

Burning Money

How China could squander over one trillion yuan on unneeded coal-fired capacity

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Executive Summary

After two decades of breakneck growth in coal-fired power generation, power generation from coal finally slowed down in 2011 and turned into a decline in 2013, as a result of booming clean energy and slowing power demand growth. While this turnaround is the decade's most important positive development for the climate, it has also precipitated an unprecedented coal power overcapacity bubble, as power generators have failed to scale back their investments in new coal plants in response. A policy change allowing provincial governments to greenlight new projects from early 2015 led to a record surge in new permits and construction starts, with 210 new coal-fired power plant projects, with a total capacity of 165 gigawatts, receiving environmental permits in 2015.

In an attempt to resolve China's coal power overcapacity crisis, the country's top energy planners put in place a new capacity control and retirement policy in April 2016. This report assesses the implications of the new policies and updates the outlook for overcapacity in coal-fired generation.

Key findings:

- Full implementation of China's new coal power capacity policy should see 110GW (160 coal-fired units) of coal-fired power projects suspended and up to 70GW (669 units) of capacity retired by 2020. The expected suspensions and retirements are equal to the entire operating coal-fired capacity of the EU.
- However, in addition to existing overcapacity, there is already 200GW (365 units) of coal-fired generating capacity under construction, after the permitting binge seen in 2015, and a further 160GW (295 units) of capacity that could still gain permits despite the controls, with at least 30GW (55 projects) of them already in 2016. Further permitting is possible because not all provinces are covered by the suspension, and because projects linked to western coal bases and long-distance transmission lines are exempt. The exemptions could still allow another seven years of one coal-fired power plant per week entering operation. Only one year of additions will be offset by retirements.
- In contrast, demand for coal-fired power generation will be flat or declining due to rapid deployment of clean energy, bringing approximately 800TWh of new non-fossil power generation to the grid by 2020, equal to the entire power generation of Germany and Poland.

- By 2020, China could have 1,200GW of coal-fired power plants in operation and under construction, resulting in overcapacity of at least 400GW. This represents wasted capital expenditure of approximately 1.4 trillion RMB (200 billion USD)¹.
- One quarter of this redundant capacity, 110GW, could still be avoided by fully suspending permits to all new conventional coal-fired projects, avoiding wasted capital expenditure of 300 billion yuan. Resolving the rest of the overcapacity will require either stopping more than a hundred recently started construction projects or retiring hundreds of coal-fired units well before the end of their expected operating life.
- By early 2020s, power producers could be losing 500 billion yuan (80 billion USD) per year due to the reduction in utilization of coal-fired capacity.
- After retirements, the average age of the coal-fired fleet will be just 10 years, meaning that retiring large additional amounts of capacity to resolve the situation will also represent major stranded capital cost.

How broad exemptions undermine China's overcapacity policy was revealed already during the first two months after the policy was issued in late April: Greenpeace mapping shows that two large coal-fired units per week continued to go into construction, and six new 'coal power base' projects in Sha'anxi and Inner Mongolia, with over 9GW of capacity applied for environmental permits immediately after the policy was published, making May the busiest month of 2016 for new applications.

Besides obvious economic and financial costs, the looming overcapacity crisis has environmental significance because

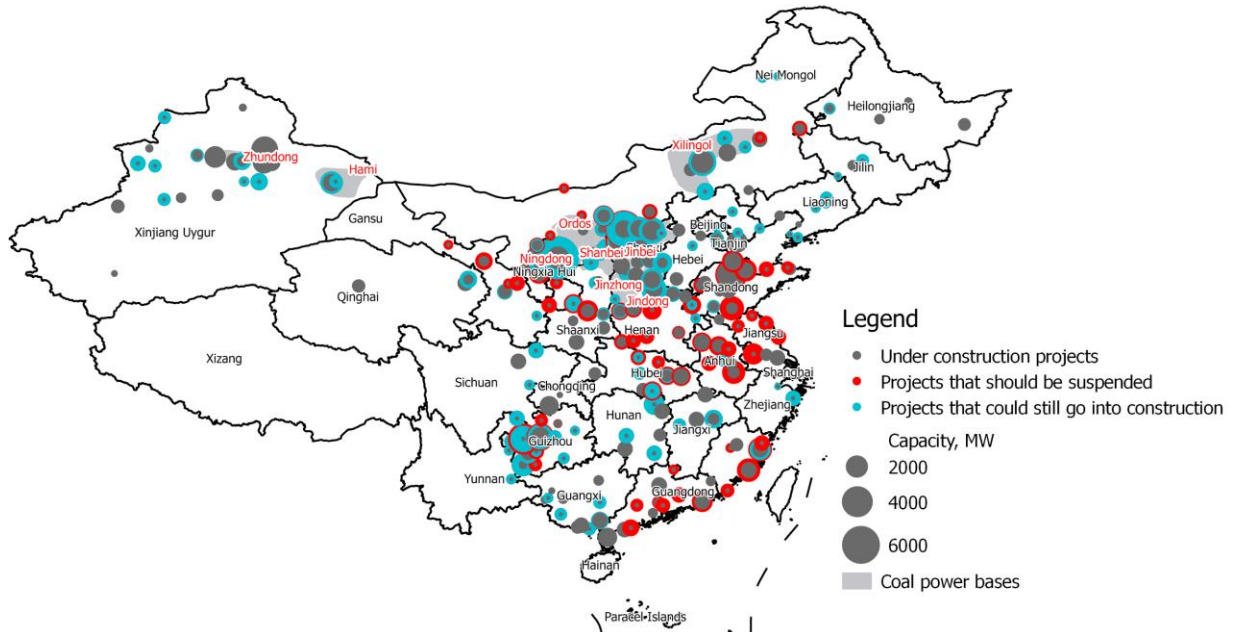
- Capacity control policy further concentrates new projects in the most water-stressed areas. 50% of the new projects that we expect not to be suspended are located in areas where water use already exceeds renewable supply.
- Continued expenditure of vast amounts of capital on redundant coal-fired capacity represents a wasted opportunity to use these resources to scale up clean energy even faster.
- As long as grid operators fail to fully prioritize grid access for renewable energy, coal power overcapacity can exacerbate the problem of curtailment, i.e. wind and solar power generated but not fed into the grid.

Policy recommendations

- Extend ban on new permits and construction starts to cover all provinces, and all conventional coal power projects.
- Cancel projects that started construction in 2015 or later in areas with coal power overcapacity, and in water overwithdrawal areas.
- Substantially reduce investments in retrofitting of older coal-fired power plants and retire this capacity instead.

¹ CAPEX estimates are based on averages of reported costs for different project types compiled from project documents.

- Strictly implement priority grid access for renewable energy. Increase transparency of information about the power system to improve planning and enable the public to scrutinize reasons for high rates of “wasted wind and solar”.
- Pay particular attention to stopping new projects and reducing existing capacity in the most water-stressed areas of the country.



China's new coal power capacity pipeline, showing projects already under construction, projects that we expect to be suspended under the new policy and those likely not to be affected. Projects in the “coal base” areas, shown in gray are expected to be able to move ahead, as well as district heating projects and projects in provinces outside the suspension policy.

China's current coal-fired capacity and pipeline

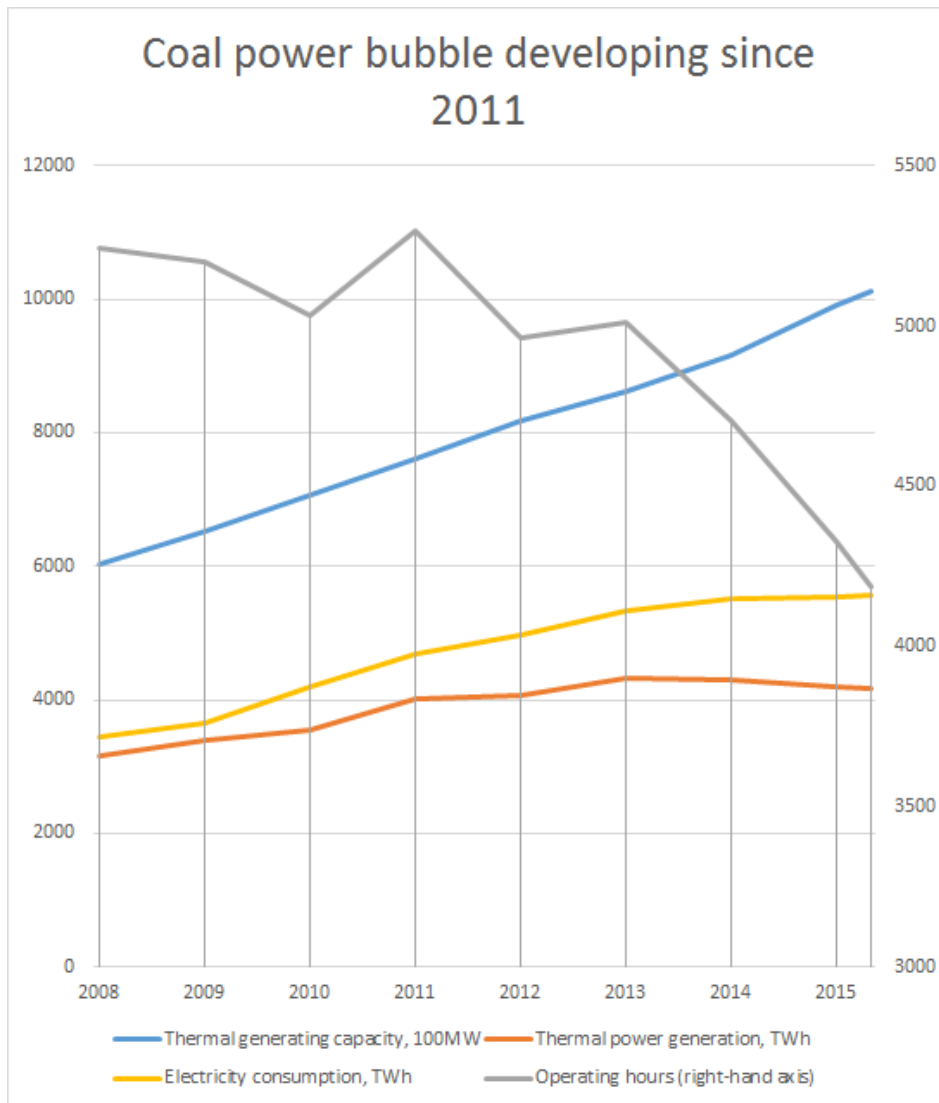
Thermal capacity passed 1,000GW in February and coal-fired capacity is over 900GW. While thermal power generation has barely grown since 2011, China has increased thermal power generating capacity by 250GW, or one third, resulting in a precipitous fall in capacity utilization. The non-fossil energy target requires bringing approximately 800TWh² of new non-fossil generating capacity online by 2020. Capacity targets for renewable energy, combined with

² 2015 non-fossil share was 12.1%, total energy 4.3 Gtce and thermal power average heat rate 315 gce/kWhe. If 2020 total energy is 5.0 Gtce, non-fossil target share 15% and heat rate continues to

hydropower and nuclear power capacity under construction, will comfortably deliver this amount of generation.

