COAL PRODUCTION AND POWER GENERATION WORLDWIDE

INDUSTRY ANALYSIS AND FORECAST

FEBRUARY 2024

SUMMARY

- Global coal production grew to 8300 million tonnes per annum (MTPA) in 2021 and 2022, up about 12% from 7400 MTPA in 2010, led by China and India (combined for 62% of the total). Incorrys is forecasting global coal to be flat in coming years (with increase from 2022 to 2030 on 3% - from 8318 MTPA to 8532 MTPA).
- Coal-fired generation capacity grew from 1300 GW in 2005 to 2246 GW in 2022 with China accounting for half (about 1100 GW) of the 2022 total.
- Of the 350 GW of new coal power projects currently under construction or approved, 72% (235 GW) are in China. If all 350 GW of projects are built, it will add an additional 20% to current capacity over the next 3-4 years.
- Incorrys projects that coal-fired generation will remain relatively stable from 2022 to 2030, experiencing a marginal increase until it reaches a peak of 10,780 TWh in 2026, followed by a subsequent decline to the 2022 levels. Notably, China is poised to contribute significantly to the 2030 global electricity generation, representing nearly 60% of the total.
- The forecast for China specifically indicates a growth trajectory in coal-fired power generation, with an expected increase to 6,200 TWh by 2030 compared to 5,350 TWh in 2022, marking a 16% growth during this period. However, Incorrys foresees a subsequent decline in coal-fired generation post-2029/2030, suggesting a shift in the energy landscape beyond that timeframe.

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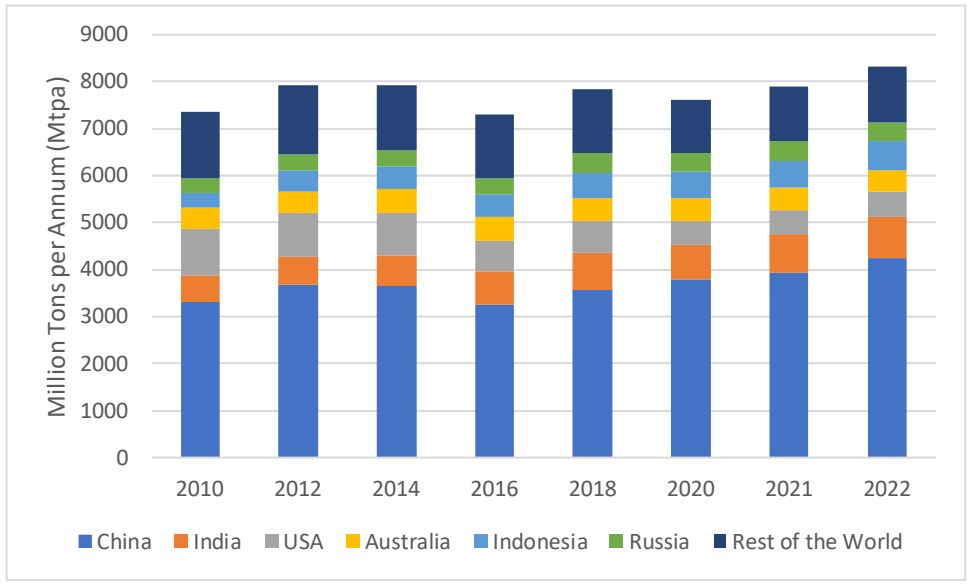
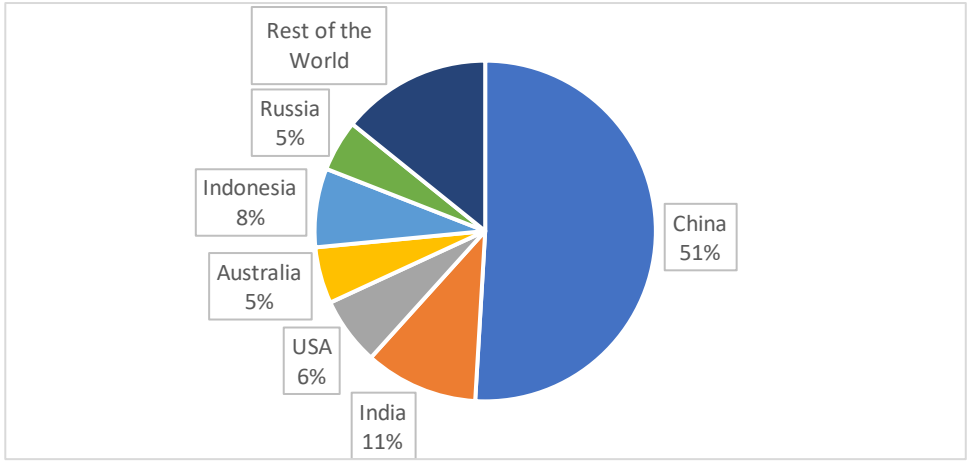
COAL PRODUCTION 2010-2022



2022 Market Share by Region



- After declining to 7600 MTPA due to impacts from the Covid pandemic, global coal production has steadily increased over the past 2 years peaking at over 8300 MTPA in 2022. Steam coal and lignite accounted for about 86% of total production.
- China and India, the world's largest coal consumers which together account for almost 70% of global coal consumption in the same time the main producers jointly producing 62% of global production.
- China is the world's largest coal and lignite producer accounting for just over half of total global production in 2022. They are followed by India at 11% and Indonesia at 8%.
- Indonesia has experienced the greatest growth rates since 2010, almost doubling production from 325 MTPA to 620 MTPA in 2022, followed by India (up 60%) and Russia (up 35%).
- The US, Australia, and Russia each account for about 5% of the total with the rest of the world making up the remainder.
- US coal production has declined from almost 1000 MTPA in 2010 to about 550 mtpa in 2022, as low-cost natural gas has pushed out coal. Excluding China, the rest of the world has seen a 15% drop.

