

# ENERGY

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# Contents

Chinese reform plans highlight reluctance to cede control.....	3
中国国企混改计划凸显政府不愿让出控制权.....	3
<b>New Energy（新能源） .....</b>	<b>4</b>
US Doubles Down On Wave Energy, \$40 Mil For New Test Bed.....	4
美国对海浪能的投入达到双倍，新的测试水域价值 4000 万美元.....	6
China Aims to Spend at Least \$360 Billion on Renewable Energy by 2020.....	8
中国将投资 2.5 万亿人民币发展可再生能源.....	9
US Geothermal Experiment Set To Go Global Real Soon .....	10
美国地热实验即将走向全球 .....	12
EIA Toots US Wind Energy Horn With Offshore Lease Summary .....	13
EIA 用离岸租赁总结吹响了美国风能产业的号角 .....	16
How Low Can Solar & Wind Go?.....	17
太阳能风能的价格底线在哪里? .....	22
India exceeded 9GW solar by end of 2016 - MNRE.....	27
MNRE: 印度太阳能市场于 2016 年底超过 9GW .....	28
ReneSola awarded 13MW portfolio of PV projects in Poland's first solar auction.....	30
昱辉阳光在波兰首个太阳能招标中获 13MW 光伏项目 .....	30
SunEdison gets greenlight to close US\$150 million sale to GCL-Poly.....	31
SunEdison 获准完成向 GCL 进行 1.5 亿美元资产出售 .....	31
Spruce closes US\$105.4 million in round of debt financing .....	32
Spruce 通过债务融资获得 1.054 亿美元 .....	32
Singyes Solar wins EPC contract for 100MW solar plant in Uzbekistan .....	32
兴业太阳能获乌兹别克斯坦 100MW 太阳能项目 EPC 合约 .....	33
<b>Natural Gas（天然气） .....</b>	<b>33</b>
Egypt to boost natural gas grid by 2017-minister.....	33
埃及将在 2017 年前推动天然气发电.....	33
Japanese utilities pursue LNG partnership with European peers.....	34
日本公用事业寻求与欧洲同行进行液化天然气合作.....	34
All eyes on imported gas to meet energy requirements .....	35
全靠进口天然气满足能源需求 .....	36
<b>Minerals（矿产） .....</b>	<b>38</b>
World's Second Largest Zinc Producer Will Go Solar .....	38
世界第二大锌生产商将走向太阳能 .....	38
<b>Clean Energy（清洁能源） .....</b>	<b>39</b>
Will 2017 be last stand of clean energy technology deniers? .....	39
2017 年将是清洁能源技术否定者的最后一战.....	41

## Mcanxixun Information

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EIA: Clean energy to grow even if Trump scraps Clean Power Plan .....	42
EIA: 即使特朗普政府废除《清洁能源计划》，清洁能源仍可发展壮大 .....	44
China emerges as global leader in clean energy .....	46
中国领衔全球清洁能源投资 .....	48
Pressure builds to fight smog in Western China .....	49
西部城市治霾压力或陡增 .....	51
China raises its low carbon ambitions in new 2020 targets .....	53
中国能源“十三五”再度调高低碳目标.....	55
With nuclear energy, Nigeria can have predictable electricity prices for 60 years – Komarov .....	57
随着核能源的出现，尼日利亚电价指日可待.....	59
<b>Coal（煤炭） .....</b>	<b>61</b>
Market Conditions Force Coal Unit Closures in Australia, Germany .....	61
市场条件迫使澳大利亚和德国煤炭厂关闭.....	62
Power sector sees 6% fall in coal supply from CIL.....	62
印度电力部门表示 CIL 公司煤炭供应量降低 6% .....	63
China targets aggressive coal capacity cuts to 2020 .....	63
中国确定每年煤炭去产能 3 亿吨 .....	63
IEA: Coal Boom Is Over .....	64
国际能源署：煤炭的繁华时代已经结束.....	66
<b>Electricity（电力） .....</b>	<b>68</b>
Renewables = 25% Of UK Electricity Generation In 3rd Quarter, Met 60% Of Scottish Needs In 2015.....	68
第三季度英国可再生能源发电到达 25%，满足苏格兰 2015 年电力需求的 60% .....	69
GE: Why grids don't need to rely on “synchronous” generation.....	70
GE: 为什么电网不需要依赖“同步”发电 .....	71
Hydro expansion will fail without energy market reform.....	72
中国大小水电面临不同命运 .....	75

## Chinese reform plans highlight reluctance to cede control

Two of China's largest state-owned companies have announced plans for partial privatisation, indicating their intention to seek private capital without substantially relinquishing control over corporate strategy.

China's Communist party wants to improve the performance of the country's state-owned enterprises, where returns on assets trail far behind those of privately owned groups. Economists say that raising efficiency in the state sector is crucial to supporting overall growth and defusing financial risks from SOE debt.

“Mixed-ownership reform” — a euphemism for partial privatisation — will be a critical pillar of SOE reform efforts in 2017, according to a statement by top Communist party leaders at their annual economic planning meeting in mid-December. The statement named electricity, petroleum, natural gas, railways, civil aviation, telecommunications and defence as the focus of mixed-ownership reforms.

But plans from rail operator China Railway Corporation and weapons manufacturer China North Industries Group provide the latest evidence that the leadership intends to use privatisation mainly as a fundraising tool rather than a way of diluting government influence over strategy and management.

Unlisted North Industries, which ranked 134th on the global Fortune 500 last year with \$52bn in assets, announced on its website last week that it had approved a 26-point plan for mixed-ownership reform, without publishing the plan itself. But there are other clues to its approach. In late December, Lingyun Industrial Corp, one of North Industries' 11 listed subsidiaries, said in a stock exchange filing that it would acquire 100 per cent equity stakes in two unlisted units of North Industries.

The use of backdoor listings would follow the model of Citic Group, the unlisted state-owned conglomerate that sold \$37bn in assets to its Hong Kong-listed unit, Citic Ltd, in 2014. That deal involved raising \$3.8bn in equity from private investors, including Och-Ziff Capital, pan-Asian insurer AIA, and Chinese internet group Tencent. But after the deal China's central government still controlled more than 80 per cent of the enlarged company.

Lu Dongfu, general manager of China Railway, said at his company's annual work meeting last week that the group would explore stock market listings and joint ventures, among other measures, to promote mixed ownership.

China Railway, which was split off from the now-defunct railway ministry in 2013, officially reported a profit in the first half of 2016, but operates at a loss when government subsidies are excluded. The company's status as a de facto public utility raises questions about whether private investors would want to buy in.

Still, some Chinese rail lines are profitable. Shanghai-listed Daqin Railway Company offers a possible model of mixed ownership. China Railway owns 62 per cent, but private investors have been happy to take minority stakes in the company, which operates the highly profitable line between Beijing and the megacity of Tianjin.

Other attempts to attract private investment into rail assets have been less successful. A Rmb28bn (\$4bn) rail line in southern Sichuan province, for which planning began in 2013, was supposed to set a precedent by relying entirely on private investment. But in the end, China Railway and the Sichuan provincial government had to fund the project themselves. Official media quoted private investors saying the long investment cycle and lack of control over passenger ticket prices made the project unattractive.

### 中国国企混改计划凸显政府不愿让出控制权

中国铁路总公司和中国兵器工业集团近日公布的混改计划表明，政府希望在保持对企业战略的控制权的前提下，引入私人资本。

中国最大型国有企业当中，有两家在近日公布了部分私有化的计划，显示出它们意图在不大幅让出对企业战略的控制权的前提下，引入私人资本。

中共希望提高中国国企的经营业绩，这些国企的资产回报率远远落后于民营企业。经济学家表示，提高国有经济部门的效率对支持整体经济增长和化解国企债务带来的金融风险至关重要。

根据去年 12 月中旬中共最高领导层在年度中央经济工作会议上发布的声明，“混合所有制改革”（部分私有化的委婉说法）将成为 2017 年国企改革的关键支柱。声明中把电力、石油、天然气、铁路、民航、电信、军工列为混合所有制改革的重点领域。

不过，中国铁路总公司(China Railway Corporation)和中国兵器工业集团公司(China North Industries Group)提出的改革计划，又一次证明了领导层主要是想把私有化作为一种国企融资的手段，而不是稀释政府对企业战略和管理的影响力的手段。

未上市的兵器工业集团以 520 亿美元的资产在去年全球“财富 500 强”(Fortune 500)企业中排名第 134 位。上周，该集团在其网站上宣布通过了一项包含 26 条意见的混合所有制改革计划，但未透露计划本身的内容。不过，对于该集团的改革方式，还有其他线索可循。2016 年 12 月底，兵器工业集团旗下 11 家上市公司之一凌云工业股份有限公司(Lingyun Industrial Corp)曾在一份提交给证交所的文件中表示，其将收购集团旗下两家未上市公司 100% 的股权。

如果兵器工业集团采用借壳上市，就套用了中信集团(Citic Group)的做法。2014 年，这家未上市的国企集团向旗下香港上市公司中信股份(Citic Ltd)出售 370 亿美元资产。这笔交易涉及从私人部门投资者手里筹集 38 亿美元股权资本，其中包括 Och-Ziff Capital、泛亚洲的保险公司友邦保险(AIA)，以及中国互联网集团腾讯(Tencent)。交易完成后，中国中央政府对扩资后的中信股份仍控股 80% 以上。

中国铁路总公司总经理陆东福在上周公司年度工作会议上表示，该集团将探索股票上市及合资企业等多种措施，以推进混改。

中铁总于 2013 年从现已撤销的铁道部分拆出来，2016 年上半年官方报告实现盈利，但若去除政府补贴，其运营仍处于亏损中。该公司事实上的公用事业企业的身份，令人怀疑私人投资者是否愿意入场。

中国部分铁路还是赚钱的。上海上市的大秦铁路(Daqin Railway)提供了混合所有权的一个可能模式。虽然中铁总持有大秦铁路 62% 的股份，但私人投资者也乐意持有该公司少数股权，大秦铁路运营着北京与天津之间的高利润线路。

不过，其他试图吸引私人资本投资铁路资产的尝试就没这么成功了。四川省 2013 年开始规划一条投资额为 280 亿元人民币（合 40 亿美元）的铁路线路，原本设想完全依靠私人投资，树立一个先例。但最终中铁总和四川省政府不得不自己出资。官方媒体引述私人投资者的话称，投资周期过长和不能自主控制客运票价令该项目缺乏吸引力。

## *New Energy* (新能源)

### **US Doubles Down On Wave Energy, \$40 Mil For New Test Bed**

It looks like the US is about to get much, much more serious about developing its vast wave energy potential. Researchers have been working at several relatively modest sites in Hawaii and the Pacific Northwest, and now the Energy Department has announced funding for a new, \$40 million utility scale test site in the waters of the continental US, off the coast of Oregon.

### Why Wave Energy?

The new wave energy test site will be built and operated under the auspices of Oregon State University's Northwest National Marine Renewable Energy Center.

In a press release announcing the plan to invest up to \$40 million in the nation's first utility scale wave energy test site, the Energy Department noted that more than half of the population of the US lives within 50 miles of a coastline.

All things being equal, coastal populations are expected to grow, but getting zero emission energy to coastal regions is becoming more complex and difficult. Aging coastal nuclear power plants will most likely not be replaced, and population density limits the potential for utility scale wind farms and solar arrays on land.

Another limitation for land-based renewable energy in coastal areas is the need for new long distance transmission lines. Plans have been in place for years to bring wind power from the wind rich midwest to points east, but the new lines have had to battle against fossil fuel interests as well as local stakeholders.

One solution is to tap the waters of the US coastlines.

That's beginning to happen in the wind energy sector on the east coast, where the relatively shallow waters of the Continental Shelf are amenable to offshore wind turbine technology.

The nation's first offshore wind farm just went online off the coast of Rhode Island, and the Obama Administration has mapped out an ambitious plan to harvest wind energy all along the eastern seaboard. It looks like New York State's Long Island is next in line for development.

The west coast is a different kettle of fish. The Continental Shelf drops off quickly, and the waters are too deep for conventional offshore wind turbines to be set on the ocean floor.

As a solution, the Energy Department has been pumping some significant dollars into R&D to commercialize floating wind turbines.

With the new investment of \$40 million the agency appears to be broadening its focus to accelerate wave energy development, too.

The payoff could be huge, so to speak:

Recent studies estimate that America's technically recoverable wave energy resource ranges between approximately 900–1,230 terawatt hours (TWh) per year...For context, approximately 90,000 homes can be powered by 1 TWh per year. This means that even if only a few percent of the potential is recovered, millions of homes could be powered by wave energy as the technology progresses.

### The New Wave Energy Test Facility

The new facility will be called the Pacific Marine Energy Center South Energy Test Site. Along with federal dollars, unspecified non-federal funding will go into the construction.

Oregon State University has already begun pre-planning for the new facility.

The site will be up and running in less than four years, by early 2020. That's a pretty quick turnaround, and there's a reason for that. OSU has already spent several years in talks with local stakeholders, including fishermen, and the permitting process has been completed complete.

The new facility will be located near the city of Newport, Oregon. It will include four grid-connected berths for testing prototypes and certifying them in accordance with international standards.

The berths can accommodate arrays of wave energy devices as well as single units.

### A Wave Energy Explainer

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Meanwhile, back in 2013 the Energy Department issued a major report on US wave energy resources, which explains how they arrived at the figure of 900-1200 terawatt hours (or near — the report's figures vary slightly from those used in the press release).

Check out the report if you'd like to get a taste of the complexities involved in estimating wave energy potential. Taking into consideration current design trends, the Energy Department report revolves around the emerging global standard, wave power density.

Here's the rundown:

...a recent overview of all major coastal regions have used “wave power density” in terms of kilowatts per meter of a unit diameter circle to aggregate the total available wave energy resource for a given nation or coastal region. Such a unit-circle approach is not only consistent with accepted global practice, but also more accurately indicates the resource made available by lateral transfer of wave energy along the crests of harmonic components in a multi-directional random seaway, which enables wave diffraction to substantially re-establish wave power densities within a few kilometers of a linear array, even for fixed terminator devices.

The report also identifies limiting factors that will have a profound influence on the siting and design of wave power arrays in US coastal waters.

Wither Wave Energy?

Not for nothing, but Oregon State University's Northwest National Marine Renewable Energy Center was established in 2008 under the Republican administration of President George Bush.

The institution bills itself as the “neutral voice of science and engineering to inform the public and decision-makers about the effects and capabilities of marine energy technologies.”

That certainly sounds reasonable enough, but the incoming Trump Administration may have other ideas.

On the campaign trail Donald Trump pledged to roll back the Clean Power Plan. He is notoriously dismissive of wind energy in particular and renewable energy in general.

Early in December, Trump's transition team sent an ominously worded — and apparently illegal — questionnaire seeking the names of Energy Department employees involved in climate initiatives, and at least two of his cabinet choices (ExxonMobil CEO Rex Tillerson for Secretary of State and Scott Pruitt to head up the Environmental Protection Agency) are aimed squarely at quashing renewable energy initiatives in favor of gas and oil development).

Trump's choice of former Texas Governor Rick Perry as Energy Secretary doesn't bode well, either. Texas's renewable energy sector blossomed in all directions (wind, solar, algae biofuel, you name it) under his tenure from late 2001 to 2014, but Texas government is set up with a “relatively weak governor.” It's unclear how much credit the state's top executive can take for the positive renewable energy trendline — especially given Perry's disaffection for climate science.

In any case, it appears that the Energy Department hopes to keep the new wave energy facility motion by appealing to the President-elect's fondness for the biggest and the best. Here's the money quote from the press release:

The site is expected to be a flagship test facility for wave energy converters globally, playing a critical role in advancing wave energy technology into commercial viability.

### 美国对海浪能的投入达到双倍，新的测试水域价值 4000 万美元

看来，美国将大力发展其广阔的波浪能潜力。研究人员一直在夏威夷和太平洋西北的几个相对温和的地点工作，现在能源部已宣布为一个新的 4000 万美元的公用事业规模的测试水域拨款，位于俄勒冈沿海。

为什么是波浪能？

新海浪能源试验场将在俄勒冈州立大学西北国家海洋可再生能源中心的资助下建成并运营。

能源部在新闻发布会上宣布计划投资 4000 万美元，给全国第一个公用事业规模的波浪能测试地点，能源部还指出，超过一半的美国人口生活在 50 英里的海岸线。

一切都是平等的，沿海人口预计将增长，但获得零排放的能源沿海地区变得更加复杂和困难。老龄化的沿海核电站最不可能被取代，人口密度限制了公用事业规模的陆上风力发电场和太阳能电池的潜力。

沿海地区的陆基可再生能源的另一个限制是需要新的长途输电线路。多年来，一直计划将风力发电从风能丰富的中西部地区推向东部，但新的线路不得不与化石燃料的利益以及当地利益相关者进行斗争。

一个办法是挖掘美国海岸线的海域。

东海岸的风能已经在开发中，那里大陆架的浅水相对适合海上风力涡轮机技术。

全国第一个海上风电场就在罗得岛海岸，奥巴马政府已经提出收获所有东海岸沿岸风能的雄心勃勃的计划。纽约州的下一个发展目标似乎会是长岛。

西海岸的水域情况有些不同。大陆架非常陡峭，海水对于传统的设置在海底的海上风力涡轮机来说太深。

作为解决方案，能源部已拨款给研发，以商业化浮动风力涡轮机。

随着 4000 万美元的新投资，该机构似乎正在增加其对发展海浪能的重视程度。

回报可能是巨大的，所以说：

最近的研究估计，美国的技术可采波能源范围约每年在 900 - 1230 太瓦小时（TWH）之间……这样，约 90000 个家庭可以每年接受供应的 1 太瓦时电力。这意味着，即使只有百分之几的潜力得到恢复，数以百万计的家庭可以通过波能源的技术进步取得电力。

新的波浪能试验设施

新的设施将被称为太平洋海洋能源中心南能源试验场。除了联邦的投资，未指定的非联邦资金也将用来建设。

俄勒冈州立大学已经开始对新设施进行预先规划。

该站点将在四年内运行，大概是 2020 年初。这是一个非常快速的周转，也是有原因的。OSU 已经花了数年与当地利益相关者，包括渔民进行谈判，审批过程已经完成。

新工厂将位于附近的俄勒冈新港市。它将包括四个网格连接的泊位测试原型，并且证明它们已经按照了国际标准。

泊位可以容纳阵列波能装置，以及单台装置。

海浪能解释

同时，在 2013 年能源部发布的美国波浪能资源的主要报告中，解释了他们如何达到 900-1200 太瓦小时的数据（或接近——与用于新闻稿的数据略有不同）。

如果你想体会一下估测海浪能的复杂性，去看一下那份报告。考虑到目前的设计趋势，能源部的报告围绕新兴的全球标准，波功率密度。

请看：

……最近主要沿海地区都在用“波功率密度”的单位直径每千瓦的总和来描述一个给定的国家或沿海地区的可用波能源资源。这样的一个单位圆方法不仅与公认的全球实践一致，而且更准确地显示在多向随机海浪波中沿谐波峰能量横向转移能提供资源的量，使波的衍射波的功率密度基本上建立在几公里的一个线性阵列，甚至对固定的终端设备也是如此。

该报告还确定了将对美国沿海水域的波浪动力阵列的选址和设计有深远影响的限制因素。

衰落的波能量？

事出有因，俄勒冈州立大学的西北国家海洋可再生能源中心在 2008 年，共和党总统乔治·布什的领导下成立。

## Mcanxixun Information

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该机构自称为“科学和工程中立的声音，将海洋能源技术的影响和能力告知公众和决策者。”

这当然听起来合理，但即将到来的特朗普政府可能有其他想法。

在竞选活动中，唐纳德·特朗普承诺将恢复清洁能源计划。他是出了名的对风能不屑一顾，特别是可再生能源。

早在十二月，特朗普的过渡团队就有过不好的说法——显然是非法的——用调查问卷寻求参与气候行动的能源部门的员工名字，至少两个他的内阁选择（埃克森美孚首席执行官 Rex Tillerson 是国务秘书，Scott Pruitt 负责环境保护局）准备撤销在天然气与石油开发中有利于可再生能源的举措。

特朗普对前德克萨斯州州长 Rick Perry 的提名并不是一个好兆头。在他 2001 年底到 2014 年的任期内，德克萨斯的所有方向可再生能源产业都发展良好（风能，太阳能，藻类生物燃料，以及你所有能想到的），但德克萨斯政府正在由“相对薄弱的州长”建立。目前还不清楚美国有多少高管会采取积极的可再生能源措施——尤其鉴于 Perry 对气候科学的不满。

在任何情况下，能源部门都希望通过迎合新当选总统对最大的和最好的爱好，来保持新的海浪能源设施。以下是新闻稿中的说法：

该站点预计将成为全球波浪能转换器的旗舰测试设施，在推动波能技术转化为商业可行性中起到关键作用。

## **China Aims to Spend at Least \$360 Billion on Renewable Energy by 2020**

China intends to spend more than \$360 billion through 2020 on renewable power sources like solar and wind, the government's energy agency said on Thursday.

The country's National Energy Administration laid out a plan to dominate one of the world's fastest-growing industries, just at a time when the United States is set to take the opposite tack as Donald J. Trump, a climate-change doubter, prepares to assume the presidency.

The agency said in a statement that China would create more than 13 million jobs in the renewable energy sector by 2020, curb the growth of greenhouse gasses that contribute to global warming and reduce the amount of soot.

China surpassed the United States a decade ago as the world's biggest emitter of greenhouse gasses, and now discharges about twice as much.

But even disregarding the threat of climate change, China's announcement was a bold claim on leadership in the renewable energy industry, where Chinese companies, buoyed by a huge domestic market, are already among the world's dominant players. Thanks in part to Chinese manufacturing, costs in the wind and solar industries are plummeting, making them increasingly competitive with power generation from fossil fuels like coal and natural gas.

Sam Geall, executive editor of Chinadialogue, an English- and Chinese-language website that focuses on the environment, said that the United States, by moving away from a focus on reducing carbon emissions, risked losing out to China in the race to lead the industry.

Mr. Trump has in the past called the theory of human-caused global warming a hoax and picked a fierce opponent of President Obama's rules to reduce carbon emissions, Scott Pruitt, the Oklahoma attorney general, to lead the Environmental Protection Agency.

The investment commitment made by the Chinese, combined with Mr. Trump's moves, means jobs that would have been created in the United States may instead go to Chinese workers.

Even the headline-grabbing numbers on total investment and job creation may understate what is already happening on the ground in China. Greenpeace estimates that China installed an average of more than one wind turbine every hour of every day in 2015, and covered the equivalent of one soccer field every hour with solar panels.

China may meet its 2020 goals for solar installation by 2018, said Lauri Myllyvirta, a research analyst at Greenpeace, who is based in Beijing.

But despite these impressive numbers, China's push to clean its air and reduce its greenhouse gasses faces pressure from coal industry.

Mr. Geall and Mr. Myllyvirta both said that Thursday's announcement was missing any language on curtailment, or the amount of electricity generated by wind and solar that never finds its way to the country's power grid. In China, wind power curtailment was 19 percent in the first nine months 2016, Mr. Myllyvirta said, many times higher than in the United States, where curtailment levels are often negligible.

The main reason for curtailment, he said, is that China is plagued by overcapacity in electricity generation and operators of China's grid often favor electricity generated from coal.

In recent years the country has also been building coal-fired power plants at a furious pace, although that has recently slowed along with China's economy. Another omission from Thursday's announcements, Mr. Myllyvirta said, was the absence of any specific target to reduce coal consumption.

But both Mr. Geall and Mr. Myllyvirta said Thursday's announcement set the stage for still more power generation from renewable energy and a gradual shift away from coal.

"My experience with China is when a numeric target gets written down, it gets implemented," Mr. Myllyvirta said. "It doesn't always get implemented in the way you like, but it does get implemented."

## 中国将投资 2.5 万亿人民币发展可再生能源

中国政府的能源机构周四宣布，中国计划到 2020 年为止，在太阳能和风能等可再生能源上共投资 2.5 万亿元人民币。

通过该计划，中国国家能源局希望能在这个全球增长最快的行业建立统治地位。与此同时，对气候变化持怀疑态度的唐纳德·J·特朗普(Donald J. Trump)即将就任总统，美国正准备反其道而行之。

国家能源局在一份声明中称，到 2020 年，中国将在可再生能源领域创造逾 1300 万个工作岗位、抑制导致全球变暖的温室气体的增长并减少煤烟。

十年前，中国超过美国成为全球最大的温室气体排放国。现在，中国的排放量约是中国的两倍。

但即便不考虑气候变化的威胁，中国宣布这一计划也是在大胆地谋求对可再生能源行业的领导权。在该领域，中国公司在巨大的国内市场的支持下，已经跻身全球主导力量之列。风能和太阳能行业的成本骤降在一定程度上是拜中国制造所赐，使得它们相较于煤炭和天然气等化石燃料发电越来越有竞争力。

重点关注环境问题的英汉双语网站中外对话的主编萨姆·杰尔(Sam Geall)说，美国不再注重降低碳排放的做法，可能会在为领导该行业而展开的竞赛中输给中国。

特朗普过去称人为原因导致全球变暖的理论是一场骗局，并选择了俄克拉何马州检察长斯科特·普鲁特(Scott Pruitt)领导美国环境保护局(Environmental Protection Agency)。后者强烈反对奥巴马总统的减排规定。

中国的投资承诺，加上特朗普的举动，意味着本可以在美国创造的就业机会可能会流向中国的劳动者。

这些关于总投资和创造就业方面的数字已颇为引人瞩目，然而相对于中国已经在发生的情况，它们仍可能偏保守。绿色和平组织(Greenpeace)估计，2015 年中国每天平均每小时安装风力涡轮机一台以上，每小时安装的太阳能组件覆盖的面积相当于一个足球场。

## Mcanxixun Information

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绿色和平组织驻北京的研究分析师柳力(Lauri Myllyvirta)表示，中国也许到 2018 年便能达到其计划于 2020 年实现的目标。

尽管有这些令人印象深刻的数字，但中国推动清洁空气和减少温室气体的行动，仍面临着在来自煤炭行业的压力。

杰尔和柳力均表示，周四的通告丝毫没提到限电问题，也就是无法进入中国电网的风能和太阳能电量。柳力说，2016 年前九个月，中国的弃风限电比美国高出许多倍。美国的限电水平通常可以忽略不计。

他说，限电的主要原因是中国受制于发电产能过剩，并且中国电网的运营商通常更喜欢煤电。

近年来，中国也在飞速修建煤电厂，不过最近已同中国的经济一起放缓了。柳力说，周四的通告中也没提到任何减少煤耗的具体目标。

但杰尔和柳力均表示，周四的通告为继续增加可再生能源发电和逐步弃用煤炭创造了条件。

“我对中国的经验是，目标数字被写下来时，就会得到实现，”柳力说。“并不一定会按照你喜欢的方式实现，但的确会实现。”

## US Geothermal Experiment Set To Go Global Real Soon

The modestly-sized US state of Utah is about to have an outsized influence on the geothermal industry. As of last month, Utah is now home to the world's first operational geothermal-hydropower plant, and the global energy company Enel has already laid plans to bring this innovative, energy efficient technology to its other facilities around the world.

The new plant could also finally help kick the US geothermal industry into high gear in the US. The country has been a global leader in geothermal-sourced electricity, but the majority of its installed capacity comes from a single state, California, and that includes geyser-based technology with roots in the early 1900s.

### What Is Medium Enthalpy And Why You Should Care

Enel describes The Cove Fort plant as a medium enthalpy plant, which basically means that it is located at a less than premium site for geothermal energy recovery (enthalpy is a measurement of heat in a system).

That's important because the Earth is loaded with low and medium enthalpy sites. The problem is transferring the geothermal energy from these sites into electricity in a way that makes sense financially and technologically.

The two high efficiency systems that use geothermal fluid directly — namely, dry steam and flash steam — can't be used at low and medium enthalpy sites due to their relatively low temperatures.

The third alternative is to use a system called a binary cycle, which is what Cove Fort deploys. Basically, a binary cycle plant uses geothermal fluid (the primary fluid, aka brine or water) to heat another fluid (the secondary fluid or working fluid).

The US Renewable Energy Laboratory provides this general explainer...

Binary cycle power plants operate on water at lower temperatures of about 225°–360°F (107°–182°C). Binary cycle plants use the heat from the hot water to boil a working fluid, usually an organic compound with a low boiling point. The working fluid is vaporized in a heat exchanger and used to turn a turbine. The water is then injected back into the ground to be reheated.

The key environmental advantage of binary cycle plants is that the two fluids never come into contact or mix with each other. The result is that emissions from the facility are kept to a low or practically zero level.

For these reasons, the Energy Department is among those predicting that binary cycle will dominate the industry in future years.

