北京大学
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SDG 7: Providing clean and renewable energy while not compromising green growth in China

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UAS Spring Campus, Berlin, April 9-13, 2018

Overview

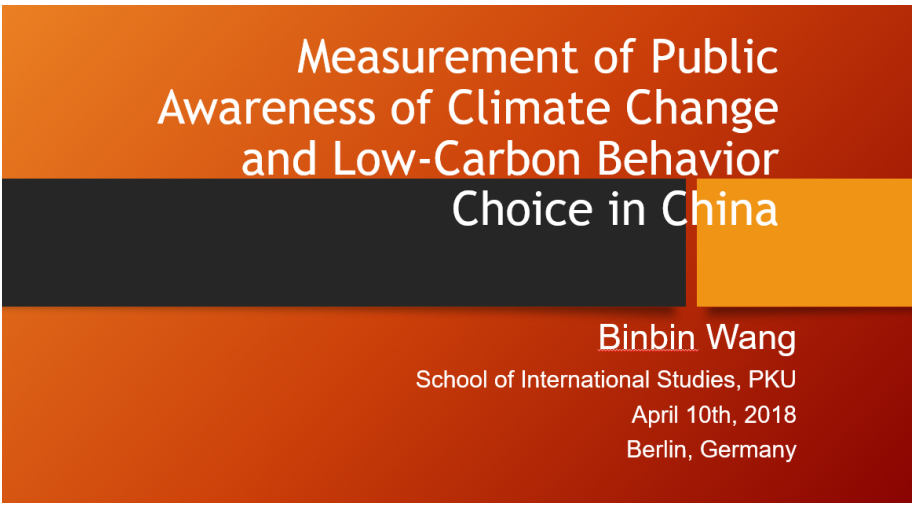
Introduction

Case study

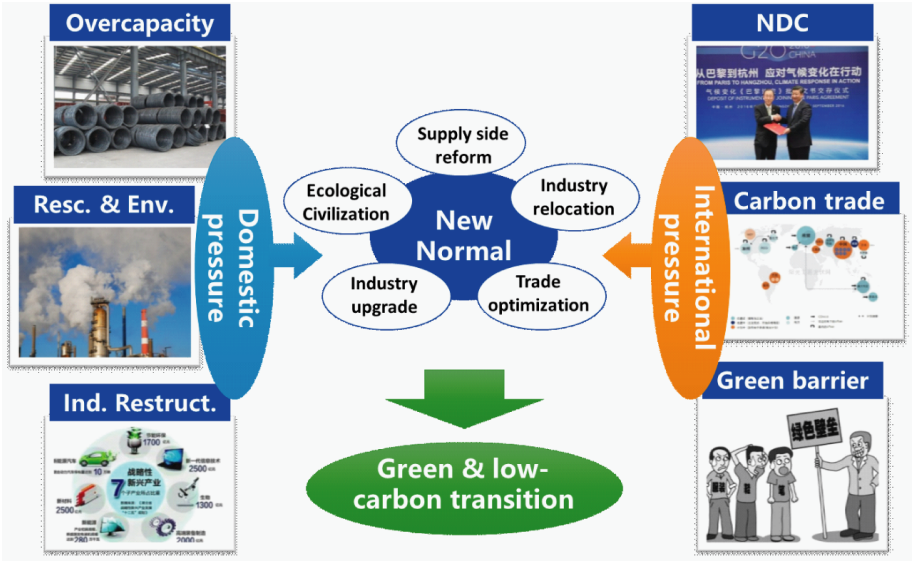
Assessment of socio-economic impacts of developing renewable energy in China towards 2050