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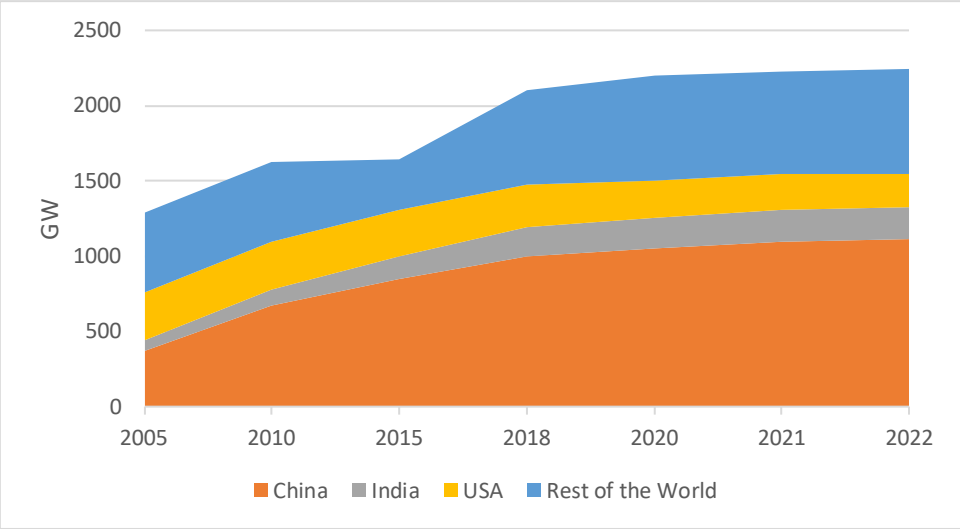
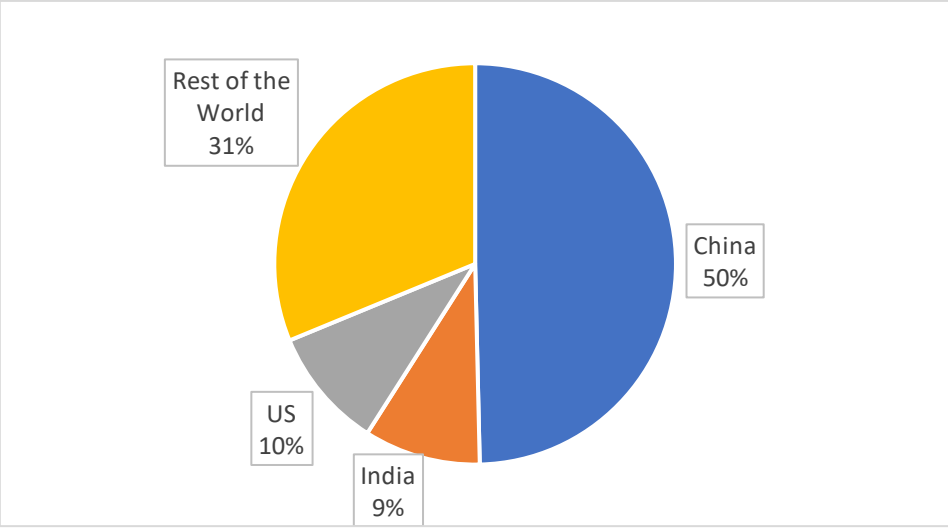
GLOBAL COAL POWER GENERATION CAPACITY 2005-2022



2022 Coal capacity Share by Region



- Global coal generating capacity grew 60% from 1300 GW in 2005 to 2100 GW in 2018. The pace of growth has slowed considerably since then increasing just 150 GW to 2246 GW in 2022. Currently, about 1/3 of operating global coal capacity has a defined phase out date and 2/3 is subject to carbon neutrality targets. As western industrial countries reduce, China and India increase capacity.
- In the last 20 years, China prioritized the development of coal-fired generation capacity and reached 1115 GW in 2022. This has powered the country's economic growth and limited its dependence on energy imports. Since 2010, however, China has also diversified its power mix, installing 160 GW of hydro capacity, 46 GW of nuclear, 360 GW of solar PV and 360 GW of wind, making it the largest developer of renewable energy capacity worldwide. In total China's capacity grew in period 2005-2022 3 times (from 370 till 1115 GW). However, the speed of growth was declined after Y2018. China accounted for half of the total global coal generation capacity in 2022 Between 2005 and December 2022, the capacity of the U.S. coal-fired fleet experienced a notable decline, decreasing from 321 GW to 219 GW. This drop was primarily driven by retirements that surpassed earlier estimates and announcements. US has 10% share
- India with 9% share, ranking as the third significant player in the market, saw its capacity grow by over threefold during the same period, escalating from 69 GW to 219 GW.
- The Russia-Ukraine conflict and resulting energy crisis has forced some countries to increase their reliance on coal, including some European countries, but also China and India which reduced LNG imports due to competition with Europe for cargoes – and resultant price spikes for LNG.

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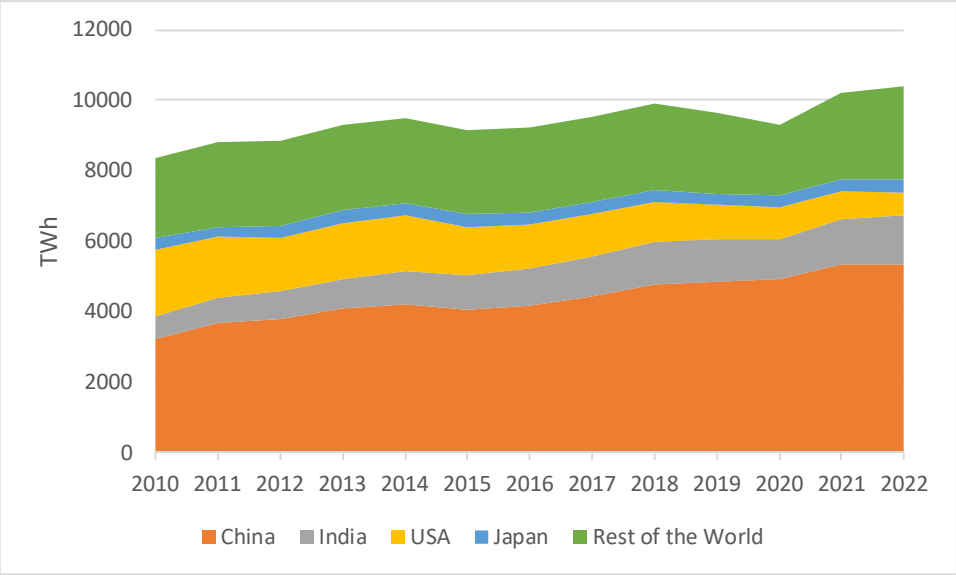
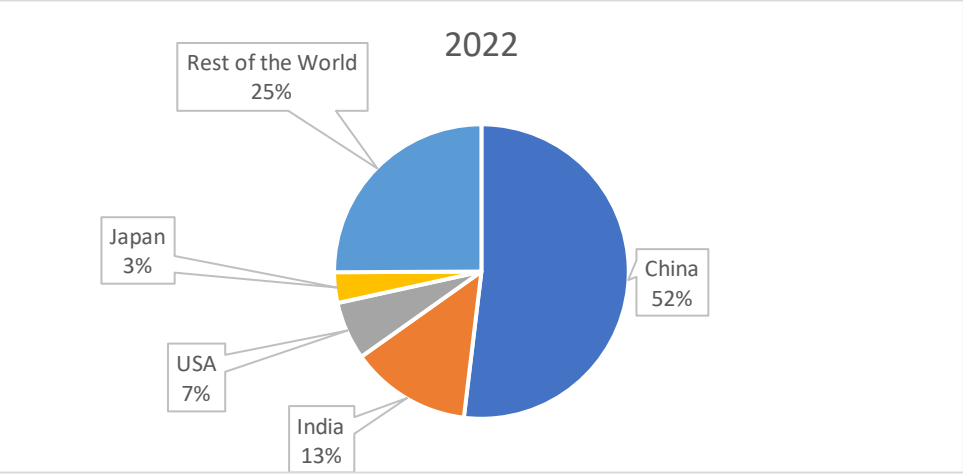
COAL POWER GENERATION 2010-2022