### A More Energy Efficient Geothermal Power Plant

With the new Cove Fort plant, Enel has come up with a way to get the best of both worlds — a low impact, high efficiency power plant.

That's where the hydropower part of the equation comes in. Simply put, Enel has sunk a turbine into the well that re-circulates spent water back underground, and gravity does the rest.

According to Enel's statistics from an initial test run earlier this year, the hydro generator offsets about 8.8% of the plant's energy consumption.

That offset translated into an increase in the plant's overall output by slightly more than 1,000 megawatt-hours over the July-to-September test period.

But wait, there's more.

The hydro generator helps to reduce wear and tear on the injection well, by acting as a regulator for brine being discharged back into the ground:

The presence of the generator creates pressure against the brine flow, which reduces the flow's turbulence into the well, hence minimising the likelihood of any potential damage to the well. The result is a first-of-its-kind innovation that can reduce operational and maintenance expenses, while also having the potential to generate additional revenues.

I know right? Here is Francesco Venturini, head of Enel's Global Renewable Energies division, enthusing over the potential for bringing the Utah experiment to the rest of the world:

“We are creating innovative solutions that are making renewable energy better, stronger and smarter. As a result we have once again discovered a more resourceful way to maximise plant operations and power generation with the aim of using this technology at our facilities around the world.”

### Upcycling An Abandoned Geothermal Area

Enel's Cove Fort success story also has implications for reclaiming abandoned or played out geothermal sites that formerly relied on steam-type generation.

The Cove Fort site area was thought to be ripe for the picking in 1974, when new federal geothermal regulations were implemented. A dozen or so companies acquired leases on federal, state and private lands in the area and many exploratory holes were drilled, but nothing panned out:

...the high cost of drilling, high corrosion rates, low reservoir pressures, and the apparent limited extent of the high-temperature reservoir led to a premature conclusion by Union Geothermal Division in 1980 that the field was not economic for large-scale electric power production...

Or, almost nothing. From the late 1980's into the 1990's the area began producing electricity on a relatively small scale for the Utah Municipal Power Authority, but that facility was sold and shuttered in 2003.

Nothing else happened until Enel came along. It acquired the right to develop the Cove Fort facility in 2007 and opened it in 2013 as a binary cycle plant.

For the record, the global company Ormat Technologies is a partner in the project.

### Onwards And Upwards For Enel

Enel (more precisely, Enel subsidiary Enel Green Power North America) also chose the US to log another global first-of-its kind back in 2012, when it started up the Stillwater hybrid facility in Nevada. That plant combines geothermal with solar thermal and photovoltaic technology.

Enel has been on something of a tear in recent years. Back in 2011 it began adding major solar projects to its portfolio, and in 2013 it qualified to bid on geothermal projects under the US Army's \$7 billion renewable energy initiative.

Moves since last January include a solar, wind, and hydroelectricity deal in Peru that adds up to 326 megawatts of utility scale renewable energy, and in October CleanTechnica noted that the company was on track to install 1 gigawatt worth of wind turbines in Oklahoma by the end of 2016.

Last May Enel also won the right to move forward with a distributed solar plan for Minnesota after a judge was convinced that electricity from the 16-site project would be cheaper than natural gas.

### 美国地热实验即将走向全球

中等规模的美国犹他州即将对地热产业产生巨大的影响。截至上个月，犹他目前是世界第一个投入使用的地热水电厂，全球能源公司 Enel 已经计划将这一创新的节能技术运用到其世界各地的其他设施。

新工厂还可以帮助美国的地热产业高速发展。美国已经是地热电力的全球领导者，但其装机容量的绝大部分来自于加利福尼亚州，包括在本世纪初的根基喷泉技术。

什么是中焓，为什么你应该了解这些

Enel 介绍科夫堡发电厂作为介质焓的工厂，这意味着它的地理位置不那么占优势，这是为了地热能源回（焓是一个系统的热的测量）。

这是很重要的，因为地球上存在低焓和中焓位置。问题是如何将这些地点的地热能源转化为电能，而且方法要在经济技术上可行。

这直接使用地热流体的两种高效的系统——即干蒸汽和闪蒸蒸汽——不能在低和中等焓的地方使用，由于其相对较低的温度。

第三种选择是使用一个称为双循环的系统，这就是柯夫堡使用的。基本上，双循环工厂使用地热流体（主要流体，又名盐水或水）来加热另一流体（二次流体或工作流体）。

美国可再生能源实验室提供的一般解释……

双循环发电厂在较低的温度下对水运行，约 225° - 360° F (107° - 182° C)。双循环利用热水中的热量沸腾工作流体，通常是沸点低的有机化合物。工作流体在换热器中蒸发，用来使涡轮转动。然后将水注入到地面再加热。

双循环发电厂的主要环境优势是两种流体从不接触或混合。结果是设施的排放量保持在低水平，几乎为零。

基于这些原因，包括能源部在内的许多机构都预测未来几年双循环将主导工业。

一个更节能的地热发电厂

随着柯夫堡的发展，Enel 已经想出了两全其美的办法——影响小，效率高的发电厂。

这是水电部分的解决方法。简而言之，Enel 已经将涡轮沉没至循环水在地下所经过的井，剩下的部分交给重力来完成。

根据 Enel 从今年早些时候最初的试运行中得出的数据，水轮发电机的偏移占工厂的能源消耗量的 8.8%。

七月至九月的测试期，补偿转化为增加工厂的总体产量略超过 1000 兆瓦小时。

远不止于此。

该水轮发电机有助于减少对喷射井的磨损，作为调节器将盐水排回地面：

发电机的存在对盐水流量造成压力，从而减少了入井的流量，继而减少了很多种潜在的损害的可能性。这一结果是它的第一类创新，可以减少运营和维护费用，同时也有可能产生额外的收入。

这里是 Francesco Venturini，意大利的全球可再生能源部门的负责人，认为犹他州的实验完全有推广至全世界的潜力：

“我们正在创造创新的解决方案，使可再生能源更好，更强更灵活。结果我们再次发现了一个更足智多谋的方式，以最大限度地提高工厂的运作和发电，目的是在全世界都能推广我们设施的这种技术的应用。

可回收废弃的地热区

Enel 在柯夫堡的成功故事，对以前依赖蒸汽发电的地热站点和废弃的地方的重新开发也有启发。

柯夫堡地区被认为是在 1974 年建立的，那时新的联邦地热法出台了。十几家公司以联邦、州和私人的名义收购租赁，进行土地勘探孔钻，但没有成功：

钻井成本高，腐蚀速率快，储层压力低，高温油藏的表现有限程度导致了联合地热事业部 1980 年的过早结论，该地区不适合大规模的电力生产…

或者说，什么都没有。从 1980 年代末到 1990 年代，该地区开始建设犹他市电力局一个规模相对较小的发电设施，但 2003 年被出售并且关闭了。

直到 Enel 到来之前，一事无成。它获得了 2007 年开发柯夫堡发电设施的权利，2013 年这一双循环发电厂投入使用。

根据记录，全球化公司 Ormat Technologies 是本项目的一个合作伙伴。

向前、向上的 Enel

Enel（更准确地说，是 Enel Green Power North America），2012 年也选择在美国建立另一个全球首个设施，就是内华达州的斯蒂尔沃特混合设备。该工厂结合了地热与太阳能光热和光伏技术。

Enel 已在近年来涉足多领域。早在 2011 年，它开始向其投资组合增加主要的太阳能项目，并在 2013 年，获得资格投标美国陆军 70 亿美元可再生能源倡议下的地热项目。

自去年一月以来的举措包括太阳能、风能、水电在秘鲁达成协议，共计 326 兆瓦的公用事业规模的可再生能源，并在十月份的 CleanTechnica 网上指出，公司有望在 2016 年底，在奥克拉荷马安装价值 1 吉瓦的风力涡轮机。

去年五月，16 个站点的电力将比天然气便宜的判断得到普遍认同后，Enel 又进一步获得了权利在明尼苏达安装分布式太阳能的计划。

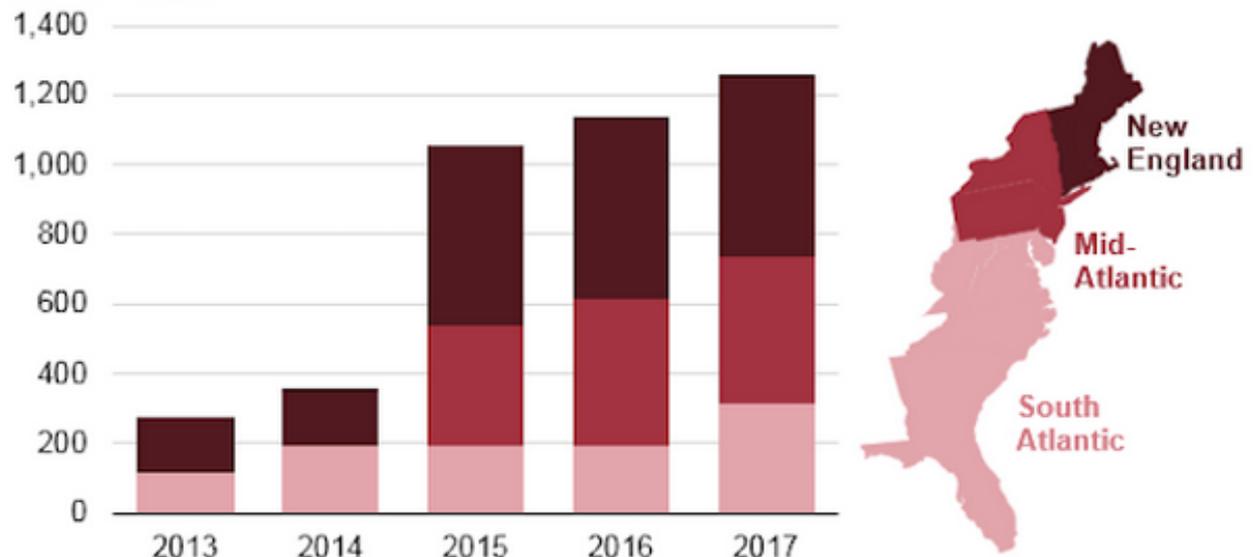
## **EIA Toots US Wind Energy Horn With Offshore Lease**

### **Summary**

The US Energy Information Agency closed out 2016 by re-issuing some of its “favorite” observations from the last 12 months, and to cap the series it chose an article that summarizes the Interior Department’s offshore wind lease program for the Atlantic Coast states.

Just a wild guess, but by favorite the agency probably means most significant, and it certainly has hit the nail on the head with offshore wind — even though the US has barely gotten its first “steel in the water.”

Cumulative purchased federal leases for offshore wind land area  
thousand acres



### US Atlantic Seaboard Should Be A Wind Energy Juggernaut But It's Not... Yet

Aside from this year's commissioning of Rhode Island's new Block Island offshore wind farm, the US has so far failed to tap into its massive offshore wind energy potential.

That's too bad, particularly for Atlantic Coast states that are characterized by burgeoning urban centers in the north, industrial acceleration in the south, and a nice long, relatively shallow Continental Shelf of the US eastern seaboard, upon which wind farms are relatively easy to build.

Recognizing the potential (and the need), in 2010 the Obama Administration enlisted practically all of the east coast states to coordinate offshore wind energy development, by committing to an active or at least an observer role in the so-named Atlantic Offshore Wind Energy Consortium.

However, with the notable exception of Rhode Island the effort has stalled, partly due to blowback from Koch-funded state policymakers.

By 2014 the Interior Department began to take matters into its own hands by holding lease auctions for designated offshore wind energy development, state level support or not.

### Wind Replaces Diesel

That brings us to the EIA summary. Before getting into the leases, EIA notes the significance of the new Block Island wind farm.

In addition to providing clean power to the mainland, the new 30 megawatt wind farm has replaced the island's local diesel-fueled power supply.

There's an interesting story behind those generators. Back in 1998, the Wall Street Journal reported that the island's power company had been installing new diesel generators without permits. Once the US Environmental Protection Agency caught on, the company proposed running a pricey undersea cable over to the mainland to draw electricity from the grid.

According to the Wall Street Journal, Block Island customers were already paying among the highest electricity rates in the US, and the \$10 million (in 1998 dollars) cable project would have boosted them even higher.

The emergence of commercial-ready wind technology provided an alternative, though electricity from the new wind farm is also relatively high. According to the Providence Journal it started at 23.5 cents per kilowatt hour in December and rose to 24.4 cents in January, which is almost three times the price of the grid blend. The contract calls for annual increases that top out at 47.9 cents in the final year, though if everything works out the increase will come out to a few cents less.

Residents of Block Island are still expected to win out, though. Even with the premium for wind, their electricity rates will drop slightly. Mainland residents on the grid will see their rates go up by just over \$1.00 monthly for the first year.

Like It Or Not, Offshore Wind Leases Are Here

State waters generally extend only three nautical miles offshore, which is why the federal government can lease areas for development relatively close to state shorelines (federal control extends to 200 nautical miles).

According to EIA, the first federal offshore wind leases went out for bid in 2013, with almost 165,000 acres off Massachusetts and of Rhode Island.

Here's the rundown from EIA as of December 2, 2016:

Since then, BOEM [the Bureau of Ocean Energy Management] has held four additional auctions for wind development in the Atlantic region. To date, it has issued 11 commercial leases in federal waters, 9 of which were purchased through the competitive bid process. BOEM issued the other 2 leases before the first competitive lease sale.

Competition for the wind leases has been steadily ramping up, demonstrating how the offshore wind market has matured over the past few years.

Only eight companies qualified to bid on the 2013 leases. In comparison, 14 companies qualified for the most recent sale, which occurred last month for 80,000 acres off New York State's Long Island (for the record, Norwegian oil and gas giant Statoil won the lease).

According to EIA, the next area up for bid will be North Carolina. That should be interesting. As described by Politico among other sources, back in 2013 the Koch brothers targeted North Carolina as part of a broader plan to influence state-level policy, including energy policy.

The plan worked, though perhaps a little too well. Backlash against state policy focused on the Koch-supported governor, Pat McCrory. The disaffection grew so intense that Governor McCrory lost his bid for re-election last November, making himself the first incumbent governor in North Carolina history to lose the office.

During his tenure McCrory claimed to support offshore wind development for North Carolina, but his Administration took steps that would effectively stop BOEM from selling leases off the coast.

Incoming Governor Roy Cooper assembled an impressive record on environmental issues during his tenure as North Carolina Attorney General, so keep an eye out for his statements on the upcoming lease sale.

Meanwhile over in New Jersey, it appears that the joke is on Governor Chris Christie. The 80,000 acre New York lease area is off Long Island, in a pocket that is nearly equidistant from the New Jersey coastline.

In fact, video simulations provided by BOEM indicate that the turbines will be visible on the horizon when viewed from parts of the New Jersey shore.

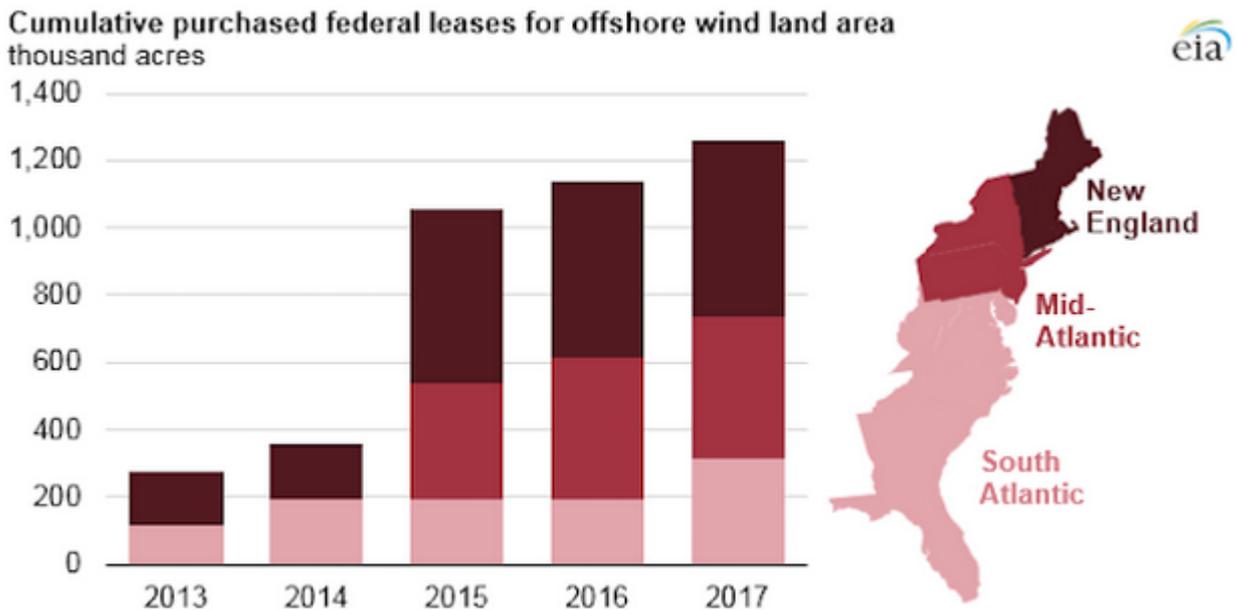
So, New Jersey gets the turbines after all. What it does not get is bragging rights to the new wind farm for its renewable energy portfolio, or the new jobs that are expected to attend its construction and operation.

Governor Christie is term-limited and has one year left in office, so stay tuned.

## EIA 用离岸租赁总结吹响了美国风能产业的号角

美国能源信息署从过去的 12 个月内重新提出一些“最喜欢”的观察记录，为 2016 年画上了句号，为了涵盖这一系列，它选择了一篇文章来总结内政部的大西洋沿海国家海上风租赁计划。

只是一个大胆的猜测，但该机构的“最喜欢”可能意味着最重要的，它肯定提出了海上风能——尽管美国几乎没有“水中的钢”。



美国大西洋海岸应该是风能巨头但实际上还不是……

除了今年罗得岛新大陆岛海上风力发电场的投产外，迄今为止，美国还未能挖掘出其巨大的海上风能资源。

那太糟糕了，尤其是对于大西洋沿岸各州而言，它们的特点是，北方有新兴的城市中心，南方工业在加速，以及美国的东海岸的较长且相对浅的大陆架，在那里，风电场相对容易建立。

认识到潜在性（和需要）后，在 2010 年，奥巴马政府召集了几乎所有的东海岸州，以协调海上风能的发展，在所谓的大西洋海上风能联盟中起到积极或至少观察员的作用。

然而，随着罗得岛的例子值得注意之外，这项努力已经停滞，部分原因是由于科赫资助的国家政策制定者的后坐力。

到了 2014 年，内务部开始通过租约拍卖来自行解决指定海上风能开发的问题，无论国家级支持与否。

风能代替柴油

这让我们开始关注美国能源署（EIA）的摘要。在进入租赁之前，EIA 就已经注意到新的块岛风电场的意义。

除了向内地提供清洁的电力，新的 30 兆瓦的风电场已经取代了岛上的本地柴油供电。

这些发电机的背后有一个有趣的故事。早在 1998 年，《华尔街日报》报道说，该岛的电力公司一直在安装新的柴油发电机而没有许可证。一旦美国环境保护局发现，公司提出的运行昂贵的海底电缆将通过大陆从电网吸取电。

据《华尔街日报》报道，布洛克岛的客户已经支付了美国最贵的电费，而 1000 万美元（以 1998 年美元计算）的有线电视项目也将使其更高。

商业现成的风力技术的出现，提供了一种替代，不过新的风力发电场的电力价格也相对较高。据《普

罗维登斯日报》，12月开始，每千瓦时为23.5美分，一月上涨到了24.4美分，几乎是电网价格的三倍。该合同要求每年增加，在最后一年的最高为47.9美分，如果一切顺利的话，增加的量会少几毛钱。

即使这样，布洛克岛居民仍有望胜出。即使有风的溢价，他们的电费也会略有下降。在网格上的内地居民会看到他们的利率第一年每月上升了超过1美元。

不管你喜欢与否，海上风租赁已经到来

州际的水域一般只能近海三海里，这就是为什么联邦政府可以租赁相对接近国家海岸线的领域发展（联邦控制延伸到200海里）。

根据EIA，第一个联邦海上风租赁的出价在2013年，近165000英亩的马萨诸塞州和罗德岛沿海地区。这是从EIA中截至2016年12月2日的描述：

此后，BOEM [海洋能源管理局举行了]在大西洋地区风电发展方面举行了四个额外的拍卖。迄今为止，它已在联邦水域发出11个商业租约，其中9个是通过竞争性招标过程购买。BOEM在竞争租赁之前就发布了剩下的2个租赁案子。

过去几年里风能租赁竞争不断加大，显示了海上风电市场如何一步一步走向成熟。

2013年的租赁，只有八家公司有资格投标。相比之下，14家公司符合最新的租赁标准，这就是上个月在纽约州的长岛80000英亩的案例（根据记录，挪威石油和天然气巨头Statoil获得租赁资格）。

根据EIA，下一个竞标地区将是北卡罗莱纳。这应该是有趣的。通过其他来源的政治描述，在2013年，科赫兄弟将北卡罗莱纳作为一个影响国家政策的一部分的更广泛的计划，包括能源政策。

这个计划奏效了，甚至效果有点太好了。反对国家政策重点在科赫支持的官员，Pat McCrory。不满变得如此激烈，以至于去年十一月，州长McCrory失去了他的连任竞选，这使他成为了北卡罗莱纳历史上第一位未能连任的州长。

McCrory任职期间，宣称支持北卡罗莱纳海上风电的发展，但他的政府则采取措施，有效制止了BOEM出售租赁海岸。

即将上任的州长Roy Cooper在他担任北卡罗莱纳总检察长期间，在环境问题上留下了令人印象深刻的记录，所以请注意他对即将到来的租赁交易的声明。

与此同时，在新泽西，似乎这个笑话在州长Chris Christie身上发生。纽约长岛80000英亩的纽约租赁面积，与新泽西的海岸线几乎等距。

事实上，BOEM提供的视频模拟表明，从新泽西某些部分海岸看时，涡轮机将在地平线上可见。

所以，新泽西最后得到了涡轮机。它没有得到的是吹嘘的权利，这里指可再生能源组合的新的风力发电场，或预计将参加其建设和运营的新工作。

克里斯蒂州长任期有限，只剩一年，敬请关注。

## How Low Can Solar & Wind Go?

Renewables are cheaper than coal and gas across much of the United States.

For the second year in a row, wind and solar accounted for roughly two-thirds of new U.S. generating capacity, while natural gas and nuclear made up most of the rest.

That's because right now, in much of the United States, wind and solar are the cheapest form of power available, according to a new report from investment bank Lazard.

Analysts found that new solar and wind installations are cheaper than a new coal-fired power installation just about everywhere—even without subsidies. The cost of renewables continues to fall rapidly.

Solar and wind are getting really, really cheap.

Since just last year, the cost of utility-scale solar has dropped 10 percent, and the cost of residential solar dropped

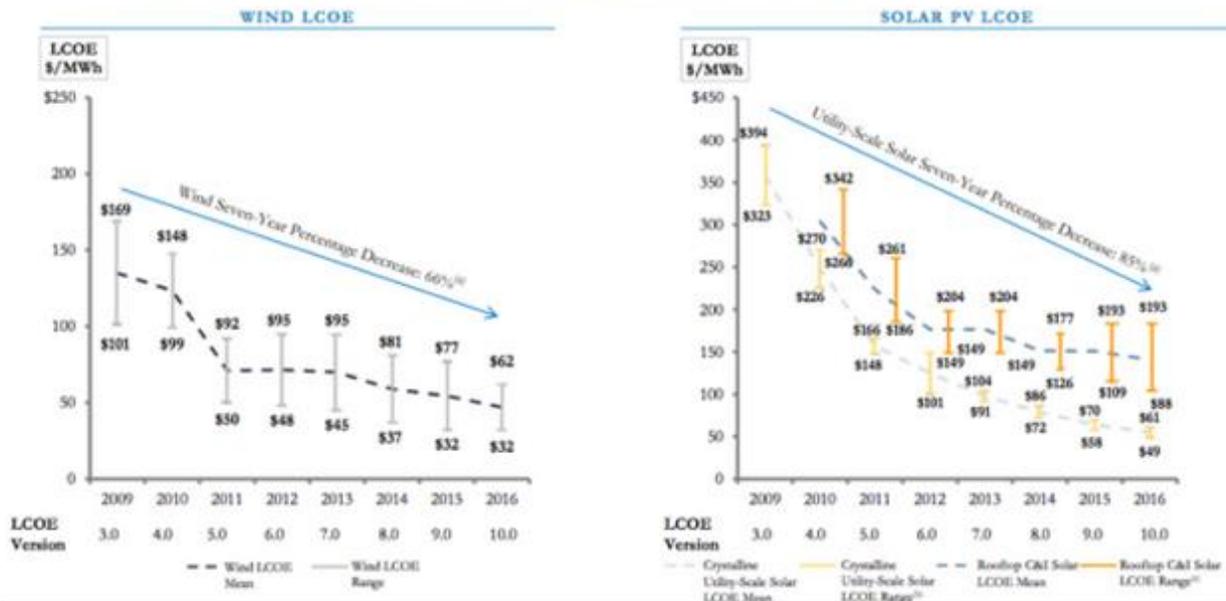
## Mcanxixun Information

a whopping 26 percent—and that is coming after years of price declines. The cost of offshore wind declined by 22 percent since last year, though it still remains more expensive than onshore wind.

The Lazard report is just the latest chapter in the success story of renewable energy. Since 2009, the cost of solar has been cut nearly in half. The cost of wind has fallen by two-thirds. The precipitous drop in price is reminiscent of shrinking costs for personal computers. Wind and, particularly solar, have yet to level off. New technologies and cheaper materials will continue to drive down costs in the years ahead.

### Unsubsidized Levelized Cost of Energy—Wind/Solar PV (Historical)

Over the last seven years, wind and solar PV have become increasingly cost-competitive with conventional generation technologies, on an unsubsidized basis, in light of material declines in the pricing of system components (e.g., panels, inverters, racking, turbines, etc.), and dramatic improvements in efficiency, among other factors



CREDIT: Lazard

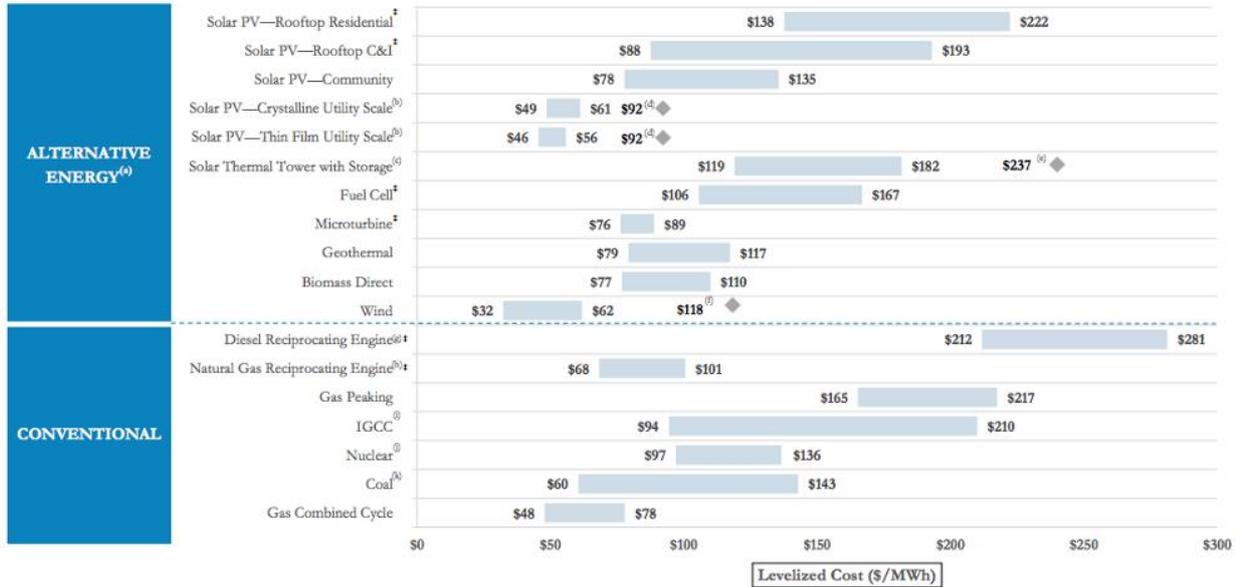
The chart below shows the total cost per megawatt-hour of different forms of power. Lazard added up the lifetime cost of parts, fuel, labor, and other expenses and divided by the number of megawatt-hours generated. From this, they produced a range for the levelized cost of energy (LCOE).

This figure does not include energy subsidies nor the cost of environmental impacts. For instance, if a solar panel costs \$100 without subsidies and \$70 with subsidies, the LCOE would still be \$100. On the other hand, if a gas turbine costs \$100 without accounting for the social cost of carbon, and \$130 after accounting for the social cost of carbon, then the LCOE stays at \$100.