Introduction

Dr. Binbin Wang, School of International Studies, PKU



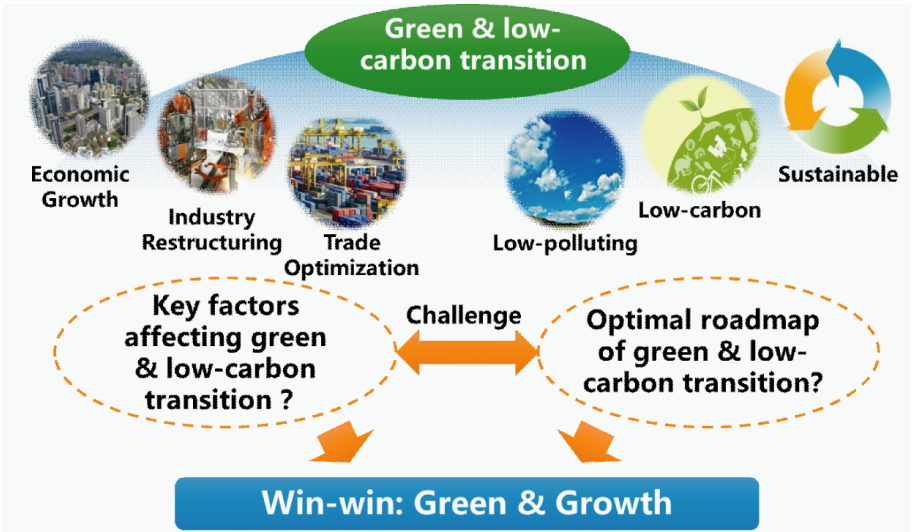
Background: Green Low-carbon transition



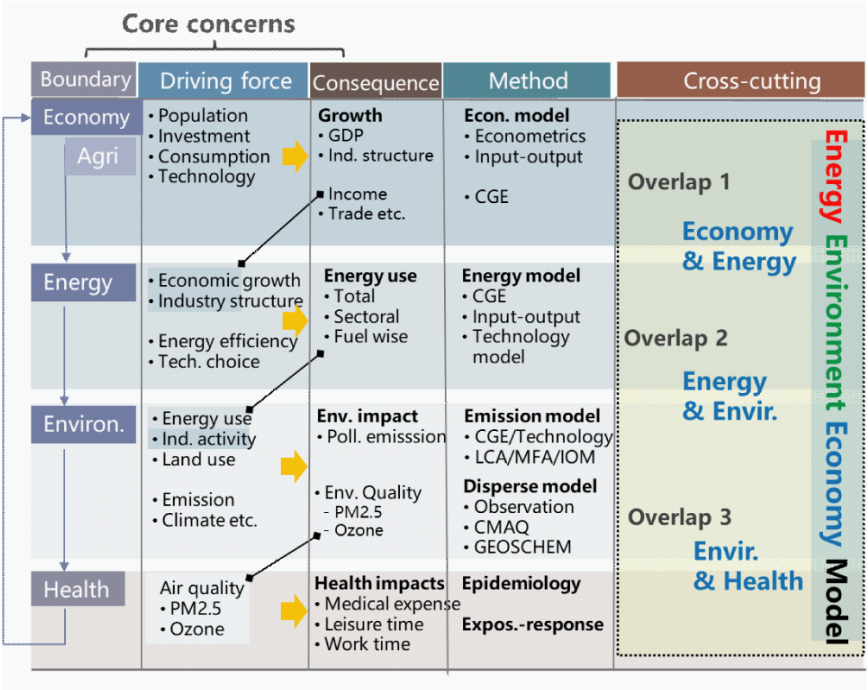
1. **Climate mitigation**

   - **IPCC Assessment Report**: Climate change resultes in many consequences such as glacier shrinkage, sea level rise, extreme weather and crop yield reduction etc.;
   - **Global target by this century** 1.5 to 2 degree;

