Observations and Suggestions
观察与建议

Mitigating Energy Shortages in the People's Republic of China

缓解中华人民共和国能源短缺问题

March 2022
NO. 2022-01

ASIAN DEVELOPMENT BANK

ADB

Mitigating Energy Shortages in the People's Republic of China

缓解中华人民共和国能源短缺问题

ASIAN DEVELOPMENT BANK

ADB

ISBN 978-92-9269-440-1 (print); 978-92-9269-441-8 (electronic)
Publication Stock No. BRF220119-2
DOI: http://dx.doi.org/10.22617/BRF220119-2

Corrigenda to ADB publications may be found at http://www.adb.org/publications/corrigenda.

Notes:
In this publication, "$" refers to United States dollars and "CNY" to the yuan.
ADB recognizes "China" as the People's Republic of China.

ISBN 978-92-9269-440-1（印刷版）；978-92-9269-441-8（电子版）
出版物库存号：BRF220119-2
DOI: http://dx.doi.org/10.22617/BRF220119-2

亚行出版物勘误信息可在以下网页查询：http://www.adb.org/publications/corrigenda。

注：
在本出版物中，"$"表示美元，"CNY"表示人民币。
亚行承认"中国"为"中华人民共和国"。

译文声明
为扩大读者范围，特将本出版物由英文翻译为中文。亚洲开发银行（亚行）尽力确保翻译的准确性，但英语是亚行的官方语言，因此，本出版物的英文原版是唯一合法的（即官方的和经授权的）文本。任何对本出版物内容的引用，必须以其英文原版内容为准。

Summary
摘要

• The recent electricity supply shortage in the People's Republic of China (PRC) is driven by a disequilibrium in demand and supply. Energy demand has picked up with the economy recovering and industry growing, strongly supported by solid merchandise export growth. At the same time, soaring coal prices have hit power producers curtailing growth in electricity supply.

最近，由于供需不平衡，中华人民共和国（中国）出现电力供应短缺。商品出口稳健增长，对经济复苏和工业发展构成强有力的支撑，推动能源需求逐步回升。但是，煤炭价格飙升，对发电企业造成严重影响，电力供应增长速度放缓。

• The government acted swiftly to increase coal output and support electricity production. More flexible energy control policies prevented electricity rationing and production suspensions resulting from efforts to curb carbon dioxide emissions. In addition, energy prices for commercial and industrial customers were liberalized so that higher prices charged to these groups would help power producers.

中国政府迅速采取行动，提高煤炭产量，支持电力生产。政府还出台了灵活性更强的能源管控政策，防止因碳减排而导致的拉闸限电和暂停生产。此外，推进工商业用户电价市场化改革，通过提高定价水平，助力发电企业。

• In the short term, liberalization of residential electricity prices—currently fixed at a low level—could help energy savings and thereby reduce power demand. At the same time, an independent regulatory agency could help regulate price setting by power producers and grid companies. In a first step, residential electricity prices could be increased gradually while regulatory capacity is built up. The regulatory agency would also be needed to review the price setting when enacting tariff reforms in the long term.

居民电价目前仍维持在较低水平。短期来讲，居民电价市场化改革有助于节约能源，从而减少电力需求。同时，还可设立独立的监管机构，监管发电企业和电网公司的定价行为。一开始，不妨双管齐下：一是增强监管能力；二是逐步提高居民电价。而放眼长期的电价改革，也需要监管机构审查价格设定。

• In the longer term, accelerating the transition to a less energy-intensive service economy is key. Shifting away from heavy industry toward services and high-tech sectors will drastically reduce the energy intensity and carbon footprint of the economy. Energy transition plans covering (i) renewable energy, (ii) energy efficiency, (iii) distributed energy, (iv) grid modernization, and (v) regional interconnection should be advanced and implemented. Tariff reforms are needed to allow the partial transferring of cost of supply to consumers, while at the same time incentivizing energy companies to fulfill their role without incurring losses. Finally, higher energy prices would accelerate the transformation to a more energy-efficient economy.