(Researchers use different methods to calculate levelized cost. Trump's transition team, for example, has hinted that it wants to change the way the federal Energy Information Administration calculates the levelized cost of renewables to make wind and solar appear more expensive.)

## Unsubsidized Levelized Cost of Energy Comparison

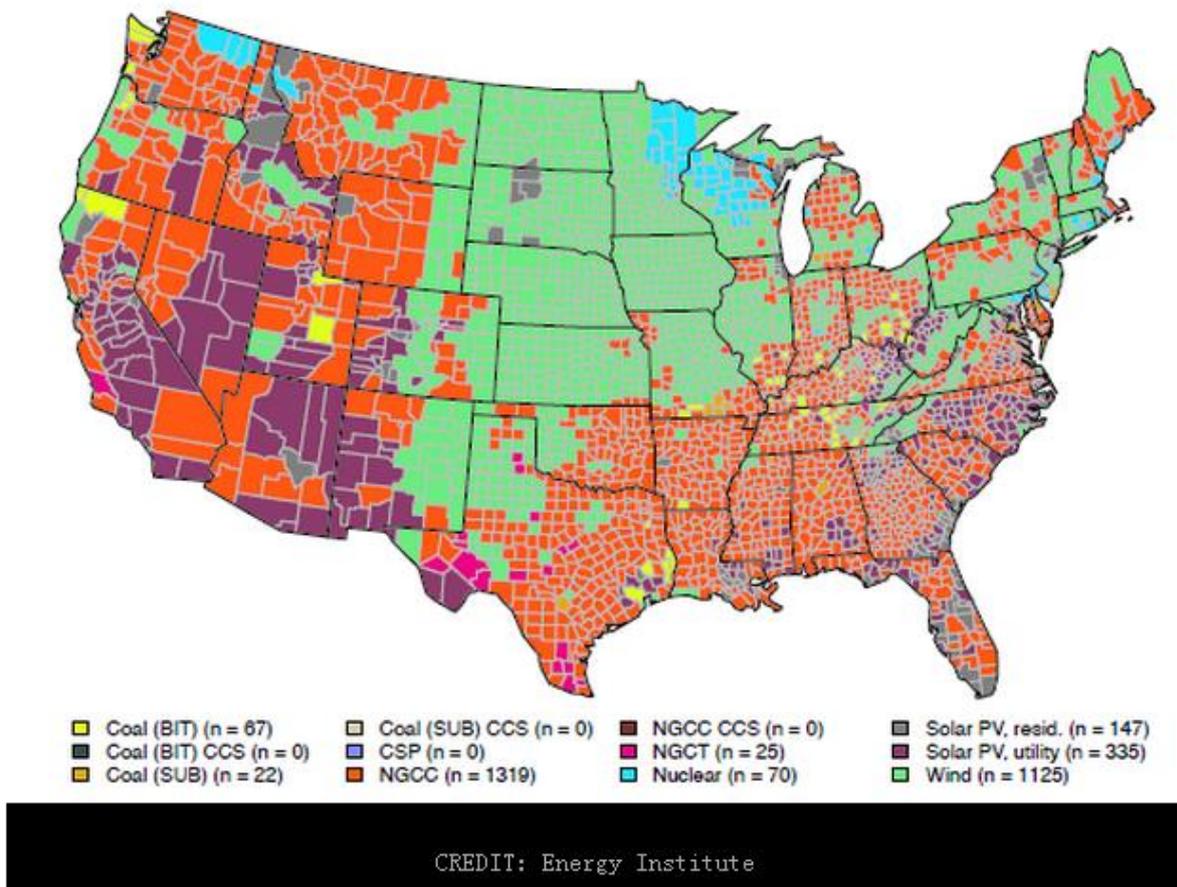
Certain Alternative Energy generation technologies are cost-competitive with conventional generation technologies under some scenarios; such observation does not take into account potential social and environmental externalities (e.g., social costs of distributed generation, environmental consequences of certain conventional generation technologies, etc.), reliability or intermittency-related considerations (e.g., transmission and back-up generation costs associated with certain Alternative Energy technologies)



By and large, wind and solar are going up in locales with an abundance of wind and sunshine. Wind is most cost-effective in the windswept states in the middle of the country—such as Iowa, Oklahoma, Kansas, and Texas. Solar is most cost-effective in the sun-drenched Southwest—states like Nevada, Arizona, and California. Natural gas is still the cheapest option in much of the rest of the country—but keep in mind that the levelized cost does not account for the environmental cost of burning fossil fuels.

A new tool from the Energy Institute of the University of Texas shows the cheapest kind of new power plant by county, accounting for land available to deploy a particular technology. (For instance, the site notes, “it is not likely that one could build a power plant in a national park.”) The map below shows which technologies are most cost-effective without subsidies.

## Mcanxixun Information



It's clear why solar, wind, and natural gas are taking over the country. In light of these trends, some may be asking why we need subsidies at all.

Subsidies account for the costs of air pollution and climate change.

Given the pace of technological progress, it would be fair to ponder whether, left to its own devices, the market would take care of climate change. Low-emissions natural gas is rapidly displacing coal. Solar, wind and battery storage are getting cheaper every day. The power grid is decarbonizing itself, right?

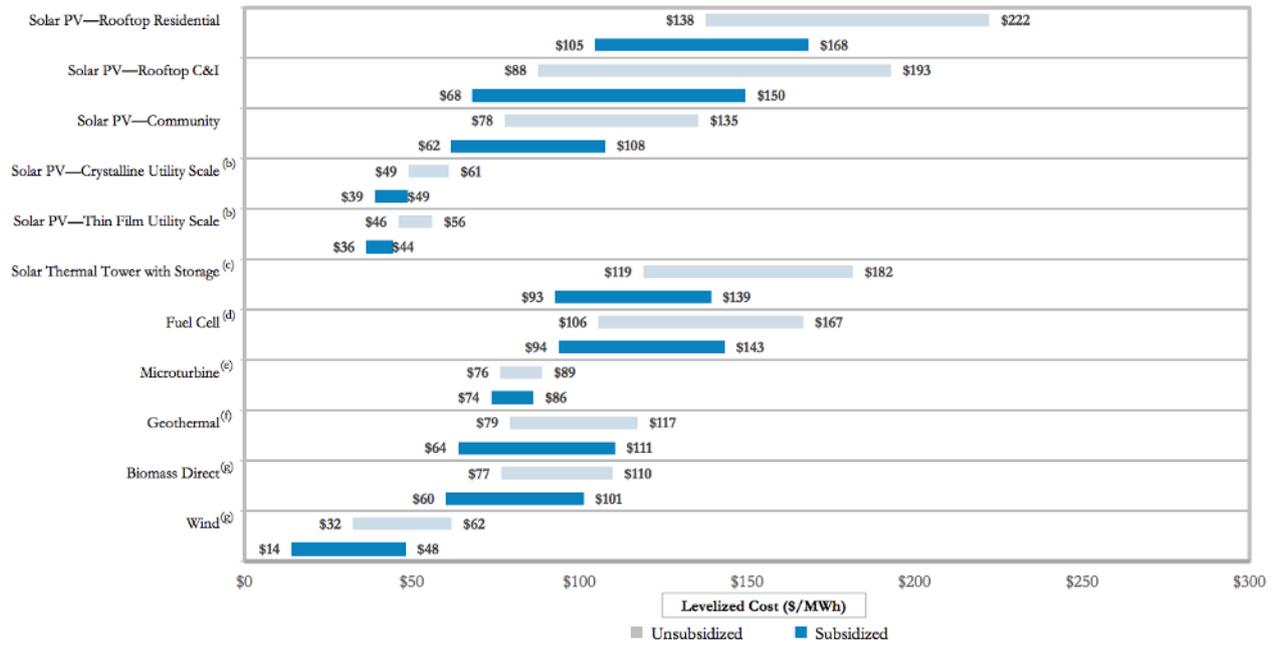
The problem is that averting dangerous climate change demands the rapid transformation of our energy system. That means we can't just build new, low-carbon power plants at the rate of replacement. We also have to shutter existing carbon-intensive power plants. Thus, while natural gas may offer an attractive way to curb emissions in the short-term, a gas-fired plant built today may need to be closed before the end of its operating life if we are to meet our emissions goals.

One remedy is to account for the cost of climate change—make polluters pay for polluting, or offer tax breaks for renewables. These policies can help expedite the transition to clean energy by making zero-carbon power more cost-competitive.

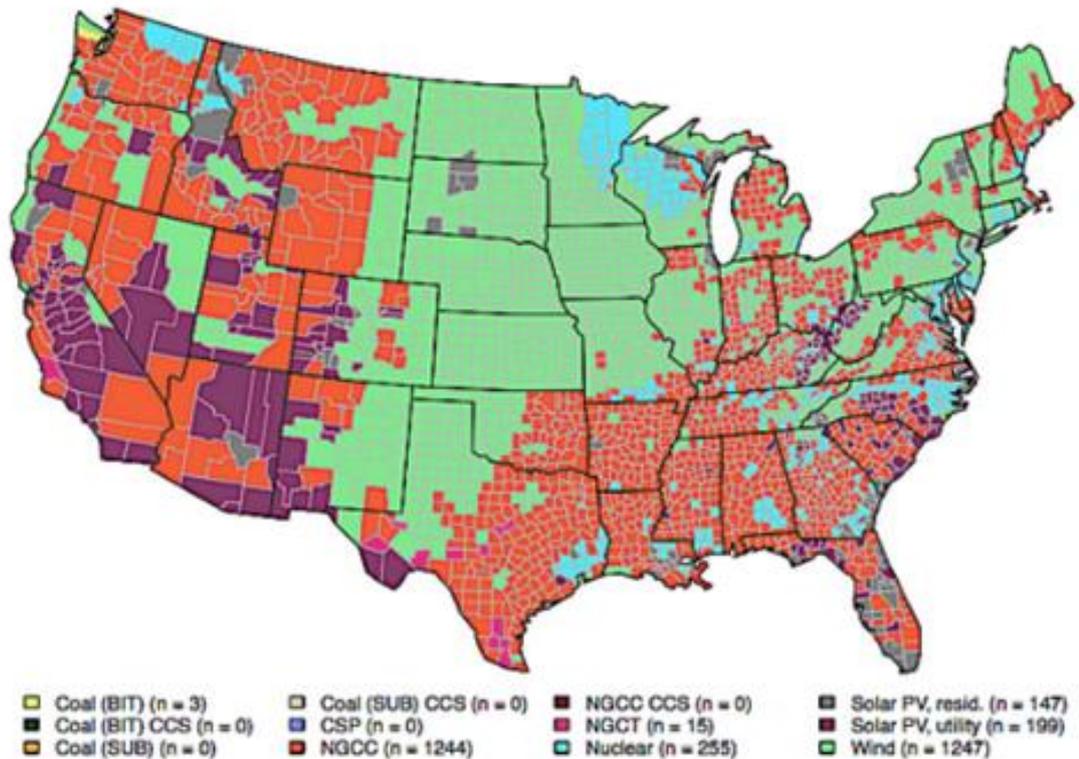
The chart below shows how federal tax credits impact the cost of renewables. The effect is modest, but it is important in helping wind and solar compete with coal and gas in much of the United States. Fossil fuels, it should be said, have benefited from decades of federal support.

### Levelized Cost of Energy—Sensitivity to U.S. Federal Tax Subsidies<sup>(a)</sup>

Given the extension of the Investment Tax Credit (“ITC”) and Production Tax Credit (“PTC”) in December 2015 and resulting subsidy visibility, U.S. federal tax subsidies remain an important component of the economics of Alternative Energy generation technologies (and government incentives are, generally, currently important in all regions)



If you applied a modest fee to carbon pollution—rather than a tax credit for clean energy—that would discourage the construction of new coal- and gas-fired power plants. Wind, solar and nuclear would become the cheapest kind of new power plant across a broader swath of the country, as shown in the map below.



## Mcanxixun Information

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The cost of power, of course, is only half the battle. There is also the matter of intermittency—the fact that wind and solar only generate power when the wind is blowing or the sun is shining.

Solving the intermittency problem

One key finding from the Lazard report is that renewables can't meet the "baseload generation needs of a developed economy for the foreseeable future." For that, grids must continue to turn to other power structures. There are a couple of tools to deal with this, and we'll likely need to use each. These include, but are not limited to:

- Energy storage. Solar panels frequently churn out surplus power during the middle of the day. That surplus power can be stored, for example, in a lithium-ion battery and used later. As the Lazard reports notes, storage costs are dropping fast.
- A national power grid that can carry surplus electricity generated in one part of the country to power-hungry cities in other parts of the country.
- Nuclear power. Nuclear power can provide a baseline level of electricity, but as the Lazard report shows, nuclear remains too costly to be practical in much of the country. However, scientists are developing new kinds of reactors that could prove cheaper and more efficient than today's nuclear plants.

Improved infrastructure (a possibility) and cheaper energy storage (an inevitability) will make wind and solar more attractive. As costs continue to fall, expect another banner year for renewables in 2017.

## 太阳能风能的价格底线在哪里？

在美国大部分地区，可再生能源都比煤炭和天然气便宜。

风能和太阳能连续两年占美国新发电量的三分之一，而天然能和核能占了其余的大部分。

根据投资银行 Lazard 的一份新报告，那是因为现在美国很多地方，风能和太阳能是可用电量最便宜的形式。

分析人士认为，任何地方新的太阳能和风能装置都比一个新的燃煤发电厂更便宜——即使没有补贴。可再生能源的成本持续快速下降。

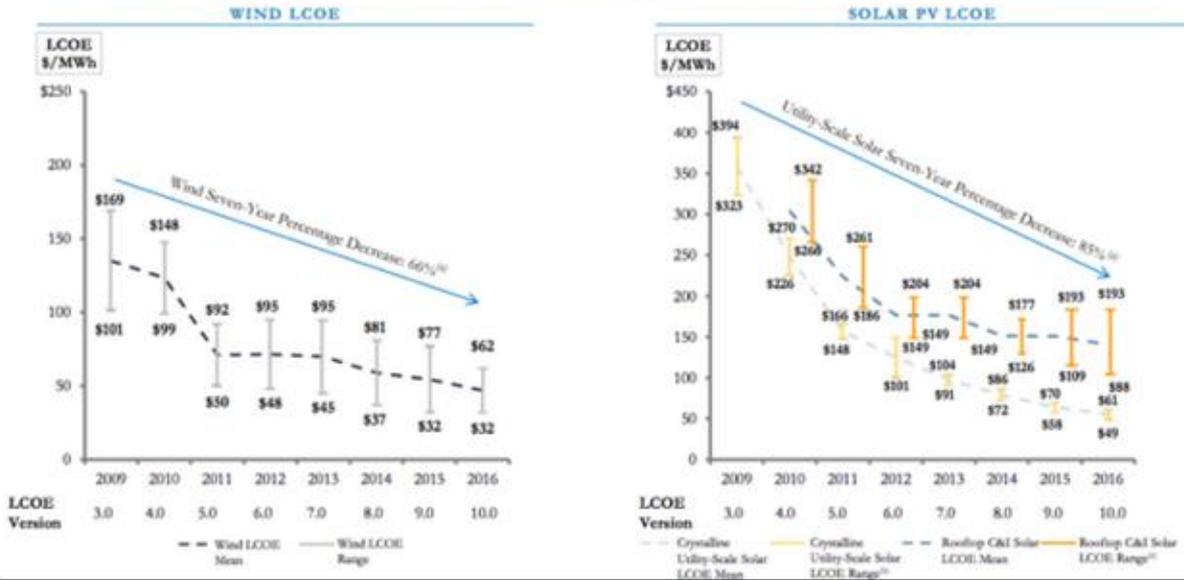
太阳能和风能变得越来越便宜。

因为就在去年，公用事业规模的太阳能成本下降了 10%，而住宅太阳能成本下降了 26%——几年来价格一直下跌。去年离岸风能的成本下降了 22%，尽管还是比陆上风贵。

Lazard 报告仅仅是可再生能源成功故事最新的一部分。自 2009 年以来，太阳能的成本已缩减近一半。风能的成本下降了三分之二。价格的急剧下降让人想起缩减成本的个人电脑。风能尤其是太阳能还没有稳定下来。未来几年，新技术和廉价材料将继续压低成本。

### Unsubsidized Levelized Cost of Energy—Wind/Solar PV (Historical)

Over the last seven years, wind and solar PV have become increasingly cost-competitive with conventional generation technologies, on an unsubsidized basis, in light of material declines in the pricing of system components (e.g., panels, inverters, racking, turbines, etc.), and dramatic improvements in efficiency, among other factors



CREDIT: Lazard

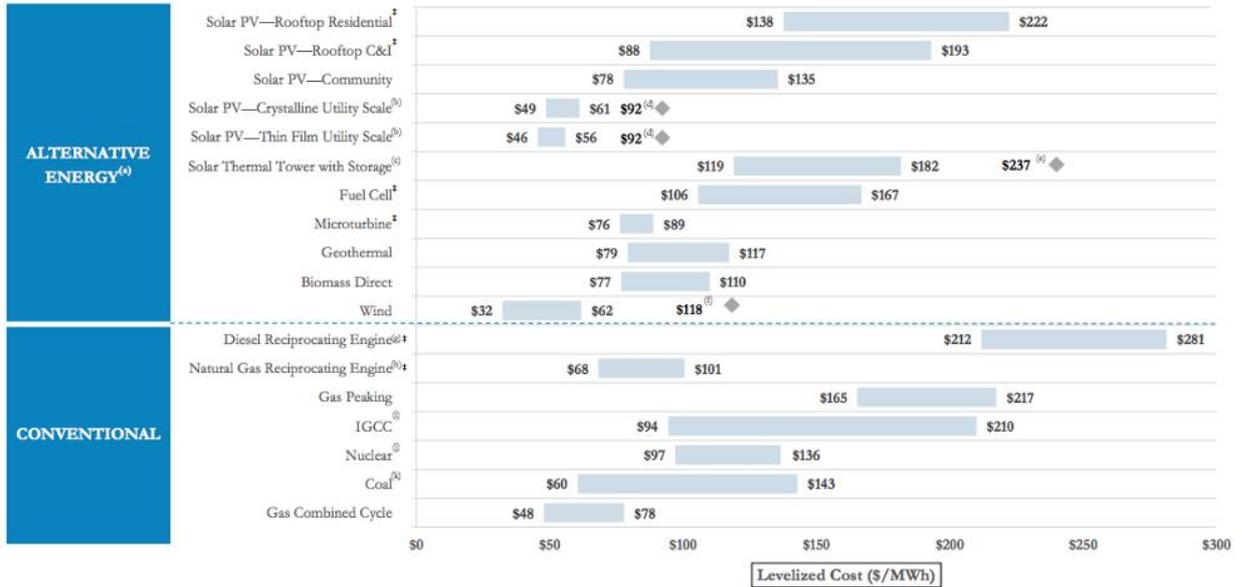
下图的图表显示了不同形式功率每兆瓦时的总成本。Lazard 还表示，用兆瓦时数除以部分寿命成本、石油、劳动力和其他费用。由此，便产生了能源发电成本（LCOE）的范围。

这个数字不包括能源补贴，也不包括环境影响成本。例如，如果一个太阳能电池板有没有补贴的成本是 100 美元，有补贴的是 70 美元，LCOE 仍然是 100 美元。另一方面，如果一个没有无碳社会成本的燃气轮机的成本是 100 美元，社会碳成本之后是 130 美元，那么 LCOE 保持在 100 美元。

（研究人员使用不同的方法来计算发电成本。例如，特朗普的国度团队暗示要改变联邦能源信息局计算可再生能源发电成本使太阳能风能更贵的方式。）

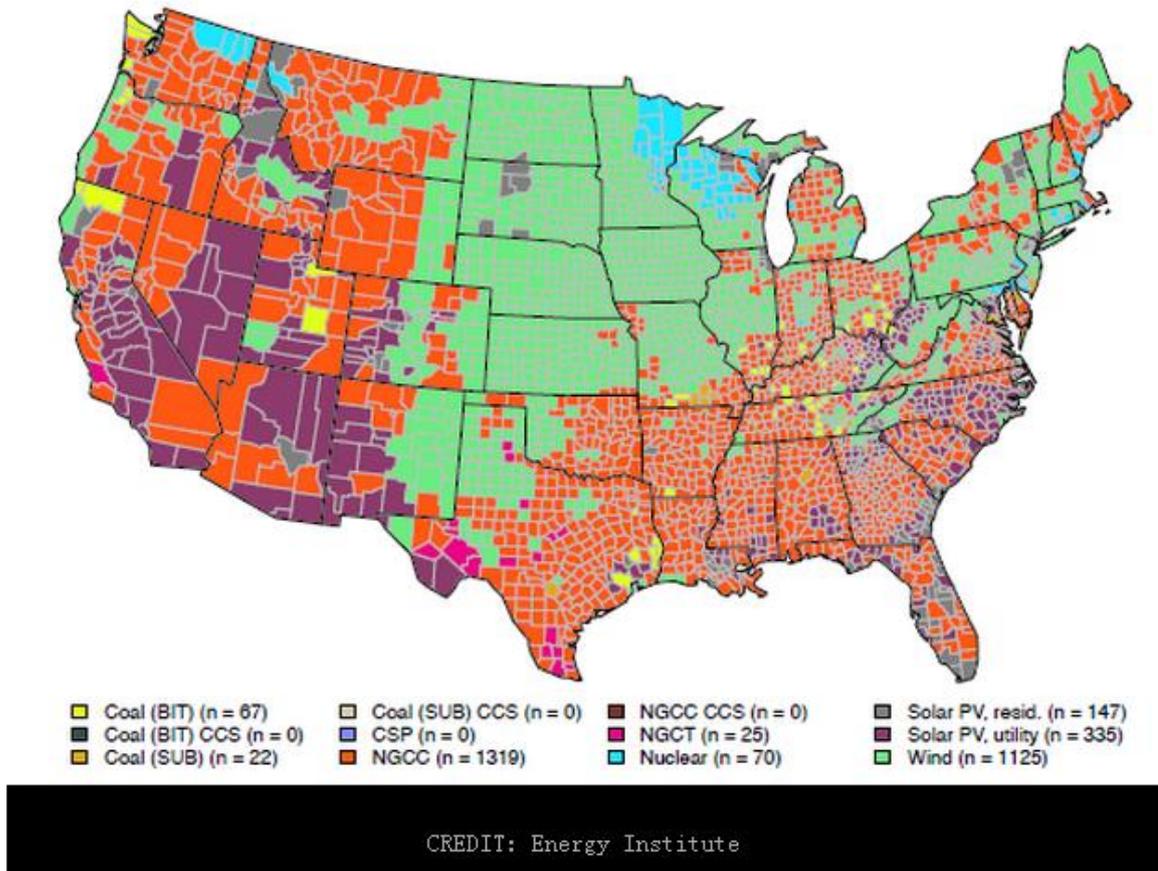
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总的来说，风能和太阳能将在富有风力和阳光的地区建造。在国家中部的迎风地区，风是最具成本效益——比如爱荷华、奥克拉荷马、堪萨斯、德克萨斯。太阳能在太阳普照的西南最具成本效益——如内达华州、亚利桑那州、加利福尼亚。在美国美国地区，天然气仍是最便宜的选择——但记住，平准价格并不算燃烧化石燃料的环境成本。

德克萨斯大学能源研究所的一个新工具显示，一种占县可用土地以部署特定技术最便宜的新能源电厂。（例如，该网站指出：“你在一个国家公园建立一个核电站是不太可能的。”）下图显示了一些最具成本效益的没有补贴的技术。



太阳能、风能和天然气正在接管这个国家的原因是很明显的。根据这些趋势，有些人可能会问我们为什么需要补贴。

补贴算入空气污染和气候变化的成本。

考虑到技术进步的速度，考虑市场是否会应对气候变化，是很公平的。低排放的天然气正在迅速取代煤。太阳能、风能和电池存储越来越便宜了。电网本身就是脱碳的，对吧？

问题是，避免危险的气候变化需要我们的能源系统快速转型。这意味着，我们不能仅仅以替代率建立新的低碳电厂。我们还必须关闭现有的碳密集型电厂。因此，天然气虽然可能会短期提供一个减排的具有吸引力

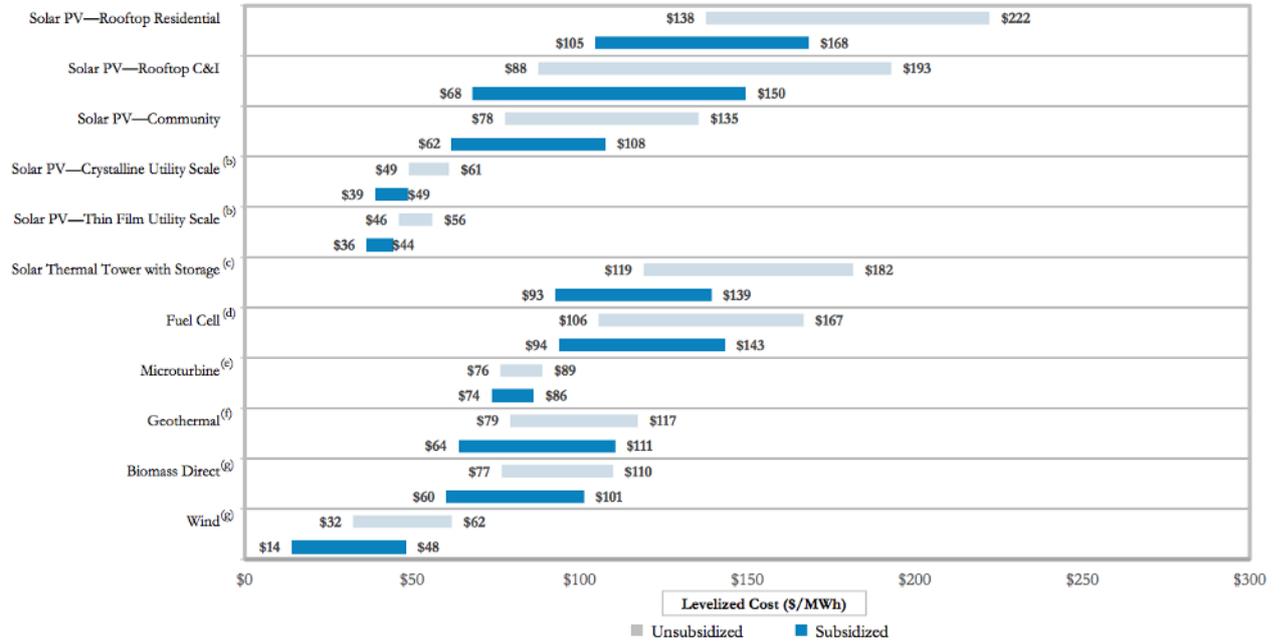
的方式，而且如果我们要达到我们的排放目标的话，现在建立的燃气电厂可能需要在它的运行寿命结束之前就关闭。

一个补救措施是，考虑气候变化的成本——让污染者支付污染费或者为可再生能源提供税收优惠。这些政策使零碳电力更具成本竞争力，可以帮助加速过渡到清洁能源。

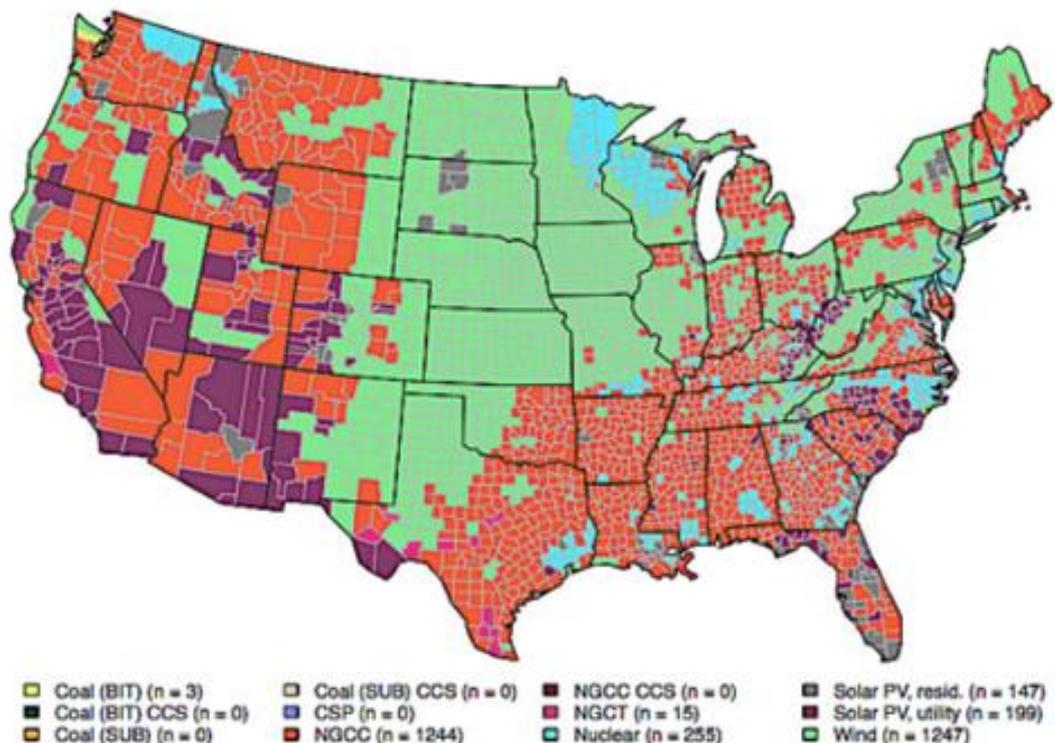
下图显示的是，联邦税收抵免如何影响可再生能源的成本。这种影响是温和的，但是对美国大部分地区太阳能风能与煤炭天然气的竞争是非常重要的。应该说，化石燃料得益于联邦政府几十年的支持。

### Levelized Cost of Energy—Sensitivity to U.S. Federal Tax Subsidies<sup>(a)</sup>

Given the extension of the Investment Tax Credit (“ITC”) and Production Tax Credit (“PTC”) in December 2015 and resulting subsidy visibility, U.S. federal tax subsidies remain an important component of the economics of Alternative Energy generation technologies (and government incentives are, generally, currently important in all regions)



如果你对碳污染采取适当的费用——而不是清洁能源的税收——这将阻止新煤炭以及燃气发电厂的建设。风能、太阳能和核能将成为广泛国家中最便宜的新发电厂，如下图所示。



电能的成本当然只是一半问题。还有间歇性——事实是风能和太阳能只有在有风或有阳光的时候才能发电。

解决间接性问题

Lazard 报告中最重要发现是，可再生能源不能满足“基荷发电会在可预见的未来发展经济。”为了这个，电网必须继续向其他权力结构转变。处理这个问题有几个工具，我们可能需要每一个都用到。这些包括，但是不仅仅局限于这些：

- 储能。太阳能电池板经常在每天的中间消费电量。例如，多余的电量可以储存在锂离子电池中，留着以后使用。正如 Lazard 报告指出的，储存成本下降的很快。
- 国家电网可以带着一些地区的国家剩余电量去电力不够的其他地区。
- 核电。核电可以提供电力的基线水平，但随着公司报告显示，核电成本太高。然而，科学家们正在开发

新的反应堆，比现在的核电站更有效率，提供的电力更便宜。

改善基础设施（可能性）和更便宜的能源储存（必然性）将使风能和太阳能更具吸引力。随着成本的不断下降，预计 2017 年是可再生能源的又一标志。

## India exceeded 9GW solar by end of 2016 - MNRE

India reached 9,012MW of solar deployment as of 31 December 2016, according to new data from the Ministry of New and Renewable Energy (MNRE).