The increase in non-fossil power generation will very likely cover the entire increase in power demand over this period, leaving no space for coal-fired generation to expand. Indeed, coal-fired power generation has been falling since 2013.

Yet China has 200GW of coal-fired generation under construction and 55GW permitted, after the 2015 permitting binge. A lot more is in planning.



The utilization of China's coal-fired generating capacity started falling precipitously in 2011 as demand for power generation from coal leveled off but utilities kept adding new capacity at a rapid pace.

improve at 0.7%p.a., the required increase is $5.0 \text{ Gtce} \times 15.0\% / (315\text{gce/kWhe} \times (1-0.7\%)^5) - 4.3 \text{ Gtce} \times 12.1\% / 315\text{gce/kWhe} = 814\text{TWh}$

Policies affecting coal plant construction and retirement

12th Five-Year Plan for Energy Development

The 12th Five-Year Plan for Energy Development³ sets out key development objectives for the industry during the 12th FYP (2011-2015). The coal power industry is estimated to grow from 660GW to 960GW, including 70GW CHP and 50GW low calorific value coal power, at yearly growth rate 7.8% in 12th FYP period.

The plan restricts the use of fossil fuels in the east and relocate energy-intensive industries and power plants to the west. The five major energy production areas, namely Shanxi Province, the Erdos Basin, eastern Inner Mongolia, Southwest China, and Xinjiang are expected to realize overall energy production capacity of 2.66 Gtce in 2015, accounting for more than 70 percent of the country's total capacity.

Coal-Power Bases

The National Development and Reform Council (NDRC) foresees the development of nine large coal power bases of minimum 10GW each, with the building of new coal-fired power plants in the large coal bases of Ordos and Ximeng (Inner Mongolia), Jinbei, Jinzhong, and Jindong (Shanxi), Shanbei (northern Shaanxi), Ningdong (Ningxia East), Hami and Zhundong (Xinjiang)⁴.

Preliminary work on the building of 70 GW of new coal power capacity, equivalent to 8% of the country's total coal power capacity, in these bases was scheduled to start in 2014.

Ultra High Voltage (UHV) lines

To move power generated in the coal power bases to the major consuming provinces, Chinese government has planned to build “five horizontal, five vertical and one ring network” alternating current UHV lines and 27 direct current UHV lines by 2020⁵. Since the policy decision taken in April 2014, the development of UHV projects has been accelerated, with 12 trans-regional UHV power transmission lines approved in the first half of 2014⁶. Preliminary work has been started and eight lines are expected to be completed by 2017. These 12 power transmission channels will deliver the power resources in Inner Mongolia, Shanxi, Shaanxi, and Yunnan provinces to Beijing-Tianjin-Hebei, the Yangtze River Delta, and the Pearl River Delta. They will link the coal, wind and solar bases, and hydropower centers in ‘inland areas’ to the east. The projects are

³ http://www.gov.cn/zwggk/2013-01/23/content_2318554.htm

⁴ http://zfxxgk.nea.gov.cn/auto82/201401/t20140124_1756.htm

⁵ <http://www.cec.org.cn/xinwenpingxi/2014-06-11/123006.html>

⁶ http://www.nea.gov.cn/2014-05/15/c_133334537.htm

meant to cut thermal coal consumption in the eastern part of the country by 200 Mt a year and reduce PM2.5 pollution levels by 4-5 percent in the central and eastern regions.

National Energy Agency guidelines to halt overcapacity in coal power industry

National Energy Agency released three guidelines in April 2016 to crack down on the severe and growing coal power overcapacity crisis⁷.

The first guideline accelerates the closing of outdated coal-fired plants that use older, dirtier technology. There is 28GW outdated coal-fired power capacity been phased out in 12th FYP. All province should set the retirement target for 13th FYP according to the criteria in the guideline. Small units capacity range from 50MW to 300MW are all included the checklist.

The second guideline states that 13 provinces and regions, including top coal producers like Shanxi and Inner Mongolia, as well as the southern economic powerhouse of Guangdong, should “strictly control” new capacity, delaying the approval of new projects until after 2017. A slightly longer list of provinces - 15, with considerable overlap - were told to put off construction of approved projects that had not yet broken ground.

In both instances, an exception has been made for projects aimed at the “people’s livelihood,” a phrase that was not explained but may include measures like providing steam heat to homes in wintertime. As well as projects built for exporting power to other provinces, which are mostly in the nine coal power bases and transfer power to east province by UHV lines.

The third guideline introduces coal power planning risk management mechanism, dubbed the ‘traffic light’ system. The system is based on three factors, with provinces assessed on the profitability of their coal-fired generation, their existing coal capacity and their ‘resource constraints’. After adding these together, each province is assigned a colour to signify the viability of their coal pipeline. Red means no new coal projects should be permitted. Orange indicates local governments and coal companies should tread carefully. And green says that there is plenty space for new coal power. In the warning for 2019, only Jiangxi, Anhui and Hainan have green light, Hubei is orange, and the rest 27 provinces all get red light, which means these provinces have to stop approving coal capacity they don’t need.

Small units replacement policy

State Council issued a policy replacing small units (less than 100 MW) with large ones in January 2007⁸. While building large-capacity supercritical (SC) and ultra-supercritical (USC) coal-fired units, China has gradually shut their smaller, outdated, and inefficient coal generation units. The initiative was very successful with 77 GW retired during the 11th FYP and 28 GW of closures during the 12th FYP. The average efficiency of the coal power fleet has greatly

⁷ http://www.cnenergy.org/tt/201604/t20160422_288464.html

⁸ http://www.gov.cn/zwqk/2007-01/26/content_509911.htm

improved in the 2000s, from 370 gce/kWh in 2005 to 333 gce/kWh at the end of 2010 and 321 g/kWh at the end of 2013, already reaching the target set for 2015 in the 12th FYP.

Air pollution 10 key measures and 'coal capacity offset principle'

State Council has issued 10 key measures to combat the air pollution - Action Plan on Prevention and Control of Air Pollution in September 2013, which serves as the guidance for national efforts to prevent and control air pollution for the present and the near future⁹.

New industrial projects, such as coal power plants and steel mills in key cities and regions, including Beijing and the Yangtze River Delta, are banned. The plan specifies that, except from combined heat and power plant (CHP) projects, the approval of other new coal-fired power plants is prohibited, while according to the 'equal coal offset principle', new coal-fired power generation units with capacity more than 300MW could be built to replace multiple small units.

Coal-fired boilers are to be phased out in favor of CHP for the chemicals, papermaking, printing, dyeing, leather, and pharmaceuticals industries. For the heavy industries such as coal-fired power generation, iron & steel, oil refining, and non-ferrous metals, the emphasis is on installation of air pollution prevention equipment such as desulfurization, denitrification, and de-dusting facilities.

Impacts of new measures

Basis for retirement and suspension estimates

National Energy Agency released guidelines in late April to crack down on the severe and growing coal power overcapacity crisis¹⁰. The retirement guidelines for 13th five-year plan period (2016-2020) are:

1. Coal power plants that can not be converted to CHP, including:
 - Unit≤50MW, conventional coal power
 - Unit≤100MW, conventional coal power connected to grid
 - Unit≤200MW, conventional coal power connected to grid, operating years exceed design life
2. Retrofitted coal power plants whose net coal consumption rate can not meet the conventional coal power limitation, excluding ultra supercritical and supercritical.
3. Coal power plants' emission can not meet MEP environmental requirements and without retrofit plan, especially those Unit<300MW, and conventional coal power unit, operating year ≥ 20 years or CHP unit, operating years ≥ 25 years.

⁹ http://www.gov.cn/zwggk/2013-09/12/content_2486773.htm

¹⁰ http://www.cnenergy.org/tt/201604/t20160422_288464.html

It is estimated up to 70GW (669 units) capacity to be retired by 2020 in CoalSwarm¹¹ Global Coal Plant Tracker database by applying the criteria from the guidelines above. We assume the average coal power designed life is 30 years and calculate the operating year by 2020.

In order to estimate the amount of capacity that is unlikely to meet the efficiency requirements, we use plant-level coal consumption rates (heat rates) for coal-fired power plants in 2012 - before the current wave of retrofits - obtained from China Electricity Council 2012 Yearbook. Reported improvements in heat rate are typically up to 40 grams coal equivalent per kWh, so plants that are more than 40 gce/kWh above the requirement for their size class and boiler type are assumed to be retired. This could well prove an overestimate, as the State Council Strategic Energy Plan for 2014-2020 included an aggressive target of retrofiting 350GW of existing capacity to meet new standards.

The guidelines suspend new approval for coal-fired power projects in 13 provinces and slow down construction in 15 provinces with exception for district heating power plants and power-exporting projects in the coal bases.

- Provinces and regions should suspend new approvals: Heilongjiang, Shandong, Shanxi, Inner Mongolia, Jiangsu, Anhui, Fujian, Hubei, Henan, Ningxia, Gansu, Guangdong and Yunnan (13 provinces and regions).
- Provinces and regions should halt or slow down new projects construction: Heilongjiang, Liaoning, Shandong, Shanxi, Inner Mongolia, Shaanxi, Ningxia, Gansu, Hubei, Henan, Jiangsu, Guangdong, Guangxi, Guizhou and Yunnan (15 provinces and regions).