从更长远的角度讲，关键在于加速向能源密度较低的服务经济转型。重心从重工业向服务业和高科技行业转移，将大幅降低经济的能源密度，减少碳足迹。应推进并实施涵盖以下五方面的能源

转型计划：（1）可再生能源，（2）能源效率，（3）分布式能源，（4）电网现代化，（5）区域电网互联。电价改革也必不可少，一来可将部分供电成本转嫁给消费者，二来可激励能源企业在确保自身不亏损的前提下履行其职责。最后，进一步提高能源价格将加速向更节能的经济转型。

I. ELECTRICITY SHORTAGES

1. The recent electricity shortage in the People's Republic of China (PRC) is driven by a disequilibrium in demand and supply. Energy demand has picked up with the economy recovering and industry (including construction) growing 8.2% year-on-year in 2021 supported by solid merchandise export growth. At the same time, soaring coal prices—more than half of PRC energy consumption is powered by coal—have hit power producers. They purchase coal at market prices but can only charge low energy tariffs due to regulations, leaving them with a loss. Thus, coal-powered plants, already at low inventories, have curtailed energy production.

2. While low energy pricing has helped industry and end users, it does not provide incentives for power producers to increase output if input prices are high. Factors behind the coal price spike in October 2021 include the closure of domestic coal mines due to environmental and safety reasons in recent years as well as restrictions on coal imports.

II. MEASURES TAKEN AND THEIR EFFECTS

3. **Energy control policies.** The government reacted swiftly to the problem by issuing new instructions to add some flexibility to the country's energy control policy, aiming to prevent electricity rationing and production suspensions resulting from efforts to curb emissions.

4. **Supporting electricity production.** Measures taken included (i) accelerating the start-up of new coal mines and reopening some of the closed ones, (ii) increasing coal imports, (iii) introducing temporary tax deference for coal-fired power plants, (iv) promoting long-term contracts between miners and power firms to guarantee thermal coal supply for electricity generation, and (v) calling on banks to increase their risk tolerance for loans to such plants.

5. **Energy price liberalization for commercial and industrial customers.** Coal-fired power plants were allowed to charge commercial and industrial customers market-driven prices for electricity from 15 October 2021. Previously, roughly half of these users had negotiated prices with grid operators, so that the shift to entirely market-driven pricing for industry is a significant change—residential and agricultural users will, however, continue to pay fixed prices. Earlier in October 2021, reforms allowed power suppliers to charge tariffs up to 20% above the base level for industrial and commercial customers, with no caps for high energy consumption industries.

6. Higher power prices will incentivize loss-making power plants to stabilize supply. Higher prices will rationalize energy consumption, thereby reducing the economy's energy intensity in support of climate change commitments. In addition, the liberalization of electricity prices will support the newly established emissions trading system allowing power generators to pass the additional cost of carbon emissions to final users.

7. **Coal price target.** In late October 2021, the PRC's state planner set an immediate price target for thermal coal. Prices for 5,500-kilocalorie thermal coal, a benchmark, were targeted at CNY1,200 per metric ton (ex-mine pit), which—according to analysts' estimate—would still be higher than the price at which power generators do not operate at a loss.[1]

8. **Short-term effects.** Overall, the measures have temporarily alleviated the power shortage ahead of the winter season. The increased coal production will result in higher carbon emissions in the shorter term, but higher electricity prices for the country's largest emitters (chemicals, metals, and building materials) will support longer-term efforts to cap emissions. Though the measures have helped to stabilize supply and marginally expand production, avoiding a severe power crisis, more efforts are needed as raising domestic coal output will take time to materialize and could jeopardize longer-term climate goals in the absence of supporting policies. Further actions in line with international best practices are needed. They include short- and medium- to long-term measures.

III. POSSIBLE SHORT-TERM ACTIONS AND THEIR EFFECTS

9. **Further electricity price liberalization.** Higher residential electricity prices in urban areas will contribute to eliminate the pricing distortion behind the power crunch, reducing energy demand and supporting climate change commitments. However, charging higher electricity tariffs will negatively impact lower-income households and might require targeted subsidies for low-income households to shoulder their burden. International experience suggests that in regional markets, electricity producers can affect electricity prices, which would warrant an independent control by an independent regulatory agency.

