



How realistic are low-carbon pathways derived by energy models for Brazil, Russia, India, China and South Africa (BRICS countries)?

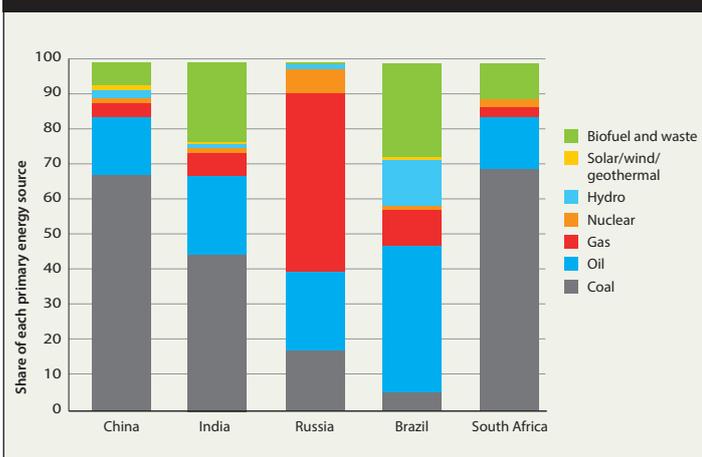
AVOID 2 modelling suggests that the lowest-cost pathways for limiting average global warming to below 2°C will involve emerging economies rapidly decreasing their greenhouse gas emissions. To consider whether this is realistic and feasible, the lowest-cost pathways for key emerging economies from the AVOID 2 least-cost energy model have been compared to these countries' most ambitious scenarios for climate change mitigation. The comparison suggests that in some cases the AVOID 2 pathways involve deploying low-carbon technologies more rapidly than the countries' own scenarios. Deployment at the rates suggested by the countries' scenarios implies more effort from other sectors and regions in order to limit warming to 2°C, and increasing the associated global mitigation costs.

Mitigation in emerging economies is critical

The International Energy Agency (IEA) projects that by 2040, the BRICS countries could account for almost half of global carbon dioxide (CO₂) emissions from fossil fuel combustion, with India and China alone responsible for 40% of the world total.¹

In 2012, China, India and South Africa relied heavily on coal (for power generation and industrial manufacturing), Russia on gas, and Brazil on oil (primarily for transport) [Fig 1]. Each of these countries has high potential for renewable energy and therefore a potentially significant role to play in mitigating climate change.

Figure 1: Split of primary energy usage in the BRICS countries, 2012



Are national and regional pathways to limit warming to below 2°C feasible for the BRICS?

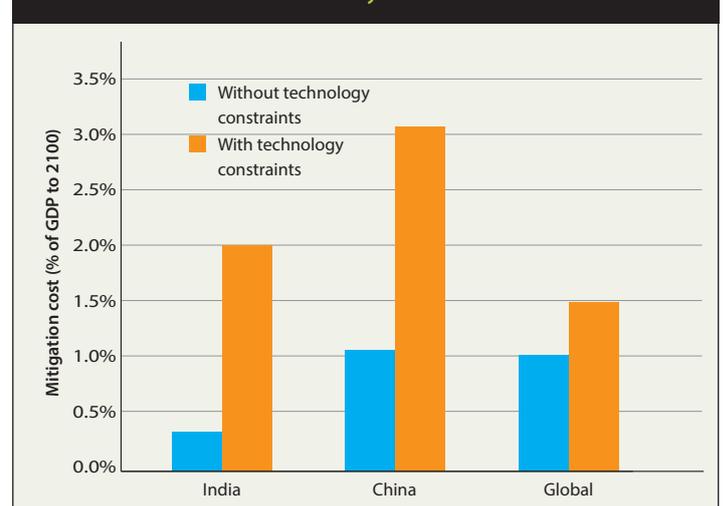
Modelling for AVOID 2 (using the TIAM-Grantham global energy systems model) produced least-cost, low-carbon energy systems pathways for China and India, and for regions containing the other BRICS countries, as part of a global pathway to limit warming to below 2°C.

