China's Energy Supply and Demand in the 2020s

*Note: These are working research findings and are subject to change. In the event of material developments, the author will post an updated version.*
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Mr. Collins holds a membership interest in Cactus Water Services, LLC. This relationship is covered by a Rice University conflict of interest management and monitoring plan.
Three Core Themes

- **Scale + legacy matter:** The first change is likely the easiest.
- “**The VII Index:**” Local endowments and conditions matter. The United States and China will make their most important energy decisions based on domestic factors and self-interest, not on international treaties.
- Energy will fundamentally be a dimension of competition because it invokes at least three critical spheres—industrial activity, technological positioning, and national security decision making.
China, U.S., India are The Global Energy Titans

- Where these three go in the energy consumption and sourcing, so goes also the global emissions balance.
- U.S. energy transition is primarily about substitution of the existing installed base.
- China and India have to manage both substitution and deciding what sources will meet future energy demand growth.
- All three must also make decisions amidst an incipient U.S.-China technology Cold War and rising tensions between China and both the U.S. and India across the diplomatic, economic, and military spectrum. Some potential outcomes of these conflicts may yield a more sustainable energy slate, others not so much.

<table>
<thead>
<tr>
<th>Proportion of 2019 Global Total Use</th>
<th>Proportion of Net Global Demand Change Between 2010 and 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Energy Consumption</td>
<td>46.3%</td>
</tr>
<tr>
<td>Electricity Generation</td>
<td>49.9%</td>
</tr>
<tr>
<td>CO2 Emissions</td>
<td>50.5%</td>
</tr>
<tr>
<td>Oil/Liquids Demand</td>
<td>39.5%</td>
</tr>
<tr>
<td>Coal Demand</td>
<td>70.7%</td>
</tr>
<tr>
<td>Natural Gas Demand</td>
<td>30.9%</td>
</tr>
<tr>
<td>Hydro Demand</td>
<td>40.3%</td>
</tr>
<tr>
<td>Nuclear Demand</td>
<td>44.6%</td>
</tr>
<tr>
<td>Renewables Demand</td>
<td>47.2%</td>
</tr>
</tbody>
</table>

Source: BP Statistical Review of World Energy 2020

Scaling: In energy unit terms, the world consumed 10X as much oil as it did renewables.
*A Million Tonnes of Oil Equivalent is on par With the Annual Fuel Use of Approximately 1 Million Sedans Driving 12,000 Miles Per Year Each*
China is The World’s Largest Energy Demand Growth Driver For 20 Years and Running

Source: BP Statistical Review of World Energy 2020, Author’s Analysis

Consider China’s role in underpinning the U.S. shale boom
China’s Energy Trajectory Since 1965

Why the Energy Demand Upswing?

Infrastructure and transport activities played a key role

- Steel: 18.2 GJ per tonne of crude steel (14,159 kWh) (WSA, 2012)
- Cement: 3.6-to-6.0 GJ/tonne (2,800-to-4,700 kWh/t)
- Passenger car: 10,000 miles per year @ 30 mpg = 8 barrels of gasoline

Source: BP Statistical Review, Author’s Analysis
China’s Energy Path: “All Sources on Deck”

- Future increasingly looks like “clean” plus “coal”
- Gas use likely to rise as well, particular with Power of Siberia (and possible subsequent pipelines) and deepening of Russia-China commodity sourcing relationship.
- Nuclear share likely to begin rising substantially 2025 and beyond, especially if overall economic growth (and rate of energy consumption) were to substantially slow.

2019 saw resurgence of coal. 2020s could see relative dependence on coal remain steady, or even increase, despite investments in nuclear and renewables

Source: BP Statistical Review of World Energy 2020
The Opaque Crystal Ball
Impact of Local Resource Availability and Global Conditions—On Energy Sourcing And Emissions

U.S. Coal and Gas-Fired Power Generation Capacity Additions

- U.S. coal plant installed base now 40 years old (or more)
- Shale gas abundance and favorable prices make gas-for-coal substitution economically and politically attractive

China Coal-Fired Power Generation Capacity Additions

- China added as much coal-fired generation in 2019 as U.S. would have in 4-5 years during its 1960-1985 buildout.

The U.S. example also shows how unexpected macro events can accelerate decoupling from legacy burdens.
In both countries, oil and gas have thus far driven the biggest shifts in the primary energy balance.
And What If The China Growth Story Runs Off The Rails?

Rising Consumer Debt is Concerning...

- From 2013 to 2019, household debts rose by nearly 35 trillion RMB, according to BIS data.
- 2013-2015 accounted for 20% of the total increase.
- 2015-2017 accounted for 38% of the total increase.
- 2017-2019 saw 42% of the total household credit expansion that occurred between 2013 and 2019 in China.
- Debt acceleration matters: it is unlikely that the quality of assets borrowed against, the supportable value of the properties purchased (for secured debts), or the strength of household finances (for unsecured debts) improved commensurately as the overall debt burden increased.
China’s Growth Profile Impacts Oil Patches Globally

Crude Oil Demand in Major Global Commodity Exporting Regions

- Between 2003 and 2014 (when oil prices first crashed), China’s own oil demand grew by about 5.4 million barrels per day.
- But the combined oil demand growth in Africa, Central and South America, the former Soviet Union, and the Middle East (commodity exporting regions heavily leveraged to Chinese growth) clocked in at 7.3 million barrels per day—134% of China’s own demand growth.
- From 2015 to 2019, the major commodity exporters’ oil demand only rose by 32% of what China’s did, a far slower rate even adjusting for the shorter time frame.

Source: BP Statistical Review of World Energy 2020, Author’s Analysis
China Gearing Up for a New Infrastructure Cycle?

- Excavator sales, one of the best lead indicators of real-economy activity in China, hit a historic high in 2020.
- Some of this represents fleet recapitalization. But even accounting for that, the sales numbers are still remarkably high.
- Heavy equipment buying sprees suggest that local contractors, the best-positioned of anyone outside government to know future construction plans, see major new projects on the horizon.
China’s CO2 Intensity Still 1/3 Higher than USA’s Kg CO2/GJ Primary Energy Consumed

Cumulative CO2 Emissions, GT
5GT= approx. 1 PPM of atmosphere

At current pace, China’s cumulative CO2 emissions would surpass America’s by 2040

China now emits 2X the CO2 each year that US does

Source: BP Yearbook of World Energy 2020, Author’s Analysis
China's primary energy use is now almost 50% larger than that of the United States.

And energy use in China is still about 1/3 more carbon-intensive per unit of energy consumed than that in America.

The US gets about 24% of its electricity supply from coal, while coal generation supplies about 65% of electricity in the PRC.

Two strategic takeaways: (1) the multi-trillion dollar investment challenge is, in purely arithmetic terms, about twice as large in China [exchange rates not included] and (2) a more aggressive US climate policy that seeks to COMPETE with China through carbon taxation and border adjustment taxes coordinated with OECD allies may in fact make more sense than the present COOPERATIVE status quo approach to climate diplomacy.
Where Am I Wrong?

1) Underestimating technology deployment’s potential capacity to compensate for a worsening demographic profile.

2) Underestimating the willingness of China’s central government to override provincial officials and prematurely undo investment-backed expectations in the carbon energy space, particularly coal.

3) China’s policy push to electrify its transport system either falters—or proves much more successful than expected.

4) Chinese entities deploy carbon offset technologies effectively and at scale.

5) Structural factors cause China’s economic growth to revert to the long-term global mean ore quickly than expected.
Thank You!
Relevant Publications