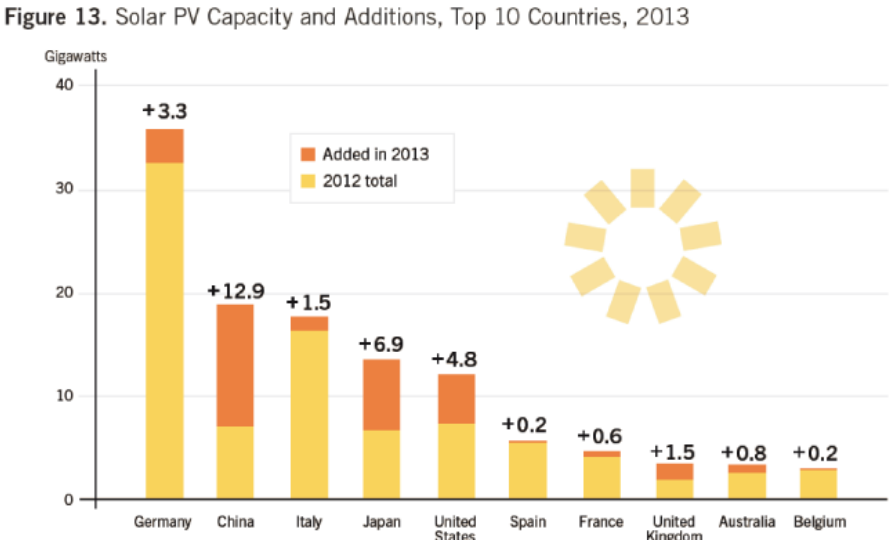
Background: Green Low-carbon transition



The Energy •Environment •Economy Systems



Background: Renewable Power Capacities

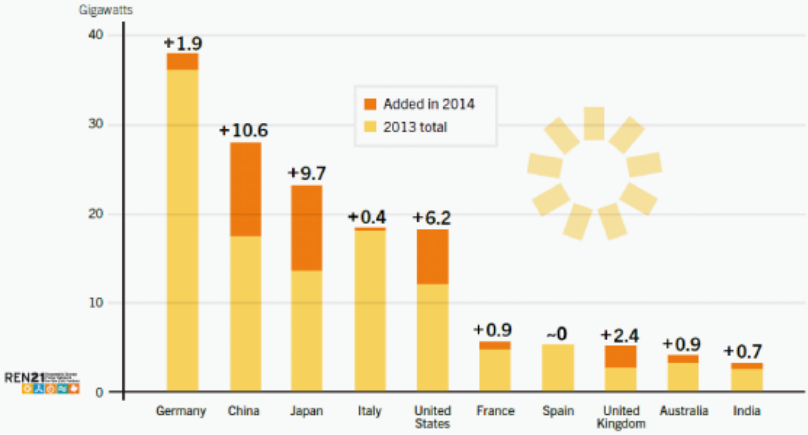


Renewable Power Capacities in World, BRICS, EU-28 and Top 6 Countries, 2016 (Source: [1]).

Background: Renewable Power Capacities

40 GW
added in 2014

Solar PV Capacity and Additions, Top 10 Countries, 2014



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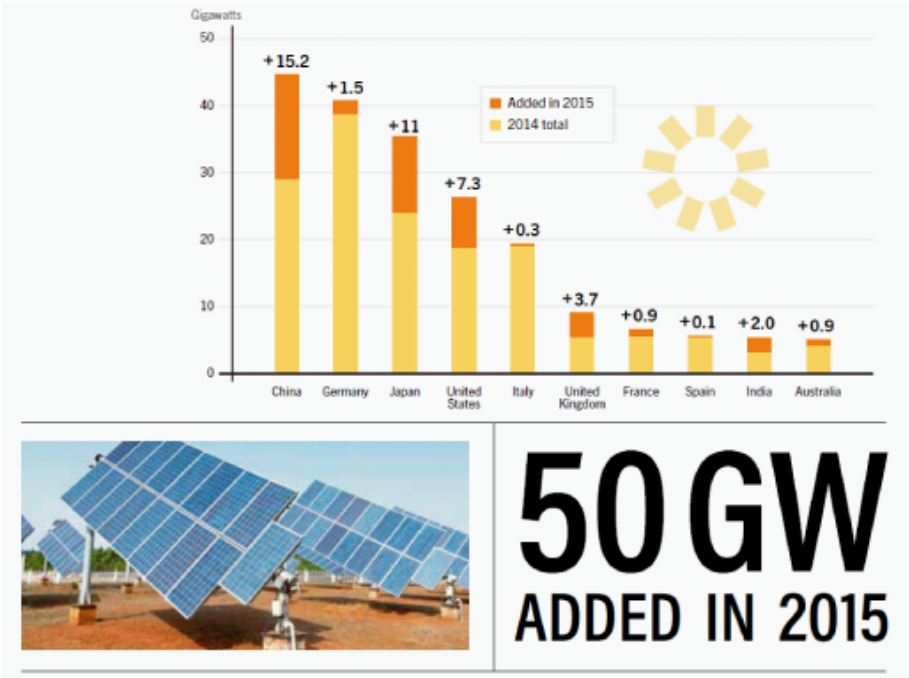