- Global coal-fired power generation increased over 20% from about 8,400 terawatt-hours (TWh) in 2010 to a little bit above 10,400 TWh in 2022.
- Despite the increase in coal generation, the share of coal in the global power mix has fallen slightly from 38% in 2010 to 36% in 2022 as solar and wind generation is making up a larger proportion of the of new capacity.
- Since November 2016, when the Paris Agreement came into effect, there has been a deceleration in the annual growth rate of coal generation. Furthermore, global power generation started to decline from 2018 to 2020, dropping from 9900 TWh in 2018 to 9300 TWh in 2020, with the decrease in 2020 primarily attributed to issues related to COVID-19. However, in 2021, power generation resumed an upward trajectory, reaching a level of 10400 TWh in 2022.
- In USA the energy produced by coal-fired plants experienced a substantial decline, dropping from 1,886 TWh to 665 TWh. This decrease in coal-generated power represents approximately 7% of the overall U.S. generation capacity.
- During this period, China and India exhibited notable positive trends. China saw a significant increase in power generation, rising 1.7 times from 2333 TWh in 2010 to 5398 TWh in 2022. Similarly, India experienced an even more substantial growth, with power generation increasing 2.15 times, escalating from 648 TWh to 1380 TWh over the same timeframe.
- In Y2022 China and India together represented 65% of the global coal power generation.

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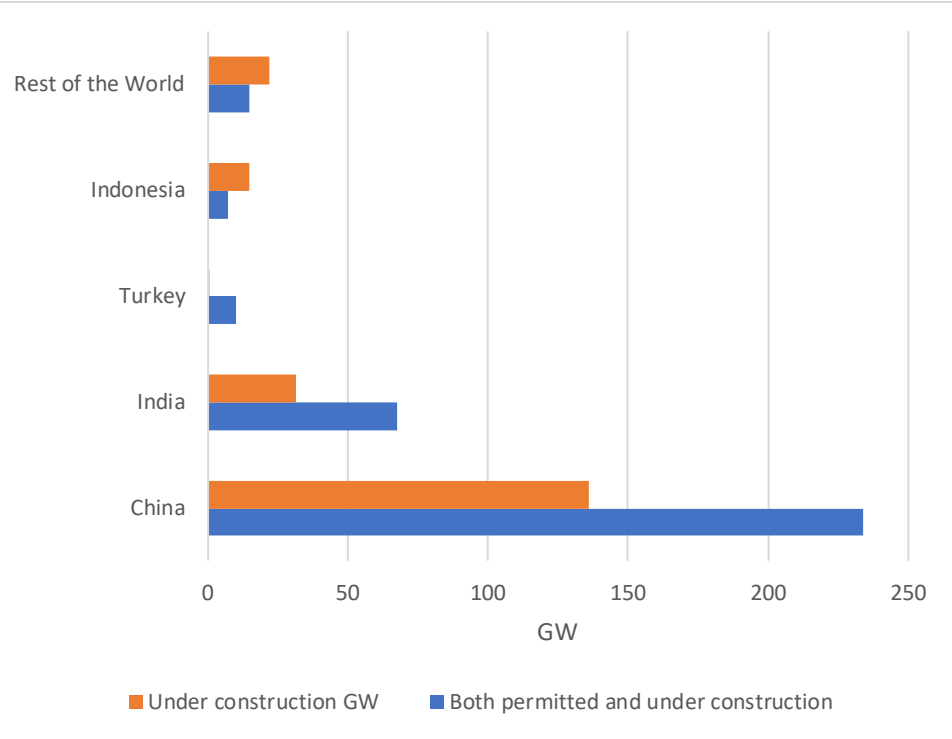
DEVELOPMENT OF COAL POWER GENERATION CAPACITY

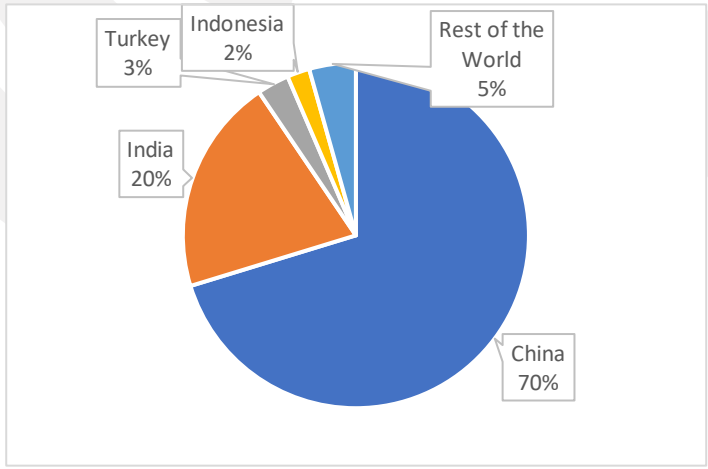


China is by far the most active player in developing new coal generating capacity. As of July 2023, a total of 550 GW of coal generation capacity were in various stages of development.