10. Europe, with its regional markets, is a good example for the PRC given its vast geographic extension. Through their production portfolios and own production costs, large European electricity producers can affect supply and demand in individual regional markets, thus affecting electricity prices.[2] Similar effects would likely play out in the PRC. The creation of an independent regulatory agency that has up-to-date information on comparative performance and costs could help in controlling price setting by power producers and, in particular, grid companies. This is especially important when liberalizing residential electricity prices as households tend to have less bargaining power than the industry. In a first step, residential electricity prices could be increased gradually, while regulatory capacity is built up.

11. **Increased coal imports** can help alleviate shortages, but they only play a minor role in overall coal consumption in the PRC. Moreover, prices of imported coal are also high, and it will be challenging to increase volumes in the short run.

---

1 *Reuters*. 2021. China Sets Target Coal Price in Bid to Ease Power Crunch – Sources. 28 October. https://www.reuters.com/business/energy/china-planner-met-with-coal-producers-study-profiteering-standards-2021-10-28/.

2 Š. Bojnec and A. Križaj. 2021. Electricity Markets during the Liberalization: The Case of a European Union Country. *Energies* 2021. 14. 4317. https://doi.org/10.3390/en14144317.

12. **Price caps on coal prices.** However, incentives for capacity additions decrease if prices are fixed at a low level. Also, energy prices would not reflect input costs, which runs contrary to efforts to move toward a more market-based economy. Cheap coal also hampers efforts to reduce the economy's energy intensity, thereby putting a burden on climate change commitments. In addition, coal imports would need to be subsidized to compensate importers for the difference to the world market price they pay. Therefore, further electricity price liberalization seems to be preferable. While capping domestic coal prices could support electricity production, it would come at a high ecological price.

IV. MEDIUM- TO LONG-TERM REFORMS

13. In the medium to long term, the main concern relates to the pace of the PRC's energy transition, which, if delayed, will affect its ambitious carbon neutrality commitments. The following recommendations pertain to three critical areas: transforming the economy, fostering energy transition plans, and reforming energy tariffs.

14. **Accelerating the transition to a service economy.** The PRC's impressive V-shaped recovery from the impact of the pandemic has been fueled by increased reliance on energy-intensive industries and construction. Shifting away from heavy industry and accelerating reforms to unlock the potential of the services and high-tech sectors will drastically reduce the energy intensity and carbon footprint of the economy. To realize its potential as a source of growth, services should be given prominence in economic planning and a similar status to manufacturing in terms of fiscal incentives, resource allocation, and openness. At the same time, a service economy will require more stable and reliable power networks that provide high-quality electricity supply.

15. **Fostering energy transition plans.** In line with the PRC's climate change objectives, national plans should be prepared to reduce the share of coal and other imported fossil fuels in the energy mix toward reducing the likelihood of shortages and supply shocks due to the excessive dependence on such fuels. This includes:

i. **Energy efficiency policies** to reduce energy intensity, which would reduce the reliance on fuels while maintaining production levels. Energy efficiency policies can cover different areas, such as district heating and cooling, which can help reduce overall energy consumption. For instance, Germany's gross domestic product has increased by 45% since 1990, whereas its electricity consumption today is virtually the same, while its primary energy consumption is 22% lower and its carbon dioxide emissions are 41% lower. Measures taken included stricter guidelines requiring more energy-efficient housing construction, modernization and upgrading of industry, and promoting more energy-efficient household devices.

ii. **Renewable energy.** New actions to speed up the development of renewable energy production (i.e., solar, wind, hydropower, geothermal, biomass, wave, etc.) to reduce reliance on fossil fuels and their price movements. In the past few months, the world has

witnessed a massive spike in energy prices, driven mostly by record-high natural gas and thermal coal prices. Nonetheless, Sweden, for example, has recently shown a relatively small energy price increase compared to its neighbors due to its minimal reliance on fossil fuels, as it generates electricity from hydropower (40%), nuclear (39%), renewable energies (19%), and fossil fuels (2%). A higher diversification of the PRC's energy mix, particularly relying on domestic renewable sources, would not only buffer the country from fossil fuel supply shocks but also contribute to carbon neutrality goals.