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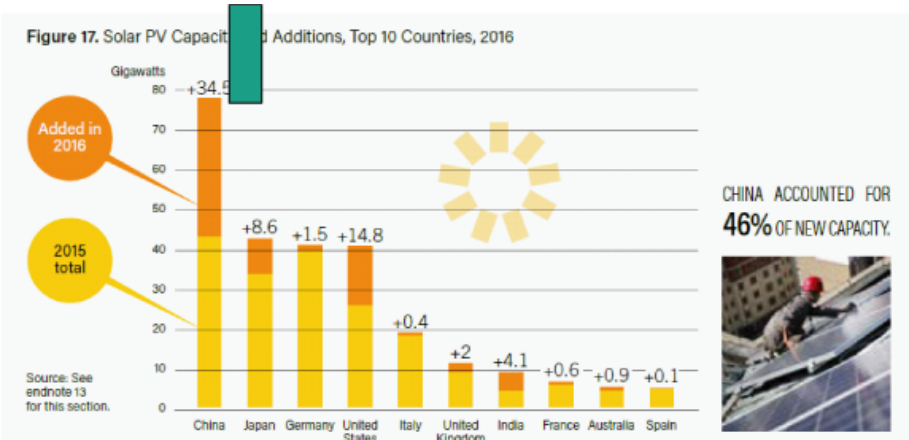


Renewable Power Capacities in World, BRICS, EU-28 and Top 6 Countries, 2016 (Source: [1]).

Case study

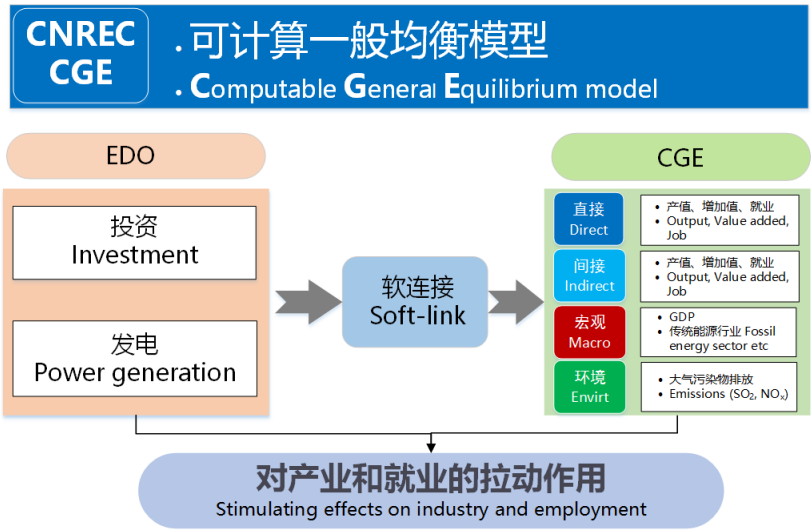
Case study

Assessment of socio-economic impacts of developing renewable energy in China towards 2050