The figures were released in an agenda note ahead of a meeting between state principal secretaries and renewable energy nodal agencies this month in New Delhi.

The top states with more than 500MW installed on this date were:

Tamil Nadu - 1,591

Rajasthan - 1,318

Gujarat - 1,159

Andhra Pradesh - 980

Telangana - 973

Madhya Pradesh - 840

Punjab - 545

MNRE figures also show that out of a target of 12GW in 2016/17 (year end 31 March), just 2,250MW had been commissioned up to 31 December 2016.

However, consultancy firm Bridge to India reported that India surpassed 10GW solar installations in November last year, while Mercom Capital Group put the figure at 9,018MW in mid-December 2016.

The ministry also revealed individual state solar Renewable Purchase Obligation (RPO) compliance data:

## Mcanxixun Information

### Solar Power Capacity Deficit States as per MoP RPO Trajectory for 2016-17

S. No.	State	(Capacity in MW)		
		Solar Capacity Required in MW to fulfill Solar RPO	Solar Capacity available as on 31.12.2016	Deficit in solar capacity
1	Arunachal Pradesh	13.31	0.27	13.04
2	Assam	112.64	11.18	101.46
3	Bihar	255.06	95.91	159.15
4	Chhattisgarh	425.69	135.19	290.50
5	Delhi	482.49	38.78	443.71
6	Goa	67.34	0.05	67.29
7	Gujarat	1548.74	1158.50	390.24
8	Haryana	772.33	53.27	719.06
9	Himachal Pradesh	64.45	0.33	64.12
10	Jammu & Kashmir	95.09	1.00	94.09
11	Jharkhand	399.69	17.51	382.18
12	Karnataka	961.82	340.08	621.74
13	Kerala	264.88	15.86	249.02
14	Madhya Pradesh	979.97	840.35	139.62
15	Maharashtra	2253.33	430.46	1822.87
16	Manipur	9.35	0.00	9.35
17	Mizoram	7.90	0.10	7.80
18	Meghalaya	17.57	0.00	17.57
19	Nagaland	8.00	0.50	7.50
20	Odisha	342.11	77.64	264.47
21	Punjab	667.92	571.20	96.72
22	Sikkim	4.52	0.00	4.52
23	Tripura	18.42	5.00	13.42
24	Uttarakhand	165.32	45.10	120.22
25	Uttar Pradesh	1438.02	239.26	1198.76
26	West Bengal	772.80	23.07	749.73
27	Chandigarh	15.31	6.81	8.50
28	Daman & Diu	44.36	4.00	40.36
29	Dadar & Nagar Haveli	118.52	0.00	118.52
30	Puducherry	59.10	0.03	59.07
	<b>Total</b>	<b>12386.06</b>	<b>4111.44</b>	<b>8274.62</b>

Indian state solar RPO compliance 2016/17. Credit: MNRE

As of 31 December 2016, India had also reached 28,665MW of wind energy capacity, led by Tamil Nadu (7,694MW), Maharashtra (4,666MW), Gujarat (4,442MW) and Rajasthan (4217MW).

**MNRE: 印度太阳能市场于 2016 年底超过 9GW**

## Solar Power Capacity Deficit States as per MoP RPO Trajectory for 2016-17

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	<b>Total</b>	<b>12386.06</b>	<b>4111.44</b>	<b>8274.62</b>

印度各州邦太阳能 RPO2016/17 年度完成状况。图片来源：MNRE

据印度新能源与可再生能源部(MNRE)称，印度市场的太阳能安装量在 2016 年 12 月 31 日时已达到 9.012GW。

这一数据是各州领导人与可再生能源产业主要机构在印度新德里召开会议前，通过议程说明公布的。

## Mcanxixun Information

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在去年年底安装量超过 500MW 的各州状况如下：

泰米尔纳德邦：1,591MW

拉贾斯坦邦：1,318MW

古吉拉特：1,159MW

安德拉邦：980MW

特伦甘纳邦：973MW

中央邦：840MW

旁遮普：545MW

MNRE 的数据同时还显示出，在 2016/17 年度(年度截止至 3 月 31 日)的 12GW 安装量中，仅有 2.25GW 在 2016 年 12 月 31 日前完成调试运行。

但是，咨询公司 Bridge to India 表示，印度在去年十一月既已完成了 10GW 的太阳能累计安装量，而 Mercom Capital Group 的数据显示，该国市场在去年十二月中旬既已达到了 9.018GW 的累计安装量。

MNRE 同时还公布了每个州邦的太阳能可再生能源购买义务(RPO)完成状况(详见配图)。

截止至 2016 年 12 月 31 日，印度已完成 28.665GW 风能累计安装量，排名靠前的州邦分别为泰米尔纳德邦(7,694MW)、马哈拉施特拉邦(4,666MW)、古吉拉特邦(4,442MW)和拉贾斯坦邦(4217MW)。

## **ReneSola awarded 13MW portfolio of PV projects in Poland's first solar auction**

Solar project developer ReneSola announced Friday that it has won 13 solar projects in southern Poland — each with an installed capacity of 1MW.

These 13 projects are eligible for a guaranteed tariff of PLN 408.8/MW, which is the highest in the auction. The installations are all expected to be completed and connected to the grid by December 2017. Electricity produced by the projects will be sold to a local utility under a 15-year purchase agreement.

The Energy Regulation Office in Poland held the country's inaugural solar power auction on December 30 2016. In this first auction for small-scale installations, 76 new solar projects received subsidies, equivalent to about 70MW of capacity.

Xianshou Li, chairman and chief executive officer of ReneSola, said: "We are excited to have been awarded the utility projects in Poland as they represent an addition to the Company's diversified portfolio of solar projects across the globe. Our team has the experience and expertise to deliver reliable, cost-competitive distributed power to serve Poland's growing energy demand, and we are proud to have the opportunity to accelerate the country's transition to a robust clean energy economy. We look forward to leveraging the project win to further support solar deployment in Poland and other emerging markets."

### **昱辉阳光在波兰首个太阳能招标中获 13MW 光伏项目**

太阳能项目开发商昱辉阳光在周五宣布中标波兰南部 13 座太阳能项目，每个项目额定安装量为 1MW。

这十三个项目可获得 PLN 408.8/MW(约合 106.97 美元/MW)的电价保证，是此次招标中的最高价格。

相关安装项目预计将在 2017 年 12 月建成联网。所产生的电力将通过一份为期 15 年的购电合同出售给当地电力企业。

波兰能源管理办公室在 2016 年 12 月 30 日举行了该国首次太阳能招标。此次招标面向小型安装项目，工由 76 个新建太阳能项目获得补贴，总量为 70MW。

昱辉阳光总裁兼首席执行官李仙寿先生表示：“我们十分高兴能在波兰获得公共事业项目，这也为公司的全球太阳能项目多样化组合增添了新的内容。我们的团队具有丰富的经验和专业技术完成并交付可靠、具有成本竞争力的分布式光伏，以满足波兰市场不断增长的能源需求，同时，我们也十分自豪能够有机会加速该国向可靠的清洁能源经济转型过程。我们十分期待能够通过此次项目中标，进一步支持波兰市场和其他新兴市场对太阳能的应用。”

## SunEdison gets greenlight to close US\$150 million sale to GCL-Poly

Bankrupt renewables firm SunEdison has finally got the green light to proceed with the US\$150 million sale of its FBR (Fluidised Bed Reactor) technology polysilicon assets to GCL-Poly Energy Holding after a deal was struck with company spinoff, SunEdison Semiconductor.

The 2014 spinoff had objected to the sale, which had received US bankruptcy court approval in October. GCL-Poly initially placed its bid for the assets, primarily held by Korean-based production plant SMP, in August, with a US\$50 million deposit.

SunEdison Semiconductor had been arguing that it had not consented to the transfer of intellectual property licences as part of the deal with the leading polysilicon and solar wafer producer, rendering the transaction unable to close.

In resolution, “the mutual consent” for the licences was given, according to court documents, enabling the licences to be transferred for GCL and for the deal to subsequently close, if granted final approval by the bankruptcy court. In addition, the settlement extended the Transition Services Agreement between Semi and SunEdison and paid for Semi’s “administrative expenses and general unsecured non-priority claims” to the sum of US\$2,679,554. Semi also received a general unsecured non-priority claim in the aggregate amount of US\$16.5 million.

The US\$150 million sale to GCL will be cleared to transpire if approved by the US bankruptcy court in a hearing on 24 January.

## SunEdison 获准完成向 GCL 进行 1.5 亿美元资产出售

尽管旗下分拆企业 SunEdison Semiconductor 的相关交易造成了一定阻碍，已申请破产的可再生能源公司 SunEdison 日前终于获准，启动向协鑫能源出售 1.5 亿美元流化床反应(FBR)多晶硅技术资产的流程。

尽管相关出售交易已在 2016 年 10 月获得美国破产法庭批准(点击查看 PV-Tech 相关报道)，但公司在 2014 年进行的分拆企业对相关出售造成了阻碍。协鑫能源早在八月份即对主要位于韩国的生产基地 SMP 进行资产竞标(点击查看 PV-Tech 相关报道)，并缴纳了 5000 万美元的抵押金。

SunEdison Semiconductor 争辩道，其并未同意将知识产权许可证作为交易内容的一部分移交至该领先多晶硅及太阳能硅片制造商，这就意味着相关交易无法完成。

根据法庭文件显示，在决议中，许可证的处置获得了“双方同意”，因此如果获得破产法庭的而最终批准，许可证将被移交至协鑫能源，从而完成相关交易。此外，此次的决议还涵盖了 Semi 与 SunEdison 之间的过度服务协议，支付给 Semi 267.9554 万美元的“行政成本和一般性无担保非优先债权”。Semi 同时还获得了总金额为 1650 万美元的一般性无担保非优先债权。

如果在本月 24 日举行的听证会上获得美国破产法院的最终批准，与协鑫能源之间的 1.5 亿美元资产出售交易将可以启动。

# Spruce closes US\$105.4 million in round of debt financing

Spruce Finance, a provider of consumer financing for residential solar and home efficiency improvements, has closed a US\$105.4 million round of debt financing with Investec and Silicon Valley Bank (SVB) as the lead arrangers.

The loan was financed against a Spruce portfolio of residential solar systems. Spruce will use the proceeds to finance additional systems in states around the US.

Darren Thompson, chief financial officer at Spruce, said: “This is a follow-on deal to the US\$120 million facility that Investec led for us last May. We’re pleased to be working with them again and with SVB on a second transaction that has allowed us to raise capital on attractive terms.

“As the residential solar financing markets evolve, the syndicated loan market has established itself as the ‘go-to’ market option for quality sponsors such as Spruce.”

Bret Turner, managing director of the energy and resource innovation practice at Silicon Valley Bank, said: “We’re excited to provide this financing alongside Investec to Spruce as it aims to scale residential solar and home efficiency improvements. Spruce is a longstanding client of SVB’s and we look forward to supporting its continued success.”

## Spruce 通过债务融资获得 1.054 亿美元

针对住宅太阳能和家庭能源效率改善的消费者融资供应商 Spruce 金融公司日前通过债务融资获得 1.054 亿美元资金，融资由 Investec 和硅谷银行(SVB)领投。

相关借款以 Spruce 旗下住宅太阳能系统投资组合为抵押资产。Spruce 公司计划将该收益用于资助各州内的新增住宅太阳能系统。

Spruce 公司首席财务官达伦·汤普森(Darren Thompson)表示：“这一投资是去年五月 Investec 领投的公司旗下 1.2 亿美元系统的后续投资。我们十分高兴能与其再次进行合作，并且与 SVB 进行第二次合作，使得我们能够以极具吸引力的条款融得资金。

“随着住在太阳能融资市场的不断发展，银团贷款市场已然将自身打造成为 Spruce 金融公司等符合要求的抵押商在金融市场中的首选。”

SVB 能源与资源创新部门总监布雷特·特纳(Bret Turner)表示：“我们十分高兴能够与 Investec 共同为 Spruce 公司提供资金，因为 Spruce 金融公司的目标是扩大住宅太阳能的应用并进行家庭能源效率改善。Spruce 公司是 SVB 的长期客户，我们十分期待能够在其获得持续成功的过程中提供支持。”

# Singyes Solar wins EPC contract for 100MW solar plant in Uzbekistan

China-based EPC and project developer China Singyes Solar Technologies Holdings has won an EPC contract for a 100MW solar plant in Uzbekistan on behalf of state-owned firm Uzbekenergo.

Singyes won the contract to build the US\$147 million plant in the Samarkand Province via a tender process.

A Hong Kong Stock Exchange filing from Singyes said the project will mostly be financed by the Asian Development Bank (ADB). PV Tech reported in 2013 that ADB would provide US\$100 million financing.

## 兴业太阳能获乌兹别克斯坦 100MW 太阳能项目 EPC 合约

中国 EPC 企业、项目开发商兴业太阳能技术控股有限公司日前作为乌兹别克斯坦国有企业 Uzbekenergo 的代表，获得乌兹别克斯坦境内 100MW 太阳能项目的 EPC 合约。

兴业太阳能通过招标流程获得将在撒马尔罕省(Samarkand Province)建造的价值 1.47 亿美元项目的合约。

兴业太阳能向香港证交所提交的一份文件中表示，该项目将极有可能通过亚洲开发银行(ADB)进行融资。PV-Tech 曾在 2013 年披露 ADB 将在相关领域内提供 1 亿美元资金。

## Natural Gas (天然气)

### Egypt to boost natural gas grid by 2017-minister

Egypt's production of natural gas is expected to witness a leap in 2017 as pursuant to state's plans for adding production of discovered fields to the national grid,Oil Minister stated Saturday.

Tarek El-Molla said that the first phase of Zohr gas field is set to add more than one billion cubic feet of gas daily before the end of 2017.

The ministry targets covering local market's needs of natural gas through adding the production of the newly-discovered fields to the national grid, the minister clarified.

Speaking about the future of Egyptian petroleum sector, El-Molla added that around 500 million ft<sup>3</sup>/day of gas would be added to the national grid before the middle of 2017 from North Alexandria filed.

Egypt's current production of natural gas is estimated at around 4.4 billion ft<sup>3</sup>/day, the minister noted.

The total amount of gas produced from Noras field reached around 870 million ft<sup>3</sup>/day, the minister pointed out, adding that this amount is expected to increase after adding new wells to the production, accordingly, the amounts of imported Liquefied Natural Gas (LNG)would be lowered.

Moreover, Minister El-Molla noted that the new gas discoveries at the Mediterranean Sea encouraged global firms to explore oil and gas in concession areas neighboring to these discoveries.

### 埃及将在 2017 年前推动天然气发电

石油部长于周六表示，埃及的天然气生产预计将在 2017 年出现跃升，根据该国增加发现领域在国家电网中的生长的计划所显示。

Tarek El-Molla 表示，Zohr 气田的第一阶段将于 2017 年末之前每天增加超过 10 万亿立方英尺的天然气。

该部长澄清说，该部长将通过向国家电网增加新发现井田的生产来满足当地市场对天然气的需求量。

谈到埃及石油行业的未来时，El-Molla 补充称，大约 5 亿立方英尺/天的天然气将在 2017 年中旬从北亚历山大港增加到国家电网中。

## Mcanxixun Information

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埃及目前的天然气产量估计为 44 亿立方英尺/天，该部长称。

Noras 井田生产的天然气的问题达到了大约 8.7 亿立方英尺/天，该部长指出，并补充称，该数量预计会在增加了新的井田之后有所增加，因此，进口液化天然气（LNG）的数量有可能会减少。

此外，El-Molla 指出，在地中海新发现的天然气鼓励全球企业在这些发现的井田附近的特许地区开采石油和天然气。

## Japanese utilities pursue LNG partnership with European peers

Tepco and Chubu Electric eye joint procurement to cut fuel costs

Tokyo Electric Power Co. Holdings and Chubu Electric Power are in talks with about 10 European energy companies over possible joint procurement of liquefied natural gas, according to sources.

The Japanese utility companies hope that joint procurement will allow them to secure better fuel prices and lower the operating costs of their thermal power plants. Such cooperation would also make it possible for companies to provide each other with LNG stocks in times of shortages.

The two companies merged their fuel operations in July under Jera, a 50-50 joint venture. By globalizing the combined unit, Tepco and Chubu Electric hope to boost its profitability. They also plan to sell LNG outside Japan.

Jera is one of the world's largest LNG traders, shifting 40 million tons a year. It first contacted Centrica, the largest gas provider in the U.K., which operates under the British Gas brand. Others, including Electricite de France and German and Dutch utility companies, are also in talks with Jera.

European utility companies import natural gas via pipelines and also buy LNG from Asia and elsewhere. Jera hopes to jointly procure LNG from those exporters in anticipation of lower prices for larger amounts.

Jera also wants to sell LNG it extracts in the U.S. to markets in Europe and elsewhere. This move is aimed at offsetting the expected fall in domestic LNG demand as Japan's electricity demand shrinks and more nuclear power plants are put back online.

More efficient procurement should lead to lower energy prices, which in turn would benefit consumers in the form of cheaper electricity bills. For the European utilities, teaming up with Jera makes sense because the company has a strong presence in negotiations with gas producers.

But whether the plan actually comes to fruition depends on movements in the LNG market. If demand increases due to, say, economic growth in emerging countries, the mooted tie-up may not be as effective in negotiating prices with gas producers as expected.

## 日本公用事业寻求与欧洲同行进行液化天然气合作

Tepco 和 Chubu 电动眼睛联合采购以降低燃料成本

据悉，东京电力公司和 Chubu 电力公司正在与大约 10 家欧洲能源公司商谈可能的液化天然气联合采购事宜。

日本公用事业公司希望，联合采购能够令他们确保更好的燃料价格，并且降低他们火力发电厂的运营成本。这样的合作还将有可能为公司在短缺时通过 LNG 储存为彼此供应。

这两家公司在 7 月根据 Jera 合并了他们的燃料业务——50-50 的合资企业，通过全球化该合并企业，Tepco 和 Chubu 电力公司希望提高期盈利能力。他们还计划在日本以外的地区出售 LNG。

Jera 是世界上最大的 LNG 贸易商之一，每年转移 4000 万吨。其首先联系了英国最大的天然气供应商 Centrica，其以英国天然气品牌进行经营。其他公司，包括法国和德国以及荷兰公用事业公司，也都与 Jera 进行着谈判。

欧洲公用事业公司通过管道进口天然气，并且也从亚洲及其他地区购买 LNG。Jera 希望从这些出口商处购买 LNG，期望降低大批量的价值。

Jera 也希望将其在美国开采的 LNG 出售到欧洲及其他地区的市场。这个举措旨在抵消国内 LNG 需求的下降，因为日本的电力需求减少，并且有更多的核电站恢复运营。

更有效的采购应该产生较低的能源价格，这反过来可能会以更便宜的电费形式令消费者受益。对于欧洲公用事业公司，与 Jera 合作具有一定的意义，因为该在与天然气生产商谈判方面具有强势地位。

但是无论该计划实际上是否能够实现取决于 LNG 市场的动向。如果需求由于，例如新兴国家经济增长而有所增加，那么该提出的合作在与天然气供应商商谈价格方面可能就不会达到的预期效果。

## All eyes on imported gas to meet energy requirements

Despite extensive drilling by oil and gas E&P companies that resulted in over 90 new discoveries in just three years, the much-talked about IP, TAPI and LNG projects are considered the thirst-quenching streams for the energy starved nation.

Now with the concerted efforts of the present government, the decades old projects-Iran-Pakistan (IP), Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipelines and import of Liquefied Natural Gas (LNG) – are almost in practical phase. Last year has already seen LNG's import, while work on TAPI began in December, 2015.

Similarly, the IP project will hopefully commence this year after amendment in the gas sale-purchase agreement with Iran.

Critics believe it or not, there is light at the end of the tunnel as setting sun of 2017 will see end to this crippling legacy of the previous years when energy shortages started to hit the country slowly and steadily.

In Pakistan, the gas supply-demand gap has reached 4 Billion Cubic Feet per Day (BCFD) as total gas demand of the country is 8 BCFD against total supply of 4 BCFD. Needless to say, in winter, the demand rapidly increases.

“The country has no option other than to import gas whether it is LNG or through IP and TAPI pipeline projects as its existing reserves are depleting and there is no major find since long,” Secretary Ministry of Petroleum and Natural Resources said while addressing a seminar titled “Transparency in public sector: An appraisal.”

The present government, he said, was eyeing on imported gas besides accelerating local oil and gas exploration and production (E&P) activities to meet the ever-growing energy needs in the country.

Commenting on IP project, official sources in the Ministry revealed that the government was in the process of negotiating amendments in the Gas Sale Purchase Agreement (GSPA) with Iran for early implementation of the much-delayed project, which was conceived in mid-1950s.

“A draft amendment has been shared with Iran, and it has agreed to negotiate on it along with some other amendments in the GSPA, following which construction work on the pipeline is expected to commence soon in collaboration with China,” the sources aware of the project updates said.

Sharing details of the project, the sources said Inter-Governmental Framework Declaration was signed between the two countries on May 24, 2009, while GSPA had been agreed on June 2009.

Subsequently, Pakistan issued sovereign guarantee on May 28, 2010. The project consultant was appointed on April 11, 2011, while the design, feasibility, route survey and other formalities of the project were completed on September 8, 2012.

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The 56-inch diameter pipeline will start from South Pars gas field in Iran and end at Nawabshah, covering a distance of around 1,931 km with 1,150 km portion in Iran and 781 km in Pakistan. The 750 mmcf/d gas flow in the IP pipeline is projected to help generate around 4,000 MW electricity ALSO, along with creating job opportunities in backward areas of Balochistan and Sindh, the sources said.

Commenting on TAPI project, the sources said Prime Minister Nawaz Sharif along with other regional leaders performed the groundbreaking of the Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline project in Turkmenistan in December last.

The groundbreaking ceremony took place near the city of Mary in the southeastern part of the central Asian country, close to the giant Galkynysh gas field which is meant to provide gas for the 1,814-kilometre (1,127-mile) link.

The \$10 billion pipeline, from Turkmenistan via Herat, Kandhar, Chaman, Quetta and Dera Gazi Khan to Multan and onwards to India, is expected to be operational by 2019.

A state-owned company of Turkmenistan is the consortium for the TAPI and overseeing coordination in the construction, financing, ownership and operation of the project.

As per the agreement, it was prerequisite for Pakistan, India and Afghanistan to have five per cent shares each in the project. Turkmengaz, leader of the consortium, would have 51 per cent shares, with the rest marked for partner countries. It is pertinent to mention here that Pakistan is already working on laying a 42-inch diameter 700-kilometre gas pipeline from Gwadar to Nawabshah, and a 1122-kilometre north-south (Karchi-Lahore) gas pipeline that can be used for supply the both regassified LNG and imported gas under IP and TAPI.

On LNG import, the official sources said this year Pakistan signed a 15 year agreement with Qatar to import up to 3.75 million tonnes of LNG a year, which was being highly appreciated by the business community as the previous governments had been reluctant to take any practical step in this regard.

After arrival of LNG, industries, gas-based power units, CNG sector, fertilizer plants and especially domestic consumers started receiving uninterrupted supply, which is not less than of any miracle by any mean.

A LNG-terminal is already operational at the Port Qasim, while two more each at Gwadar and Karachi are also being set up on priority basis to handle increased cargoes of the imported commodity for onward injection in the transmission network of gas companies – Sui Northern Gas Pipeline Limited and Sui Southern Gas Company Limited.

With the present government firmly resolved and making all-out efforts to bring these projects to maximum fruition, the sources expressed high hopes that gas shortfall problem would be solved to maximum extent within remaining period of the government.

## 全靠进口天然气满足能源需求

尽管过去短短三年内，石油和天然气勘探开发公司新挖掘了 90 个钻井，谈论最多的 IP、TAPI 和 LNG 项目是能源匮乏的国家最渴望的。

现在，在政府的共同努力下，几十年的老项目伊朗-巴基斯坦（IP）、土库曼斯坦-阿富汗-印度（TAPI）天然气管道和液化天然气（LNG）进口几乎都在实践阶段。去年已经见证了 LNG 的进口，而对 TAPI 的工作开始于 2015 年 12 月。

同样，IP 项目有望在今年与伊朗修改天然气销售买卖协议。

不管评论者信不信，在隧道的尽头有一道光芒，因为，当能源短缺开始缓慢而稳定地袭击全国时，2017 年将终结过去几年这种遗留的严重问题。

在巴基斯坦，天然气供需缺口已达每天 40 亿立方英尺（BCFD），因为该国的天然气总需求是 80 亿立方英尺，总供给是 40 亿立方英尺。不用说，冬季的需求迅速增加。

“国家除了进口天然气，没有其他选择，无论是 LNG 还是通过 IP 和 TAPI 管道现有的储备消耗，长期以来都没有重大发现。”石油和自然资源部秘书在一个题为“公共部门的透明度：评价（Transparency in public sector: An appraisal）”研讨会上表示。

他说，现任政府正着眼于进口气体，并加快当地石油和天然气勘探和生产（E&P）活动，来满足国家不断增长的能源需求。

谈到 IP 项目，卫生部官方消息显示，政府在 1950 年与伊朗天然气购销协议修订（GSPA）过程的谈判中延期的项目将早日实施。

了解该项目的人员表示：“修正案已于伊朗共享，而且它已同意在 GSPA 与一些修正案进行谈判，管道的建设工作预计将很快与中国展开合作。”

关于共享项目的细节，该人士表示，两国于 2009 年 5 月 24 日签署政府间的框架宣言，而 GSPA 签署于 2009 年 6 月。

随后，巴基斯坦于 2010 年 5 月 28 日发布主权担保。2011 年 4 月 11 日任命项目顾问，该项目的设计、可行性、路线调查等手续于 2012 年 9 月 8 日完成。

该人士表示，这个 56 英寸直径的管道将从伊朗的南帕尔斯气田开始到纳瓦布沙阿结束，覆盖了伊朗约 1931km 以及 1150km，巴基斯坦 781km 公里。IP 管道 750 立方英尺天然气流量预计将有助于产生约 4000MW 的电力，为俾路支省和信德省落后地区创建就业机会。

谈到 TAPI 项目时，该人士称，Nawaz Sharif 总理和其他地区的领导人在图尔库斯曼进行了 TAPI 天然气管道项目的奠基仪式。

奠基仪式在中亚国家中南部的玛丽市附近举行，靠近将为 1814km（1127 英里）以外的管道提供天然气的 Galkynysh 大油田。

从土库曼斯坦经赫拉特、坎大哈、恰曼、奎达和寺嘎子汗到木尔坦再到印度的 100 亿美元的管道，预计 2019 年底投入使用。

图尔曼斯坦的一个国有企业是 TAPI 项目的财团，而且监督建设、在该项目的融资、建设、所有权、和运营上监督协调。

协议的前提条件是，巴基斯坦、印度和阿富汗在每个项目中拥有 5% 的股份。该财团的领导人 Turkmengaz 会有 51% 的股份，剩下的股份分给各个国家。在这里适当提一下巴基斯坦正在铺设的一条直径 42 英寸、700 公里长、从瓜达尔到纳瓦布沙阿的天然气管道，以及一条 1122km 南北向（卡尔齐到拉合尔）的天然气管道，可用于供应经由 IP 和 TAPI 进口液化天然气和天然气。

关于液化天然气进口，官方消息称，今年巴基斯坦与卡塔尔签署了一项 15 年的协议，每年进口的 LNG 高达 375 万吨，这是商业界的最高赞誉，因为以前的政府在这方面不愿意采取任何步骤。

LNG 到来之后，产业、天然气发电机组、天然气行业、化肥厂尤其是国内消费者开始接受不间断的供应，这是不低于任何方面的奇迹。

加西姆港的 LNG 终端已经开始运作，而瓜达尔和卡拉奇也正在优先的基础上开始处理货物进口的增加，为了在天然气公司传输网络（绥北天然气管道有限公司和绥南燃气有限公司）上开始进入轨道。

目前政府正在全力解决并推动这些工程取得最大成效，有关人士表达了他们的高期望，希望政府在余下时间最大限度地解决煤气短缺问题。

## Minerals (矿产)

### World's Second Largest Zinc Producer Will Go Solar

Hindustan Zinc Limited will join scores of Indian companies ready to set up solar power projects to meet their captive needs.