Notably, China plays a dominant role in these developments, contributing to a substantial 70% of all projects anticipated in the near future*

***After China, India represents 20%. So, China and India together present 90% of all coming projects in coal industry*.**

No new coal projects are under consideration in North America or the EU for the first time since data collection began. The remaining proposed projects are in Turkey (3%), Indonesia (2%), and rest of the world.



China is still building new coal plants in 2022, even if far fewer than in the past. Most industrialized coastal provinces do not have any new coal capacity in their 14th Five Year Plans, (the period from 2021-2025) but another, inland provinces are still building more coal over this time, with some 33GW of capacity started in 2021 and another 8GW approved in the first quarter of 2022. Coal additions during this period must be limited to 150GW of installed capacity by 2025. It's important to note this doesn't mean 150GW will all be built, but that this is the most that can be built over the period. Before the start of the 14th FYP, the total installed coal plant capacity stood at 1074GW. After adding all 150GW of capacity allowed during the Five-Year Plan and accounting for around 50GW of plant retirements over that same period, China's installed coal capacity could reach ~1175 GW by 2025. China has 135 GW of capacity currently under construction, 67% of the total 205 GW under construction worldwide. Half of their capacity under construction is expected to be operational by 2025 with the other half operating by 2027. Post 2027, China is expected to slow construction of new power plants after 2027 - as new nuclear and renewable facilities are commissioned.

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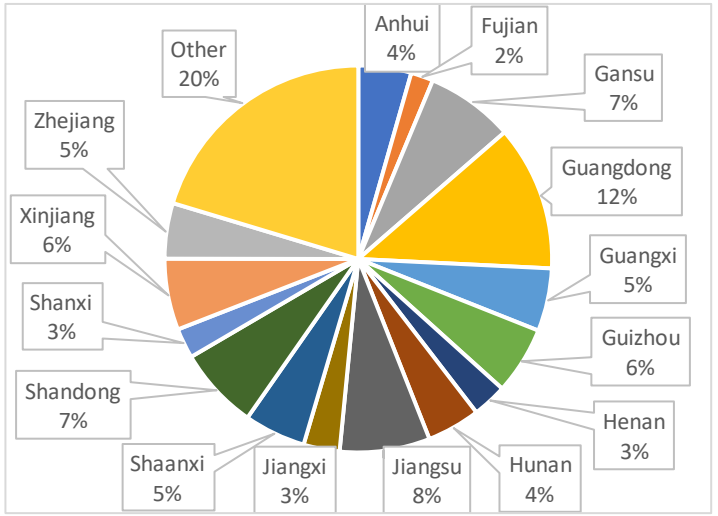
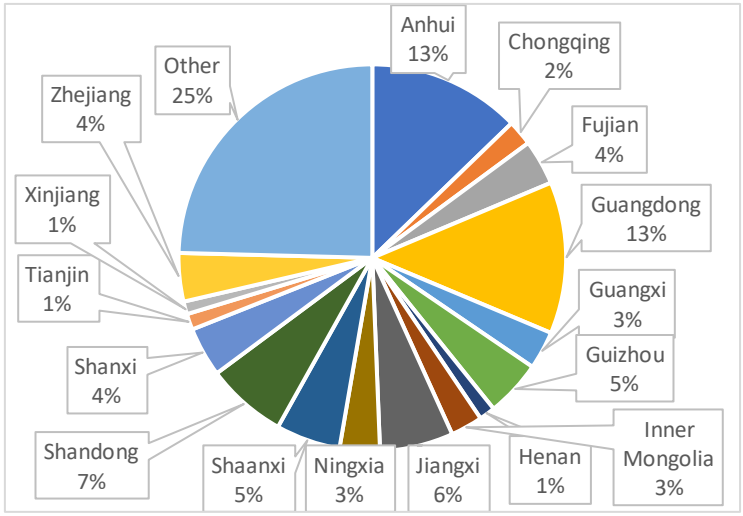
CHINA'S COAL-FIRED ENERGY SECTOR IN 2022

Announced	Pre-permit	Permitted	Announced + Pre-permit + Permitted	Construction
60,46	96,063	98,94	255,463	136,237

PROJECTS UNDERS CONSTRUCTION/PROVINCE



APPROVED PROJECTS/PROVINCE



Main provinces where projects are in construction phase are Guangdong (16.6 GW or 12%, Jiangsu (10,3 GW or 8%), Gansu (10 GW or 7%)

Main approved projects in Y2022 were in Anhui (12,6 GW or 13%), Guangdong (12,5 GW or 13%, Shandong (6,7 GW or 7%)

- China now accounts for two thirds (68%) of global capacity under development, up from 55% a year ago. Total amount of projects under construction – 136GW. According to Global Energy Monitor (July 2023), 98GW of new coal power projects were permitted in China, the equivalent of two large coal power plants per week (in 2021 it was only 23 GW)*
- During the drafting period of the 14th Five Year Plan, power generated from renewables alone was not expected to be able to meet China's annual growth in power demand growth from 2021-2025** – that was the main reason for development of coal further, in spite of climate change goals.
- Coal additions during period till Y2025 must be limited to 150GW of installed capacity. As total (construction +approved) is 235GW, the rest will be in operation after Y2025.
- Incorrys expects that in Y2025 total coal-fired capacity in China will reach 1175GW (plus 45 GW in comparison with Y2024) and than growth will start to decrease: from Y2025 to Y2026 plus 35GW, from Y2026 to Y2027 – plus 25GW. From Y2029 to Y2030 it is expected just plus 5 GW and after Y2030 no surpluses are expected.

* 50 GW of coal power capacity started construction in Y2022, a more than 50% increase from 2021
** Prices for imported gas skyrocketed in 2022. The coastal provinces (Jiangsu, Zhejiang, Shandong, Guangdong and some others) that have relied on gas-fired power plants to cover demand peaks are building alternatives for gas power.