iii. **Distributed energy.** Connected to renewable energies, there is a growing trend in places like Australia, Germany, or California in the United States where businesses and consumers install their own distributed generation systems, mostly using solar photovoltaic and thermal panels, but also small wind or hydro turbines, heat pumps, etc. These generating assets are connected at the distribution network level, and consumed within the same area, not requiring large transmission lines. Combined with a more efficient use of energy, these would reduce the need for more large coal power plant capacity, helping reduce coal consumption and associated carbon emissions.

iv. **Grid modernization.** A switch to renewable energy technologies requires a modern power grid capable of absorbing a more variable electricity supply. Such modernization efforts include new initiatives to accelerate the development of energy storage. Technologies for energy storage have already been commercialized in several countries to further increase the reliability of the grid and allow for increased variable renewable energy penetration. Yet, electricity storage is not enough to balance demand–supply fluctuations. A modern "smart" digitized grid is necessary, along with additional technical and regulatory requirements.

v. **Regional interconnection.** It is also useful to benefit from regional cooperation and integration by building transmission lines for electricity and natural gas with neighboring countries, which supports energy security by expanding the energy supply sources from outside the country's borders. Good examples can be found in Europe, where all countries are interconnected, as well as in Asia, where India and Bangladesh, for example, have built grid-to-grid transmission lines.

16. **Tariff reforms.** The power shortages provide an opportunity to promote a revision of electricity tariffs to allow the partial transferring of cost of supply to consumers, while at the same time incentivizing energy companies to fulfill their role without incurring losses. Higher electricity prices will lead to a more efficient use as well as investment in more efficient and modernized utilities and energy networks.

一、电力短缺问题

1. 最近，由于供需不平衡，中国出现电力供应短缺。2021年前三季度，商品出口稳健增长，拉动经济复苏，工业增加值同比提高10.6%，能源需求随之回升。由于中国煤炭消费占能源消费总量的一半以上，所以，煤炭价格飞涨，对发电企业造成严重影响。发电企业按市场价购煤，但由于监管政策限制，只能收取较低的电价，导致出现亏损。因此，燃煤电厂在煤炭库存已捉襟见肘的情况下，不得不削减电力生产。

2. 虽然电价较低有利于工业用户和终端用户，但投入价格高企，无法激励电力企业增产。2021年10月，煤价暴涨，主要是因为近年来中国倡导环保和安全，关停大量煤矿，同时限制煤炭进口。

二、 已采取的措施及其作用

3. **能源管控政策。**中国政府当机立断，出台了一系列新的政策指导，增加国家能源管控政策的灵活性，以防止减排导致拉闸限电和暂停生产。

4. **支持电力生产。**采取的措施包括：（1）加快新煤矿筹建，准许部分已关闭的煤矿恢复生产；（2）提高煤炭进口；（3）对燃煤电厂实行临时税收优惠政策；（4）推动煤矿企业与发电企业签订长期合同，以保证用于电力生产的动力煤供应；以及（5）呼吁银行提高对燃煤电厂贷款的风险容忍度。

5. **推进工商业用户电价市场化改革。**自2021年10月15日起，允许燃煤电厂按市场决定的价格向工商业用户收取电费。此前，约有一半的工商业用户与电网运营企业协议定价。因此，转向完全由市场决定的电价对行业是一次重大变革。不过，居民用电和农业用电仍实行固定价格。2021年10月上旬颁布的改革措施允许供电企业向工商业用户收取不高于基准水平20%的电价，对高耗能行业没有上限。

6. 提高电价有利于激励亏损发电厂稳定其电力供应。提高电价将使能源消费趋向合理化，从而降低经济的能源密度，支持中国履行气候变化承诺。此外，电价市场化改革允许发电企业将碳排放产生的额外成本转嫁给终端用户，有利于巩固新建立的碳排放交易体系。

7. **煤炭价格目标。**2021年10月下旬，国家发展和改革委员会设定了动力煤的短期价格目标。其中，5,500大卡动力煤基准价为1,200元/吨（坑口价）。但据分析师估计，该价格仍高于不会导致发电企业运营出现亏损的价格。[1]

8. **短期作用。**总体而言，上述措施暂时缓解了冬季来临前的电力短缺问题。虽然短期内，煤炭产量增加将推高碳排放量，但对化工、金属制造和建材生产等中国碳排放大户的电价上涨，有助于降低长期的碳排放量。尽管这些措施有助于稳定电力供应并小幅扩大生产，避免严重的电力危机，但必须坚持不懈地推进有关工作。这是因为提高国内煤炭产量需要时间来实现，如缺少配套

