

SUSTAINABLE DEVELOPMENT PATHWAY FOR CHINA: A COMPARISON OF 2°C SCENARIOS

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Overview

Several long-term scenarios exist which try to comply with the Paris agreement to stabilise global temperature increase below 2°C in 2100 above pre-industrial level. In all scenarios, China has a critical role to play as China is the first CO₂ emitter in the world since 2006 and as Chinese CO₂ emissions are still expected to grow under current policy. This paper compares three of these scenarios: IEA Energy Technology Perspectives 2017 - 2 Degrees Scenario, Shell - Sky scenario and Greenpeace - revolution scenario. The three of them have the same goal, which is to limit the temperature increase to 2°C, but they differ on the path to follow: energy consumption level, energy mix and sectorial consumption are quite different.

According to these scenarios, Chinese contribution to global emissions reduction by 2050 will exceed Chinese share in total emissions, reflecting the importance of efforts expected. In order to have a synthetic view of a scenario and to facilitate comparisons, we have built a synthetic index reflecting the effort needed to achieve the scenario. As a result, Greenpeace scenario seems to require much more efforts than IEA or Shell scenarios would.

Beyond the comparison of scenarios, this paper highlights the different possible pathway for China. Even in strongly constrained context (limitation of temperature elevation to 2°C), Chinese efforts and Chinese contribution to world global objective differ significantly, reflecting the uncertainties surrounding Chinese future, but also the leeway China has in implementing its energy and environmental policies.

Methods

This paper focuses on three out the most popular global scenarios pursuing a goal of limiting global warming to 2°C. It takes a closer look at Chinese projections. We analyse here global and Chinese energy trends and we look more precisely at a sectorial level to see where major reductions are. Given the political attention they get, power generation and transport sectors are especially analysed.

We have also developed a synthetic index to facilitate the comparison of scenarios. The main idea is to give a measure of the “efforts” needed to achieve a scenario. The proposed index is based on five components representing three main levers of an energy transition, namely: energy efficiency, energy decarbonisation and electrification of uses. For each component (per capita energy consumption, energy intensity, share of renewables in total primary energy demand, share of nuclear in power generation and share of electricity in final energy demand), an indicator is calculated. The final index is then obtained by the arithmetic average of these components. This new index has been tested on several scenarios at the world level and is applied here specifically on China.

Results

Although having the same global objective, the 3 scenarios do not project the same future for China.

All three scenarios are logically expecting a decline of CO₂ emissions, but the amount of reduction in 2050 varies from 50% in Shell scenario to more than 80% in Greenpeace. Primary energy demand is set to grow in all three scenarios in the short term, but demand is peaking very rapidly in Greenpeace, later for IEA, although at a lower level. Shell differs both in terms of level of consumption and profile. Primary energy demand is almost twice higher in 2050 in Shell scenario compared to Greenpeace Revolution. On a per capita basis, energy consumption will rapidly decline in Greenpeace scenario, while it remains almost constant for the IEA. Shell is expecting a still growing per capita consumption.

Chinese contribution to global reduction is higher in IEA scenario, while Greenpeace is relatively less ambitious. Beyond these results, this comparison shows that there is a wide range of energy futures for China, even in a very constraining context.

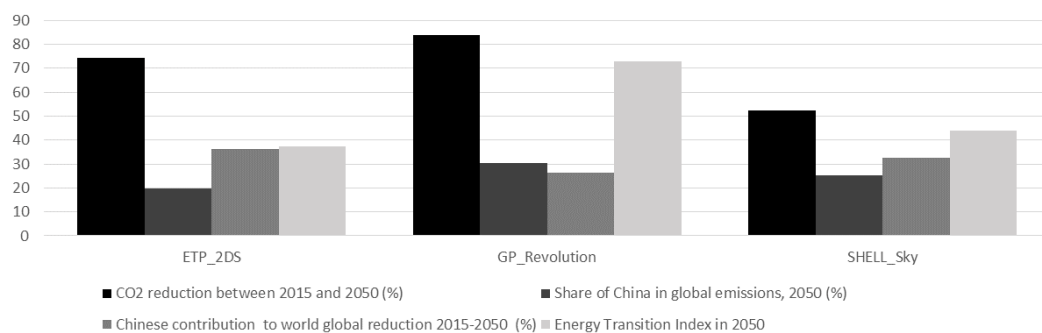


Figure: Chinese efforts in the three 2°C Scenarios

The power sector will see major upheavals in the coming decades. Electrification of uses is indeed the main lever of these scenarios to achieve sustainable energy development. World power generation will continue to grow strongly especially in China. At the same time, the world electricity mix needs to be decarbonised, particularly with the gradual abandonment of coal and the growing penetration of renewable energies. China's power sector is relying heavily on coal. The challenge for this sector is therefore to develop rapidly enough decarbonised production capacities in order to respond to a still growing electricity demand, and replace existing coal plants. The three scenarios show that by 2030, China will have a hard time reducing the share of coal by 50%. Nuclear projections are less consensual. Only Greenpeace Revolution scenario assumes a phase-out of nuclear energy in the world. Other scenarios envisage a growth of nuclear, essentially in China, where its share in the electricity mix could reach 20%. Nuclear power is seen as a mean for decarbonising Chinese electricity mix and accompanying the decline of coal. Gas will also contribute to substitute coal. Its share in the electricity mix is increasing sharply in the first decade, and decreasing after 2035 leaving room for renewable energies. Finally renewable energies are the main lever to decarbonize the electricity mix in the long-term.

Chinese transport demand has been growing rapidly since the late 2000s due to the increase of the middle class standard of living and galloping urbanisation still in operation, causing roads saturations and contributing to the dramatic air pollution. Indeed, Chinese transport energy use has tripled within 15 years, so as the direct CO₂ emissions and transport sector counts for 55% of China total oil final consumption in 2015.

Scenarios agree on the fact that the current transport demand trend will pursue and the traffic activity will not reach maturity before 2050, despite of demographic and economic growths slowdowns. To overcome the surge of motorized vehicles and to prevent an increase of GHG emissions due to the transport sector, existing 2°C scenarios count on changes in transport modes, energy efficiency

improvement and strong electrification of railway and vehicles. Thanks to government recent incentives, this fuel switch has already been engaged and China has become within 5 years, the world's largest electric vehicles (EV) market, overtaking the USA and giving credence to large and rapid EV diffusion scenarios.

As for the energy consumption projections, scenarios are consensual on the fact that the transport oil consumption will decline but differ on the horizon. Time varies between 2025 and 2050 according to scenarios, and the decrease is very much related to the hypothesis set for the diffusion pace of new energy vehicles. Indeed all of the 2°C scenarios bet on the electric technology breakthrough for vehicles and as a result, they foresee a significant increase of electricity consumption that has to come along with the decarbonisation of China electricity production mix.

Conclusions

This study provides a comparison of three possible future for China in a context where the global temperature increase is limited to 2°C. This comparison stresses the importance of transport and power generation in achieving this target. The development of an energy transition index facilitates the comparison by providing an aggregated view of the “policy” content of a scenario. In all three scenarios studied here, China has a major role to play, but the means used to reduce CO₂ emissions are significantly different. The contrast between scenarios highlights the uncertainties surrounding Chinese evolution. Scenarios follow different pathways which rapidly diverge – a sign that China is at the crossroad.

References

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