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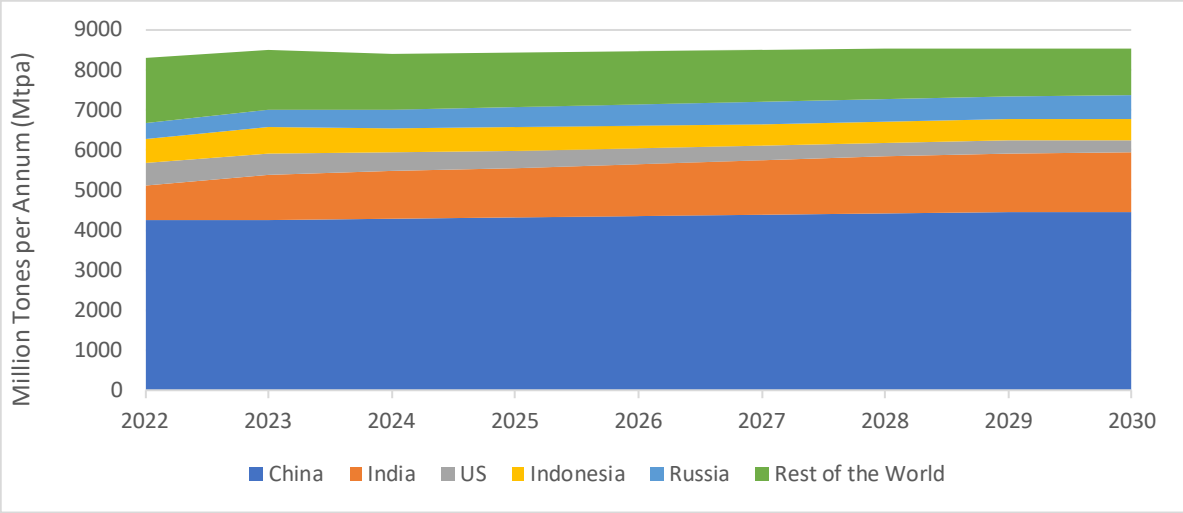
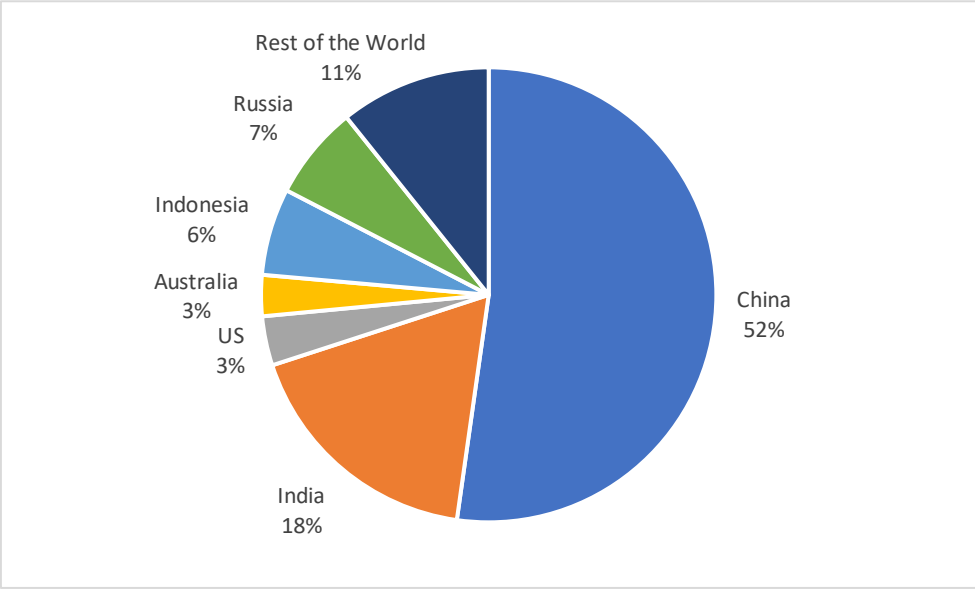
COAL PRODUCTION FORECAST 2022-2030





- Incorrys expects global coal will be flat in coming years (with increase from 2022 to 2030 on 3% - from 8318 MTPA to 8532 MTPA).
- Three nations—China, India, and Russia—are anticipated to sustain growth in their domestic coal production over the forecast period to meet escalating demand for power generation and industrial applications. China is expected to increase its production from 4273 MTPA to over 4440 MTPA by 2029, after which it is projected to stabilize due to the commissioning of new renewable facilities. In Y2030 the China's share in coal production will be 52% (almost the same as in Y2022).
- Within the framework of China's 14th Five-Year Plan (2021-2025), there was an initial aspiration to elevate coal production to 4100 MTPA by 2025. However, according to Incorrys' forecast, this target is unlikely to be met. The forecasted adjustment underscores the dynamic nature of the energy landscape, reflecting the evolving priorities and strategies within the timeframe of the Five-Year Plan
- India is poised for substantial growth, with coal production forecasted to rise from 900 MTPA in 2022 to 1520 MTPA by 2030. Its share will be increased from 11% in Y2022 to 18% in Y2030.
- Meanwhile, Russia is anticipated to see an increase in production from 400 MTPA to nearly 600 MTPA over the same period (its share will be increased till 7% - up from 5% in Y2022)
- Production is Indonesia and other regions anticipated to experience a steady decline. Australia is expected to maintain relatively stable production until a decline is projected around 2026. Meanwhile, the United States is forecasted to persist in its downward production trend until 2030.