The world's second largest zinc producer — Hindustan Zinc Limited, part of the Vedanta Group — will set up 115 megawatts of solar power capacity for captive consumption.

According to company officials, the capacity will be set up in two phases — 15 megawatts and 100 megawatts. In the first phase, 10 megawatts of capacity will be set up near a smelter facility while a 5 megawatts project will be set up close to a zinc mine.

The 100 megawatts capacity will also be used for company's own power needs but the officials reportedly did not disclose the location of the project.

The company reported that the total investment needed for the 115 megawatts capacity is around Rs 630 crore (\$93 million) which puts the per megawatt cost at just under Rs 5.5 crore (\$810,000). This capital cost matches the one assumed by the Central Electricity Regulatory Commission to determine the solar power feed-in in tariff for the current financial year.

These projects planned by Hindustan Zinc will perhaps be among the cheapest large-scale solar power projects in India.

By setting up captive solar power projects the company will fix its power costs for the entire project age, around 20-25 years, thus making significant financial savings. Additionally, the projects will also help the company meet its solar power purchase obligation.

### 世界第二大锌生产商将走向太阳能

印度斯坦锌业有限公司 (Hindustan Zinc Limited) 将加入印度公司, 准备建立太阳能发电项目来满足他们的目前需要。

世界上第二大锌生产商印度锌有限公司是韦丹塔集团的一部分, 将建立 115 兆瓦的太阳能发电能力, 来满足消费需求。

据公司官员称, 产能将分为两个阶段- 15 兆瓦和 100 兆瓦。在第一阶段, 10 兆瓦的容量设施在冶炼厂附近建立, 而一个 5 兆瓦的项目将建立在接近锌矿的地方。

100 兆瓦的容量也将用于公司自身的电力需求, 但官方报告没有透露该项目的位置。

该公司报告说, 115 兆瓦容量需要总投资约 63 亿卢比 (9300 万美元), 每兆瓦成本在 5500 万卢比 (810000 美元)。这项资本成本与中央电力监管委员会所承担的一项确定本财政年度的太阳能供应税有关。

由印度锌公司计划的这些项目, 也许会列在印度最便宜的大型太阳能发电项目中。

该公司会通过建立专属的太阳能发电项目, 确定整个项目的电力成本, 大约 20-25 年, 因此是很重要的金融储蓄。此外, 该项目还将帮助公司满足其太阳能购买义务。

## *Clean Energy* (清洁能源)

### **Will 2017 be last stand of clean energy technology deniers?**

It's difficult, and probably a little bit pointless, to make predictions about the year ahead. But we are beholden to media custom at this time of year. The only question is whether to bury you in numbers, or simply outline the major themes.

Let's go with the latter, because there are plenty of them.

Two major forces stand opposed in 2017. One is the falling cost of clean energy technology – solar, wind, storage and other smart controls – that is heralding what Alan Finkel calls an “unstoppable” energy transition away from centralised, polluting fossil fuel plants.

Solar now costs less than \$30/MWh in many major economies, wind energy is about the same. As Bloomberg recently pointed out, this makes them cheaper than any new generation, and cheaper than much existing generation.

Battery storage costs have fallen 50 per cent in 12 months, and energy experts are freely talking about new energy systems with concepts such as localised and shared energy, zero marginal costs, and even “free energy.” Electric vehicles, inspired by Tesla, are also on the rise with major car makers investing billions in new electric models.

The other major force is political – funded, aided and abetted by the very fossil fuel interests threatened by renewables, storage and EVs. They've hit the jack-pot in Washington, and when Donald Trump moves into the White House on January 20, he will be accompanied by a cabinet notable for its collection of climate change deniers, fossil fuel lobbyists and billionaires. And with the Exxon Mobil CEO and chairman as secretary of state.

It is unthinkable, and it is potentially dangerous, but there it is. Clean energy technology will never have faced greater politics headwinds than Trump's America.

Can you pick a winner? It's hard to imagine any political force standing in the way of cheaper technology alternatives for long, despite what has happened in some hermit kingdoms. But you can bet that the Trump administration will seek to tilt the table to help incumbent interests fill their pockets as quickly and for as long as they can.

This will have an impact on Australia too. Australia finds itself at the cutting edge of this energy transition, with a huge natural and technological advantage, and even greater motivation (enormous electricity costs and a dirty inefficient grid).

But it also boasts a powerful fossil fuel incumbency. The Trump administration will encourage the climate deniers and vested interests within the ruling Coalition, and there are many.

The Frydenberg Review of climate change policies should be promising, but it has already been hamstrung by Malcolm Turnbull's subservience to the Far Right.

The only hope will be that the review by chief scientist Alan Finkel will provide some clarity, and may actually be read by the government. Just how long will it take to sink in?

The first draft was promising, so much so that it could turn out that the South Australian blackout was the best thing that happened to renewables in Australia: it did not signal the death of wind and solar, as the media screamed, but it did highlight how dirty, costly and ill-fitted Australia's ageing grid is to the modern era.

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On the technology front we are going to see numerous changes.

The first is the concept of free energy: Elon Musk gave us a taste of the future when he unveiled the solar roof in November. No, it's not the first solar roof on the market, and it probably won't be seen in Australia for a few years.

But the implication is clear: solar generation built into infrastructure, thereby coming at no extra cost to consumers. Utilities and their economists are going to struggling to get their minds around this. It is diametrically opposed to anything that they had every considered.

Battery storage: The economists are already struggling with zero marginal cost from wind and solar, and now this output can be stored cheaply. Energy is shifting rapidly from centralised to distributed energy – and battery storage will play a key role.

Australia, with its high electricity costs caused by greedy government network owners, will be at the forefront and lead the first mass-market take-up of storage.

Devices will get cheaper, more powerful, and easier to use. The price cuts will likely be visible from February or March when the Tesla Powerwall 2 arrives and its competitors are forced to cut prices or roll out more cost-effective models.

Expect to see more trials of the likes of AGL's virtual power plants, the network offset trials by SAPN, Ausnet and others, and the power-sharing technology liberated by blockchain software and being rolled out by Powerledger and AO4 and the like.

Solar and wind costs will continue to fall. In Australia, that could be significant as the backlog in large-scale renewables projects finally breaks: expect to see numerous large-scale solar projects, many of them displacing second tier wind developments.

“Merchant” models will be the vogue for a while, before the big retailers wake up and lock in more projects on contract, particularly as consumers rail against the soaring cost of the “green energy” component of their bill, caused only by the retailers' own failure to invest.

But it's not the technology that is the major concern, it is the politics, and the potential for powerful interests to bamboozle politicians and encourage them to make dumb decisions about energy choices – or in the case of the Australian federal government, no decision at all.

The Finkel review will be critical to cut through the myth-making of technology deniers and myth-makers. But it will likely take time to sink in, presuming that anyone in the Coalition actually reads it.

The mainstream media could play a constructive role, but there is not much hope there. They seem completely enthralled by incumbents and completely uninterested in the potential of new technologies.

It is disconcerting enough that most energy market and pricing regulators seem to think that their primary role is to protect the incumbent over the consumer – see the way they protect network revenue, how they demonise renewable incentives as a “transfer of wealth from the generators to the consumers.

Consider the mainstream media response to our revelation that BHP's Olympic Dam “blackout” in December wasn't actually a blackout at all, but a contracted “load shed” over a three-hour period (70MW from the 170MW they were using). Most completely ignored it. “Splitting hairs” sniffed the AFR.

Don't expect much from the ABC either. When the excellent Finkel review was published, chief political reporter Chris Uhlmann tweeted with glee, and then congratulated himself in subsequent tweets for his prescience.

For some reason, as The Climate Institute's John Connor quickly pointed out, Uhlmann completely ignored the next sentence in Finkel's summary: “Fortunately, solutions are available to effectively integrate variable renewable electricity generators into the electricity grid.”

Finkel even put it in very big type later in the report so that even ABC political editors could find it.

It just goes to show, it's going to be a long year. As Connor pleaded with Uhlmann over Twitter, "all we want is a mature debate." The chances are that we won't get it: Technology marvels on one hand, and Trump, post truth, ideology and media indifference and ignorance on the other.

## 2017 年将是清洁能源技术否定者的最后一战

预测下一年的情况可能很难，而且可能有点无意义。但是我们每年这个时候仍受制于大众媒体。唯一的问题是，是否用数字打压你们，还是简单的概述主要主题。

我们还是看看后者吧，因为有很多主题可讲。

2017 年澳大利亚有两个主要反对力量。一个是清洁能源技术成本降低——太阳能、风能、储存等智能控制——这预示着 Alan Finkel 所说的“不可阻挡的”能量过度远离中央集权的污染化石燃料发电厂。

现在在很多主要经济体中，太阳能的成本低于每兆瓦时 30 美元，风能也差不多如此。正如 Bloomberg 最近提出来的那样，这使得他们比现有的任何一代都要更便宜。

电池储存成本在 12 个月内下降了 50%，而且，能源专家们自由地谈论带有一些概念的新能源系统，如局部共享能源，零边际成本，甚至是“自由能源”。受特斯拉启发的电动汽车也由于各大汽车厂商数十亿的投资，开始在新电动模式中崛起。

另一主要力量是政治——资助的化石燃料被可再生能源、存储和电动汽车所威胁。他们在华盛顿取得了重大成功，当唐纳德·特朗普 1 月 20 日搬进白宫时，他将由一个内阁陪同参加气候变化否认者、化石燃料的说客以及亿万富翁的集会。集会者还有埃克森美孚石油公司的 CEO 和国务卿的主席。

这是不可想象的，而且有潜在的危险，但事情确实如此。清洁能源技术将面临比特朗普上台的美国更大的政治阻力。

你能选出一个赢家吗？很难想象会有政治力量长时间阻挡更便宜的技术选择，虽然是在一些不起眼的小国发生的事。但你可以打赌，特朗普政府将寻求帮助现在的利益来尽快填补他们的口袋。

这对澳大利亚也会产生影响。澳大利亚发现自己处于能源转型的前沿，拥有巨大的自然和技术优势。甚至更大的动力（巨大的电力成本和非常低效的电网）。

但它也有一个强大的火力优势。特朗普政府将鼓励气候变化否认者和执政联盟内的既得利益，而且有很多。

气候变化的 Frydenberg 审查应该是有前途的，但它已经被 Malcolm Turnbull 屈从于右翼。

唯一的希望是，首席科学家 Alan Finkel 的观点能提供一些清晰的东西，可能实际上会将由政府阅读。那完全理解它需求多长时间？

第一稿是有希望的，所以就变成了南澳大利亚停电是澳大利亚可再生能源发生的最好的事：这并不意味着风能和太阳能的死亡，像媒体尖叫的那样，但它确实凸显了澳大利亚老化的电网对现代有多肮脏、昂贵又不合时宜。

在技术方面，我们仍会看到许多变化。

首先是自由能的概念：Elon Musk 在他 11 月推出太阳能屋顶时，让我们领略了未来。不，这不是第一个出现在市场的太阳能屋顶，而且最近几年可能不会在澳大利亚见到。

但其含义是很明显的：太阳能发电建成之后，不会给消费者产生额外的消费成本。公用事业和他们的经济

学家正在努力研究这个。这与他们考虑的截然相反。

电池储存：经济学家已经正在努力研究风能太阳能的零边际成本，而且现在这个产量可以廉价储存。能量从中央到分布式能源——电池存储将发挥关键作用。

澳大利亚的发电成本较高是贪婪的政府网络业主造成的，澳大利亚将在时代的前沿，成为第一个储存

的大众市场。

设备会变得更便宜、更强大、更容易使用。降价可能会在 2 月或 3 月推出，届时 Tesla Powerwall 2 将来临，而且其竞争对手将被迫降价会推出性价比更高的机型。

期待看到更多 AGL 像榴弹炮年代的虚拟实验电厂，SAPN、Ausnet 和其他的网络抵消，以及由区块链软件促进并由 Powerledger 和 AO4 等推出的电力共享技术。

太阳能和风能的成本将继续下降。在澳大利亚，这很重要，因为大规模的可再生能源项目的积压终于打破：希望看到众多大型太阳能项目，其中很多将发展成二级风。

在大型零售商醒来并锁定更多的合同项目之前，商人模式将成为时尚，尤其是当消费者抱怨“绿色能源”飞涨的成本，这是由零售商自己投资失败造成的。

但这并不是主要关注的技术，政治和强大的利益迷惑政客，鼓励他们做出愚蠢的能源选择——或者在澳大利亚联邦政府的掌管下，根本没有决定。

戳穿技术否认者和神话编造者编造的神话，对 Finkel 的评论至关重要。但假如联盟的人真的有读过它，理解可能也是需要时间的。

主流媒体可以发挥建设性作用，但是并没有太多希望。他们似乎完全被当权者迷惑，并完全对新技术的潜力不感兴趣。

大多数能源市场和价格监管机构认为他们的主要作用是保护消费者——看看他们保护网络收入的方式，他们如何妖魔化可再生能源激励，作为一种“从发电机到消费者的财富转移”，这已经够令人不安的了。

考虑到主流媒体对我们去启示的回答，12 月 BHP 的奥林匹克坝停电其实根本不是灯火管制，而是三个小时内的负荷（从他们用的 170Wh 减少到 70Wh）。最容易忽略。“吹毛求疵”地闻一闻 AFR。

也不要对 ABC 期望太多。当优秀的 Finkel 评论发表后，首席政治记者 Chris Uhlmann 欢乐地发了条推特，然后，庆幸自己在后来的推特中的先见之明。

因为某些原因，气候研究所的 John Connor 很快指出，Uhlmann 完全忽视 Finkel 总结的下一句话：“幸运的是，有效整合可再生能源到电网的解决方案是可行的。”

之后，Finkel 甚至在报告中把它放在一个大的类型中，这样，即使是 ABC 的政治编辑也能找到它。

它只是表明，这将是漫长的一年。Connor 在推特上恳求 Uhlmann：“我们想要的是一个成熟的辩论”。我们不会得到这次机会：一方面，是技术奇迹和特朗普的后真相时代，另一方面，是意识形态以及媒体的冷漠与无知。

## **EIA: Clean energy to grow even if Trump scraps Clean Power Plan**

Even if president-elect Trump follows through with his threats to dismantle the Clean Power Plan, renewable energy will still be on the rise regardless, according to a new report by the US Energy Information Administration.

The report, entitled Annual Energy Outlook 2017, contains long-term projects up to 2050 that indicate that clean energy and natural gas will continue to grow, even in the scenario where the CPP is omitted. The administration warns that the outlook is not a prediction, however, but a series of potential options the nation could follow dependent on certain circumstances.

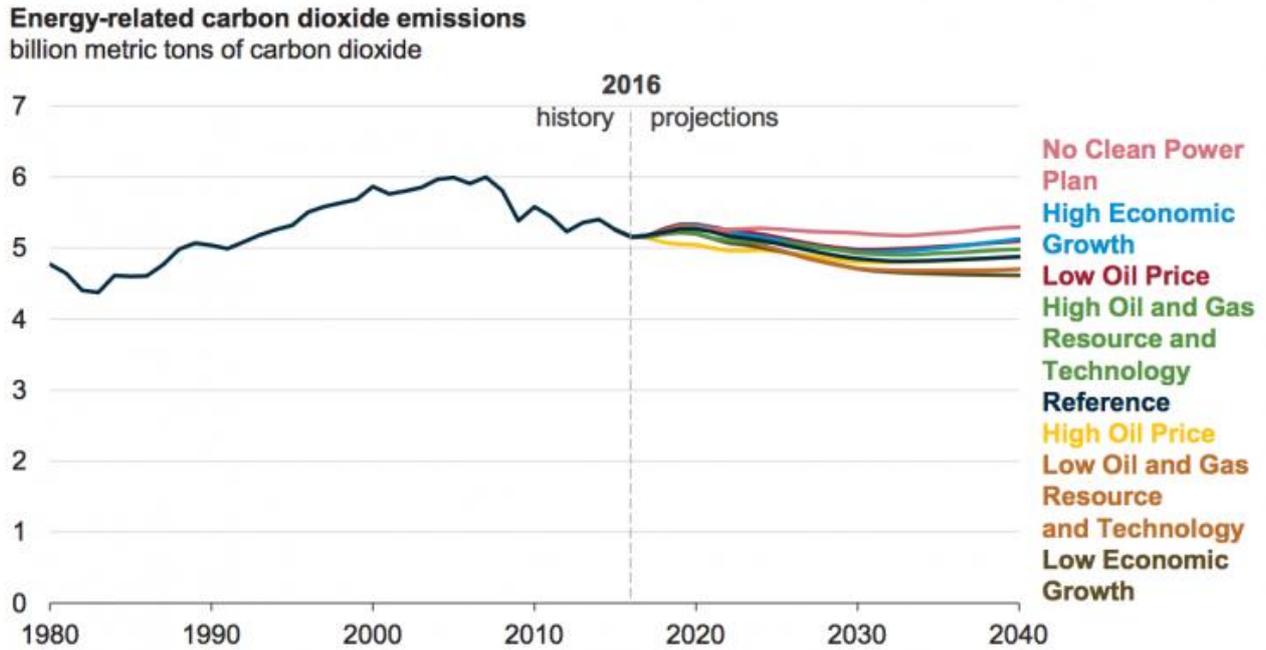
"Even if the CPP is not implemented, low natural gas prices and the tax credits result in natural gas and renewables as the primary sources of new generation capacity," the EIA report reads.

The emissions regulation, penned by the EPA under the Obama administration, is currently stayed while subject to judicial review by the Supreme Court as part of a legal battle that asserts the EPA is guilty of overreach.

Even without the contentious proceedings, the CPP is endangered by threats by Trump to dismantle it, and other federal spending on any regulations pertaining to climate change.

The EIA contends however that the primary driver of new alternative electricity capacity will be an ongoing series of coal-fired plant retirements. Report forecasts detail that without the CPP, coal generation will still remain steady through the 2020, and whilst at a slower rate than with the emission regulations in place, renewables and natural gas will continue to expand.

Furthermore, if Trump scraps the CPP has he has been so called on to do by a 24-state coalition spearheaded by West Virginia AG Patrick Morrisey, energy-related carbon emissions would increase.

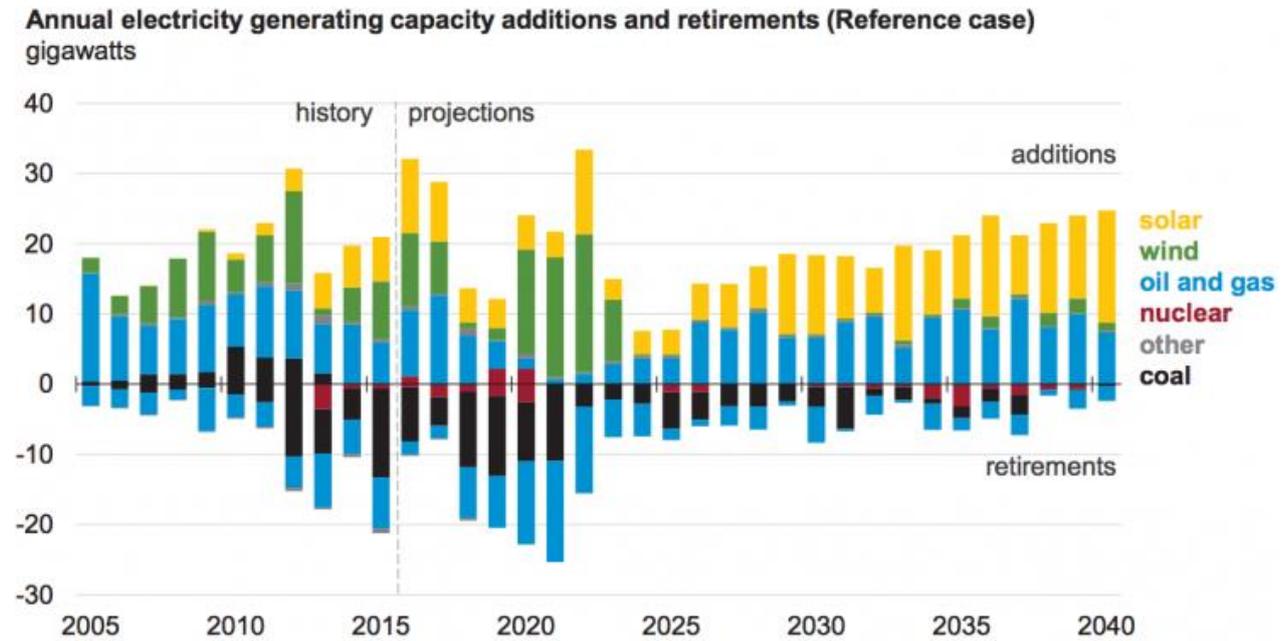


Energy-related carbon dioxide emissions. Source: Energy Information Administration

However, in the case without the CPP, the declining cost of natural gas is still encouraging utilities to shift away from coal. Utilities retired 1.48GW of coal-generating capacity in 2015, according to the EIA, representing about 5% of US coal-generating capacity.

Another 6.5GW of coal-fired generation were retired in the first half of 2016.

The EIA expects almost 70GW of new wind and solar capacity to be added by 2021, with utility-scale solar being the main driver for renewable capacity additions; spurred on by declining costs and the ITC. After 2030, natural gas is forecast to catch up, with new capacity to be split between the two energy sources.



Annual electricity generating capacity additions and retirements. Source: Energy Information Administration

Whilst EIA predictions for both renewables and emissions fared better under the scenario with the CPP, many feel that the decline of fossil fuels is more economic driven than regulatory. In fact, outgoing EPA administrator Gina McCarthy said critics give the CPP “too much credit” during a speech in November.

“The CPP was designed to follow the clean energy transition that was already underway, the one that the energy market depends on and the one that the energy market will continue to demand,” she said. McCarthy also noted that 24 states already had lower emissions in 2015 than required by 2022 under the plan.

Despite confirmation from the EIA that the renewable energy outlook remains positive in the absence of the Plan, contention over its fate continues with 15 states planning to litigate if Trump does scrap the regulation.

## EIA：即使特朗普政府废除《清洁能源计划》，清洁能源仍可发展壮大

据美国能源信息办公室(EIA)的一份最新报告显示，即使新当选总统特朗普确实执行废除《清洁能源计划》(CPP)的威胁，可再生能源仍将继续发展。

此份名为《2017 年度能源展望》的报告包括直至 2050 年的长期项目，显示出即使在 CPP 被废除的状况下，清洁能源和天然气产业将持续增长。EIA 警告称，此展望并非产业预期，而是改过可根据不同发展环境进行选择的一系列潜在发展方式。

“即使 CPP 无法执行，较低的天然气价格及所产生的税惠可使得天然气和可再生能源成为新一代能源产能中的主要来源。”

奥巴马政府委托 EPA 起草的排放条例目前仍在实施，但其命运仍将取决于最高法院对其的司法审查结果，该举动是针对 EPA 越权行为进行的一系列法律诉讼之一。

即使没有这些法律诉讼，特朗普要废除该法案及其他与环境变化相关的政策领域内的联邦预算的威胁，也使得该法案陷入危机。

但 EIA 争辩道，新可替代电力能源的主要发展动因是基于一系列火电厂即将达到服役年限的情况。报

告预计，若不执行 CPP，煤炭发电将在 2020 年前保持稳定，同时，尽管速度缓慢，但随着排放监管政策的逐步实施，可再生能源与天然气产业将持续增长。

此外，如果特朗普废除 CPP，在 24 个州的联盟内与能源相关的碳排放量将出现增加。

但是，即使 CPP 无法执行，天然气不断下跌的价格仍会促使电力公司逐步废弃煤炭电力。据 EIA 表示，公共事业电力公司在 2015 年停用了 1.48GW 煤炭电力产能，占到美国总煤炭电力产能的 5%。

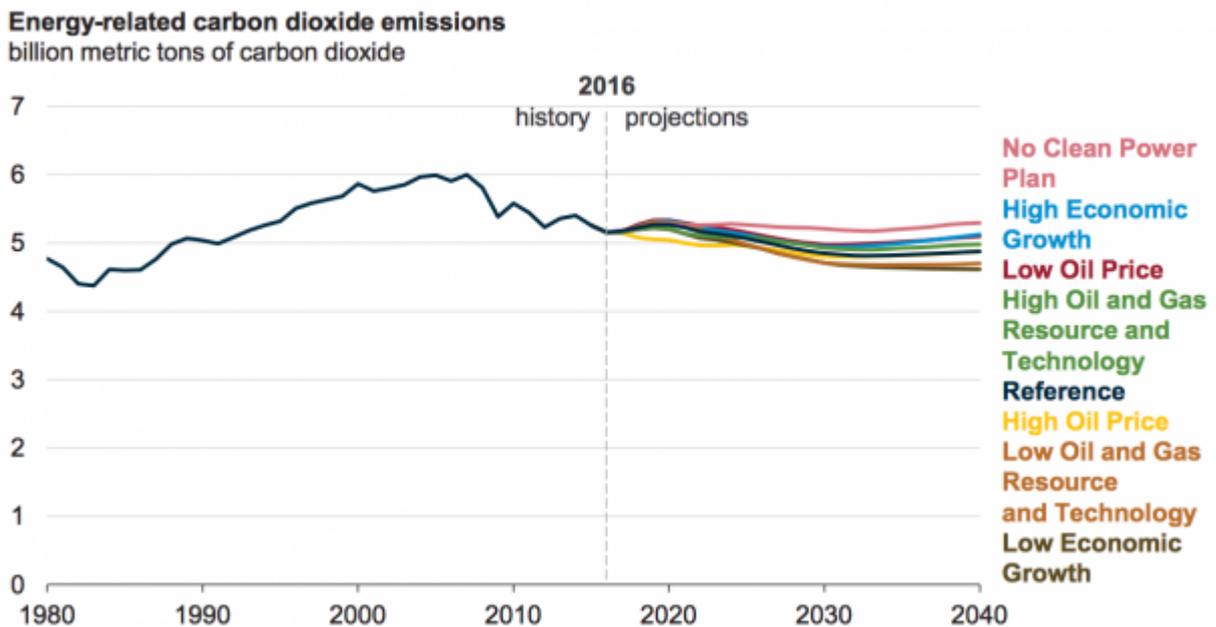
在 2016 年上半年，电力公司另停用 6.5GW 煤炭电力产能。

EIA 预计至 2021 年，将有近 70GW 的新增风能和太阳能产能上限，其中公共事业级别太阳能在新增可再生能源中占主要地位；相关增长受到成本下降和 ITC 政策的促进。在 2030 年之后，预计天然气产业将会迎头赶上，并且在新增产能领域内与太阳能平分秋色。

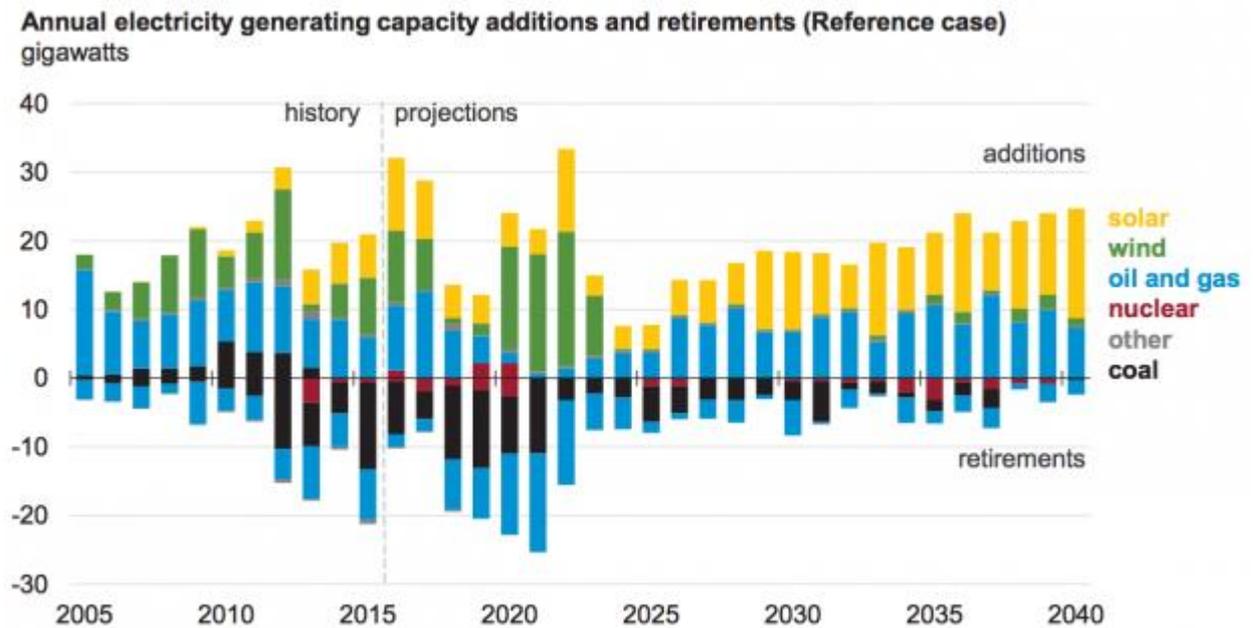
尽管 EIA 认为，可再生能源领域和碳排放量领域将在执行 CPP 的环境下有更好的发展，很多人认为化石燃料价格的下跌具有比监管条例更大的经济促动力。事实上，即将卸任的 EPA 官员 Gina McCarthy 在去年十一月的一次演讲中曾表示，评论家们给予 CPP “过多的含义”。

“CPP 旨在促进已处于进行中的清洁能源转型，这一转型是能源市场所以来的，也是能源市场的未来需求。” Gina McCarthy 称。她还表示，已有 24 个州在 2015 年即实现了低于 2020 年计划标准的碳排放量。

尽管 EIA 表示即使《清洁能源计划》缺席，可再生能源的发展前景仍旧十分乐观，但如果特朗普执意废除该计划，将有 15 个州计划对此提起诉讼，对于《清洁能源计划》命运的争论仍将继续。



能源领域内的二氧化碳排放量。图片来源：EIA



年度电力产能增长与弃用状况。图片来源：EIA

## China emerges as global leader in clean energy

With US investment expected to wane, China will become the “unrivaled” leader of the clean power age

Chinese companies are poised to accelerate international investment in clean energy technology and fill the void left by such major economies as the US, new data shows.