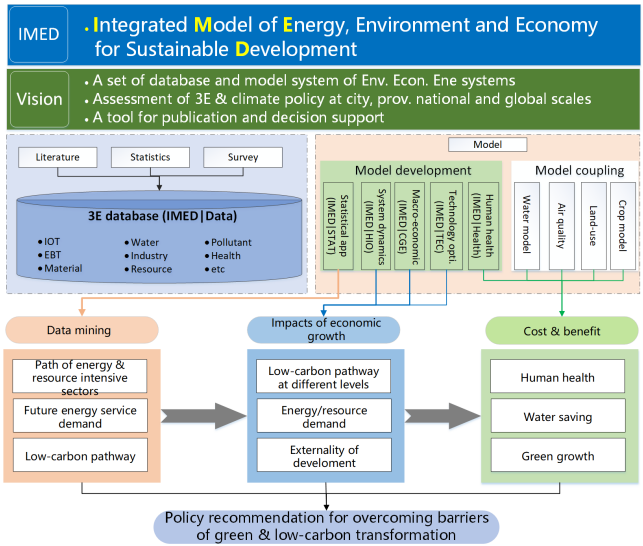
Study objectives

- The impacts of RE development on socio-economy and environment up to 2050

Method: Coupling EDO and CGE Models

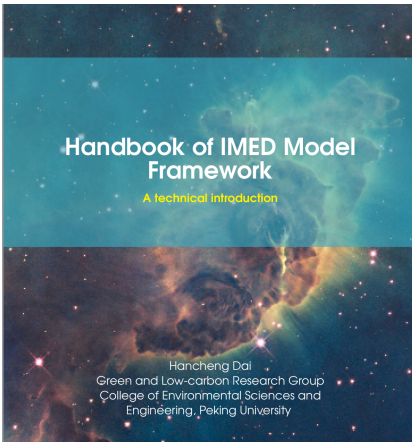


IMED Integrated assessment model [1].



- Process based model;
- Data intensive;
- Stylized simulation: intensive assumption, highly uncertain but still conveys the main message quite well.

[1] An up-to-date introduction here: http://scholar.pku.edu.cn/hanchengdai/imed_general



Full documents in Chinese and English freely available at:
http://scholar.pku.edu.cn/hanchengdai/imed_general

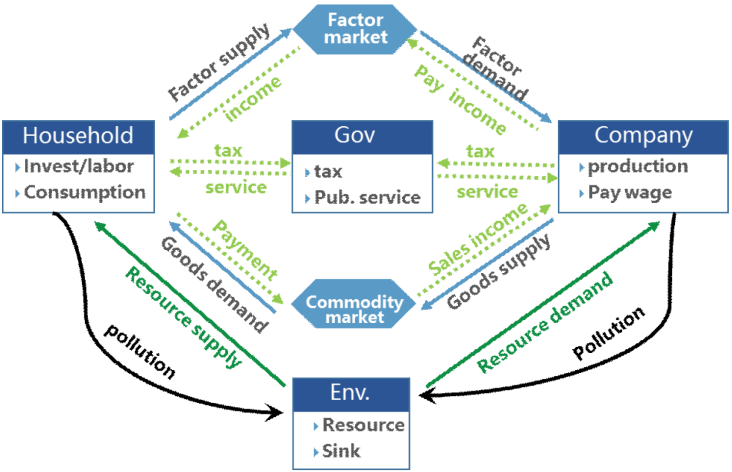
Research History

Model	Static	Dynamic	Two-region	Guangdong	30-region Global	Shanghai CGE	Liaoning	Chongqing	Resource CGE	IMED IMED|DATA IMED|MIN IMED|HEL IMED|CGE IMED|TEC IMED|HIO
Paper		1	1	0	4		7	16	10 10+ in preparation	
Topic	Non-fossil	Consumption pattern	ETS Renewable		Transport China/India		Wind		PM2.5 health Ozone health	
Outreach		NIES	ERI		GIEC		SJTU		NEU, Texas A&M, RMU, Duke John Hopkins, IIASA etc.	

Beyond paper

- **Coding** **10** global, national and provincial CGE models with >20000 lines source code
- **Outreach** Collaboration with **10** institutes, **15+** student/researchers for publication

IMED|CGE: Computable general equilibrium (CGE) model of economy [2].

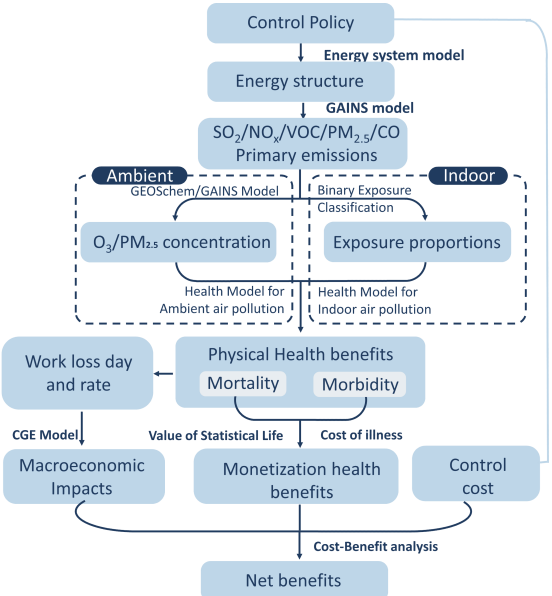


- Provide trajectories of future economic development;
- Multi-sector, multi-region, recursive dynamic CGE model;
- 30 provinces of China and 14 world regions;
- 22, 25, 33, and 91 sectors.