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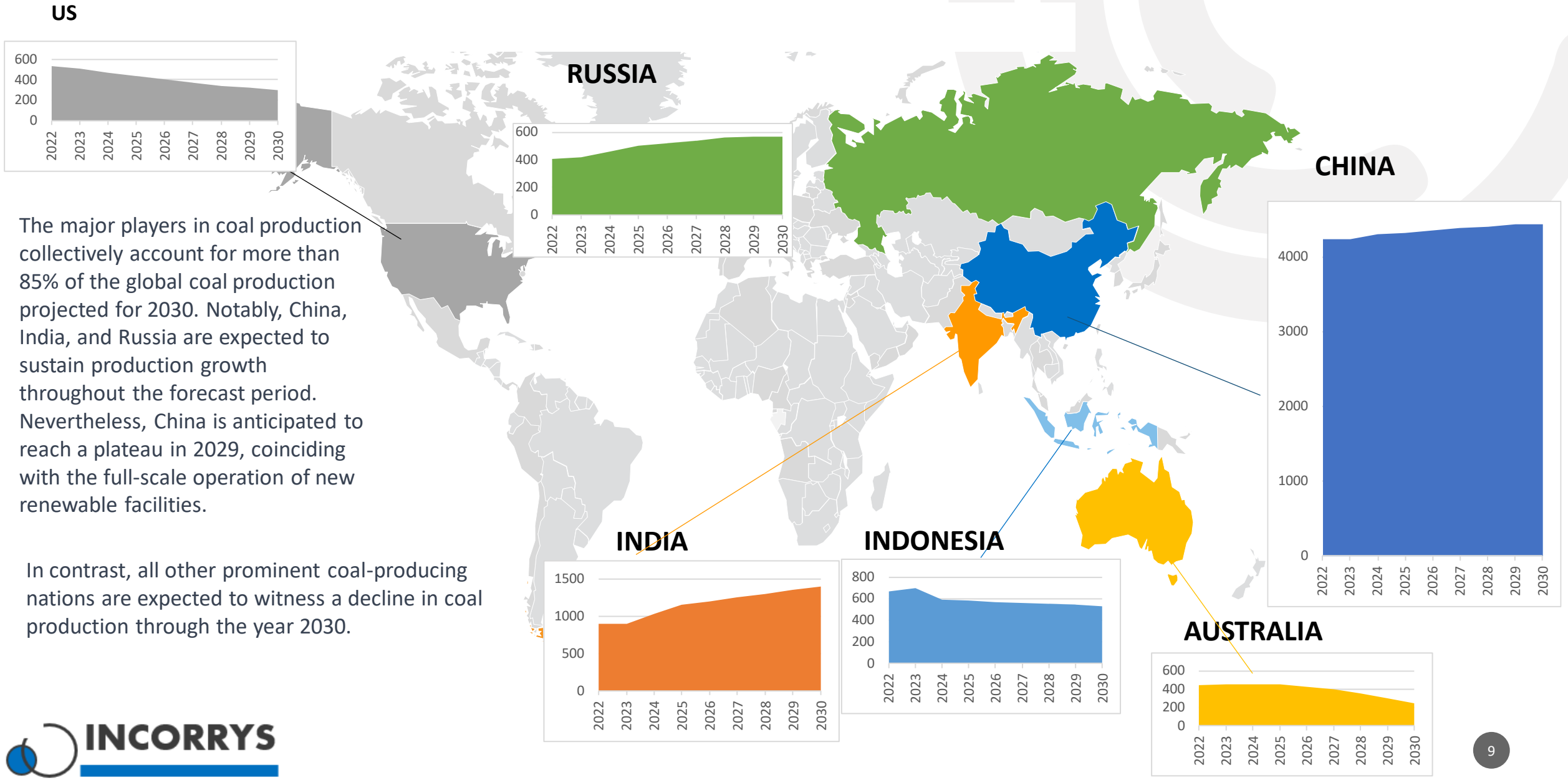
COAL PRODUCTION FORECAST BY COUNTRY (MTPA) 2022-2030



The major players in coal production collectively account for more than 85% of the global coal production projected for 2030. Notably, China, India, and Russia are expected to sustain production growth throughout the forecast period. Nevertheless, China is anticipated to reach a plateau in 2029, coinciding with the full-scale operation of new renewable facilities.

In contrast, all other prominent coal-producing nations are expected to witness a decline in coal production through the year 2030.

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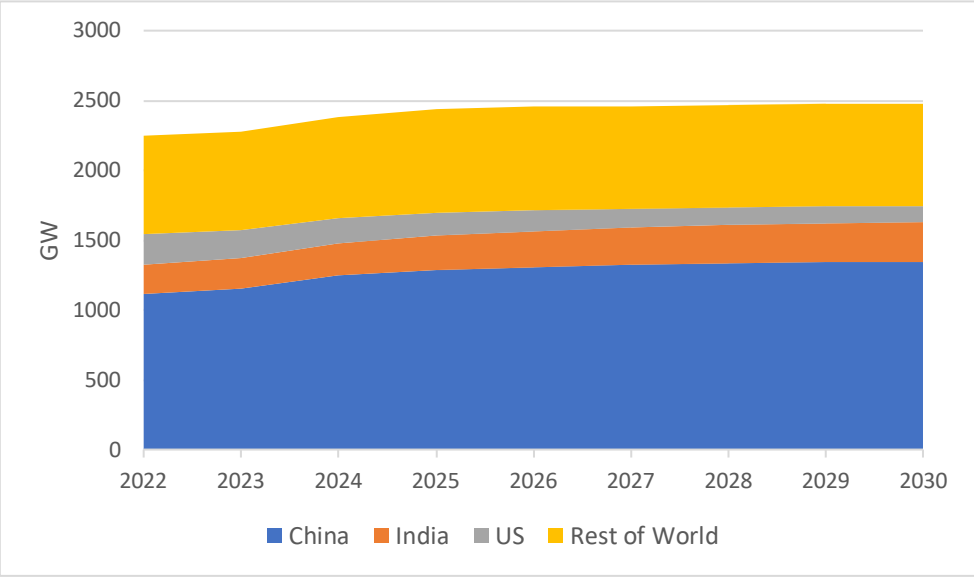
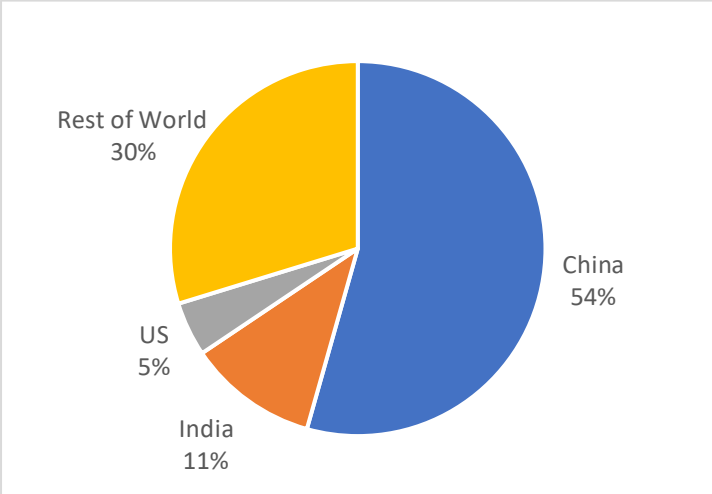
COAL POWER GENERATING CAPACITY 2022-2030