A new report from the Institute for Energy Economics and Financial Analysis (IEEFA) reveals that China invested a record US\$32 billion (220 billion yuan) in overseas renewable energy and related technologies last year, marking a 60% year-on-year increase in spending.

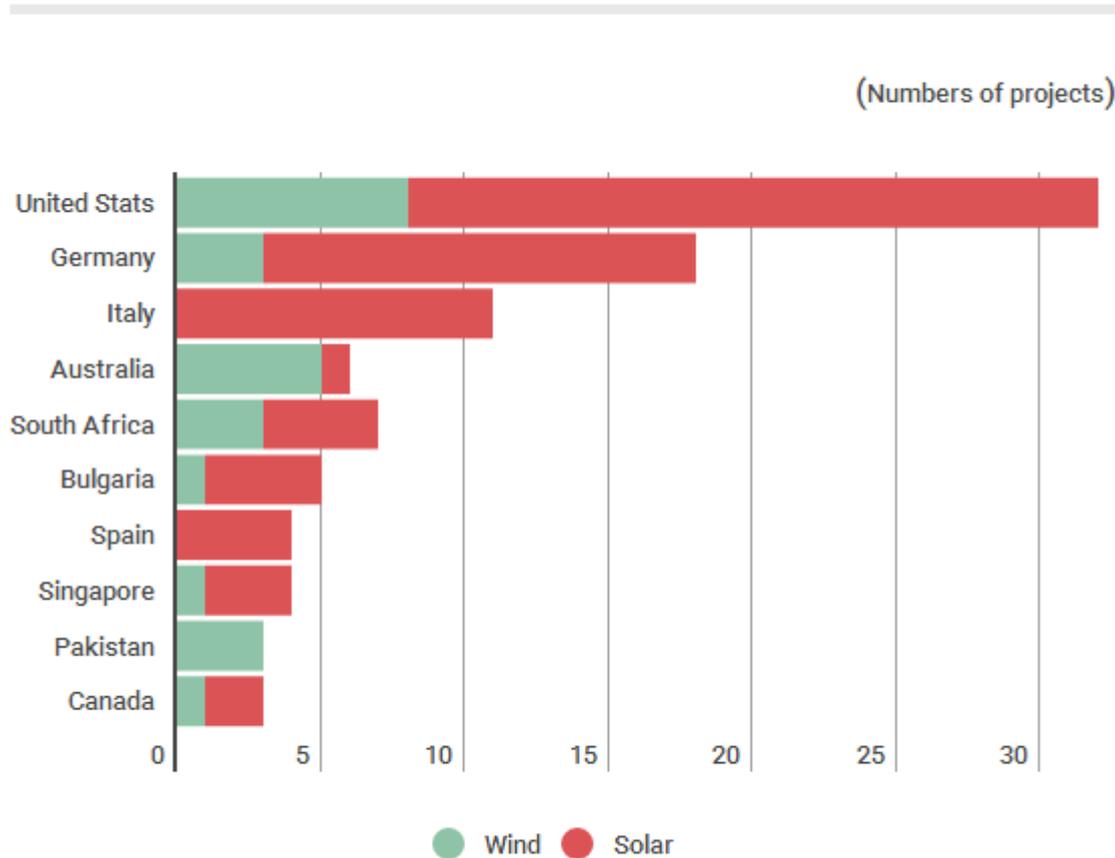
Over the period 2015-2021, China will install around a third of the world’s total wind energy, solar and hydroelectric generation capacity. Meanwhile, China-led lending institutions, such as the Asia Infrastructure Investment Bank (AIIB) and the Export-Import Bank of China, have enough financial capacity to lead electricity-sector transformations across Asia.

The scale and growth of this investment indicates that China is ready to embrace the role of global leader in the 21st century's "clean energy era" with future US environmental policy under a Trump administration uncertain.

“The US is already slipping well behind China in the race to secure a larger share of the booming clean energy market. With President-elect Trump talking-up coal and gas, prospective domestic policy changes don’t bode well,” said Tim Buckley, director of energy finance studies, Australasia, at IEEFA, in a statement.

“If the US is serious about stimulating manufacturing based growth, this isn’t a sector to turn your back-on,” he added.

China's Overseas Investments in Renewables 2002-2012



Source: World Resources Institute, April 2013

China is already a leader in terms of domestic investment in renewable energy. On Thursday 5, an announcement from China’s National Energy Administration (NEA) revealed that China will plough 2.5 trillion yuan (US\$361 billion) into renewable power generation by 2020, as part of its five-year economic development plan (The 13th Five-Year Plan), as it shifts its domestic market away from dirty coal power towards cleaner fuels.

Part of this “Going Global” strategy dovetails with plans to build a series of trade and infrastructure networks across Asia reaching as far as Europe, under the banner of “One Belt One Road” or the “New Silk Road”.

This means that China will become the world’s largest employer of green energy jobs globally. The International Energy Agency’s World Energy Outlook for 2016 estimates that Chinese firms hold 3.5 million of the 8.1 million renewable energy jobs worldwide. This compares to the 769,000 jobs dependent on renewables in the US.

### Top Five Destinations for Accumulated Chinese Investment (US\$m)

Country	Total value 2005-2013	Global share (%)
China	59,900	13
Australia	57,250	12
Canada	37,650	8
Brazil	29,180	6
Britain	18,530	4

Source: "Demystifying SOE Investment in Australia", KPMG & Uni of Sydney, August 2014, The Heritage Foundation China Global Investment Tracker database.

The bulk of Chinese investment in wind and solar energy installation is being channelled into the US, Germany, Italy, Australia and South Africa. In terms of new markets, Latin America is currently one of the most attractive regions for renewable energy development and Chinese companies are already invested heavily in Mexico, Brazil, Argentina, Chile, and elsewhere in the region.

In 2016, Tianqi Lithium, China's largest extractor of lithium from ores, invested US\$2.5 billion (17.2 billion yuan) in acquiring a minority stake in SQM of Chile, the world's fourth largest lithium farm. Lithium is used to make batteries for electric vehicles. Over the next nine years global demand for the metal for battery use will double, according to IEEFA's report.

In the other strategic area of grid transmissions, the State Grid Corp of China (SGCC) last year pledged US\$13 billion (89.5 billion yuan) towards an energy and electricity and distribution deal with Brazil's CPFL Energia SA. The influx of Chinese money in Latin America is expected to have serious implications for regional geopolitics, adding to competition from US and European countries over influence in the region.

"China understands that renewables present a huge commercial opportunity. Staggering domestic investment in a move to clean energy, compliments its active pursuit of commercial growth overseas. As the US owned the advent of the oil age, so China is shaping-up to be unrivalled in clean power leadership today. The US may look back in regret in years to come," said Buckley.

## 中国领銜全球清洁能源投资

在美国投资预计将会减少的预测下，中国无疑的成为了全球清洁能源的领导者。

最新数据显示，中国公司正准备加大对清洁能源技术领域的国际投资，以填补美国等主要经济体投资缩减所留下的空缺。

能源经济与金融分析研究院（IEEFA）发布的最新报告显示，去年中国在可再生能源及相关技术领域的海外投资同比增长 60%，达 2200 亿人民币，创历史新高。

2015 至 2021 年间，中国新增的风能、太阳能以及水力发电能力大约将占全球三分之一。与此同时，亚洲基础设施投资银行（AIIB）以及中国进出口银行等中方引导的贷款机构也有足够的财力来引领全亚洲电力部门的转型。

中国在清洁能源产业的投资规模和增速都说明，中国已经做好准备成为全球新清洁能源时代的领军者，尤其在美国特朗普政府环境政策存在不确定性的情况下。

“中美两国都想要在蓬勃发展的清洁能源市场中占有更大的份额，但在这场竞赛中，美国已经远远落后于中国。当选总统特朗普大力鼓吹煤炭和天然气行业的发展，这对其国内未来的政策改革而言并不是好兆头，” IEEFA 澳大拉西亚能源金融研究主管蒂姆·巴克利在一份申明中说。

“美国如果真的要振兴制造业，就不该放弃清洁能源部门的发展，”巴克利说。

中国的国内可再生能源投资规模已经居世界首位。上周四，中国国家能源局（NEA）宣布，作为国家“十三五”规划的一部分，中国将在 2020 年之前投资 2.5 万亿元人民币发展可再生能源发电，推动国内市场逐步放弃高污染的煤电，转而使用更加清洁的能源。

中国“走出去”战略最新阶段的一部分也与国家能源战略相吻合，计划通过“一带一路”倡议，建立一系列横跨亚洲、影响力远及欧洲的贸易及基础设施网络。

这意味着中国将成为给全球带来绿色就业机会最多的国家。国际能源署《2016 年世界能源展望报告》估计，全球 810 万可再生能源工作岗位中有 350 万个来自中国企业。相比之下，美国可再生能源工作岗位仅 76.9 万个。

中国的风能和太阳能投资大部分都流向了美国、德国、意大利、澳大利亚以及南非。而拉丁美洲则是目前可再生能源发展最具吸引力的新兴市场之一，中国企业已在墨西哥、巴西、阿根廷以及智利等拉美国家投入了非常可观的资金。

2016 年，中国最大的锂生产商天齐锂业投入 172 亿人民币，收购全球第四大锂生产商智利化工矿业公司（SQM）少量股权——后者刚刚在 2016 年底退出这桩交易。锂主要用于制造电动汽车的电池。根据 IEEFA 的报告，未来 9 年，全球电池制造业对锂的需求将翻一番。

针对电力传输这一战略领域，中国国家电网（SGCC）去年与巴西电力公司 CPFL Energia SA 就能源、发电、以及电力输配达成了价值 895 亿元人民币的协议。中国资本涌入拉美预计将对该地区的地缘政治造成重大影响，撼动欧美国家几十年来的主导地位。

“中国非常清楚可再生能源领域蕴藏的巨大商机，不仅在国内投入海量资金推动清洁能源转型，更积极寻求扩大海外商机。美国开启了石油时代，而中国正在塑造其在当今清洁能源行业中无可撼动的领军者地位。日后回看这段历史，美国或许将后悔不已，”巴克利说道。

## Pressure builds to fight smog in Western China

As the air pollution crackdown in China's eastern cities intensifies public outcry in the west is rising, writes Tang Damin and Zhang Chun

Three years into Premier Li Keqiang's declared "war on pollution," and this winter's smog is taking a new turn. On the one hand, statistics show that overall air quality in China has improved; on the other, a growing gap in air quality between China's east coast and its inland cities has tensions flaring.

In Chengdu, the city of 14 million people in central Sichuan province, the exceptionally poor air has become unbearable. Thick fog and smog closed runways at Shuangliu International Airport for 14 hours in December, resulting in morning cancellations that stranded 20,000 travellers.

That month, Chengdu experienced nine days of sustained air pollution, bringing media outlets to report on rising outcry from residents. According to the Sixth Tone, police clashed with a group of artists at an air pollution protest.

Around 600 kilometres away, in the large western city of Xi'an, another group of artists led an avant-garde protest following nearly a week of continuous smog. Putting their creativity into practice, students at the Xi'an Academy of Fine Arts affixed face masks to a stand of stone lions, turning the bad air into part of an art installation.

Perhaps more than the air pollution itself, residents of western cities are infuriated by the weak response from local governments. Beijing-Tianjin-Hebei (also known as Jing-Jin-Ji), being the region most closely associated

## **Mcanxixun Information**

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with smog, is putting forward ever stronger measures to combat the problem.

Far-reaching, regional, emergency air pollution response measures linking Beijing, Tianjin, Hebei, Henan and Shandong are now in place. Earlier this year, Shijiazhuang simply shut down industrial production for a month-and-a-half in order to meet air quality standards. The difference in government response between these eastern cities and China's western urban centers has been striking.

### **Development and pollution**

The differences between smog response measures in Beijing and Chengdu are a case in point. The pollution conditions triggering a level-three (yellow) alert in Chengdu are basically identical to the triggers for a level-two (orange) alert in Beijing. This implies that under similar pollution conditions, mitigation measures in Chengdu will be weaker than in Beijing.

Chengdu's economic development model is also facing criticism.

At its core, Chengdu's pollution problem is bound up in the structure of the economy. In 2015, the city's Air Pollution Sources Analysis showed that the top three sources of PM2.5 were transportation, coal-burning and dust – each accounting for over 20% of the total. Although direct emissions from industry account for only 6%, heavy industrial plants like steelworks are big coal consumers, meaning that large-scale industrial production both directly and indirectly causes significant air pollution.

The local economy's overreliance on real estate development and infrastructure projects have added to Chengdu's environmental burden. Data from the National Bureau of Statistics website show that in 2014, real estate development sites in Chengdu covered 170 million square metres, overtaking both Beijing and Shanghai.

By comparison, development projects only occupied 20 million square metres in 2002. Chengdu is transforming into one big, dusty construction site, and this dustiness is a major source of particulate matter.

Chengdu's traffic regulations are an even more direct source of air pollution. While the odds of winning Beijing's license plate lottery have dwindled to virtually nil, Chengdu residents still face no restrictions when buying a car. In 2013, rates of vehicle ownership in Chengdu were second only behind Beijing, and they continue to rise at an astounding rate: car ownership doubled between 2013 and 2016.

According to media reports, Chengdu currently has 4.64 million vehicles on the road, which contribute half of the city's nitrogen oxide emissions. In hot weather, nitrogen oxide produces ozone, which in high concentrations can cause respiratory inflammation, nerve damage, dizziness, and headaches.

Cities in eastern China have responded to environmental bottlenecks by carefully limiting development. In Beijing, Tianjin, Hebei, Henan, and Shandong, coal consumption is controlled, steel and cement producers have been forced to cut capacity, and factories must sometimes shut down on smoggy days. The old high-pollution industrial economic model is now facing serious challenges.

### **Out of time in China's "other cities"**

It is important to note that the strength of atmospheric pollution regulations varies by place in China. In September 2013, the State Council released ten regulations setting higher air quality targets for Beijing-Tianjin-Hebei, the Yangtze River Delta, and the Pearl River Delta (all the in the east of the country), relative to the rest of the country. By 2017, the Beijing-Tianjin-Hebei region is mandated to reduce PM2.5 levels by 25% relative to 2013 levels, while other cities need only to reduce levels by 10% (in the two deltas the target is 15%).

These three dense urban regions, which have the highest GDP in China, are closely bound to high pollution sources. Yet the pollution management challenges facing other regions in China are no less daunting. According to a Greenpeace East Asia analysis of air quality data from 362 Chinese cities in the first quarter of 2016, of the 91 cities which experienced worsening air pollution, two-thirds of them were located in central or western China – namely, the "other cities" outside of the three key eastern regions.

Compared to the relatively strict smog-control regulations in eastern cities, actions taken by central and western Chinese cities have been slow-coming. One reason for this trend, according to Greenpeace East Asia climate and energy campaigner Dong Liansai, is that governments in eastern regions have forced heavy polluting industries like coal-fired power plants and chemical factories to move elsewhere.

China's western provinces, which seek new investment to propel economic development, have welcomed these companies with open arms: in 2015, three-quarters of the country's 210 newly-approved, coal-fired power plants were slated to be built in central or western China.

But for these "other cities," the grace period to deal with air pollution is coming to a close. The recently-published 13th Five-Year Plan for Eco-Environmental Protection has set clear targets for cities not yet in line with air quality standards, which includes perhaps 78% of Chinese cities. By 2020, these cities must achieve an 18% improvement in air quality relative to current levels.

At present, average annual air pollution is slightly better in Chengdu than Beijing. In 2015, the average concentration of PM2.5 in Chengdu was 61 micrograms per cubic metre, compared to Beijing's 81 micrograms per cubic metre. But no matter whether or not Beijing reaches its target of 60 micrograms per cubic meter by 2017, the relatively clean air enjoyed by residents in Chengdu and other western cities – if it can be called that – is likely to become worse.

And clearly, as residents of western cities become more environmentally aware, their patience for poor air and poor environmental governance will soon run out.

## 西部城市治霾压力或陡增

面对东部地区政府的强势治霾措施和本地市民高涨的不满情绪，西部城市的雾霾治理“缓冲期”即将用尽。

在国家总理李克强表示“向雾霾宣战”近三年后，这个冬天的雾霾中有了一丝微妙的味道。一方面，数据显示中国整体空气质量的确取得了好转；另一方面，东部沿海地区和中西部地区空气治理力度的差异，似乎正在制造新的紧张情绪。

最近格外糟糕的空气令成都市民无法接受：先是双流机场因大雾和雾霾关闭跑道 14 个小时，取消上千航班，2 万名旅客滞留在机场；紧接着成都地区又经历了一轮长达九天的持续空气污染。媒体很快注意到民众高涨的愤怒情绪。据第六声报道，一群艺术家在对空气污染进行公共表达时与治安民警发生不快。

在距离成都 600 公里的另一座西部大城市西安，艺术家同样率先对持续近一周的污染天气做出先锋表达。一群西安美术学院的学生学以致用，给校园里的一组石雕狮子带上了防雾霾口罩，把糟糕的空气变成了装置艺术的一部分。

也许令西部城市居民愤怒的不仅仅是空气污染本身，更是本地政府治理污染不力。当最常与雾霾联系在一起的首都北京以及京津冀地区的治霾手段越来越强悍——京津冀和河南、山东建立了庞大的区域统一雾霾应急机制，而石家庄为了空气质量达标干脆关停工业生产半个月——西部城市空气治理和污染应急力度的差距更是彰显无遗。

### 发展与污染

以成都为例，该城现行的重污染天应急预案与北京有明显差异，三级（黄色）预警触发条件和北京的二级（橙色）基本一致，这意味着同样的污染状况下，成都的应对措施将明显弱于北京。

除了应急措施，成都的经济发展模式也受到诟病。

归根结底，污染还是与成都的现行经济结构息息相关。以空气污染物中最受关注的细颗粒物为例，2015 年成都市的空气污染源解析明确显示 PM2.5 排名前三的来源是交通排放、燃煤和扬尘，均超过 20%。尽管工业直接排放仅占 6%，但鉴于钢铁厂等重工业企业也同时是燃煤大户，大规模的工业生产直接和间接造成的空气污染依然可观。

过度倚重房地产开发和基础建设投资的地方经济也极大增加了成都的环境负担。国家统计局网站数据显示，成都市 2014 年房地产开发企业施工房屋面积超过 1.7 亿平米，超过了北京和上海。而在 2002 年，这一数据不过才 2000 万平米出头。成都正在变成一座尘土飞扬的大工地，而扬尘是颗粒物的一大来源。

成都的交通规划更是直接造成污染。当北京的私家车号牌摇号中签率已经低到可以忽略不计时，成都人买车依然没有任何限制。该市从 2013 年起机动车拥有量就紧随北京之后位居全国第二，且增速惊人，从 2013 年到 2016 年短短三年时间翻了一倍。目前成都有机动车 464 万辆，据媒体报道，车辆氮氧化物排放占到全市排放的一半。高温下氮氧化物产生臭氧，而高浓度臭氧可能导致呼吸道炎症、神经中毒、头晕头痛等。

相比之下，环境瓶颈已经令东部城市的发展变得小心翼翼，以京津冀和河南、山东为例，煤炭消费受限，钢铁水泥被要求去产能，重污染天工厂可能被停产，以往依靠污染大户拉动经济的模式受到严峻挑战。

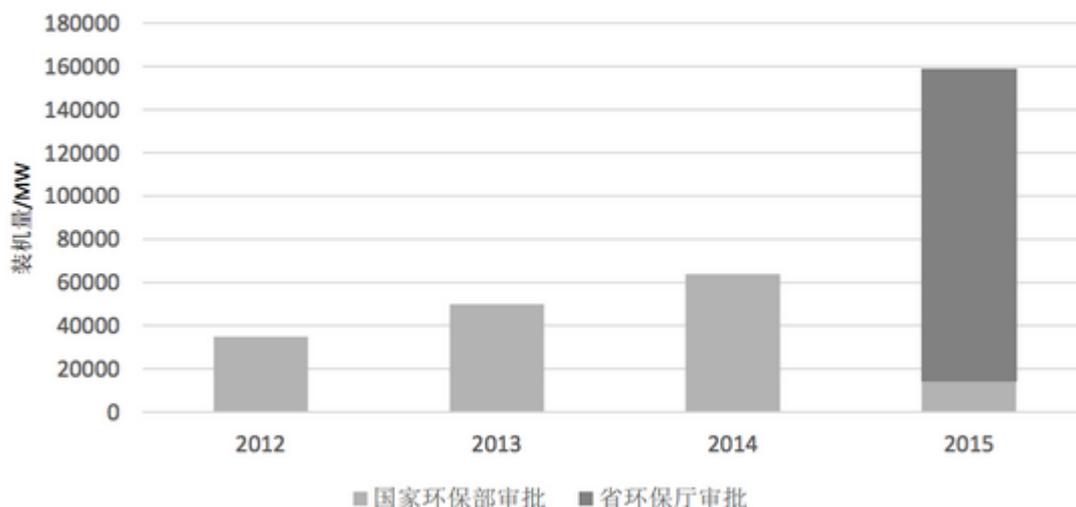
“其他城市”不再轻松

一个不得不注意的细节是，大气污染治理措施在中国不同地区的力度并不平均。2013 年 9 月国务院发布的十条大气治理政策规定京津冀、长三角、珠三角三个区域的空气质量改善幅度比其他城市高：到 2017 年，京津冀地区要在 2013 年基础上降低 PM2.5 年均浓度 25%，而其他城市是 10%。

这三个中国 GDP 最高的城市群的人口和污染源都比较密集，但这并不意味着中国其它地区污染治理挑战更小。按照绿色和平东亚分部对今年第一季度全国 362 个城市空气质量数据的统计，91 座空气质量相比去年同期更差的城市中，三分之二位于中西部内地——即三个重点区域以外的“其他城市”。

相较大手笔治理雾霾的东部沿海城市，中西部城市的空气治理动作更为缓慢，似乎已成趋势。绿色和平东亚分部项目主任董连赛认为这一现象的背后因素之一是东部地区为治理环境将重污染企业，如燃煤电厂、化工厂等，向外迁移，而急需投资拉动经济发展的西部地区则拥抱了这些企业：2015 年中国批准建设的 210 座燃煤电厂中，四分之三都位于中部和西部地区。

### 2012-2015 年国家环保部和各省级环保部门环评审批的燃煤电厂项目



但“其他城市”的缓冲期即将结束，新出台的《十三五生态环境保护规划》明确，所有空气质量不达标的城市——可能涉及 78% 的中国城市——必须在 2020 年底把空气质量相比目前提升 18%。

其实目前成都全年的空气质量还是比北京略微好一点，2015 年该市 PM2.5 平均浓度为 62 微克/立方米，而北京是 81。但随着北京向 2017 年 60 微克/立方米的目标狂奔，不管能不能最终达标，成都等西部城市相对东部传统污染重灾区的空气质量优势——如果有的话——都将逐渐减弱。

而且显然，随着西部城市居民环境意识的提高，西部地区对环境污染的“忍耐窗口”可能就要关闭了。

## **China raises its low carbon ambitions in new 2020 targets**

China unveiled its 13th Five-Year-Plan on energy development with the most far-reaching aims yet, writes Ma Tianije

China's 13th Five-Year-Plan on Energy Development (Energy 13FYP) might be one of the most anticipated energy blueprints in the world for its far-reaching implications for the carbon trajectory of the planet's largest emitter.

On Jan 5, 2017, the National Energy Administration finally unveiled the plan to reporters, with a set of 2020 targets covering everything from total energy consumption to installed wind energy capacity. Before we delve into details of the plan, one thing is worth noting: with the Energy 13FYP, China might have once again raised ambitions for its low-carbon future, highlighting the urgency that this smog-ridden country attaches to moving away from fossil fuels.

What's with all the FYPs?

Our readers may remember that in March, China unveiled its 13th Five-Year Plan for Economic and Social Development (2016-2020), which contains a set of climate and energy related targets, including an energy consumption cap and a 15% goal for the share of non-fossil-based energy in the country's primary energy mix. So what's the connection between this plan and the Energy 13FYP?

If we consider this the "Master Plan" for all aspects of China's development in the next five year period (2016 – 2020), then the Energy 13FYP is the breakdown of that Master Plan for the energy sector, with more detailed targets to better guide policymaking, government spending and project planning in the sector.

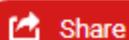
The chart below illustrates the hierarchy of Chinese government planning; the Energy 13FYP is designated a "special plan" for a specific sector.

What's in the Energy 13FYP?

The table illustrates the numerous 2020 targets already announced by the Chinese government in its Strategic Energy Action Plan (2014-2020) and its national 13th Five-Year Plan. They are cross-referenced with actual levels at the end of 2015. Comparing these to the latest targets is a way of gauging changes to the scale of ambition.