Comprehensive lists of power generation projects linked to each coal base were not available, so projects were designated to bases on the basis of location (see figure below). All projects that are designed to provide power to the UHV lines are expected to go ahead. For the "coal by wire" UHV lines, generally coal-fired capacity equal to at least 110% of the net capacity of the line is planned, to cover losses and unit non-availability. Most of this capacity was identified to plant level based on UHV resource plans, and the rest was assigned based on location. It is conservatively assumed that projects not yet in pre-permitting phase do not proceed, even when there is no explicit policy preventing this.

We also estimate the capacity to be suspended and slowed down for approval and construction in CoalSwarm database under pre-permitted, permitted and construction status respectively. We assess that approximately 160 coal-fired power projects with a total capacity of 110GW should have approval and construction suspended.

¹¹ CoalSwarm is a global network of researchers seeking to develop collaborative informational resources on coal impacts and alternatives. Current projects include identifying and mapping proposed and existing coal projects worldwide, including plants, mines, and infrastructure.



Rough outlines of the “coal base” areas used to judge which projects belong to the coal bases.

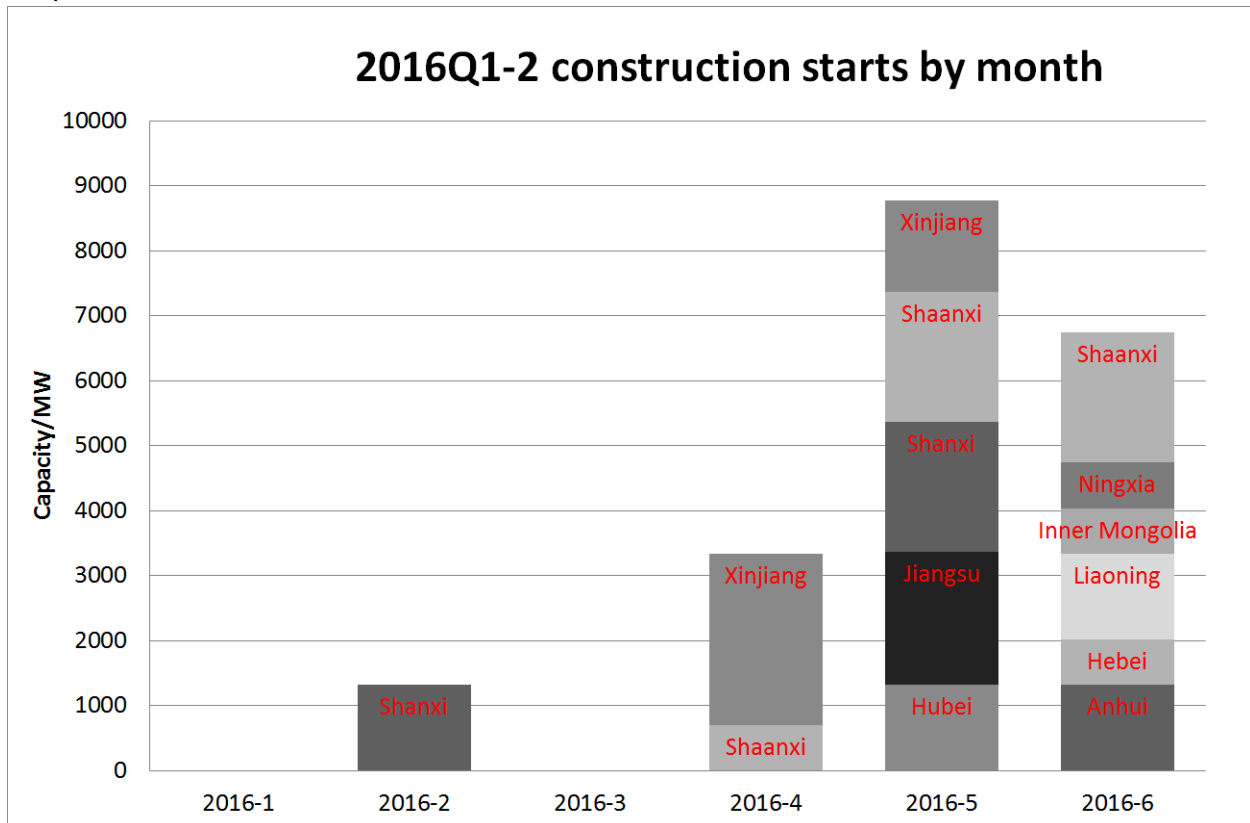
Developments since the April overcapacity policy

New Greenpeace mapping shows that in the two months following the issuance of the new coal power overcapacity policy, power companies started construction on 13 new coal power units, with a total capacity of 15.5GW, and applied for new Environmental Impact Assessment (EIA) permits for a total capacity of 15GW. This translates into two large coal-fired plants per week. These construction starts and new applications were possible because of the numerous exemptions in the policy, especially the fact that expansion in coal power bases in the western provinces is still permitted.

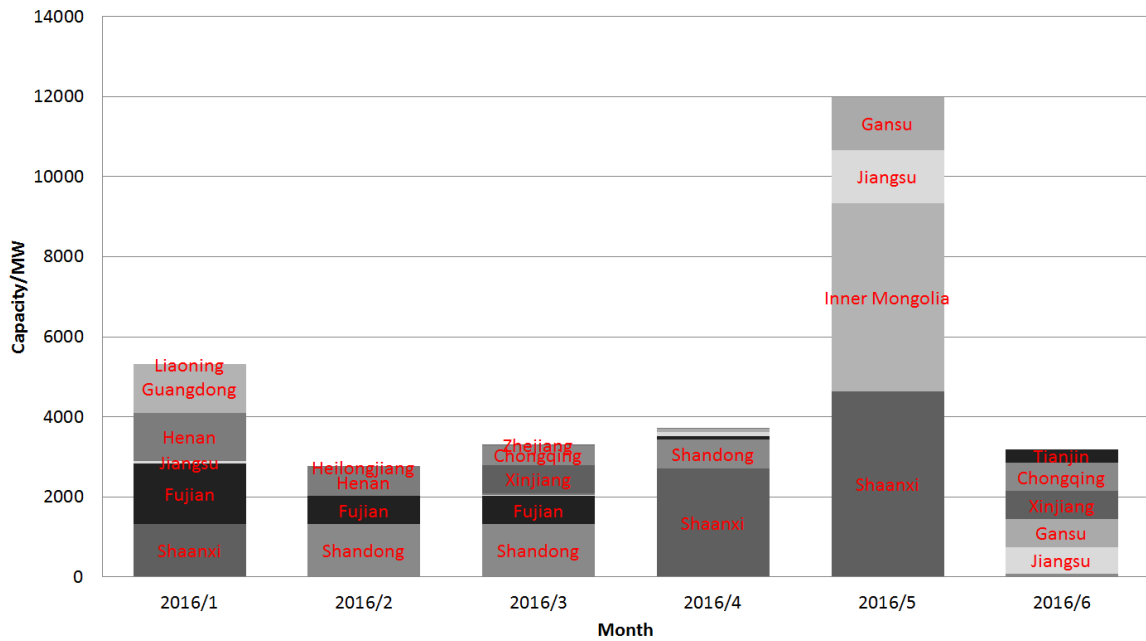
Furthermore, Greenpeace analysis of the applications for environmental permits reveals that up to 55 projects with 30GW of capacity could still gain green light for construction among the 2015 to first half year of 2016 applicants, if provincial governments exploit the exemptions to the maximum extent. This would keep the rate of approvals at two large coal plants per week.

Alarmingly, new construction initiations and new environmental permit applications jumped right after the policy was issued, possibly indicating that some developers viewed the policy as a green light for projects that were not explicitly suspended.

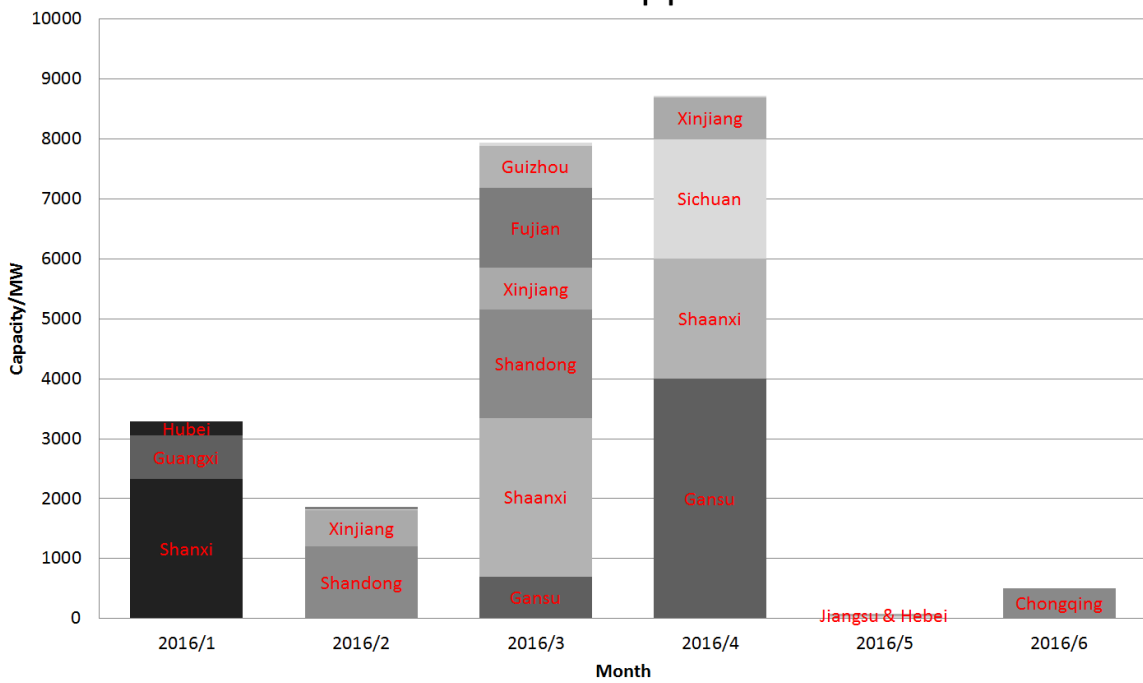
In a more positive sign, there were few new final approvals of coal power projects from provincial DRCs in the two months, even in provinces that are not covered by the suspension. This could signal one of three things: either the DRCs are simply assessing the policy before resuming approvals, they are 'lying low' for a while before resuming approvals, or the policy was taken as a broad red light to new final approvals, even for projects that are technically not suspended.



