONS TRADING, AND ECONOMIC GROWTH:

CHINA'S ENERGY SYSTEM AT THE CROSSROADS

Yidan Chen[1], Jiang Lin*[2], David Roland-Holst*[2], Can Wang[1]

OCTOBER 2020

* *Corresponding authors*

[1] **State Key Joint Laboratory of Environment Simulation and Pollution Control (SKLESPC)**
School of Environment Tsinghua University
Beijing, China

[2] **Department of Agricultural and Resource Economics**
207 Giannini Hall
University of California
Berkeley, CA 94720

RESEARCH PAPERS ON ECONOMIC AND ENERGY POLICY

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ABSTRACT

In the wake of decades of renewable energy innovations, it has become increasingly clear that the supposed tradeoff between economic growth and climate risk reduction is based on a fallacy. Low and zero emission electric power generation costs are now falling below those of carbon fueled generation, and renewable co-benefits such as air quality improvements are becoming ever more apparent. Nowhere is the issue more compelling than in China. In recognition of the need for low carbon transition, China is experimenting with a variety of mitigation policies, including technology standards, emission trading systems (ETS), and carbon taxation. Using a detailed forecasting model for China's economy, we show how falling renewable energy technology costs can interact with market based ETS schemes to deliver dramatic GHG reductions with net positive aggregate economic growth. Results show that increased productivity of renewable energy will promote the rapid transition to renewable electricity from fossil fuel energy, and completely compensate the economic loss of mitigation. Multiplier effects including shifting in consumption patterns, larger labor supply elasticity, and spillover effects of renewable technology progress toward total factor productivity would provide additional economic growth by 1.3%, 6.9% and 15.6% respectively by 2030.

EXECUTIVE SUMMARY

China is the world's largest greenhouse gas (GHG) emitter, 44% (4.14 billion metric tons of CO_2) of which came from the electric power system in 2017. President Xi announced on September 22, 2020 that China will enhance its Nationally Determined Contributions, peak its emissions before 2030, and strive to reach carbon neutrality before 2060. Accelerating the replacement of traditional energy with renewable substitutes would help transform China's energy system and reduce carbon emissions, and put China on a pathway to carbon neutrality.

New evidence shows that renewable energy costs have continued an unprecedented decline. Even without accounting for the social cost of carbon, all-inclusive costs of electricity from new PV and onshore wind are now below the costs of coal-fired power plants in major regions of the world. In market economies, this increasing competitiveness (technology cost "crossover") will support autonomous power system transformation, reduce fossil fuel dependence and related environmental impacts, and reduce wholesale and retail electricity costs. As a result, new opportunities will arise for cutting consumer and manufacturer energy costs, improving human welfare, and boosting economic growth.

Furthermore, authoritative studies indicate that environmental regulations induce innovation in cleaner technologies. Carbon emission trading schemes (ETS) can be among the most impactful approaches to driving the renewable transition. Earlier research literature has suggested that China's ETS mitigates CO2 emissions and promotes renewable energy deployment, but its costs might hinder the economy. Today, however, there is significant disagreement about the magnitude and direction of net economic impacts. Continued declines in renewable energy cost seem destined to moot this controversy. In addition, the existing literature does not account for three critical multiplier effects – household expenditure shifting, more accommodating labor supply and the spillover effect of renewable energy innovation — that could magnify the impacts of accelerating China's renewable electricity transition through technology improvement and the ETS.

The objective of this study is to assess the economic and social impacts of accelerating renewable energy technology uptake and the anticipated ETS in China, taking account of technology costs, shifting consumption patterns, labor market and factor productivity responses.

Six scenarios are evaluated in this study. In addition to a reference Business-as-Usual (BAU) dynamic scenario, others depict the economic and social impacts reflecting not only emerging evidence of renewable technology cost crossover (R scenario) and ambitious mitigation policies (C50 scenario), as well as the role of possible multiplier effects, including shifting expenditure from energy spending (Keynes scenario), more accommodating labor market in the post-Covid period (EMP scenario), and expected energy productivity spillovers (PROD scenario).

Results

Results from a detailed dynamic Computable General Equilibrium (CGE) model show all enhanced renewable scenarios grow China's economy, compared with the BAU scenario that assumes slower renewable cost improvements and no ETS. In the R scenario, sustained renewable cost improvements alone more than compensate for the cost of a significant renewable buildout, adding over 607 billion RMB or 0.4% to China's real GDP by 2030. Even the C50 scenario, with low renewable energy costs interacting with the ETS to slash power sector GHG emissions by 50%, results in net positive economic growth. In both these scenarios, overall economic growth and real consumption both improve. Lower electricity costs also translate into greater Chinese competitiveness, stimulating exports and (to a lesser extent) imports.

