Supplementary Information

Promoting economic and environmental resilience in the post-COVID-19 era through the city and regional on-road fuel sustainability development

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Supplementary Tables

Supplementary Table 1 | Corresponding province name in Fig. 3. Name of cities or province was plotted as sequential numbers in Fig. 3. This table provides each city and province's name accordingly. The order is in ascending according to each province's transportation sector carbon intensity with the GDP of corresponding province or city as denominator.

Province	**Number**	**Province**	**Number**
Hebei	1	Shanxi	16
Beijing	2	Chongqing	17
Shanghai	3	Innermongolia	18
Tianjin	4	Shaanxi	19
Anhui	5	Guangdong	20
Henan	6	Gansu	21
Fujian	7	Hubei	22
Hainan	8	Ningxia	23
Jiangsu	9	Qinghai	24
Jilin	10	Heilongjiang	25
Shandong	11	Liaoning	26
Zhejiang	12	Guizhou	27
Hunan	13	Guangxi	28
Jiangxi	14	Xinjiang	29
Sichuan	15	Yunnan	30

Supplementary Table 2 | Corresponding province name in Fig.4. Name of cities or province was plotted as sequential numbers in Fig. 4. This table provides each city or province's name accordingly. The order of provinces is in ascending according to each province or city's average transportation sector carbon emission intensity with the GDP of the transport sector as the denominator.

Province	**Number**	**Province**	**Number**
Beijing	1	Chongqing	16
Shanghai	2	Heilongjiang	17
Jiangsu	3	Jiangxi	18
Zhejiang	4	Shaanxi	19
Henan	5	Hubei	20
Fujian	6	Shanxi	21
Hainan	7	Qinghai	22
Tianjin	8	Gansu	23
Sichuan	9	Guangxi	24
Hebei	10	Xinjiang	25
Anhui	11	Guizhou	26
Guangdong	12	Liaoning	27
Jilin	13	Yunnan	28
Shandong	14	Inner Mongolia	29
Hunan	15	Ningxia	30

Supplementary Table 3 | Corresponding province name in Fig.7. Name of cities or province was plotted as sequential numbers in Fig. 7. This table provides each city or province's name accordingly. The order of cities and provinces are the same as original data in the CEADs.

Province	**Number**	**Province**	**Number**
Shanghai	1	Jiangxi	16
Yunnan	2	Hebei	17
Innner Mongolia	3	Henan	18
Beijing	4	Zhejiang	19
Jilin	5	Hainan	20
Sichuan	6	Hubei	21
Tianjin	7	Hunan	22
Ningxia	8	Gansu	23
Anhui	9	Fujian	24
Shandong	10	Guizhou	25
Shanxi	11	Liaoning	26
Guangdong	12	Chongqing]	27
Guangxi	13	Shaanxi	28
Xinjiang	14	Qinghai	29
Jiangsu	15	Heilongjiang	30

Supplementary Table 4 | Steady state expressions comparison

	No Policy	Emission intensity	Emission cap	Emission Tax
k	$\hat{\kappa}\alpha$	$\frac{\hat{\kappa}\alpha(1-\mu)}{1-\gamma}$	$\hat{\kappa}\alpha$	$\hat{\kappa}\alpha$
c	$1-\gamma-\delta\hat{\kappa}\alpha$	$1-\mu-\delta\frac{\hat{\kappa}\alpha(1-\mu)}{1-\gamma}$	$1-\frac{\gamma}{1+\hat{\phi}}-\delta\hat{\kappa}\alpha$	$1-\gamma/(1+\tau)-\delta\hat{\kappa}\alpha$
d	$\frac{1-\alpha-\gamma}{\eta(1-\gamma-\delta\hat{\kappa}\alpha)}$	$\frac{1-\alpha-\gamma}{\eta(1-\gamma-\delta\hat{\kappa}\alpha)}$	$\frac{1-\alpha-\gamma}{\eta c}$	$\frac{1-\alpha-\gamma}{\eta c}$
m	γ	$\frac{\gamma(1+\hat{\phi}\mu)}{1+\hat{\phi}}$	$\frac{\gamma}{1+\hat{\phi}}=\frac{\bar{M}}{\bar{Y}}$	$\frac{\gamma}{1+\tau}=\frac{\bar{M}}{\bar{Y}}$

Supplementary Table 5 | Summary of simulation parameter values

Parameter	Description	Value	Literature resources
γ	Cobb-Douglas parameter for H	0.349	Sun & Jiang (2012)
α	Cobb-Douglas parameter for K	0.493	Fan et al. (2016)
η	Utility parameter	0.77	Sun & Jiang (2012)
β	Discount factor	0.985	He et al. (2017)
δ	Depreciation rate	0.025	Bai et al. (2006)
ρ_z	Shock persistence parameter	0.95	Fischer & Heutel (2013)

Supplementary Table 6 | Abbreviation notation list

Abbreviations	Meaning
BEVs	Battery electrical vehicles
BP	BP p.l.c.
CEADs	Carbon Emission Accounts & Datasets for emerging economies
CEI	Carbon emission intensity
CBDR	Common but differentiated responsibilities
DSGE	Dynamic stochastic general equilibrium
FCVs	Fossil cell vehicles
FFVs	Fossil fuel vehicles
IEA	International Energy Agency
NEVs	New energy vehicles
PHEVs	Plug-in hybrid electrical vehicles
TWC	Three Way Catalytic Converter

Supplementary Notes:

When the stochastic process under consideration is Markovian, the Chapman-Kolmogorov equation is equivalent to an identity on transition densities. When the probability distribution on the state space of a Markov chain is discrete and the Markov chain is homogeneous, the Chapman-Kolmogorov equations can be expressed in terms of matrix multiplication; thus, P(t+s)=P(t)P(s), where P(t) is the transition matrix of jump t and X_t is the state at time t. (For more information, please refer to https://en.wikipedia.org/wiki/Chapman%E2%80%93Kolmogorov_equation and Chapman-Kolmogorov Equation - an overview | ScienceDirect Topics (accessed on May 4th, 2021).)

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