## Mcanxixun Information

2020 Targets	SEAP (2014-2020)	National 13FYP	Energy 13FYP	2015 actual levels
Total energy consumption cap	about 4.8Gtce	5Gtce	no more than 5Gtce	4.3Gtce
Energy consumption per unit of GDP	N/A	-15% from 2015 level	N/A	-18.2% from 2010 level
GO2 emissions per unit of GDP	N/A	-18% from 2015 level	N/A	-20% from 2010 level
Percentage of coal in primary energy consumption	62%	N/A	less than 58%	64%
Percentage of non-fossil fuel in primary energy consumption	15%	15%	more than 15%	12%
Wind energy installed capacity	200GW	N/A	more than 210GW	129GW
Solar energy installed capacity	100GW	N/A	more than 110GW	43GW
Hydro energy installed capacity	350GW	N/A	380GW	320GW
Coal energy installed capacity	N/A	N/A	less than 1100GW	900GW



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Source: chinadialogue

From this comparison, it appears that most of the Energy 13FYP targets are not entirely “new”. Many are in line with the existing thinking of previous announcements, in particular the Strategic Energy Action Plan (2014-2020), which, at the time of its publication was already considered ambitious in curbing coal consumption and CO2 emissions beyond international expectations.

However, this time round, policymakers seem even more determined to squeeze out coal’s share in the country’s energy mix, lowering its 2020 percentage in primary energy consumption from 62% to 58%.

The country is also aiming higher for renewables: installed capacity of wind energy and solar energy should reach “more than 210GW” and “more than 110GW”, respectively, by 2020; higher than what was declared at the end of 2014.

A quick look back at the progress of China’s energy targets since the 2009 Copenhagen climate summit, it is clear that:

China has repeatedly strengthened its decarbonisation and low-carbon energy targets.

China exceeded most of its 2015 low-carbon energy and decarbonisation targets and has made its 2020 energy and emissions targets more ambitious over time.

It plans to reduce “emissions intensity” (the volume of emissions produced relative to economic activity) by more than other major economies.

Set against the background of other major emitters, particularly the United States’ potential backtracking from its climate commitments, China’s continued strengthening of its own targets looks even more remarkable.

### Challenges

But ambitious targets do not necessarily translate into results. To achieve these goals in less than five years, China would have to overcome chronic problems in its energy sector. Media reports about the Energy 13FYP reveal deep-rooted concerns that have troubled Chinese policymakers.

**Overcapacity:** China's power sector is faced with a severe overcapacity problem. Slowing demand for electricity due to the economic downturn and the slashing of energy intensive industries has caused widespread under-utilisation of existing power generation capacities, which are seeing their lowest utilisation hours since 1978.

Yet the country is still seeing a fast build-up of coal-fired power capacity as a result of inertia (many projects were approved in the heyday of the economic boom), and perverse incentives (dropping coal prices and a government fixed electricity tariff is increasing the profit margin for coal power).

The situation has prompted regulators to consider putting a two-year "freeze period" in the Energy 13FYP for the approval of any new coal-fired power projects. At the press conference to launch the Energy 13FYP, government vowed to keep coal power capacity below 1100 GW by 2020, setting an upper limit for new coal capacity.

**Curtailement:** The other side of the overcapacity coin is curtailment of renewable energy, particularly wind and solar energy in western parts of the country.

A combination of transmission bottlenecks and market set-up has prevented large chunks of renewable electricity from reaching the grid. In 2015, 15% of China's wind energy was wasted, a record high. Based on the Energy 13FYP, the problem seems to have pressed policymakers to put more emphasis on reining in curtailment, as opposed to further expansion of installed capacity. It has also prompted them to plan more new renewable electricity capacity in China's eastern regions, where electricity demand is concentrated, reducing the need to transmit renewable energy across the country.

## 中国能源“十三五”再度调高低碳目标

中国政府发布十三五能源规划，在数年之内又一次提高低碳雄心，凸显能源转型紧迫性。

中国的能源“十三五”规划可能是世界上最受关注的能源发展蓝图之一。它对于中国这个世界第二大经济体和最大的碳排放国未来五年的碳足迹将带来深远影响。1月5日，国家能源局终于公布了这份广受期待的计划中所涉及的关键目标，涉及从能源消费总量到风电装机容量的一系列2020年指标。在我们详解这份计划之前，有一点值得注意的是：通过能源“十三五”，中国可能又一次调高了自己的低碳雄心，凸显出这个饱受雾霾困扰的国家急于实现能源转型的迫切心情。

### 十三五规划体系

大家应该还记得，今年3月中国发布了《国民经济和社会发展第十三个五年规划纲要（2016-2020）》。这其中就包括了一系列的气候与能源目标，比如设置能源消费上限，以及将非化石燃料在国家一次能源构成中的比例提高到15%等等。

如果我们将这份“顶层计划”看作中国未来五年（2016-2020）的全面发展规划，那么十三五能源规划就可以看作是能源领域的“子计划”。这份规划将包括更多分解目标，从而更好地引导能源部门的政策制定、公共支出、以及项目规划。

下图展示了中国规划制定的层级结构：“十三五”能源规划是一项针对特定领域的专项规划，规划步骤位于国家整体规划之后。

### 能源“十三五”详解

下表展示了中国政府在《能源发展战略行动计划（2014-2020）》和“十三五”规划中已经明确的诸多2020年的气候与能源目标。我们将2015年末的实际水平作为参照与这些目标并置。将十三五能源规划中的目标与它们进行对比，有助于我们判断这些目标是否具有足够的雄心并足以确保落实中国对国内外的各

项承诺。

从上述比较不难看出，“十三五”能源规划的大多数目标都不是全新的。许多其实都与此前公布的政策一脉相承，尤其是《能源发展战略行动计划（2014-2020）》。《战略计划》发布之时就对煤炭消耗和二氧化碳排放做出了超出国际预期的限制，这样的努力可谓魄力十足。

2020 年目标	《能源发展战略行动计划（2014-2020）》	“十三五”规划	“十三五”能源规划	2015 年实际水平值
能源消耗总量上限	大约 48 亿吨标准煤	50 亿吨标准煤	不超过 50 亿吨标准煤	43 亿吨标准煤
单位 GDP 能源消耗	不适用	相比 2015 年水平下降 15%	不适用	相比 2010 年水平下降 18.2%
单位 GDP 二氧化碳排放量	不适用	相比 2015 年水平下降 18%	不适用	相比 2010 年水平下降 20%
一次能耗的煤炭占比	62%	不适用	58%以下	64%
一次能耗的非化石燃料占比	15%	15%	超过 15%	12%
风电装机容量	2 亿千瓦	不适用	2.1 亿千瓦	1.29 亿千瓦
太阳能发电装机容量	1 亿千瓦	不适用	1.1 亿千瓦	4.3 亿千瓦
水电装机容量	3.5 亿千瓦	不适用	3.8 亿千瓦	3.2 亿千瓦
火电装机容量	不适用	不适用	11 亿千瓦以内	9 亿千瓦

然而，决策机构似乎要下决心进一步缩减煤炭在整个国家能源构成中的比重，预计 2020 年煤炭在一次能耗中的比例将从 62% 下降到 58% 甚至更低。

此外，中国还是致力于进一步加快可再生能源发展。2020 年风电与太阳能发电装机总量将分别达到 2.1 亿千瓦和 1.1 亿千瓦以上，高于 2014 年年末公布的目标。

如果我们回顾中国从 2009 年哥本哈根气候大会以来公布过的多个能源与低碳目标，就会发现：

中国曾多次主动调高自身设定的低碳目标

中国超额完成了大多数的 2015 年低碳和能源目标，并使得其 2020 年目标越来越具有雄心

相比全球其他主要经济体，中国的碳排放强度削减目标是最为激进的

如果将中国的这种姿态置于全球其他主要排放国的背景之下，尤其是美国在气候问题上的可能退步，中国的这种进取尤为引人瞩目。

挑战

但雄心勃勃的目标并不会自动转化成实打实的结果。如果要在不到五年之内实现能源“十三五”目标，中国仍需克服很多障碍。媒体有关“十三五”能源规划的报道同样揭示了困扰中国决策机构的那些深层担忧。

产能过剩：中国的电力部门面临着严重的产能过剩问题。总体经济下行与能源密集型产业疲软导致电力需求增长放缓，现有发电机组出现大面积利用率不足现象，利用小时数跌入自 1978 年以来最低水平。

然而，中国政府在此前经济快速发展时期批准了大量燃煤发电项目，再加上煤价下跌和政府固定电价导致煤电利润不降反升，这样的前期惯性和逆向刺激导致目前中国的燃煤电厂建设反而继续大步向前。

这样的状况曾促使监管机构考虑在“十三五”能源规划中设定为期两年的“冰冻期”，不再批准新的燃煤电厂项目。而在最新公布的计划中，国家能源局官员明确了力争将煤电装机控制在 11 亿千瓦以内的目标，并表示要压缩新增煤电装机规模。

弃风弃光：煤电产能过剩的另一面却是可再生能源领域的弃风弃光现象，尤其是西部地区的风能和太阳能产业。

传输瓶颈和电力市场配置问题导致大量可再生电力无法成功并入电网。仅 2015 年风能发电总量中有 15% 被浪费，达到历史最高水平。“十三五”能源规划显示，相关决策机构将会将重心优先放在遏制这一趋势。另外，政府也已将未来五年新增风电和太阳能发电装机向中东部地区倾斜，减少未来的可再生能源自西向东的传输压力和可能造成的瓶颈。

## **With nuclear energy, Nigeria can have predictable electricity prices for 60 years – Komarov**

Nigeria's expedition into Nuclear energy seems to be gathering momentum. The country has taken even more steps in that direction since it signed a cooperation accord with Russia towards the construction of its first nuclear power plant in 2012.

While this has garnered positive attention from many observers across the world, it has also gathered criticism from naysayers who compare the country with a toddler who has not learned to walk, but is in a hurry to run.

However, not many people understand nuclear power like Dr. Kirill Komarov. As First Deputy CEO of Rosatom, Russia's nuclear energy company, he believes that the country is more than ready for nuclear energy.

In this exclusive interview with Hi-Tech, he talks about nuclear's ability to transform the nation's power sector, and invariably the economy at predictable costs. Excerpts:

By Prince Osuagwu

WHAT brought you here?

Nigeria is very interesting to us at Rosatom from several points of view. We are a very unique organisation which combines two statuses at the same time. One is the status of Ministry of nuclear energy in Russia, and the second is our status as a commercial organisation. We own more than 400 business entities. But the most unique is that we are the only organisation in the world that combines all the technological elements in the nuclear area; from mining and enrichment of uranium to production of nuclear fuels to manufacturing of nuclear equipment, construction of nuclear power plants among others.

For a country like Nigeria, it means we can bring a lot to the table because our experience is now more than 70 years. We began our nuclear experience in Russia in 1945 just after the Second World War. In 2015, we celebrated our 70th year anniversary.

How does your history help us?

We can bring our experience not just strictly in the area of nuclear power, but to use nuclear in other areas such as nuclear medicine, radioactive technologies for agriculture, radioactive tech for different industrial solutions among others. One opportunity is the fact that there is a huge energy deficit in Nigeria; there are several figures to compare. Nigeria's population is more than that of Russia.

We have 140 million people in Russia, Nigeria has about 180 million. We have about 220 Gigawatts of electricity in the national energy system, Nigeria has six Gigawatts. This means that Nigeria is suffering from lack of electricity. "Nigeria is very similar to Russia. We have many natural resources like coal, gas, among others, just as Nigeria does. But even at that, Russia is still investing in nuclear.

Why?

Every country should have a special solution as to what sort of energy mix it wants to have. And it is very dangerous to have only one source of energy no matter how efficient it is. For example, we have a lot of coal and gas, but their prices have a high volatility. Sometimes they are very high, sometimes they are low. What we must take note of is the final cost of electricity, which is approximately 60 or 70 percent higher.

If the price of coal doubles, it means that the final cost of electricity will be 70 percent more; same for gas. However the cost of uranium, which is produced on a nuclear power plant, has just a three percent implication on the cost of electricity. Even if the cost of uranium goes up, you may not even feel the little impact it would have on electricity. That is very important for the people and for the industries. If you have predictable prices for electricity for the next sixty years, which is the minimum time to operate a modern nuclear power plant, it really

## **Mcanxixun Information**

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helps to grow the economy.

In 2012, Nigeria signed an international agreement for the construction of the first nuclear power plant and Rosatom was chosen to do that. How far has it been?

You are correct. We are very proud of that and will do our best to achieve this goal. “What we decided to do was to create a special joint committee which is headed from the Russian side by me, and from the Nigerian side, by Dr. Franklin Erepano Osaisai, Chairman, CEO of Nigeria Atomic Energy Commission. This joint coordination committee had several tasks.

The first was to implement this agreement with Nigeria about the construction of the first nuclear power plant. We have made some practical steps. We have prepared the project development agreement. It is a lot of work even before the project itself starts. We need to prepare good feasibility studies for banks and other investors.

Future nuclear development

We also prepared a very detailed plan about what we will do in the next two years to be able to finalize this feasibility study and then be ready to commence the project before the start of 2019. It is a good opportunity for both countries. “Our focus is on preparing a detailed plan on how we can answer all the tough questions in the space of two years.

But, in 2016 in Moscow, there was another Inter-Governmental agreement?

Yes, that is for the first multi-purpose nuclear research centre in Nigeria. It is very important because it can be done much faster than a nuclear power plant, it can create a platform for the future nuclear development of the country, and can help young people to start making scientific experiments and research in the field. It is a very practical step and can aid in area of nuclear medicine. The centre would be able to make nuclear isotopes that can aid therapy and fight against cancer and other types of ontological diseases. We will start work on the centre immediately.

This will also aid in the agricultural sector. Radiological treatments can keep agricultural products fresher for longer. It also fights against microbes. Just like we discussed with the Minister of Science and technology, Agriculture is very important to Nigeria. So if we find a way to preserve products for longer, it aids trade and exportation. It is very important that we prepare a draft of project development agreement for this project. Our idea is to finalize plans and sign all relevant contracts before the first half of 2018, and then in the second half of 2018, we plan to construct the nuclear resource centre.

How long can this project take to achieve?

We are just at the preliminary stages now, but I believe that we have a very detailed timeline of what we want to do in the future. Rosatom isn't the only determining factor, there are other players. However, if all the parties follow the timeline we agreed on today, I think we can be successful. It's difficult to say because it is the first nuclear project in the country, but the results of the special check up mission which was just a few months ago, by Atomic agencies of the most respected international organisations is very positive.

Please pardon my curiosity. Is low electricity capacity enough reason to jump into nuclear? Why does Nigeria need nuclear?

It is true that nuclear is new for Nigeria. But it is new for a lot of countries as well. But it should be a comfortable move when you are working with an experienced partner like Rosatom.

Using an energy mix is very profitable. You can use coal, solar, wind, hydro and nuclear. Nuclear is very stable and very predictable. Coal and gas plants are like a box, but it's not your box. It is a box which is imported to your country from another country, and the participation of Nigerian industry in construction is very small. Nuclear however, is a huge infrastructure. Even countries that just began their construction of nuclear, there is a lack of experience. 20 to 25 percent of the project can be done by local companies.

Equipment producer

Four nuclear units for example is a huge investment, about 20 billion dollars. If you create four units, believe me, you will be able to fulfil about 40 percent of the project; which means about eight billion dollars for local companies. We can calculate the social economic impact of the construction of nuclear power plants to the whole economy.

Each dollar invested in a nuclear power plant adds three to four dollars to a country's GDP. The equipment is produced from metal, so the equipment producer makes some orders to the metal producer, who will pay salaries for people, produce the next level of orders, and on each level, you have money and there is a multiplier effect. This has a positive effect on the economy, particularly now there is recession.

## 随着核能源的出现，尼日利亚电价指日可待

尼日利亚对核电站的探索，看似正在积蓄能量。自从尼日利亚与俄罗斯就于 2012 年建立第一个核电厂签署合作协议以来，该国已经在这方面做出了很多努力。

虽然这种做法引起了世界各地很多观察者的注意，但也受到了很多否定者的批评，他们将这个国家比作一个还没学步就想学会跑的幼儿。

当然，不是所有人都像 Kirill Komarov 博士一样了解核能源。作为俄罗斯一家核能源企业 Rosatom 的行政副总裁，他坚信这个国家已经在核能方面做足了准备。

在这次对 Hi-Tech 的独家采访中，他谈及到了在可预见的成本范围内，核能对于转移国家的能源使用方面和改变一成不变的经济的能力。摘录：

来自 Osuagwu 王子

是什么将你带到这里？

在某写方面，Rosatom 对于尼日利亚非常感兴趣。我们是一个很独特的组织，因为我们同时有两层社会身份，一层是俄罗斯的和能源部门，另一层面是作为一个商业组织存在。我们拥有 400 多个营业单位。但最独特的莫过于我们是世界上唯一一个融合了所有在核能方面所要求的技术的组织，从缩小或扩大铀来生产核燃料产品，到生产核设备并且从中建造核工厂。

对于像尼日利亚这样的国家，我们能将很多东西搬到台面上来，因为我们已经有了 70 多年研究核能的经验。我们在俄罗斯，也就是二战结束不久的 1945 年就开始了研究核能，我们已经庆祝了我们研究 70 周年的纪念日。

你们的历史能够帮助我们什么？

我们不仅能够将我们的经验放在核能领域非常严格的研究上，还能将核能利用在别的领域，例如在农业方面可以应用的核药物，放射性技术。还能将放射技术应用到不同工业解决方案。这是一个千载难逢的机会，因为尼日利亚已经出现了很严重的能源赤字，这也有很多数据可以比对，尼日利亚的人口已远远超过俄罗斯的人口数目。

我们在俄罗斯有 1 亿 4000 万人，尼日利亚大约 1 亿 8000 万人。我们国家能源系统有大约 220 吉瓦的电力，而尼日利亚是 6 吉瓦。这意味着，尼日利亚正遭受着电力短缺。尼日利亚和俄罗斯非常相似。我们有很多像煤炭、天然气等这样的天然资源。但即使如此，俄罗斯仍在投资核能。

原因

对于希望的能源结构，每个国家应该有一个特殊的解决方案。只有一种能源来源都是非常危险的，不管它有多高效。例如，我们有大量的煤炭和天然气，但它们的价格有很高的波动性，有时高有时低。我们必须注意的是，最终的电力成本大约是 60% 或者 70%。

如果煤炭价格翻倍，则意味着最终的电力成本将增加 70%；同样用于天然气。然而，核电站的铀成本仅占电力成本的 3%，即使铀的成本上升，你甚至都感觉不到它对电力的影响。这对人民和工业都是非常重要的。如果你预测未来 60 年的电价，也就是现代核电站运营的最短时间，这对经济增长确实有帮助。

2012 年，尼日利亚签署了第一个核电厂建设的国际协议，所以选择了 Rosatom。现在进行到哪里了呢？

你是正确的。我们对此感到非常自豪，并将尽我们最大的努力实现这一目标。我们决定要做的是，创建一个特殊的联合委员会，俄罗斯方面以我为首，尼日利亚有尼日利亚原子能委员会的 CEO 兼董事长 Franklin Erepano Osaisai 博士。该联合协调委员会有几个任务。

首先是与尼日利亚就第一核电站建设达成协议。我们已经做了一些实际的行动。我们已经准备好了项目开发协议。项目本身启动前甚至还有大量工作。我们需要为银行和其他投资者准备好可行性研究。

未来的核发展

我们还准备了一个非常详细的计划，我们将在未来两年内完成这项可行性研究，然后准备在 2019 年之前开始这个项目。这对两个国家都是一个很好的机会。我们的重点是准备一个详细的计划，我们如何在两年内解决所有的问题。

但是，2016 年莫斯科会有另一个政府间的协议？

是的，这是尼日利亚第一个多用途核研究中心。这是非常重要的，因为它可以做得比核电厂快得多，可以为国家未来的核发展创建一个平台，并可以帮助年轻人开始在该领域的科学实验和研究。这是一个非常实用的步骤，可以帮助核医学领域。该中心可以使用核同位素，可以帮助治疗并对抗癌症和其它类型的本体论疾病。我们马上就要开始工作了。

这也有助于农业部门。放射治疗可以保持农产品新鲜的时间。它也对抗微生物。正如我们与科技部长讨论过的一样，农业对尼日利亚非常重要。因此，如果我们找到一种使产品保存时间更长的方法，它会有助于贸易和出口。我们为这个项目准备一份项目开发协议草案是非常重要的。我们的想法是，在 2018 上半年敲定计划并签署所有有关合约，然后在 2018 下半年，我们计划兴建和资源中心。

这个项目需要多长时间才能实现？

我们现在正处于初步阶段，但我相信我们有一个非常详细的时间表，关于我们未来做什么。Rosatom 不是唯一的决定因素，还有其他的玩家。不过，如果所有的政党都按照我们今天商定的时间表，我认为我们能够成功。这很难说，因为这是该国的第一个核项目，但几个月前，最受尊敬的一个国际组织原子能机构特殊检查任务的结果是非常积极的。

请原谅我的好奇心。低电量是否足够致使我们走上核能的道路？为什么尼日利亚需要核能？

核能对尼日利亚的确是很新鲜的。但它对于很多国家也很新鲜。不过这应该是一个很舒适的举动，当你与像 Rosatom 这样经验丰富的合作伙伴一起工作时。

使用能源组合是非常有利可图的。你可以使用煤炭。太阳能、风能、水能和核能。核能很稳定且可预测。煤炭和天然气厂就像一个盒子，但不是你的盒子。这个盒子是从一个国家进口来的，而且尼日利亚工业参与建设是非常小的。然而，核是一个巨大的基础设施。即使是刚开始建设核的大国，也缺乏经验。项目的 20-25% 是由当地公司完成的。

设备生产商

举个例子，四核机组是一个巨大的投资，约 200 亿美元。如果你创建四核机组，相信我，你将能够完成项目的 40%，这对本地公司意味着约 80 亿美元。我们可以计算出核电站建设对整个社会经济的影响。

投资于核电站的每一美元，都会给国家的 GDP 贡献 3-4 美元。设备是由金属制造而成，所以设备生产商向金属生产商下达订单，他们支付人们工资让其生产下一级订单，而且每个级别都是如此。你有钱，并且有乘数效应。这对经济有积极的影响，尤其是现在经济正处于衰退。

## Coal (煤炭)

### **Market Conditions Force Coal Unit Closures in Australia, Germany**

Difficult market conditions have accelerated the much-hyped closures of a string of coal-fired power units in the U.S., but the phenomenon is extending overseas, gripping plants in Australia and Germany.

In the wake of the Paris agreement in December 2015, a number of governments have moved to phase out coal-fired generation. This October, France, which gets a mere 3% of its power from coal, said it would shut down all its remaining coal plants by 2023. Then, in early November, Canada's Liberal government announced a nationwide phase-out of coal power without carbon capture and storage by 2030, though it later allowed the province of Saskatchewan to keep running coal plants under an equivalency agreement. The move echoed the UK's intentions, announced nearly a year before, to shutter all unabated coal power plants by 2025 and restrict their usage from 2023. Then, in November 2016, Finland also announced a plan to phase out all coal burning by 2030, noting that coal-fired power made up about 7% of the Nordic country's generation in 2015. Finally, a non-binding motion by the Dutch parliament in September 2016 to cut the country's carbon emissions 55% by 2030 has spurred lawmakers to contemplate retiring five remaining coal units in the Netherlands.

In addition to these policy shifts, coal plants are also suffering economically in several countries, forcing their premature retirement.

In November, French firm ENGIE, which has publicized a strategy to gradually end its coal activities, announced it would close the 1.6-GW Hazelwood coal generating station (Figure 5) and an adjoining mine in Victoria, Australia's most densely populated state, by the end of March 2017. Among the reasons for its decision to shutter the plant are that it has been operating in "difficult market conditions with lower electricity prices and a surplus of electricity supply" in Victoria.

According to a market insight report published in November by the Australian Energy Market Operator (AEMO), the plant accounts for about 14% of total firm capacity in Victoria, and 4% of total firm capacity installed in Australia's National Electricity Market. But because Victoria's generation exceeds the needs of the region, Hazelwood's closure will serve only to reduce surplus generation that the state has traditionally exported. AEMO projected that increased output from black coal generation in New South Wales and South Australian gas-fired generation would replace more than 90% of the consumption previously met by Hazelwood. However, it warned that the supply and demand balance would be "tighter" during peak periods.

Also in November, Germany's fifth-largest power generator, STEAG, cited "changes to the market environment brought about by energy policy" and persistently low power prices as reasons to close five of its hard coal units—a combined capacity of about 2.5 GW—before the end of 2017: West 1 and 2 in Voerde and Herne 3 in North Rhine-Westphalia, and Weiher and Bexbach in the Saarland. The company remarked that the troubling market conditions have led to "a situation in which many large-scale conventional power plants in Germany can no longer operate cost-effectively." STEAG also noted that it has been able to keep its power plant portfolio on the market "for a long time by optimizing the cost and revenue structure at an early stage but that a "drastic deterioration in the market situation," had forced it to take the "hard and sad step" to close the plants to preserve the company's commercial viability.

### 市场条件迫使澳大利亚和德国煤炭厂关闭

艰难的市场环境加速了美国一系列燃煤火电机组的关闭，但该现象延伸到了海外，澳大利亚和德国的工厂也面临这种情况。

在 2015 年 12 月的巴黎协议之后，一些政府已经开始逐步取消燃煤发电。今年十月，法国仅有 3% 的煤炭能源，并称在 2023 年前将关闭所有剩余的煤炭工厂。然后，在十一月初，加拿大自由党政府宣布在 2030 年全国淘汰煤炭发电的捕获和储存，虽然后来允许萨斯喀彻温省保持对等协议下运行的燃煤电厂。此举呼应了英国的意愿，英国在一年前宣布，从 2023 年开始限制燃煤电厂的使用率，在 2025 年前关闭所有燃煤电厂。然后，在 2016 年 11 月，芬兰还宣布了一项计划，在 2030 年前逐步淘汰所有燃煤，并指出，燃煤电力在 2015 年占了北欧国家电量的约 7%。最后，由荷兰议会在 2016 年 9 月提出的不具约束力议案，旨在 2030 年前减少国家 55% 的碳排放量，促使立法者考虑关闭在荷兰仅剩的五个煤炭厂。

除了这些政策的转变，煤炭厂在几个国家中也遭受了经济上打击，迫使他们提前退休。

十一月，法国公司 ENGIE，有宣传策略将逐步结束其煤业务，宣布截至 2017 年 3 月底将关闭在 Victoria 澳大利亚人口最密集的州邻近一个的煤矿和 1.6-gw Hazelwood 煤炭发电站（图 5）。决定关闭该工厂的原因之一是，在 Victoria 它一直以“低电力价格和电力供应过剩的艰难市场条件下运行”。

根据由澳大利亚能源市场运营商市场（AEMO）发表在十一月的洞察报告中指出，该公司负责 Victoria 地区的能量为其总产能的 14%，并投入到澳大利亚国家电力市场的部分为公司总容量的 4%。但由于 Victoria 超过了该地区的需求，Hazelwood 的关闭只会减少该地区电力出口的传统。AEMO 预计增加产量将来自新南威尔士的黑煤炭发电和南澳大利亚的燃气发电，这些可以代替 Hazelwood 发电厂 90% 的量。然而，它警告说，在高峰期供应和需求平衡将很“紧”。

同样在十一月，德国的第五大发电厂 STEAG，引用“能源政策改变”和持续低功率价格为理由，在 2017 年底前关闭五个硬煤单元组，容量总计约为 2.5 GW：West 1 和 2 在北莱茵，Herne 3 在北威斯特法伦州，Weiher 和 Bexbach 在萨尔兰州。该公司说，令人不安的市场环境导致了“德国的许多大型传统发电厂不能成本有效运作”的情况。STEAG 还指出，该公司已经能够保持其电厂投资市场上“在早期阶段通过优化成本和收入结构在很长一段时间保持盈利，但是在市场形势急剧恶化下，迫使他们采取“艰苦和悲伤的步骤”以关闭工厂保护公司的商业可行性”。

### Power sector sees 6% fall in coal supply from CIL

The despatch of dry fuel by Coal India Ltd (CIL) to the power sector in November last year stood at 35.9 million tonnes (MT), according to government data.

The supply of coal by CIL in April–November period of the ongoing fiscal also dropped by 4 per cent to 250.7 MT over 261.4 MT in the corresponding period last fiscal. The supply of coal by Singareni Collieries Company (SCCL) during the April – November period was almost flat at 31.3 MT against 31.1 MT in the year–ago period.

SCCL is a government coal mining company jointly owned by Telangana and the Centre on a 51:49 equity basis.

The government, in October, had said that there were no plans to cut down coal production as the demand had already picked up.

In October, the demand started picking up for both coal and power sectors, it had said.

CIL, which accounts for over 80 per cent of the domestic coal production, is eyeing 598 MT production in 2016–17. CIL has a target to produce 1 billion tonnes of fossil fuel by 2020.