2016 Q1-2 Provincial Environment impact assessment permitting



2016 Q1-2 Provincial Development and Reform Commission approvals



Projecting supply and demand balances by province

In order to assess the electricity supply-demand balance in each province in 2020, we compiled data on operating and under construction capacity of coal, gas, other thermal, hydro, wind, solar and nuclear in each province at the end of 2015. Data on coal-fired power plants was taken from the Global Coal Plant Tracker database (April 2016), and for other technologies from Platts World Electric Power Plants database (April 2016). Capacity for 2020 projected by assuming that all under construction projects are completed by then. For wind and solar power, which have much shorter project cycles, installations in 2016-2020 were projected by scaling 2015 installation rates so that installed capacity nation-wide reaches 250GW of wind and 150GW of solar by 2020, in line with anticipated capacity targets. This is likely to prove conservative, as the numbers imply a slight deceleration of wind installations and a slight acceleration of solar installations compared with 2015, keeping the total rate of capacity additions for the two technologies at 2015 level. Solar power could well overachieve this level of installations, as the first half of 2016 is reportedly on track to match the record installations during all of 2015¹².

The starting point for assessing power demand and net exports by province was data on power demand, output and net exports for each province in 2014, and power demand growth in 2010-2014. To project the amount of capacity needed to meet demand peaks, data on peak demand in 2014 and peak demand growth rate was compiled. We projected power demand to 2020 assuming a national demand growth rate of 2.5%, representing a slight acceleration from the 2014-2015 average of 2.1%. The growth rates in 2010-2014 for each province were scaled down in accordance with the projected national growth rate in order to project the growth rates in 2016-2020. Peak demand was projected by calculating past elasticity between average demand and peak demand.

Average power supply from each source of power generation was projected based on average utilization rates in 2014-15. For thermal power, for the purpose of defining overcapacity, a "healthy" coal-fired capacity level is defined as there being enough firm and dispatchable capacity (coal, gas, hydro, nuclear) to meet peak load and coal plants getting average utilization of 5000 hours. Capacity above this level is seen as overcapacity.

Key assumptions regarding power supply and demand balances are:

- China will meet the capacity targets for clean power and add enough generation to grow non-fossil generation to 15% of the official target for total energy consumption of 5 billion tonnes
- National power demand growth recovers to 2~3% per year from current ~1%.
- Under construction projects are completed and retirement targets are implemented

The province-level results turned out to be very sensitive to the average utilization of the ultra-high voltage transmission lines set to be completed in 2017. No fixed assumption was made about this rate, but the situation was rather analysed for a range of possibilities (see figure Projected coal power plant utilization rates in 2020). There are many more transmission lines

¹² <https://neo.ubs.com/shared/d1aT8OW8dAK/>

planned in western provinces' five-year plans for 2016-2020, but given the overcapacity situation in the east, these seem unlikely to go ahead. The projections in this report assume no new UHV lines before 2020 beyond those that are already permitted. If the plans for another wave of UHV lines from the northwestern provinces were in fact realized, the result would be an even more extreme version of the 'high UHV utilization' scenarios below. The total amount of overcapacity nation-wide would not be appreciably affected, but much more of the overcapacity would be shifted from the west to the east.

Results: Outlook for Overcapacity with New Policies

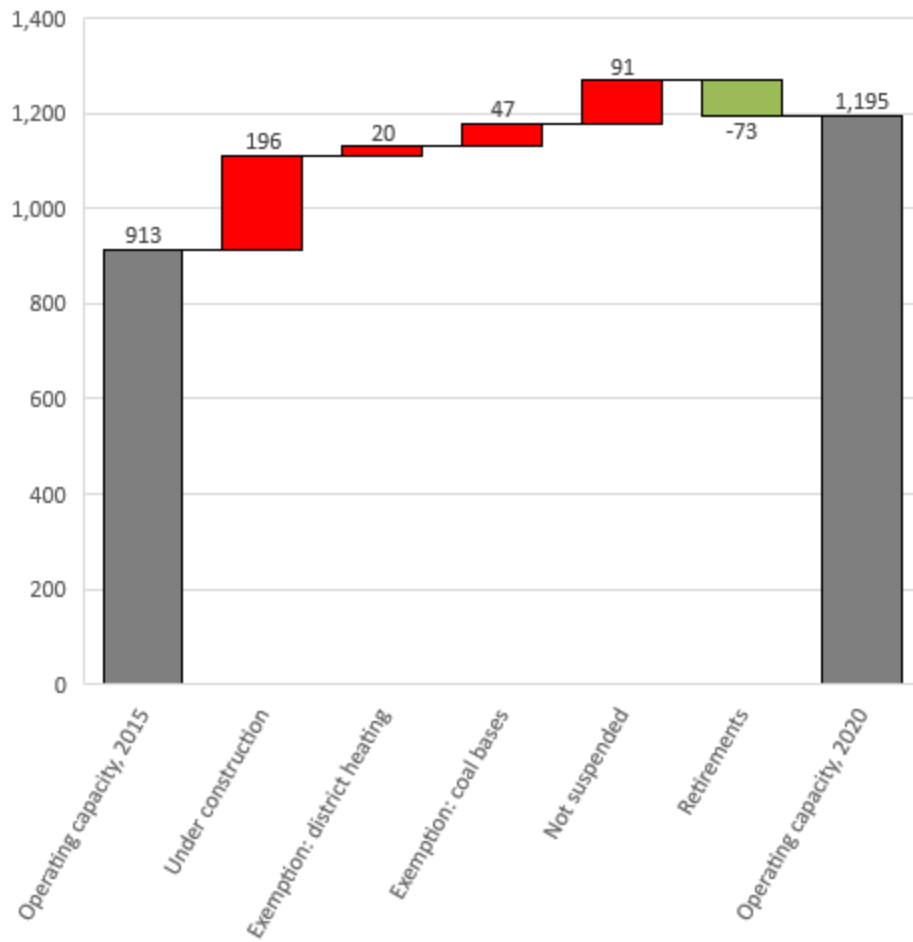
Full implementation of the new rules announced by the NEA and the NDRC should see a total of 110GW of coal-fired power plant projects suspended before entering construction. Furthermore, we project 70GW of retirements by 2020 if the policy is fully implemented, as 32GW coal-fired capacity should be shut down by 2020 based on age and unit size, at least 20GW should be shut down in the key control regions due to the requirements of the National Air Pollution Action Plan of not increasing coal-burning capacity. A further 48GW could be retired if it is found not to comply with environmental requirements - we expect half of this capacity to be retrofitted to meet the standards, given aggressive retrofitting targets.

However, Greenpeace has identified 165GW of capacity that could still go ahead despite the curbs on approvals and construction starts, in addition to approximately 196GW of capacity under construction. In total, China's coal-fired capacity could increase by an estimated 280-310GW from 2015 to early 2020s.

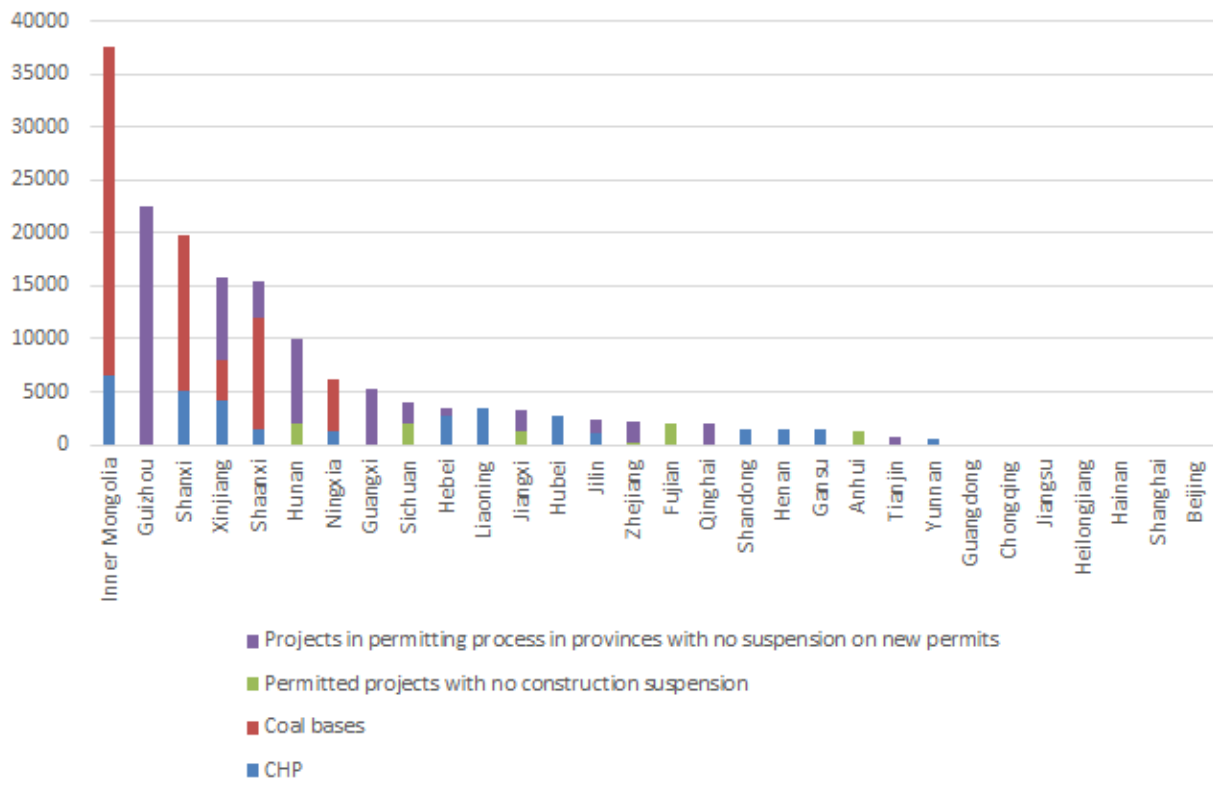
It is projected that non-fossil power generation will grow by 800-900TWh from 2015 to 2020, based on wind and solar power installation rates achieved in 2015 and hydropower and nuclear power capacity already under construction. This scale of additional power generation is also required to fulfill the 15% non-fossil target in 2020, if primary energy consumption is assumed to grow in line with the government's target of 5 billion tonnes of coal equivalent in 2020. Electricity demand, in contrast, will not increase by more than 800TWh (annual growth rate of 2.5%), meaning that demand for power generation from coal will fall.