TABLE ES-1.
MACROECONOMIC IMPACTS IN CHINA

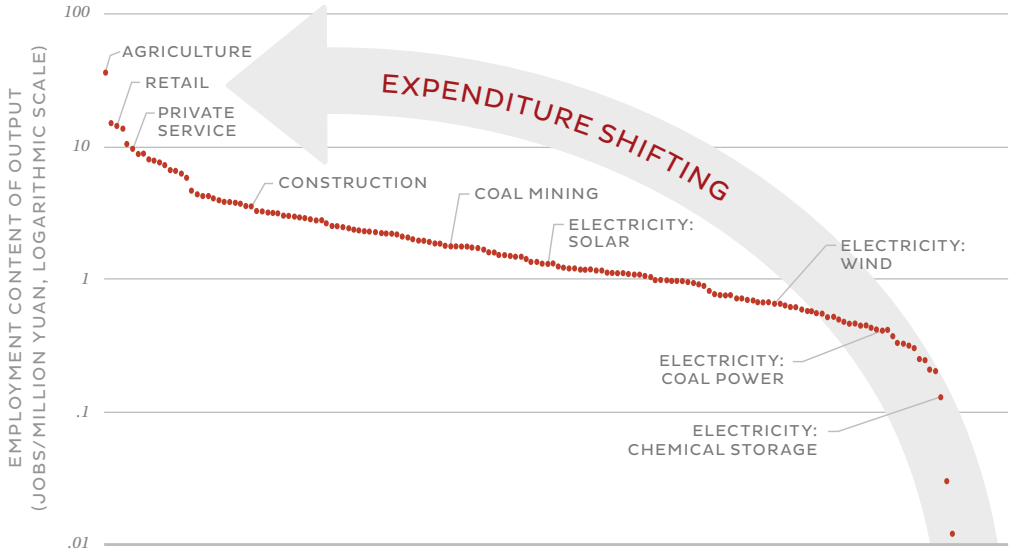
(CHANGE FROM 2030 BAU IN REAL BILLION RMB)

	R	C50	KEYNES	EMP	PROD
GDP	607.4	228.6	2,249.1	11,959.7	26,998.1
Consumption	490.0	329.1	1,051.7	3,871.5	8,697.3
Investment	-897.8	-1,048.1	1,984.5	7,044.2	14,426.5
Exports	267.0	229.4	-518.8	1,112.3	4,450.1
Imports	97.9	113.8	1,057.6	1,278.6	2,424.3
Employment (million FTE)	1.2	0.7	1.7	66.6	79.0

Accounting for indirect and induced demand side (multiplier) effects reveals larger potential benefits from low carbon energy transition. This is apparent in the Keynes scenario, which accounts explicitly for expenditure diversion from lower cost electric power to other goods and services, adding 2 trillion RMB to GDP in 2030 (or 1.3%), compared with the C50 scenario on which it is based.

Although net macroeconomic impacts in the R, C50, and Keynes scenarios are positive, the growth dividend from lower-cost energy is less than 1.5% in 2030. To a significant extent, this is due to assumed resource constraints, particularly in labor markets. Shocks from and adjustments to the Covid-19 across China will contribute to a more accommodating labor market over the coming years. Compared with the traditional power sector, a more resource efficient renewable portfolio would reduce electricity costs, saving money for households and enterprises across the Chinese economy. These savings would be redirected to mainstream expenditure, most of which is much more job intensive than the conventional energy sector (Figure S1). The resulting expenditure shifting would increase labor demand across a broad spectrum of occupations, which would accelerate job creation and growth. In the EMP scenario, incremental GDP in 2030 rises from 1.3% in the Keynes scenario to 6.9% in the EMP scenario, adding 9.7 trillion RMB and 64.9 million full-time equivalent jobs to the overall economy.

FIGURE ES-1.
EMPLOYMENT INTENSITY BY SECTOR, 2017



Source: Author Calculations Based on Data from Input-Output Table 2017 and China Labor Statistical Yearbook.[45,48]

Finally, the PROD scenario demonstrates that substantial growth potential can arise from productivity spillovers in an economy-wide renewable energy transition. The 1% annual TFP increase in the PROD scenario more than doubles aggregate economic growth to 2030 compared with the EMP scenario, adding 15.6% to real GDP in just over a decade.

Overall, our results strongly support China's new commitment to an accelerated transition to carbon neutrality, not only for the air-quality and climate benefits, but also for the broad and positive impact on innovation, employment, and economic growth. As China considers its post-COVID recovery measures, building green energy infrastructure offers a double dividend: supporting sustained economic growth and accelerated climate mitigation that are consistent with its long-term target of carbon neutrality by 2060.