1 路透社。2021年。《中国设定煤炭目标价，应对电力缺口 》。来源：10月28日。https://www.reuters.com/business/energy/china-planner-met-with-coal-producers-study-profiteering-standards-2021-10-28/。

政策，或将影响长期气候目标的实现。中国政府需要依据国际最佳做法再接再厉，短期和中长期措施并举。

三、 短期可行的措施及其作用

9. **深化电价市场化改革。**通过提高城镇居民电价，有助于消除电力供应短缺背后的价格扭曲问题，降低能源需求，支持气候变化承诺的履行。但提高居民电价会对低收入家庭产生负面影响，因此，或需给予低收入家庭针对性的补贴，减轻他们的负担。国际经验表明，在区域市场中，电力生产商可以影响电价，因此有必要成立独立的监管机构对其进行单独监管。

10. 欧洲幅员辽阔，其区域市场的情况对中国是很好的参照。欧洲大型发电企业凭借自身的产品组合和生产成本优势，可影响特定区域市场的电力供需状况，进而影响电价。[2] 在中国也有可能产生相似的影响。对此，可建立一个独立的监管机构，随时掌握有关电力供需是否平衡和成本的最新信息，有助于管控发电企业（尤其是电网公司）的定价。这对推进居民电价市场化而言尤其重要，因为家庭用户的议价能力往往低于工业企业。一开始，不妨双管齐下：一是增强监管能力；二是逐步提高居民电价。

11. **增加煤炭进口量**确实有助于缓解煤炭短缺问题，但相对于中国的煤炭消费总量而言，只是杯水车薪。加之进口煤炭价格不菲，要在短期内增加煤炭进口量无疑困难重重。

12. **对煤炭价格设定上限。**不过，如果定价较低，煤炭企业就会失去扩大产能的动力。而且，如果能源价格无法反映投入成本，则与迈向市场经济的初衷背道而驰。煤价低非但不利于降低经济的能源密度，反而会掣肘气候变化承诺的履行。此外，需实行煤炭进口补贴，以对进口商因按世界市场价格购入煤炭而承担的差价予以补偿。因此，进一步深化电价市场化改革是可取的。虽然对国内煤炭价格设定上限可支持电力生产，但这将付出沉重的生态代价。

四、 中长期改革

13. 从中长期来看，主要的担忧来自中国能源转型速度一旦延缓，将影响实现雄心勃勃的碳中和承诺。以下建议涉及三大关键领域：经济转型，促进能源转型计划，以及电价改革。

14. **加快向服务经济转型。**由于对能源密集型产业和建筑业的依赖程度增加，中国经济摆脱疫情影响，实现了“V”型复苏，成就令世人瞩目。中国不再以重工业为依托，而是通过加快改革释放服务业和高科技领域的潜力。这必将大幅降低经济的能源密度，减少碳足迹。服务业是潜在的经济增长点。为此，在做经济规划时，应给予服务业更多重视，在财政激励、资源配置和扩大开放等方面将其摆在与制造业同等重要的位置上。同时，服务经济需要更加稳定可靠的电力网络，以保证高质量的电力供应。

2 斯特凡·博伊科和阿兰·克里泽克。 2021年。《电力市场市场化改革：以欧盟某国为例》. 《能源》杂志, 2021，14，4317。 https://doi.org/10.3390/en14144317。

15. **促进能源转型计划。**根据中国的气候变化目标，应制定国家计划，降低煤炭及其他进口化石燃料在能源结构中的比重，减少因过度依赖此类燃料而出现短缺或供应冲击的概率。

此计划包括：

(1) **能效政策，**以降低能源密度，在保持生产水平不变的情况下减少对燃料的依赖。能效政策可涵盖区域供热和制冷等不同领域，推动降低整体的能源消费。例如，自1990年以来，德国的国内生产总值（GDP）增长了45%，但其能源消费迄今几乎不变，一次能源消费量和二氧化碳排放量反倒分别减少了22%和41%。德国采取的措施包括制定更加严格的政策指导，要求建造节能型房屋，促进工业现代化和产业升级，推广更节能的家用设备。