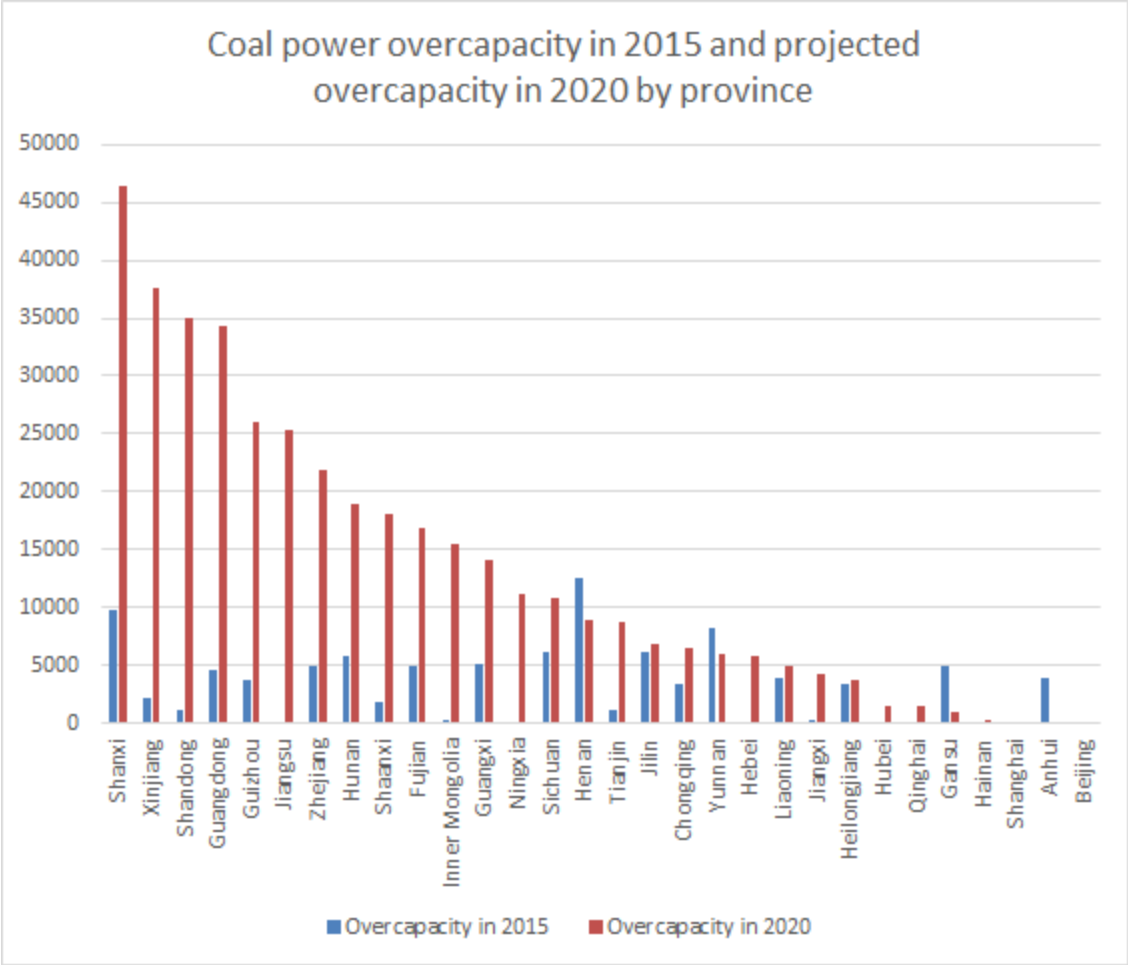
In 2015, the average utilization of China's thermal power generating capacity fell to an all-time low of 4300 hours, and has fallen a further 10% in the first five months of 2016. This implies that there was already approximately 120GW of overcapacity compared to the industry standard assumption of 5,000 hours per year (57%; very low by international standards). By early 2020s, the amount of overcapacity could exceed 400GW, given how many projects could still be started under the new rules. Put another way, average utilization could fall to around 35%, an incredibly low level that spells hardship and very poor financial performance for utilities.

Development of China's coal-fired generating capacity under new permitting and retirement rules



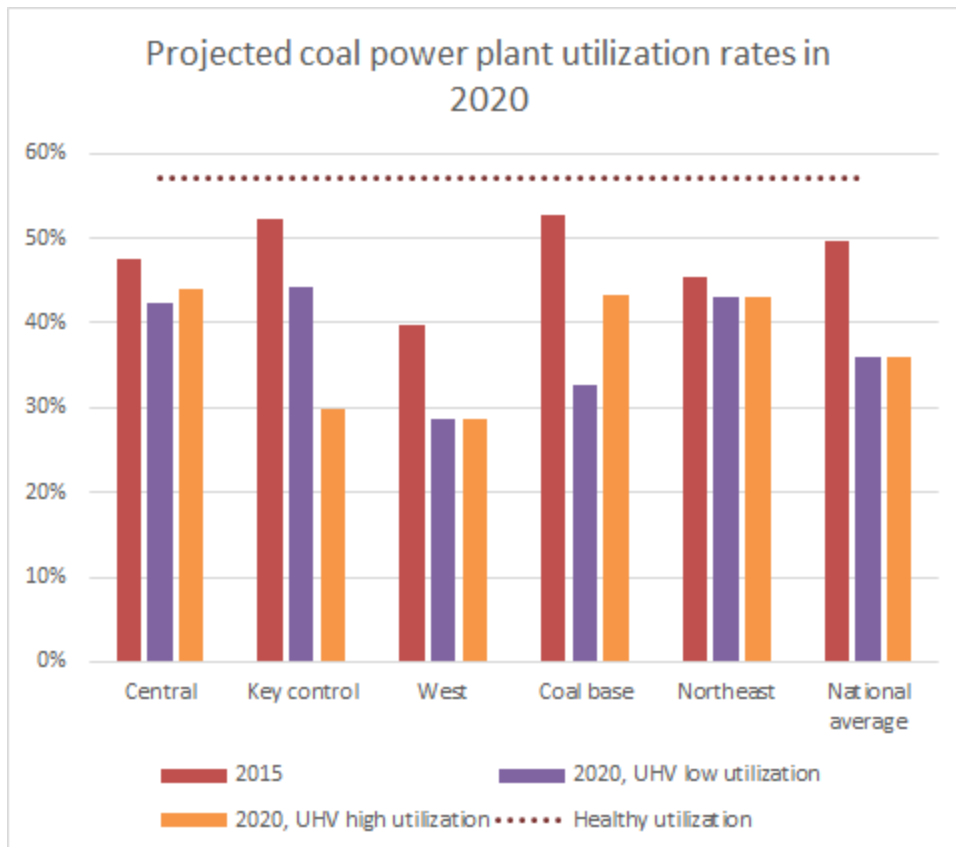
Potential new construction starts under the new policy





Overcapacity is defined as less than 5,000 hours per year as of utilization and firm capacity exceeding peak demand. Projections assume 60% utilization of the ultra-high voltage long-distance transmission lines (see below for discussion on the implications of alternative assumptions).

Among the provinces with largest projected overcapacity are two of the coal base provinces, Shanxi and Xinjiang, three of the ‘key air pollution control’ provinces, Shandong, Guangdong and Jiangsu, which are building a lot of new capacity while being expected to absorb exports from the west, and in Guizhou which is pursuing a massive expansion in a corner of the country chock-full of hydropower and little chance of being able to export its excess power. In the graph above, Inner Mongolia has a relatively small overcapacity compared to the enormous size of the province’s generating fleet. This is due to the vast amount of UHV capacity originating from the province. Consequently, Inner Mongolia and Anhui are the provinces with most at stake in compelling the eastern provinces to buy vast amounts of power through the UHV lines - if the utilization rate of those lines is low, Inner Mongolia could have well over 30GW of overcapacity, ranking third after Shanxi and Xinjiang.



In 2015, for the first time on record, the average utilization rate of coal-fired power plants fell below 50%. In other words, the average plant was more likely to stand idle than to generate power. By 2020, the average utilization is likely to fall well below 40%, given the enormous ongoing construction of new coal-fired power plants. Depending on how much power gets imported from the western coal bases to the east, utilization in either region could fall below 30%.

Coal bubble in the west

There is approximately 110GW of coal-fired capacity under construction in the six “western coal base” provinces, with the expectation of major exports to the eastern provinces. Another 100GW of new projects could still go ahead under the new permitting rules, with less than 20GW expected to retire. This far exceeds the under construction UHV capacity of 70GW from these provinces.