[2] An up-to-date introduction here: http://scholar.pku.edu.cn/hanchengdai/imedcge

Case studies:

- Taxation: **Carbon tax** [2, 3, 4, 5], **Air Pollutant Tax** [6];
- Contribution of **renewable energy** to: carbon intensity reduction [7, 8]; carbon emission trading [9, 10]; macroeconomy [11];
- Carbon **emission trading** in Guangdong [12, 13], Shanghai [14, 15], China [9];
- Impacts of **household consumption pattern** on energy consumption and carbon emissions [16, 17];
- Co-benefits of carbon reduction on **resource use** [18, 19];
- Co-benefits of carbon reduction on **air pollution** control [20];
- Impacts of carbon reduction on regional **industrial competitiveness** in Liaoning [2], Shanghai [3], Guangxi [21] and China [4];
- **Soft-link** with bottom-up technology model [22].



IMED|HEL model]: A health assessment model.

- Quantifying health and economic impacts caused by air pollution.
- Provide cost-benefit analysis of energy or air pollution control policy.
- Combining with many other models such as GAINS, energy system model and air quality model.

[3] An up-to-date introduction here: http://scholar.pku.edu.cn/hanchengdai/imedhel

Case studies:

- Impacts of $PM_{2.5}$ pollution on health and economy [23, 24, 25, 26, 27][4] [5] [6] [7] [8];
- Impacts of ozone pollution on health and economy [28] [9].

[4] Yang Xie, Hancheng Dai*, Huijuan Dong, Tatsuya Hanaoka and Toshihiko Masui (2016). "Economic impacts from $PM_{2.5}$ pollution-related health effects in China: A provincial-level analysis." Environmental Science & Technology 50 (9): 4836 - 4843.

[5] 谢杨，戴瀚程，花岗达也，增井利彦 (2016). "$PM_{2.5}$ 污染对京津冀地区人群健康影响和经济影响." 中国人口资源与环境 26(11): 20-28.

[6] Xiang Zhang, Yana Jin, Hancheng Dai, Yang Xie and Shiqiu Zhang (2018). "The health and economic benefits of "coal to electricity" policy in residential sector: Evidence from the Beijing-Tianjin-Hebei region in China." Applied Energy.

[7] Rui Wu, Hancheng Dai*, Yong Geng*, Yang Xie, Toshihiko Masui, Zhiqing Liu, Yiying Qian (2017). "Economic Impacts from $PM_{2.5}$ Pollution-Related Health Effect: A Case Study in Shanghai." Environmental Science Technology. 51(9):5035-5042.

[8] Xu Tian, Hancheng Dai, et.al. (2018). "Economic Impacts from $PM_{2.5}$ pollution-related health effects in China's road transport sector: a provincial-Level analysis." Environmental International (115): 220 - 229.

[9] Yang Xie, Hancheng Dai*, Yanxu Zhang, Tatsuya Hanaoka and Toshihiko Masui (2017). "Economic impacts from ozone pollution-related health effects in China: A provincial-level analysis." Atmospheric Chemistry and Physics, Discussion paper.

Scenario setting

Two scenarios are constructed from 2015 to 2050:

Stated Policies Reference scenario.

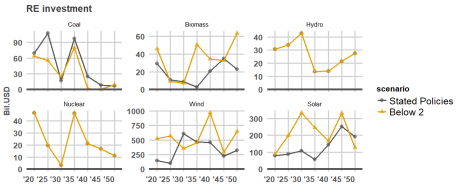
- The current ambitions for RE development correspond to minimum requirements for fulfilling the energy and environmental goals set for China to achieve by 2050.
- Coal is still the dominant fuel.

Below 2 More renewables and 2-degree target.

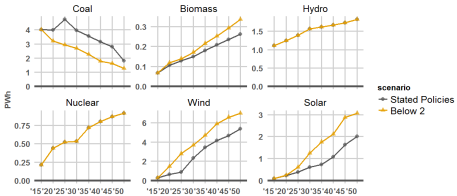
- Differs from the Stated Policies scenario with the amount of new wind and solar PV capacity and with the degree of electrification in the end-use sector.

The **core** message is **how RE development benefits the economy**.