Beyond AVOID 2, an increasing number of detailed country-level studies examined the deployment of low-carbon technologies in the BRICS countries' most ambitious mitigation scenarios, including the UN's Deep Decarbonisation Pathways Project (DDPP) scenarios and the 2050 country pathways calculators, based on DECC's 2050 UK Pathways Calculator, which includes high ambition levels for technology deployment.

In comparison, the lowest-cost pathways to limiting warming to 2°C in the TIAM-Grantham model require some low-carbon technologies to be deployed more rapidly in some sectors, despite in most cases reaching similar levels.

According to TIAM-Grantham, the cost of remaining below 2°C in 2100 increases from 1.0% to 1.5% of 21st century global GDP if the model's technology deployment rates are brought in line with the country-level studies in China and India. This is because greater and costlier mitigation effort is required by other sectors and regions.

Figure 2: Mitigation costs modelled by TIAM-Grantham, with technology deployment rates constrained in line with India and China's country-level studies.



¹IEA current policies pathway projection. (World Energy Outlook 2014).



For China and India, how do the AVOID 2 deployment rates compare with country-level studies?

Biomass (electricity and buildings)



In China: By 2020, biomass electricity capacity is over 100 GW in TIAM-Grantham, compared to 30 GW in China's 12th Five Year Plan.

In India: By 2020, biomass electricity capacity is over 20 GW in TIAM-Grantham, compared to 7 GW in India's Planning Commission scenarios.

In India: By 2050 biomass makes up over 50% of final energy use in buildings in TIAM-Grantham, compared to 30% in residential and <10% in commercial buildings in India's Deep Decarbonisation Pathways scenario.

Wind (on- and offshore)



In China: By 2050, total wind capacity is over 4,000 GW in TIAM-Grantham, compared to 2,400 GW in China's 2050 High Renewable Energy Roadmap.

In India: By 2050, onshore wind capacity is over 1,200 GW in TIAM-Grantham, compared to just over 400 GW in the most ambitious of India's 2047 Energy Security Scenarios.

Carbon capture and storage (for electricity and industry)



In China: By 2050, CCS is applied to all gas plants in TIAM-Grantham, as opposed to a lower share (80%) in China's Deep Decarbonisation Pathways scenario.

By 2050, CCS captures almost 60% of CO₂ emissions from the industrial manufacturing sector, whereas in other studies (China's Deep Decarbonisation Pathways scenario and the China 2050 Pathways Calculator's most ambitious scenario) the figure is less than 30%, by 2050.

Hydrogen vehicles



In China: By 2050, hydrogen fuel cells dominate cars in TIAM-Grantham, whereas in China's 2050 Pathways Calculator there is a more balanced mix of electric and hydrogen cars as well as hybrids.

In India: By 2050, hydrogen fuel cells dominate cars in TIAM-Grantham, whereas in both India's Deep Decarbonisation Pathways scenario and the most ambitious scenario in India's 2047 Energy Security scenarios, hydrogen and electric vehicles make up only 50% of the total.

How do the numbers compare in the other BRICS countries?

- TIAM-Grantham does not represent Russia, Brazil and South Africa as separate regions so they cannot be directly compared.
- In the "Former Soviet Union" region (of which Russia makes up two-thirds by GDP), TIAM-Grantham sees CCS rapidly deployed from 2020, when in reality there are no explicit plans at this time for CCS deployment at scale in Russia, which strongly suggests CCS would begin – if at all – later than this date.
- For the "Central and South America" region (of which Brazil makes up over two fifths by GDP) TIAM-Grantham sees energy and industry-related CO₂ emissions reducing significantly by 2030, whereas the Brazil Deep Decarbonisation Pathways study actually sees emissions rising to 2030 (before subsequently falling).
- These comparisons indicate that further parameters may need to be constrained in TIAM-Grantham to align the model with countries' most ambitious low-carbon pathways. **This could potentially mean mitigation costs will be higher than previously estimated and more challenging to limit global warming to below 2°C.**

Read more

AVOID 2 report C5: *Low-carbon transition patterns in the BRICS countries* available on our website www.avoid.uk.net.