Furthermore, the coal base provinces have also been among the biggest investors in renewable energy generation, with most of their in-province electricity demand growth projected to be covered from the renewable energy expansion. All told, assuming a high rate of utilization of the UHV lines and fairly rapid growth of electricity demand within the coal base provinces, there is probably going to be enough demand in 2020 to justify most of the current under construction capacity in the west, with approximately 50GW of under construction capacity redundant even in

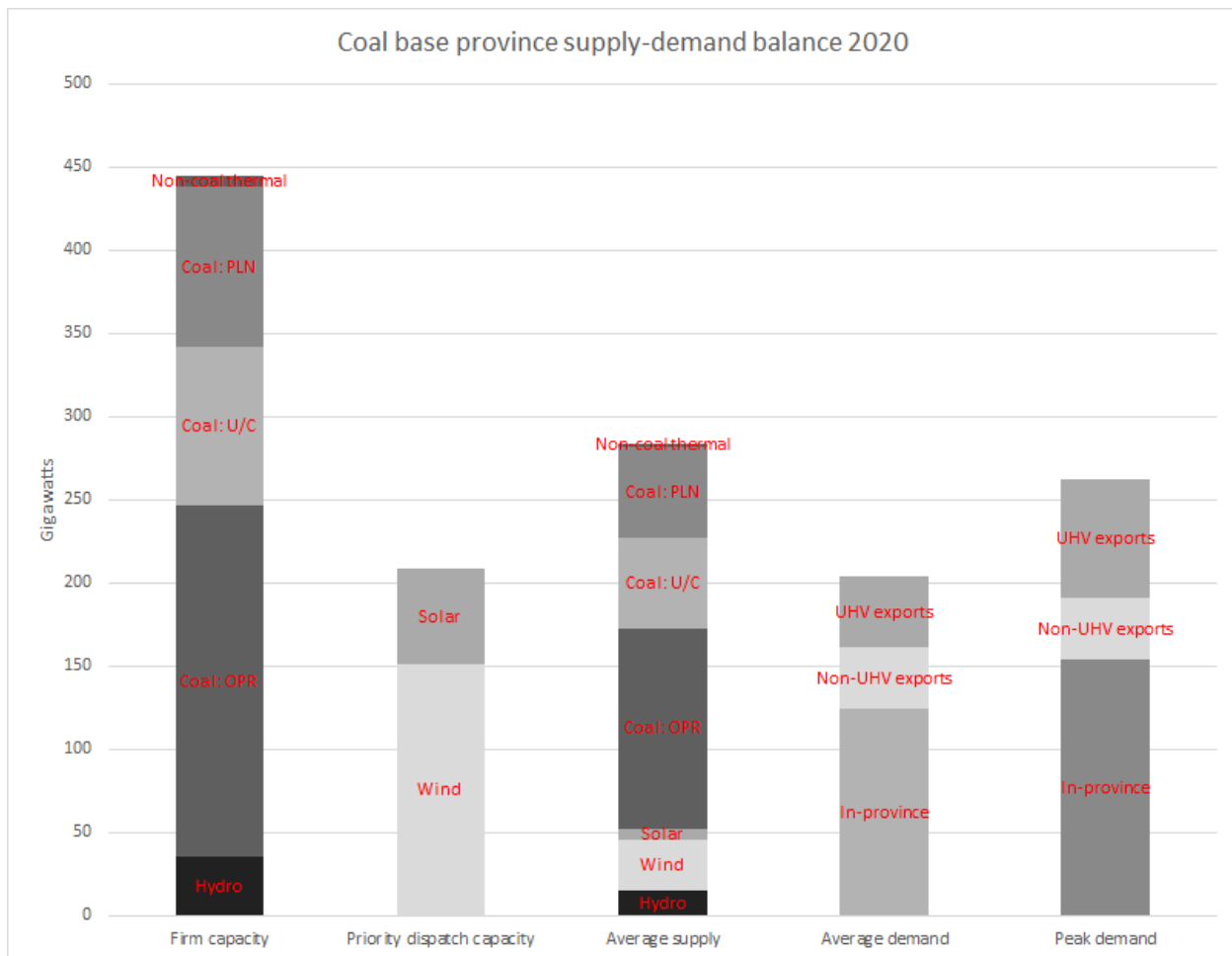
this optimistic scenario. If the planned projects that are outside the suspension policy go ahead, overcapacity could reach 150GW.

For example, in its new provincial five-year plan for 2016-2020, Sha'anxi is targeting an increase of 27GW in coal-fired capacity, while having only 3GW of long-range transmission capacity to the east and with local demand growth justifying at most a few GW; Ningxia is targeting an increase of almost 20GW, while having only 8GW of transmission capacity and with growth in non-fossil generation likely to exceed growth in local demand by a significant margin.

Furthermore, the coal power plant retirement policies are not sufficient to create a supply deficit anywhere in the country (except, possibly, Shanghai). In fact, the eastern regions that are supposed to import all this power will themselves be suffering from overcapacity.

Competing with the coal-fired power exports from the northwest, southwestern provinces are expecting to export very large amounts of hydropower. This means that the eastern regions would have to idle their own coal-fired plants while paying for imports of hydropower from the southwest as well as for imports of wind, solar and coal-fired power from the northwest. In this competition, non-fossil power has the clear priority, making it exceedingly unlikely that demand for coal-fired power imports from the western provinces will ever materialize.

If the efforts to force eastern provinces to shutter or idle their own generators and pay for imports from the west prove unsuccessful, the western "coal base" provinces could be saddled with 200GW of overcapacity by early 2020s. The western coal bases are also among the most water stressed areas in the country with high potential for lack of water or conflicts with other water uses to hinder operations.

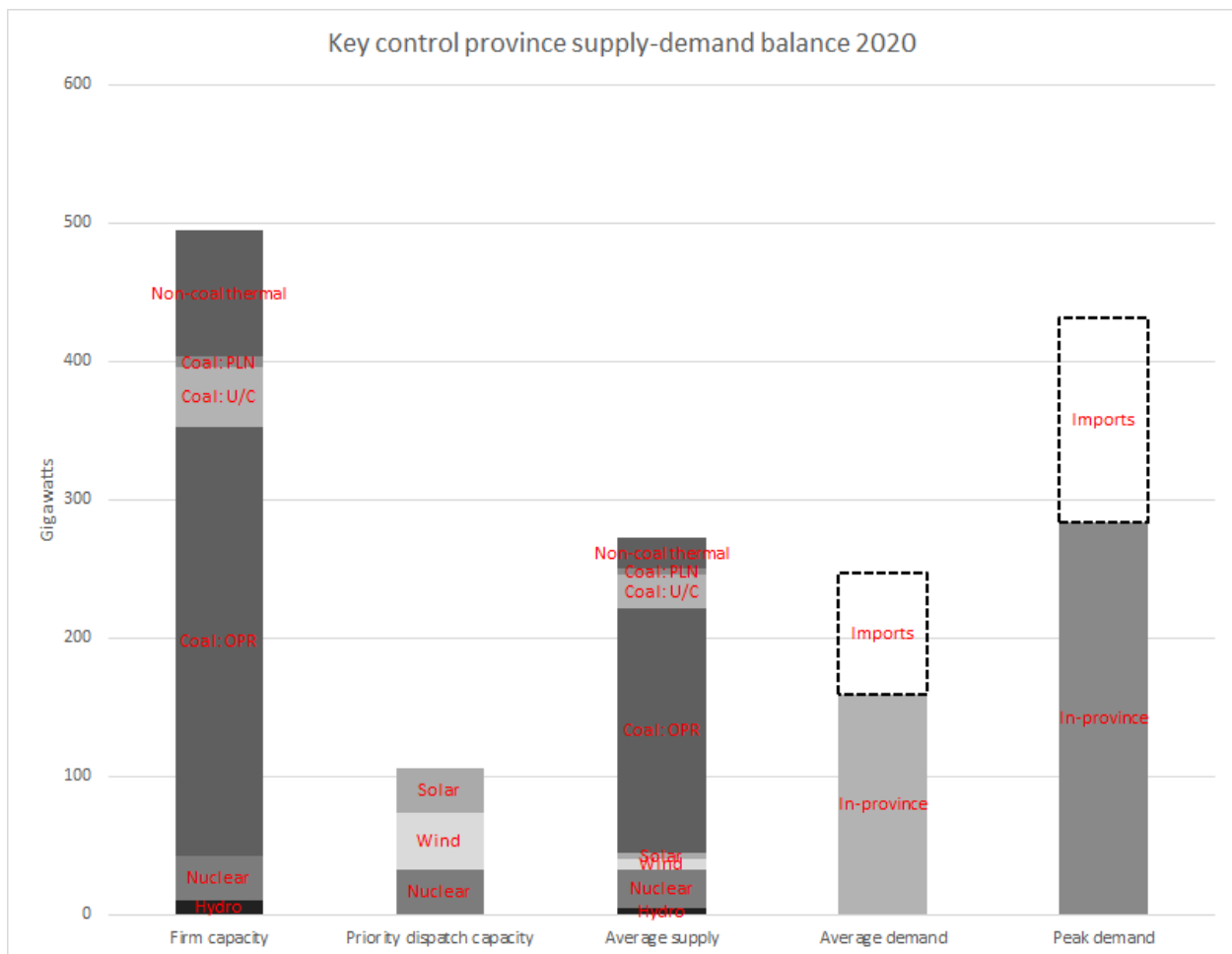


Projected supply and demand of power in the six western ‘Coal base’ provinces in 2020, assuming high utilization of the UHV lines and completion of under construction and planned coal projects. “Average supply” is calculated using 2015 average utilization rates for other technologies and a “minimum healthy utilization” of 5,000 hours per year for coal-fired capacity. Average supply of power far exceeds average demand, implying low utilization of coal-fired generating assets. Variable wind and solar capacity is close to average power demand, meaning that there will be little to no curtailment assuming that local grid bottlenecks are resolved, and that coal-fired power plants - both those serving in-province demand and those powering the transmission lines - are responsive to variations in wind and solar output. “Firm” capacity far exceeds peak demand, meaning that the plants under construction are not needed to cover demand peaks.