2030 Market Share by Region



- Incorrys forecasts slight increase of global coal generating capacity till Y2030 on 10% (from 2246 GW to 2488 GW)
- China is expected to increase capacity on 234 GW or by 21% (from 1115 GW in 2022 to 1349 GW in 2029 and than do not increase its capacity anymore due to renewable facilities). Its share on the market will reach 54%.
- In 2030, China and India will be account for almost 70% of total coal generation capacity, up from 60% in 2022.
- The U.S. is on track to close half of its coal-fired generation capacity by 2026, just 15 years after its 2011 peak. Roughly 40%, about 80 GW, of remaining U.S. coal-fired capacity is set to close shortly after 2030.
- India is expected to increase capacity over 30% over the forecast period from 211 GW in Y2022 to 300 GW by 2030. No declines are expected before 2030.
- The US will only have about 116 GW of capacity in 2030 (5%)

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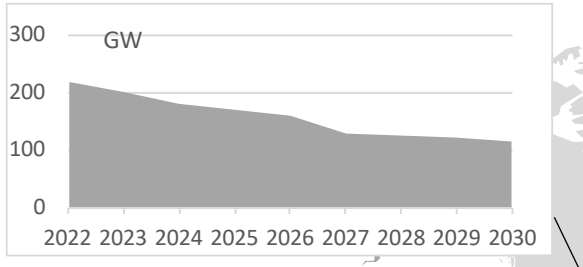
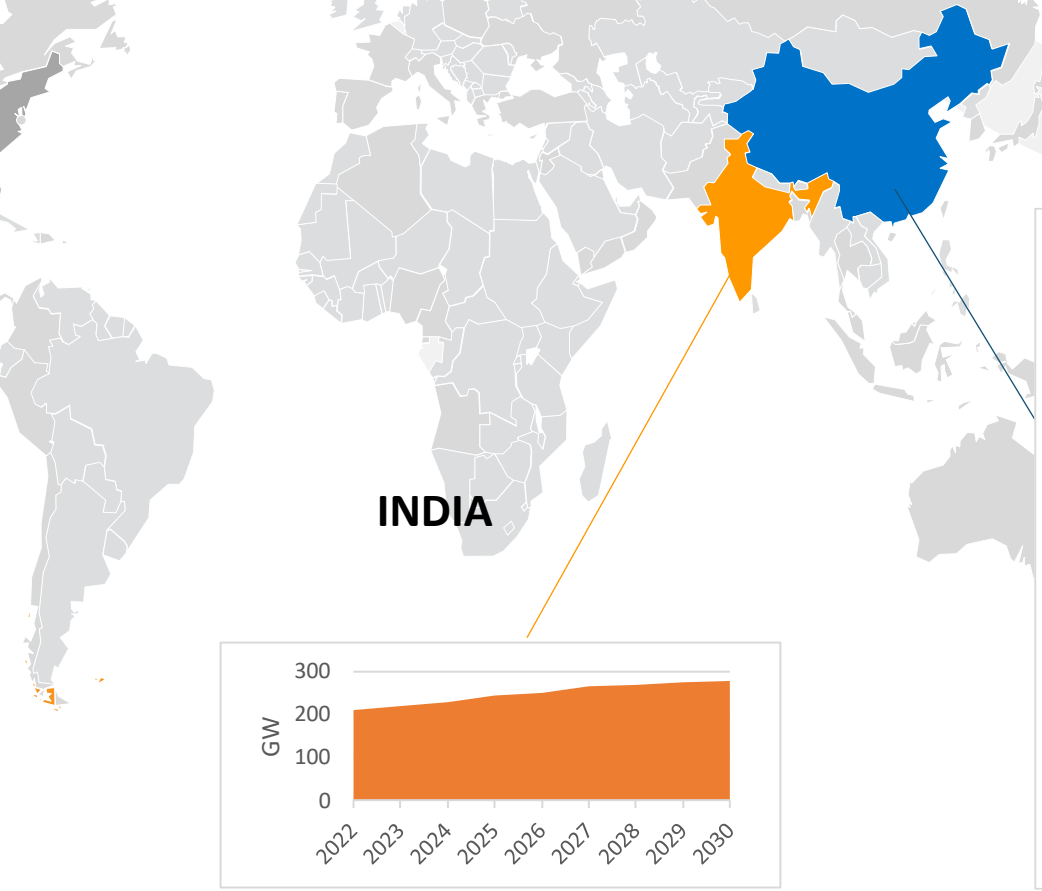
COAL POWER GENERATING CAPACITY BY COUNTRY 2022-2030

US

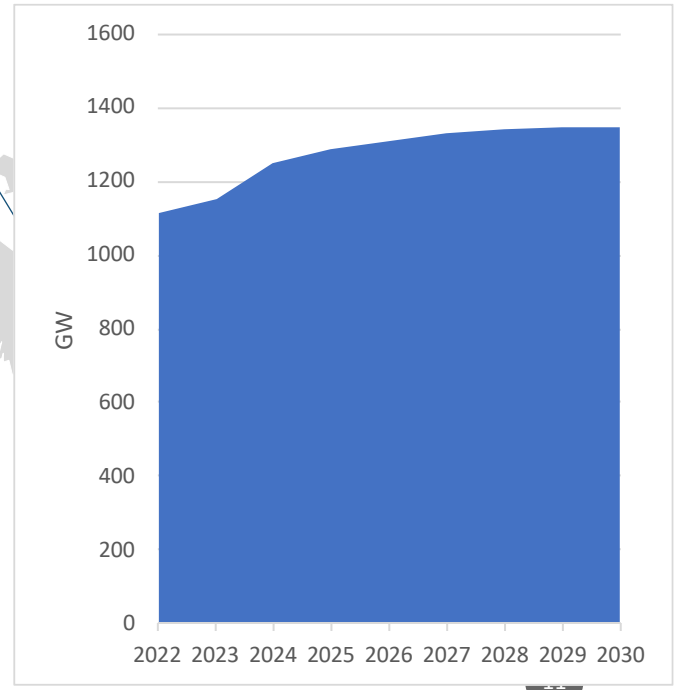


- By the year 2030, almost 75% of the world's coal electricity capacity is expected to be concentrated in China, India, and the USA.
- China's capacity is projected to experience gradual growth, until 2026, followed by a more modest 1-2% growth thereafter. By 2029, China's capacity is anticipated to stabilize and remain flat.
- India, on the other hand, is poised to demonstrate a more consistent growth trajectory with an annual increase in capacity ranging from 3-5%.
- In contrast, the United States is anticipated to exhibit a negative trend in coal capacity over the specified period.