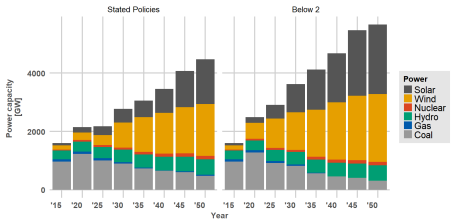
Scenario setting: the power sector

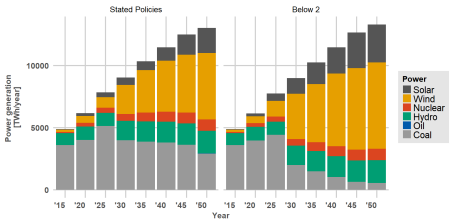


The power mix Power generation



Power capacity





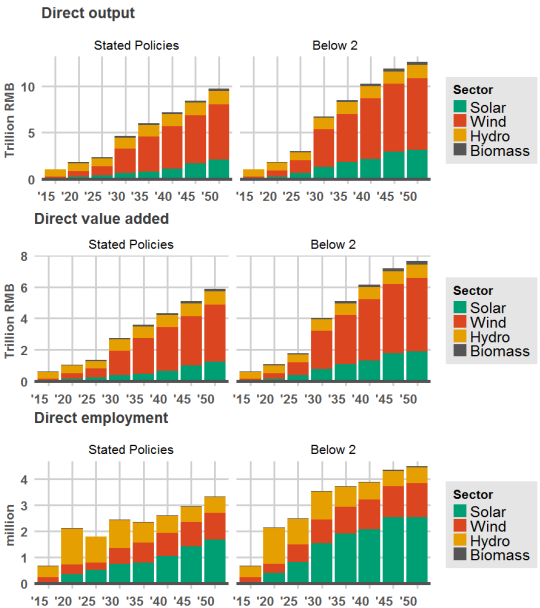
Key points in Below 2 in 2050

☞ No investment in coal after 2040.

☞ Most investment in wind (2320 GW, 665 bilUSD) and solar (2389 GW, 130 bilUSD).

☞ Renewable power rises from 71% to 89%, coal falls from 22% to 4%.

Direct impacts of RE



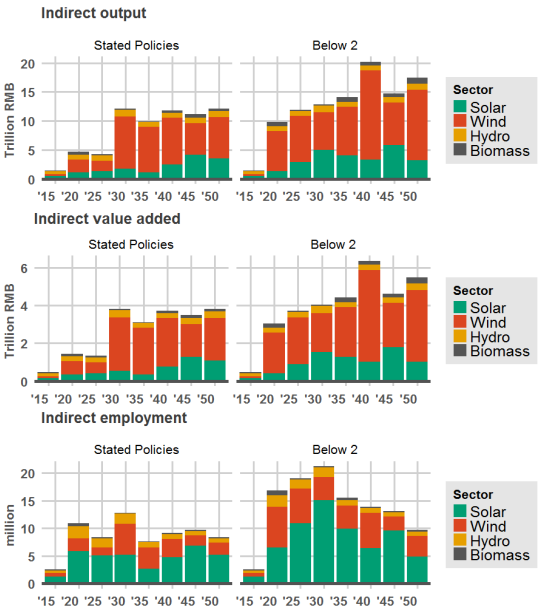
Key points in 2050

☞ Total RE output in 2050: 12.6 triY (2010constant price), total value added: 7.6 triY, 2.9% of GDP.

☞ Value added of hydro 0.85 TriY, wind 4.7 TriY, solar PV 1.89 TriY, biomass 0.21 triY.

☞ Total direct employment > 4 million.

Indirect impacts of RE



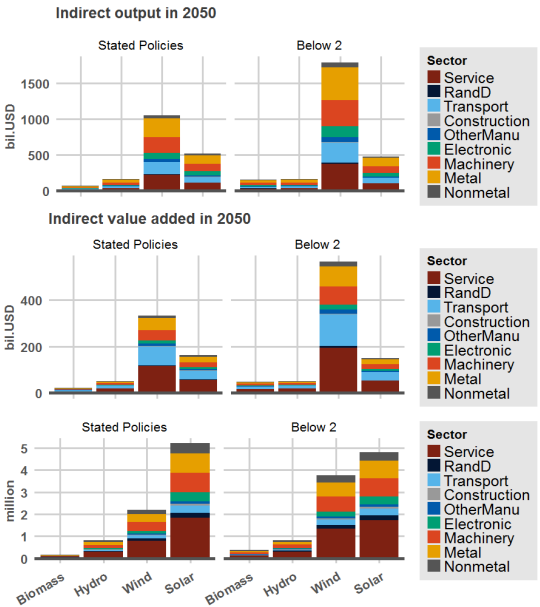
Key points in 2050

☞ Strong stimulating effects on upstream industries.