Coal bubble in the eastern “key regions”

Despite the control policies included in the National Air Pollution Action Plan, the eight “key control” provinces still have over 40GW of coal-fired capacity under construction, and another 10GW of capacity could be added through Combined Heat and Power projects. An optimistic reading of the retirement policies suggests that by 2020, up to 30GW of capacity could be

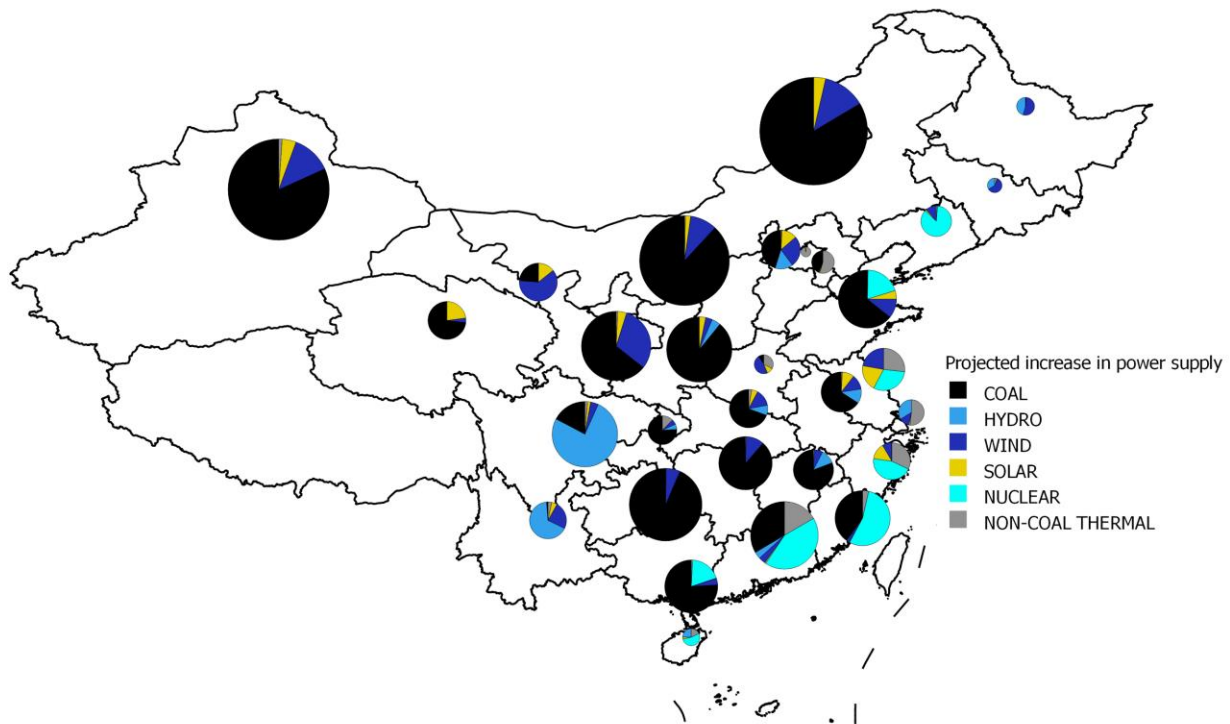
retired in these provinces; however this is more than the entire national target in the State Council energy plan for 2014-2020. In any case, coal-fired capacity is projected to increase by at least 20GW. In-province power demand growth to 2020 will be covered by expected expansion in wind, solar and nuclear power generation. At the same time, approximately 120GW of coal-fired capacity will be made redundant if the planned imports through UHV lines are realized. Given that utilization of coal-fired generators in the key regions would decline even if there was no increase in power imports, this surge of imports is likely to prove contentious. These provinces will be expected to pay over 200 billion CNY (over 30 billion USD) per year for power that they don't need, while depriving their in-province generators of the said revenue.



Projected supply and demand of power in the 'Key control' provinces in 2020, assuming high utilization of the UHV lines and completion of under construction and planned coal projects. "Average supply" is calculated using average utilization rates for other technologies and a "minimum healthy utilization" of 5,000 hours per year for coal-fired capacity. Even assuming an improbably strict implementation of coal plant retirement policies, the "key control" provinces will be suffering from in-province coal power overcapacity, and will have no capacity deficit that needs to be filled through imports.

Other standout provinces

Besides the nationally sanctioned, if vastly oversized, coal power base programme, there are a number of other provinces pursuing large coal power expansions. Guizhou and Hunan stand out, each with 5GW under construction, and a further 23GW and 10GW, respectively, in planning. Neither province had new approvals suspended and could be facing utilization below 30% if the plans go ahead. Guizhou has, in theory, access to the UHV line transporting power from hydro-rich Yunnan to Guangdong, but in practice there will be little to no space for coal-fired power exports through this line if Yunnan's hydropower is to be transmitted into the national grid: Yunnan has 12 gigawatts of hydro under construction, and only 5GW of UHV transmission capacity is being built at the moment.

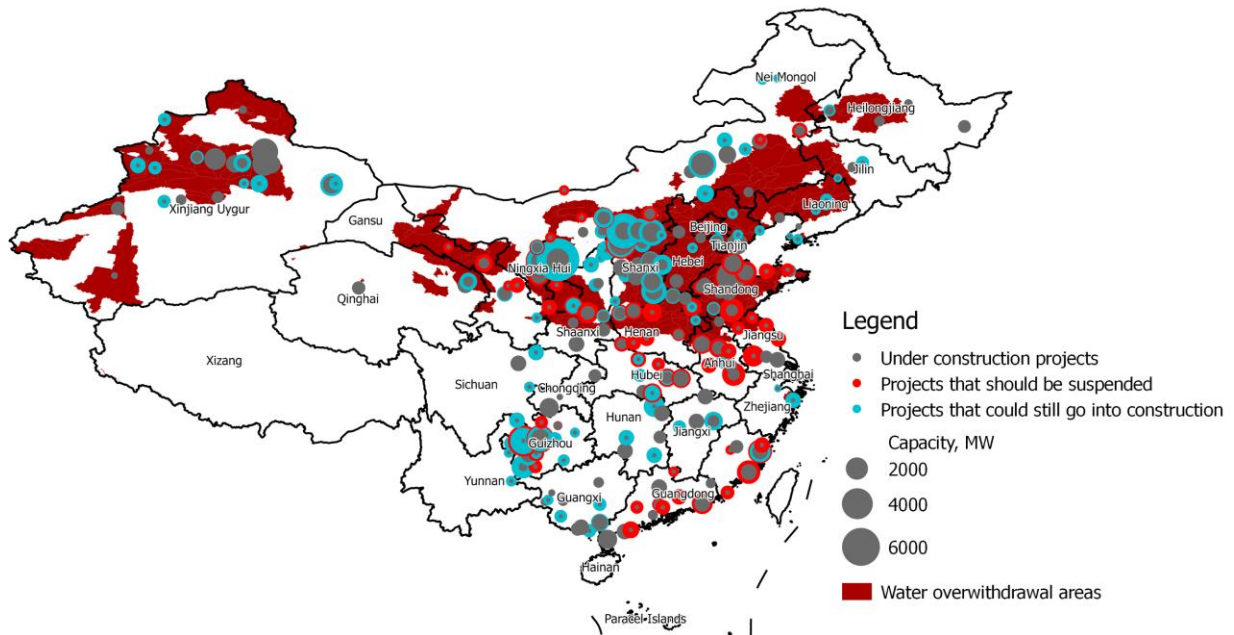


Expected increase in power supply by province and energy source from 2015 to 2020, in terawatt-hours. All regions are substantially increasing generating capacity, leading to an expected clash between provinces and generating technologies - a clash in which we expect provinces heavily invested in coal to eventually lose.

Water stress

One of the key concerns regarding China's coal-fired power plant expansion is that much of the new projects are concentrated in the country's most water-stressed areas. The new coal power overcapacity policy appears to recognize this problem in principle, including amount of water resources as one of the reasons for giving a province a 'red light' for new permits. However, no province is given a red or even orange light on this basis, and the actual impact of the policy is

to further concentrate new coal-fired power plant project in the areas with least water resources, as expansion is still allowed in Xinjiang and Qinghai, as well as in the extremely water-stressed coal base areas in Ningxia, Inner Mongolia and Shanxi.



The new policy threatens to further concentrate new coal power capacity in the most water-stressed areas, by eliminating projects on the coast and in several provinces with relatively good water resources, but allowing projects in the northern and western coal bases to go ahead.

Policy recommendations

With billions of yuan being committed in new coal-fired capacity every passing month, it is urgent that the government stop all new projects from entering construction. The current policy has taken an important step in this direction, but the various exemptions leave the door open for another six years of one coal-fired power plant per week entering operation, net of retirements.

Furthermore, as new coal-fired power plant projects have continued to enter construction, China's coal power overcapacity situation has reached a point where simply stopping new projects is not sufficient.

Greenpeace recommendations:

- Extend ban on new permits and construction starts to cover all provinces, and all conventional coal power projects.
- Cancel projects that started construction in 2015 or later in areas with coal power overcapacity, and in water overwithdrawal areas.
- Substantially reduce investments in retrofitting of older coal-fired power plants and retire this capacity instead.

- Strictly implement priority grid access for renewable energy. Increase transparency of information about the power system to improve planning and enable the public to scrutinize reasons for high rates of “wasted wind and solar”.
- Pay particular attention to stopping new projects and reducing existing capacity in the most water-stressed areas of the country.

Appendices

Appendix A: Province data

Key statistics on coal-fired power generating capacity by province, megawatts. (Global Coal Plant Tracker, April 2016, China Electricity Council Yearbook 2012; Greenpeace analysis)

Province	Operating & new coal-fired capacity					Coal-fired units due for retirement		
	Operating	Under Construction	New capacity permitted & in permitting process	New district heating CHP projects	New projects in coal power bases	Size <100M W	Old 100-300M W	Very inefficient units
Anhui	42260	5520	12640	0	0	570	0	0
Beijing	1645	0	0	0	0	75	1200	0
Chongqing	13320	4540	0	0	0	200	800	0
Fujian	22618	5320	10555	0	0	462	0	540
Gansu	20555	2000	11340	1400	0	155	1270	0
Guangdong	67753	11000	11000	0	0	1025	780	520
Guangxi	14105	7220	5240	0	0	265	400	0
Guizhou	26870	5320	30785	0	0	130	800	2240

Hainan	3711	0	0	0	0	0	250	0
Hebei	44133	6000	3500	2800	0	1053	4937	1040
Heilongjiang	18425	2600	0	0	0	800	3525	1200
Henan	64615	4880	12900	1400	0	1300	3900	2000
Hubei	25314	5020	9320	2720	0	969	1850	0
Hunan	18944	5200	10000	0	0	360	870	0
Inner Mongolia	68792	19360	45970	6500	27740	2110	1520	6770
Jiangsu	74862	4500	10420	0	0	2604	1350	1744
Jiangxi	17770	5000	3320	0	0	300	1720	980
Jilin	18540	700	2370	1050	0	1810	1200	0
Liaoning	29426	800	3450	3450	0	2138	3225	1000
Ningxia	17519	11030	9320	1360	4740	274	2925	0
Qinghai	2465	4040	1980	0	0	0	0	0
Shaanxi	28410	8720	18060	1400	7320	1190	1050	0
Shandong	77026	18900	19300	1400	0	2866	1830	910
Shanghai	14250	0	0	0	0	500	1666	0
Shanxi	54520	23464	21840	5020	14820	850	1825	1400
Sichuan	13284	2000	4000	0	0	600	2830	600
Tianjin	12112	2000	800	0	0	200	400	0
Xinjiang	31035	31035	15820	4200	3720	740	440	1230
Yunnan	13035	0	600	600	0	0	230	1600
Zhejiang	45110	0	2200	0	0	1345	335	0
Tibet	995	0	0	0	0	0	995	0
Total	912329	193529	276730	33300	58340	24891	44123	23774