INDIA

CHINA



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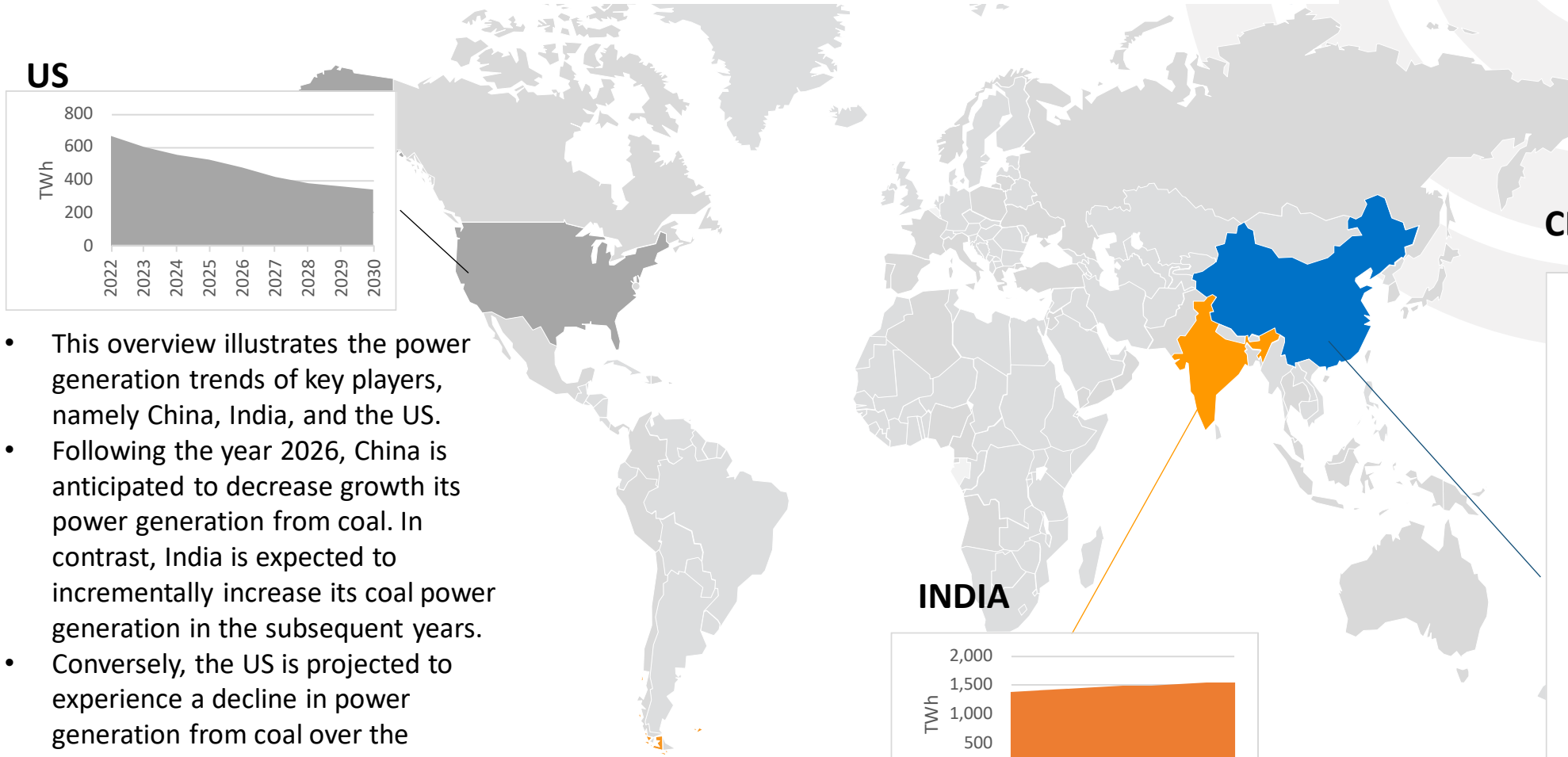
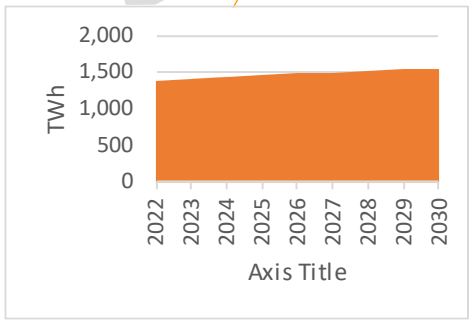
COAL POWER GENERATION BY REGION 2022-2030



US

- This overview illustrates the power generation trends of key players, namely China, India, and the US.
- Following the year 2026, China is anticipated to decrease growth its power generation from coal. In contrast, India is expected to incrementally increase its coal power generation in the subsequent years.
- Conversely, the US is projected to experience a decline in power generation from coal over the forecast period on 55%

INDIA



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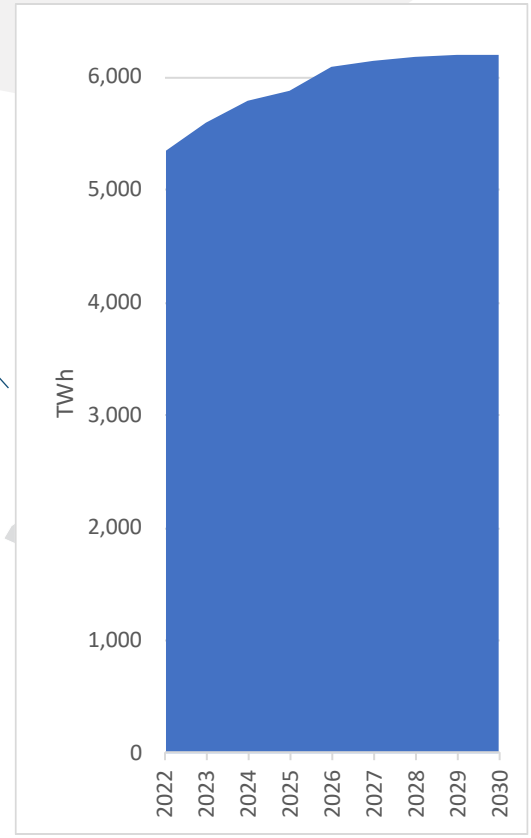

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WHY INCORRYS INFORMATION SYSTEM

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ADVANCED ANALYTICS

Incorrys performs data analysis to ensure quality and consistency among different industries and jurisdictions

ACCURATE FORECASTS

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