(2) **可再生能源。**应当采取新措施，加快发展可再生能源（即太阳能、风能、水能、地热能、生物质能、波浪能等），以减少对化石燃料的依赖，平滑其价格波动。在过去几个月里，天然气和动力煤价格创历史新高，成为导致全球能源价格大幅飙升的最主要原因。尽管如此，以瑞典为例，该国发电能源构成依次为水电（40%）、核能（39%）、可再生能源（19%）和化石燃料（2%），其对化石燃料的依赖程度极低，所以，能源价格的涨幅相对邻国较小。如果中国的能源结构更加多样化，尤其依赖国内的可再生能源，不仅可以使其免受化石燃料供应的冲击，而且还有助于实现碳中和目标。

(3) **分布式能源。**澳大利亚、德国、美国加利福尼亚州等地的企业和消费者越来越流行安装分布式发电系统。这些系统以利用太阳能光伏和太阳能集热板为主，小型风力或水力涡轮机、热泵等为辅。此类发电设备接入输配电网，供同一地区的用户使用，而无需搭建大型输电线路。分布式发电系统除提高能源使用效率外，还减少了对增加大型燃煤电厂产能的需求，有助于降低煤耗及其造成的碳排放。

(4) **电网现代化。**要转而使用可再生能源技术，必须建设现代化电网，改善电网的可变供电性能。为此，相关新举措包括加速储能建设。储能技术在有些国家已进入商业化运行阶段，以期进一步提高电网可靠性和可变可再生能源的渗透程度。然而，电能储存尚不能平衡供需波动。因此，现代化的“智能”数字化电网必不可少，同时还应当提出与之配套的技术及监管要求。

(5) **区域电网互联。**与邻国建立输电线路和输气管道，促进区域合作与一体化，也是大有裨益的，因为增加来自境外的能源供应源可加强本国的能源安全。欧洲各国的能源网络都已经实现了互联互通；在亚洲，印度和孟加拉国之间也铺设了互联电网的输电线路。这些都是很好的范例。

16. **电价改革。**电力短缺为推进电价改革提供了机会。通过电价改革，可将部分供电成本转嫁给消费者，同时激励能源公司在确保自身不亏损的前提下履行其职责。提高电价不仅能够改善用电效率，还会促进投资流向更加高效、更现代化的公用事业和能源网络建设。

Mitigating Energy Shortages in the People's Republic of China

The recent electricity supply shortage in the People's Republic of China (PRC) is driven by a disequilibrium in demand and supply. Energy demand has picked up along with economic recovery and industry growth, but at the same time, soaring coal prices have hit power producers so that they curtailed growth in electricity supply. The PRC government has acted swiftly to increase coal output and support electricity production. This report makes further recommendations to mitigate future shortages in electricity supply, including liberalization of residential electricity prices to accelerate the transformation to a more energy-efficient economy and the transition to a less energy-intensive economy to reduce the country's carbon footprint.

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 68 members —49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

缓解中华人民共和国能源短缺问题

最近，由于供需不平衡，中华人民共和国（中国）出现电力供应短缺。随着经济复苏和工业增长，能源需求逐步回升。但是，煤炭价格飞涨，对发电企业造成严重影响，电力供应增长速度由此放缓。中国政府迅速出手，提高煤炭产量，支持电力生产。本报告就如何减轻未来电力供应短缺问题提出了更多建议，包括推进居民电价市场化改革，以加快向更节能的经济转型，以及向能源密集度较低的经济转型，减少中国的碳足迹。

关于亚洲开发银行

亚行在坚持消除极端贫困的同时，致力于实现繁荣、包容、有适应力和可持续的亚太地区。亚行成立于1966年，现有68个成员，其中49个来自亚太地区。亚行主要通过政策对话、贷款、股权投资、担保、赠款以及技术援助等工具向发展中成员体提供帮助。

ADB

ASIAN DEVELOPMENT BANK
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org

亚洲开发银行驻中国代表处
北京朝阳区建国门外大街1号
国贸大厦A座17层
邮编: 100004
www.adb.org/prc
cn.adb.org