Key statistics on non-coal-fired generating capacity by province, megawatts. (Platts World Electric Power Plants database, April 2016)

Province	Wind		Solar		Nuclear		Hydro		Non-coal thermal	
	Operating	Added in 2015	Operating	Added in 2015	Operating	Under construction	Operating	Under construction	Operating	Under construction
Anhui	1360	530	1210	710	0	0	3367	1500	914	200
Beijing	150	0	160	20	0	0	1257	0	8613	1325
Chongqing	230	130	0	0	0	0	5154	400	1142	1401
Fujian	1720	130	150	30	5445	6680	9101	80	4683	1469
Gansu	12520	2450	6100	930	0	0	7174	10	80	30
Guangdong	2460	420	630	110	8292	7820	10994	1200	16335	10334
Guangxi	430	300	120	30	0	2160	17636	0	1183	276
Guizhou	3230	900	30	30	0	0	19144	90	30	0
Hainan	310	0	240	50	650	650	541	600	690	733
Hebei	10220	1090	2390	890	0	0	2062	1800	629	185
Heilongjiang	5030	490	20	10	0	0	1100	1200	504	2
Henan	910	470	410	180	0	0	43	0	2459	1624
Hubei	1350	580	490	350	0	0	4771	1000	1673	516
Hunan	1560	860	290	0	0	0	41565	0	157	160
Inner Mongolia	24250	4070	4890	1870	0	0	13729	105	1217	50
Jiangsu	4120	1100	4220	1650	2120	2252	1565	0	9386	6610
Jiangxi	670	310	430	40	0	0	1381	1500	123	0
Jilin	4440	360	70	10	0	0	3366	600	183	174

Liaoning	6390	300	160	60	3356.37	3278	5054	0	1481	172
Ningxia	8220	4040	3090	920	0	0	2895	0	558	444
Qinghai	470	150	5640	1510	0	0	550	0	421	0
Shaanxi	1690	390	1170	620	0	0	16669	1500	187	0
Shandong	7210	990	1330	730	0	2700	2153	0	1673	149
Shanghai	610	240	210	40	0	0	1304	1800	5997	4748
Shanxi	6690	2140	1130	690	0	0	3622	9	1752	375
Sichuan	730	450	360	300	0	0	51768	26040	1722	760
Tianjin	290	0	120	30	0	0	0	0	3098	3850
Xinjiang	16910	8870	5660	2100	0	0	4670	0	323	1500
Yunnan	4120	900	650	300	0	0	75291	7214	54	600
Zhejiang	1040	310	1640	900	6564	2500	10255	26	12605	6018
Tibet	10	0	170	20	0	0	1187	173	301	0
Total	129340	32970	43180	15130	26427	28040	319370	46847	80169	43704

Key statistics on electricity demand by province for 2014-2015. (China Energy Statistics Yearbook; National Energy Administration Statistical releases; peak demand reported by grid operators and compiled from various news reports)

Province	Electricity consumption, TWh, 2014	Demand growth 2014	Thermal power operating hours, 2015	Net exports, TWh, 2014	Peak demand, GW, 2015
Anhui	159	3.7%	4541	45	30
Beijing	93	2.7%	4158	-57	19
Chongqing	87	6.6%	3708	-19	15

Fujian	186	4.9%	3872	1	33
Gansu	110	2.1%	3778	15	16
Guangdong	524	8.4%	4028	-129	95
Guangxi	131	5.6%	3193	0	19
Guizhou	117	4.1%	4304	57	17
Hainan	25	8.6%	5586	-1	4
Hebei	331	1.9%	4846	-81	47
Heilongjiang	83	-0.9%	4081	5	12
Henan	316	2.4%	4025	-43	50
Hubei	185	2.2%	4024	53	27
Hunan	151	0.9%	3452	-20	22
Inner Mongolia	242	10.8%	4979	144	38
Jiangsu	501	2.9%	5125	-66	81
Jiangxi	102	7.5%	4927	-15	18
Jilin	67	1.3%	3326	10	10
Liaoning	204	1.5%	4343	-39	29
Ningxia	85	6.8%	5422	31	13
Qinghai	72	6.9%	4958	-14	11
Shaanxi	123	6.4%	4690	39	20
Shandong	422	3.4%	4924	-53	65
Shanghai	137	-2.9%	3716	-58	29
Shanxi	183	-0.3%	4100	82	26
Sichuan	206	3.6%	2682	102	30
Tianjin	82	3.7%	4519	-20	13
Xinjiang	192	19.5%	4730	18	32
Yunnan	153	17.2%	1879	102	25

Zhejiang	351	1.5%	3950	-62	58
Total	562	4.5%	4342	31	825

Appendix B: Coal fleet structure by age, size and type

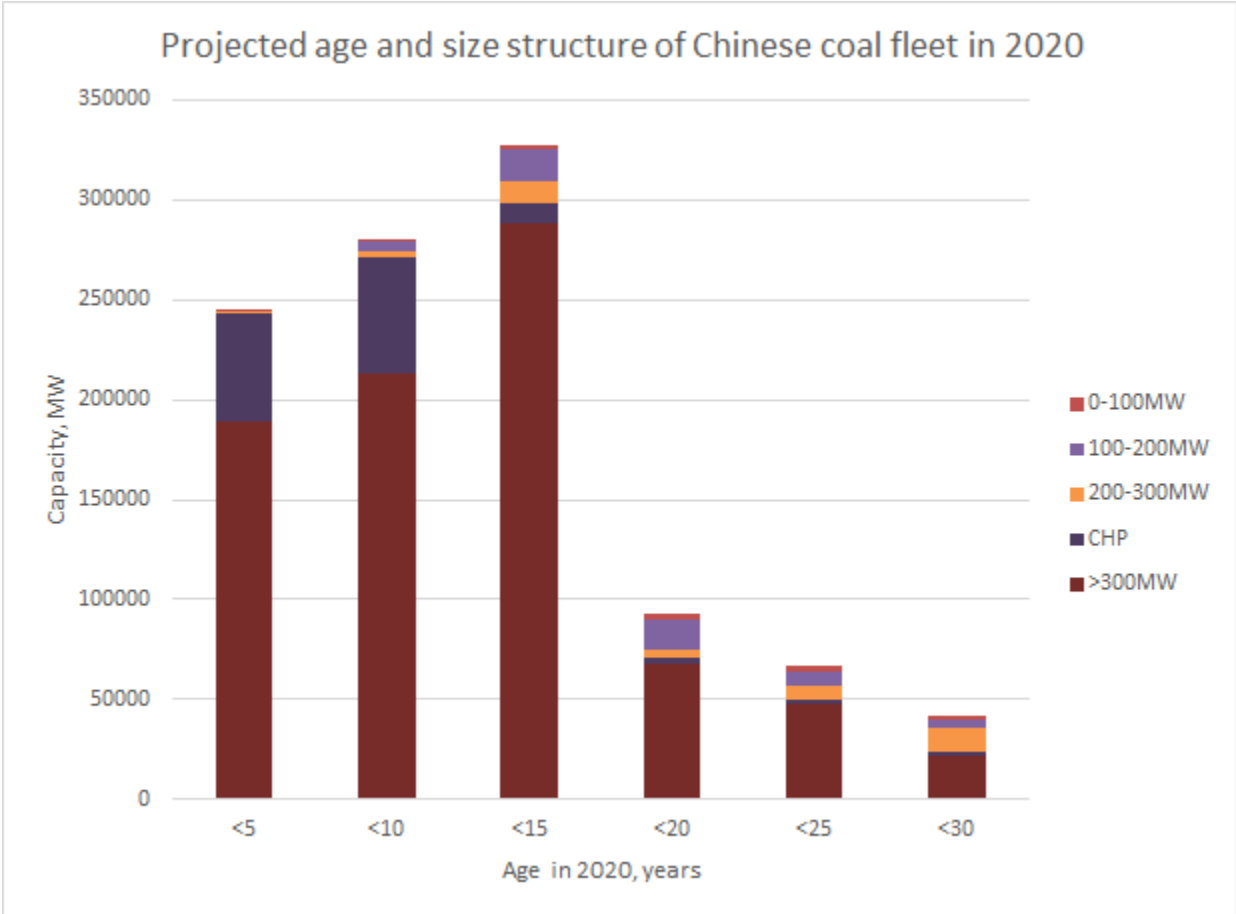


Figure B1: The relatively small impact of even a full implementation of the retirement rules on total coal-fired capacity is due to the fact that the vast majority of coal-fired capacity is in large units commissioned after 2005. This also means that further accelerated retirement involves significant stranded capital and asset write-down issues.

Appendix C: Coal-fired power plant projects in permitting

Key statistics on coal-fired power capacity in EIA process without approval suspension by province, megawatts. (situation at the end of June 2016, Greenpeace analysis of data compiled from provincial environmental authority websites)

Provinces	Province without permit approval suspension/MW	Residential CHP projects/MW	Coal power base export projects/MW	Grand total
Shaanxi	8660	0	0	8660
Inner Mongolia	0	0	5240	5240
Xinjiang	5172	0	0	5172
Hunan	2009	0	0	2009
Shandong	0	1089	0	1089
Liaoning	837	0	0	837
Hebei	775	0	0	775
Anhui	0	700	0	700
Gansu	0	700	0	700
Hainan	700	0	0	700
Jilin	700	0	0	700
Ningxia	0	700	0	700
Shanxi	0	700	0	700
Chongqing	700	0	0	700
Heilongjiang	0	397	0	397
Tianjin	350	0	0	350
Zhejiang	279.5	0	0	279.5
Grand total	20182.5	4286	5240	29708.5