☞ Stimulating effects on upstream industry 2050: 18.5 triY of output, 5.9 triY of value added, 2.2% of GDP, 10 million job indirectly

☞ Energy and pollution intensive sectors are negatively affected, policy is needed to rellocate those jobs

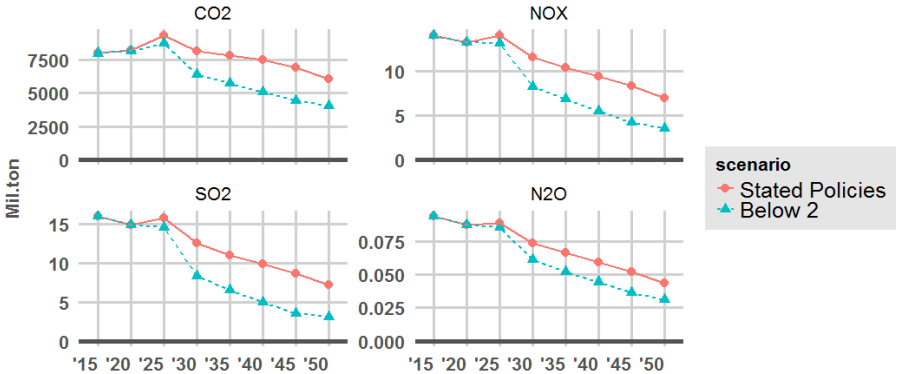
Indirect impacts of RE in 2030



Key points

☞ Key beneficial sectors: electronic manufacturing, machinery, R&D etc.

Air polluant emissions



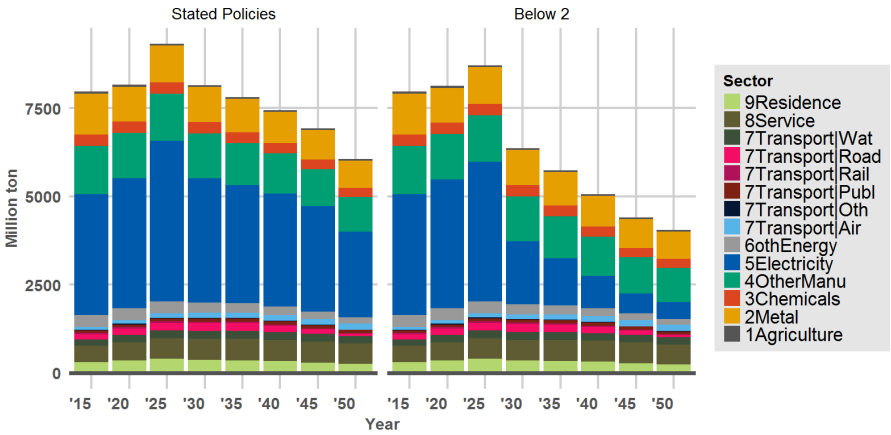
Key points

☞ Huge environmental co-benefits.

☞ In 2050 Stated Policies scenario, due to energy saving, coal control and env. regulation, CO_2 reduces to 6 Gt, SO_2 7 mil ton NO_x 7 mil ton (back to 1990 levels).

☞ In B2C, CO_2 further reduces by 2 Gt, SO_2 and NO_x reduce by 3 bil. ton.

Carbon Emissions



Conclusions

RE development has:

- Huge ecomonic benefits: contributes to >5% of GDP in 2050.
- Job creation: 4 million direct and over 10 million indirect jobs in 2050.
- Environmental benefits: reduction in CO_2 and air pollutant emissions.

However, policy is needed to offset the negative impacts related to the traditional energy sector.

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Thank you for your attention! Questions?

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