Source: PTI

## 印度电力部门表示 CIL 公司煤炭供应量降低 6%

根据政府数据，去年 11 月，印度煤炭有限公司（CIL）分派给电力行业的干燃料（dry fuel）达 3590 万吨。

在去年 4 月到 11 月的财政年，CIL 的煤炭供应与同期的 261.4 公吨煤炭供应，也下降了 4 个百分点至 250.7 公吨。4 月到 11 月期间，Singareni 煤矿公司（SCCL）与前年同比是 31.3 公吨比 31.1 公吨，几乎持平。

SCCL 是一个政府煤矿公司，以 51：49 的股权与股权基础中心共同拥有。

政府曾在 10 月分表示，由于需求已经回升，没有计划削减煤炭产量。

去年 10 月，煤炭和电力行业的需求开始回升。

CIL 在国内煤炭生产中的占比超过 80%，旨在 2016-2017 年生产 598 公吨煤炭。CIL 的目标是，到 2020 年生产 10 亿吨化石燃料。

来源：PTI

## China targets aggressive coal capacity cuts to 2020

China aims to cut the capacity of its coal mines by 300m tonnes a year until 2020 even as production and consumption of the fuel increases, according to the country's top economic planner.

Beijing is targeting output of 3.9bn tonnes of coal in 2020, up from 3.75bn tonnes in 2015, said the National Development and Reform Commission, adding that consumption will rise to 4.1bn tonnes from 3.96bn tonnes over the same period.

Under the plan, revealed at the end of last week, the NDRC will cut 800m tonnes of "outdated" and inefficient coal capacity each year while adding 500m tonnes of "advanced" capacity. The reductions will be concentrated among smaller mines in the north-east. Big producers in the western regions, such as Inner Mongolia and Xinjiang, will boost supplies.

Surging coal prices were among the biggest surprises in commodity markets during 2016. After China introduced production curbs in April the price of thermal coal, used to generate electricity in power stations, more than doubled, reaching \$110 a tonne in Asia as utility companies were forced to import material. International suppliers include BHP Billiton, Glencore and Rio Tinto.

The price of coking coal, a key ingredient in steelmaking, also surged as a consequence of the supply curbs, to more than \$300 a tonne, making it the best performing commodity of 2016.

Those gains have faded as Beijing — alarmed by the spike in price — relaxed the controls. High-quality Australian thermal coal is trading around \$94 a tonne, while premium hard coking coal has slipped back to \$224.

With China the world's largest coal consumer and biggest emitter of greenhouse gasses, Beijing has set aggressive targets to cut coal overcapacity by half a billion tonnes "over the next few years".

The reductions reflect an effort to bolster prices and allow China's chronically bloated state coal miners to repay loans. However, planners failed to account for the degree to which private miners had also dropped out of the market, and were caught off-guard when investors profited by the squeeze to drive up futures prices of coking coal.

## 中国确定每年煤炭去产能 3 亿吨

国家发改委公布，到 2020 年，每年将淘汰 8 亿吨“落后”和效率低下的煤炭产能，同时增加 5 亿吨“先进”产能。

中国最高经济规划机构称，中国的目标是到 2020 年每年减少 3 亿吨煤炭产能，即便这种燃料的生产和消费在增加。

国家发展和改革委员会(NDRC)表示，北京方面的 2020 年煤炭产量目标为 39 亿吨，高于 2015 年的 37.5 亿吨。该机构补充说，同期消费量将从 39.6 亿吨升至 41 亿吨。

根据上周结束时公布的这份计划，国家发改委每年将淘汰 8 亿吨“落后”和效率低下的煤炭产能，同时增加 5 亿吨“先进”产能。淘汰落后煤矿的行动将集中在东北地区规模较小的煤矿。西部地区（如内蒙古和新疆）的大型生产商将增加供应。

煤炭价格飙涨是 2016 年大宗商品市场最大的意外之一。在中国于 4 月出台生产限制措施后，用于燃煤电厂的动力煤的价格上涨一倍多，在亚洲达到每吨 110 美元，因为公用事业公司被迫进口原料。国际供应商包括必和必拓(BHP Billiton)、嘉能可(Glencore)和力拓(Rio Tinto)。

炼钢关键材料焦煤的价格也因为供应限制而出现飙升，达到每吨 300 美元以上，成为 2016 年表现最好的大宗商品。

随着对煤价飙升感到震惊的北京方面放松控制，煤炭价格涨幅已有所缩水。高品质澳大利亚动力煤目前价格为每吨 94 美元左右，而优质硬焦煤的价格已回落至每吨 224 美元。

鉴于中国是世界上最大的煤炭消费国和最大的温室气体排放国，北京方面先前就设定了激进的目标，拟在未来几年将煤炭过剩产能削减 5 亿吨。

这个去产能目标反映了旨在支持价格、让中国长期臃肿的国有煤矿企业能够偿还贷款的努力。然而，规划者低估了私营矿企也在退出市场的程度，而且在投资者利用供应紧缺推高焦煤期货价格而获利时措手不及。

## IEA: Coal Boom Is Over

If broad policy commitments announced by various countries are implemented, coal will not only lose its rank as the dominant fuel for power generation to renewables by 2040, but the world's coal fleet will be significantly transformed by technology advances, the International Energy Agency's (IEA's) newly released World Energy Outlook (WEO-2016) forecasts.

Under a baseline (“New Policies”) scenario that assumes national decarbonization pledges will be satisfied and fossil fuel subsidies will be phased out, the forecast predicts that recent growth of coal use in the global power sector (coal accounted for a hefty 41% share of global power generation in 2015) will slow substantially. Coal generation will grow only modestly, to 10,785 TWh in 2040, up from 9,700 TWh in 2014. The WEO-2016 starkly notes: “[T]he boom is over: global coal demand declined in 2015 for the first time since the late 1990s.”

One reason is that by 2040, the world's coal fleet will be transformed by efficiency improvements underpinned by a shift in boiler technology. Today, about 70% of the world's coal fleet operates at subcritical steam conditions. By 2040, the share of subcritical plants will plummet to 45%. Meanwhile, around 400 GW of new supercritical and 330 GW of new ultrasupercritical plants will be built over the next 25 years, the IEA said.

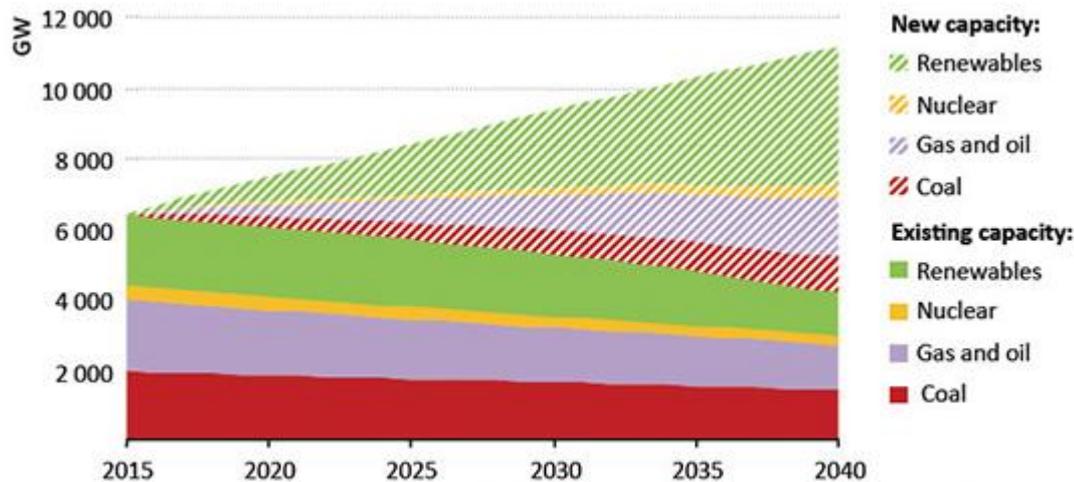
The agency also doled out dim predictions for global gas-fired generation. The power sector accounts for about 34% of growth in global gas, but gas will face stiff competition in some import-dependent markets—especially in Asia—where it cannot compete with coal on price or with renewables for policy support. “In key Asian power systems new gas plants would be a lower cost option than new coal plants for baseload generation by 2025 (when gas prices reach \$11/MBtu and coal prices approach \$75/tonne), only if coal prices were \$150/tonne,” the agency said.

The European Union (EU) has seen “subdued” economic growth along with a rapid build-up of renewable

generating capacity, the agency noted. This has created slack in the EU Emissions Trading System, reducing the carbon dioxide (CO<sub>2</sub>) price and “helping to tilt the economic calculation away from gas and towards coal,” the IEA said. In a notable reversal, gas use in the EU power sector has fallen by nearly 12% per year, on average, between 2010 and 2014. Even in countries showing strong power demand growth—as in much of Asia—gas has struggled to gain ground. “In China, the double-digit growth rates in gas demand have faded: liquefied natural gas (LNG) imports to China hardly increased in 2015,” the IEA said. Gas, which is carbon intensive, could also be impacted by the Paris Agreement, it added.

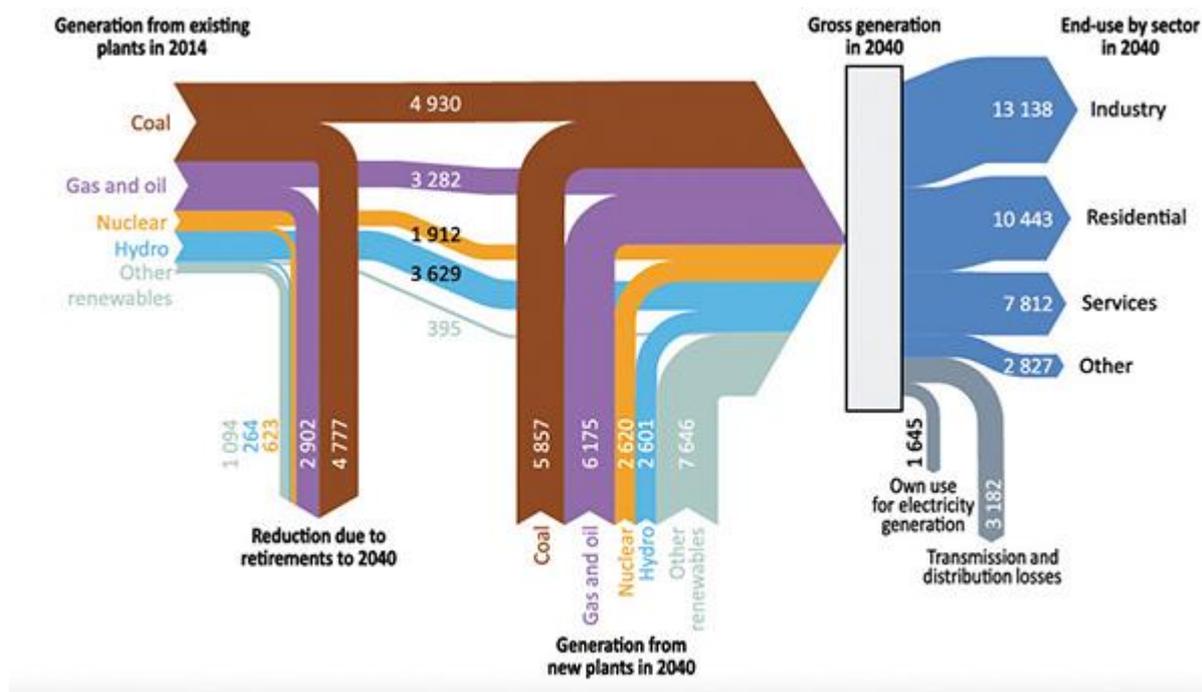
Notably, the IEA underscored widespread uncertainty owing to shifting policies during what it deems will be a period of unprecedented transformation. Clear winners may emerge over the next 25 years, such as wind and solar, said Dr. Fatih Birol, the agency’s executive director. “But there is no single story about the future of global energy: in practice, government policies will determine where we go from here.”

However, by 2040, the world’s electricity supply will likely diversify and decarbonize, the agency predicted (Figure 1). For the first time, in 2015, additions of renewables-based generating capacity worldwide exceeded those from all other energy sources combined, while total installed renewables capacity (including hydropower) surpassed that of coal. Wind and solar and bioenergy-based renewables are also poised to increase their market share from 6% in 2014 to 20% in 2040. “Globally, by 2040 producing a unit of electricity is projected to emit one-third less CO<sub>2</sub> than today; but emissions from the power sector still rise by 6%,” said the IEA.



1. A generation shift. The International Energy Agency (IEA) projects that global installed generating capacity will rise from 6,400 GW in 2015 to nearly 11,200 GW in 2040 under a baseline scenario, which assumes that currently announced policies and plans will be implemented. But, it cautions, within this overall figure lies a complex regional pattern of capacity retirements, additions, and shifts in the makeup of the generation capacity, varying over time. Source: IEA World Energy Outlook 2016, Figure 6.10

Nuclear power will play a mammoth role in decarbonization efforts. Between the start of 2015 and late 2016, 19 new nuclear reactors commenced operation (two-thirds of them in China), and construction began on nine new reactors over the same period. Today, about 64 GW of new nuclear capacity is under construction, a third of it in China, but also in Russia, the United Arab Emirates, the U.S., South Korea, the EU, and in India. And, the IEA stressed, while 14% of the global nuclear fleet is 40 years old or more, some countries are moving to extend nuclear plant lifetimes to 60 or even 80 years.



2. Global generation by fuel and demand. Under a baseline scenario, the IEA projects that the global generation mix will become more diverse to meet a power demand increase of 13,700 TWh by 2040. Source: IEA World Energy Outlook 2016, Figure 6.11

However, the IEA expects that a majority of the world’s currently existing power facilities—of all fuel types—will be retired by 2040. Only 36% of total generation will come from existing plants, it said, highlighting what it expects will be a massive challenge in attracting investment for new generation capacity (Figure 2). Cumulative global investment in the power sector will hover at \$19.2 trillion over the period between 2016 and 2040—averaging \$770 billion per year. About 42% will be spent on transmission and distribution, 14% on fossil fuels, 13% on wind, 11% on solar, 9% on hydro, 7% on nuclear, and 4% on other renewables, it projected.

## 国际能源署：煤炭的繁华时代已经结束

如果各国宣布的广泛政策承诺会实施，煤炭不仅会在 2040 年败给可再生能源失去其在发电的主导地位，而且煤炭舰队也将随着技术的进步明显转化，国际能源署 (IEA) 公布了最新的世界能源展望预测 (WEO—2016)。

在基线 (“新政策”) 情况下，假定国家承诺兑现脱碳的承诺，且化石燃料补贴被淘汰，该预测认为近期煤炭在全球能源结构中的增长 (2015 年，煤炭占全球发电量高达 41%) 将大幅减缓。煤炭发电将增长缓慢，从 2014 年的 9700 太瓦时到 2040 年只达到 10,785 太瓦时。WEO-2016 赤裸裸地指出：“【T】该繁荣已经结束了：2015 年，全球煤炭需求量下降，这是自上世纪 90 年代末以来的第一次。”

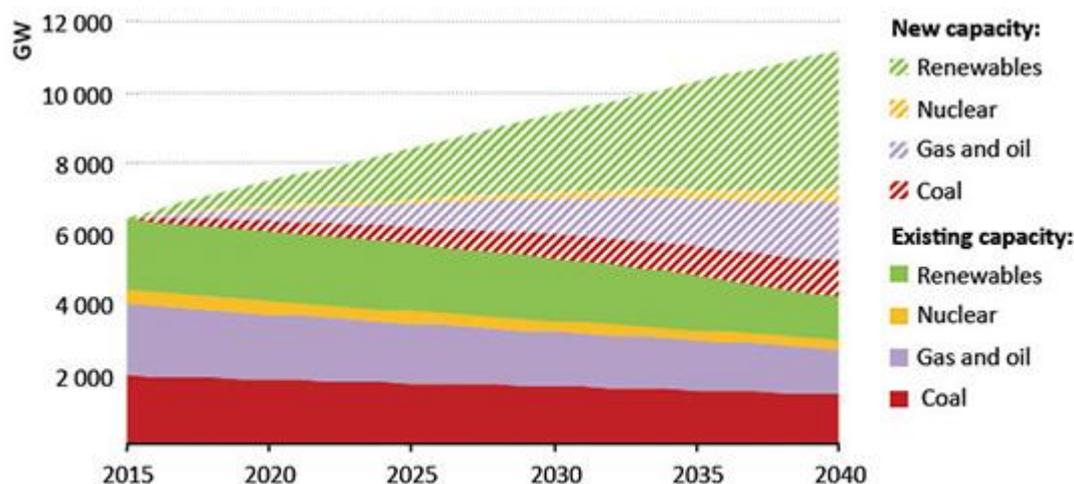
一个原因是，到 2040 年，世界煤炭舰队将转变锅炉技术支持的效率改进。现在，大约 70% 的世界煤炭舰队在亚临界蒸汽条件下运行。2040 年，亚临界电厂的份额将下降 45%。与此同时，IEA 表示，400GW 的新超临界电厂和 330GW 的新超超临界电厂将在未来 25 年内建成。

该机构还提供对全球燃气发电的预测。全球天然气在能源部分大约占 34%，但是天然气将面临一些依赖进口市场的激烈竞争——尤其是在亚洲——天然气无法与价格低廉的煤炭或政策支持的可再生能源进行竞争。该机构说：“到 2025 年的基荷发电，在亚洲主要的动力系统中，新型天然气发电厂将比新的煤炭发电厂的成本更低 (当天然气价格达到 \$11/MBtu，煤炭价格接近每吨 75 美元)，只要煤炭价格是每吨 150 美元。”

该机构指出，欧盟（EU）已经看到了“疲软的”经济增长，以及可再生能源发电能力的迅速增长。IEA表示，这造成了欧盟牌坊交易体系的松弛，减少了二氧化碳（CO<sub>2</sub>）的价格，并且“帮助倾斜的经济计算天然气和煤炭的价格”。在一个显著的逆转中，欧盟电力部门天然气的使用量在2010-2014年期间，平均每年下降近12%。即使在用电需求强劲增长的国家——许多亚洲国家——天然气已经争取到了普及。IEA表示：“在中国，天然气的需求增双位数增长已经停滞：2015年，进口到中国的液化天然气（LNG）几乎没有增加。”天然气是碳密集型能源，可能也会受到巴黎协定的影响。

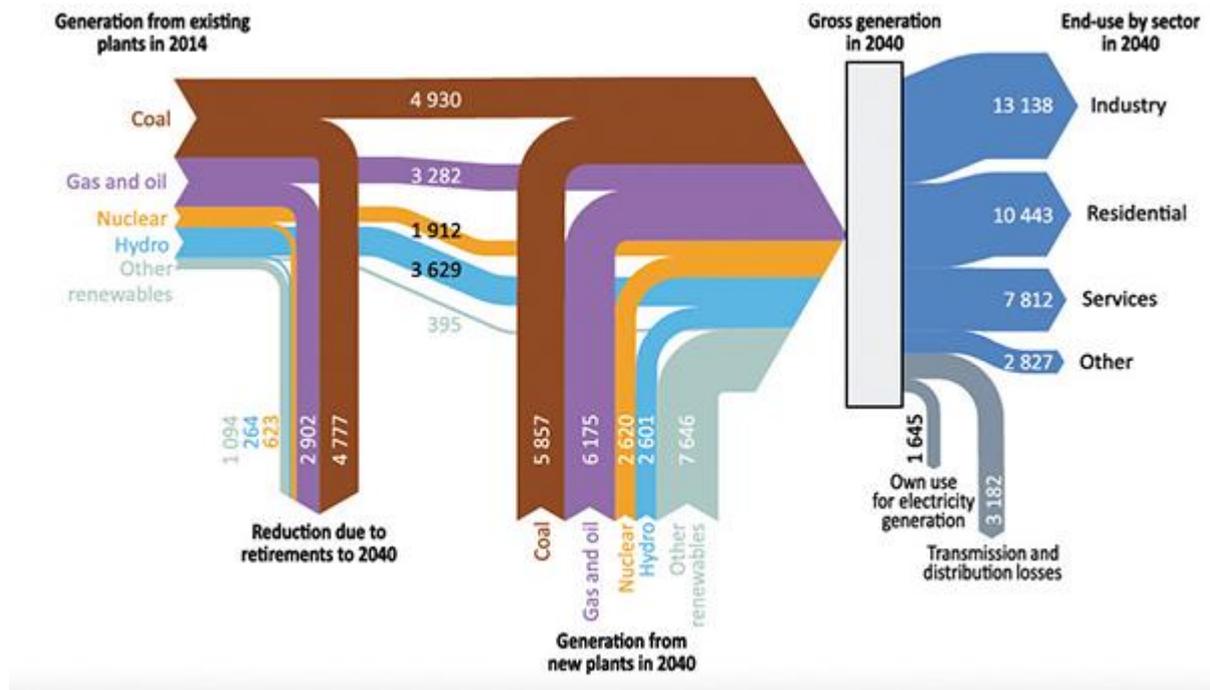
值得注意的是，IEA强调了转移政策广泛的不确定性，这看起来将是前所未有的一段转型。该机构的执行主任Fatih Birol博士说，接下来的25年内，会出现真正的赢家，例如风能和太阳能。“但是关于全球能源的未来不仅仅只有一个：在实践中，政府的政策将决定我们何而来。”

然而，该机构预测，到2040年，全球电力供应将可能会多样化脱碳化（图1）。2015年，全球可再生能源的增加将第一次超过其他所有的能源总和，而可再生能源（包括水电）将超过煤。风能太阳能和生物质能这些可再生能源的市场份额也将从2014年的6%增加到2040年的20%。IEA表示，全球范围内，2040年生产的单位电量预计将比今天少三分之一的二氧化碳排放；但电力部门的排放量依然上涨了6%。



1.能源的转变。国际能源署（IEA）计划，在基线下，全球发电装机容量将从2015年的6400GW到2040年的11200吉瓦，这表明，目前宣布的政策和计划将实施。不过，它也警告说，这一整体形象下是一个复杂的区域能力要求，另外，发电容量的组成会随着时间变化。来源：IEA2016年世界能源展望，图6.10。

核电将在脱碳方面发挥巨大的作用。在2015年的开头和2016年的结束，19个新的核反应堆开始运作（中国占了三分之二），并同期建设了九个新的反应堆。现在，大约64GW的新核电站正在建设中，三分之一在中国，其他的在俄罗斯、阿拉伯联合酋长国、美国、韩国、欧盟及印度。IEA强调，全球14%的核舰队的寿命是四十岁以上，而一些国家的正在努力延长核电站的寿命到60年甚至是八十年。



2.全球燃料的需求。在基线的情况下，IEA 计划全球发电组合会更加多样化，以满足 2040 年增长 13700 太瓦时的电力需求。来源：IEA2016 年世界能源展望，图 6.11。

然而，IEA 预计，世界上多数现有的各种类型的燃料发电将在 2040 年停工。只有 36% 的总发电量将来自现有的电厂，而且突破他的期望吸新一代能源的投资，将是一个巨大的挑战（图 2）。电力领域累积的全球投资在 2016-2040 年间，平均每年达到 7700 亿美元。预计，其中，约 42% 将用于传输和分配，14% 用于化石燃料，13% 用于风能，11% 用于太阳能，9% 由于水能，7% 用于核能，4% 用于其他可再生能源。

## Electricity (电力)

### Renewables = 25% Of UK Electricity Generation In 3rd Quarter, Met 60% Of Scottish Needs In 2015

Electricity generated by renewables has accounted for 25% of the UK's total electricity generation for the third quarter according to government figures, while the same report reveals that renewables accounted for nearly 60% of Scotland's electricity needs in 2015.

New figures published by the UK's Department for Business, Energy & Industrial Strategy in its Energy Trends December 2016 report show that renewables' share of electricity generation increased to 25% in the third quarter, up from 23.6% a year earlier. Specifically, offshore wind electricity generation increased by 3.8% and onshore wind generation increased by 19.4%, accounting for 3.5 terawatt-hours (TWh) and 4.6 TWh respectively.

Solar PV increased its share by an impressive 30%, growing to 3.5 TWh up from 2.7 TWh due to increased capacity. Unfortunately, keeping renewable energy's contribution from soaring even higher, bioenergy fell by 14.5% due to outages at the Drax power station.

All told, with renewables accounting for 25%, the remainder was made up with 25% from nuclear energy (which

you can fight over whether it's a good or a bad thing), and gas with 43.6%. Coal only accounted for 3.6%, down from 16.7% a year earlier.

“The Government took the right decision when it announced the phasing out of coal, and its confidence in low carbon generation has been repaid by growth in the sector,” said Maf Smith, RenewableUK's Deputy Chief Executive.

“Renewables are now part of our energy mainstream, helping us modernise the way we keep the lights on by building new infrastructure for the generations to come. Wind is playing a central role as a reliable part of our new modern energy system, delivering reliable low carbon power at low cost.”

The Energy Trends report also highlighted the impressive role renewable electricity generation is playing in Scotland. According to the report, renewable energy produced enough power to meet 59.4% of Scotland's electricity needs throughout 2015 — up from 49.7% in 2014.

“These figures are great news for Scotland,” said Jenny Hogan, Director of Policy at industry body Scottish Renewables. “They underline the disproportionate contribution that Scotland is making to the UK's efforts to clean up our energy system.

“We know that to fight climate change we must reduce the amount of carbon emitted by our energy sector, and renewables are doing just that.”

## 第三季度英国可再生能源发电到达 25%，满足苏格兰 2015 年电力需求的 60%

根据英国政府第三季度的数字，可再生能源电力占该国总发电量的 25%，而同一份报告显示，可再生能源占苏格兰 2015 年电力需求的约 60%。

英国商业、能源与工业战略部(Department for Business, Energy & Industrial Strategy)在《2016 年 12 月能源趋势》(Energy Trends December 2016) 报告中表明，在第三季度，可再生能源的发电份额从一年前的 23.6% 提高到了 25%。具体而言，海上风力发电量增加了 3.8%，陆上风力发电增长了 19.4%，总计分别为 3.5 太瓦时 (TWh) 和 4. 太瓦时。

由于产能增加，太阳能光伏发电的市场份额上升了惊人的 30%，从 2.7 TWh 增长到了 3.5 TWh。不幸的是，为了使可再生能源的贡献更高，由于德拉克斯发电站的停运生物能源下降了 14.5%。

总之，随着可再生能源占总量的 25%，其余的 25% 来自核能源（无论你认为它是好是坏），天然气占 43.6%。煤炭只占 3.6%，低于去年同期的 16.7%。

“政府采取了正确的决定，它宣布逐步淘汰煤炭使用低碳发电的信心得到了该行业增长的回报，” RenewableUK 首席执行官 Maf Smith 说。

“可再生能源现在成为我们能源的主流部分，帮助我们实现现代化，通过世代建设新的基础设施，让我们灯光长明。风能作为我们新的现代能源系统中可靠的一部分，起着核心作用，可以低廉的成本提供可靠的低碳能源。”

能源趋势报告还强调了可再生能源发电在苏格兰令人印象深刻的作用。根据报告，可再生能源生产了足够的电力，以满足整个苏格兰 2015 年电力需求的 59.4%——比 2014 年的 49.7% 有所增长。

“苏格兰的这些数字都是好消息，” 苏格兰中体产业可再生能源政策主任 Jenny Hogan 说。他们强调，苏格兰对净化英国能源系统做出了不成比例的贡献。

“我们知道，应对气候变化，我们必须减少能源部门的碳排放量，以及如可再生能源现在正在做的这样。”

# **GE: Why grids don't need to rely on "synchronous" generation**

GE, the world's biggest industrial group and the largest supplier of energy machinery, says the world no longer needs to rely on so-called "synchronous" generation provided by coal and gas plants to ensure the stability and reliability of electricity grids.

"The days of relying solely on synchronous generation for everything are over," says Nick Miller, senior technical director for GE Energy Consulting, adding that alternatives such as inverter-linked solar can perform many of the same functions, and much more efficiently.

This is significant, particularly in Australia where a massive political debate, and media debate, has erupted over how much variable renewable energy such as wind and solar should be allowed into the system, and whether it will impact on reliability and grid security.

But the debate is not just political. The CSIRO and the network owners envisage a future based around solar, wind and storage, and little or no "synchronous" generation from coal and gas, and this vision was supported by chief scientist Alan Finkel, who pointed to the numerous technology alternatives already available.

However, the fossil fuel lobby and the conservative institutions that manage the grid operations and its rules – the Australian Energy Markets Operator and the Australian Energy Markets Commission – warn of increased disruption if synchronous generation (coal and gas plants) is replaced by renewables. They struggle to imagine a future with no large spinning machines, and AEMO's chairman Tony Marxsen insists that alternatives are years or even decades away.

GE's Miller, however, supports Finkel's view that technologies are readily available to perform the functions that many presume can only be delivered by fossil fuel generators.

He points to a new 300MW solar PV plant in California, which was connected recently with GE inverters and delivered frequency response "many times as fast and accurate" as thermal synchronous generators on the same grid.

In Texas, he says, all wind turbines are required to provide primary frequency response.

"Their markets are being adapted to make sure that every technology – wind, solar, energy storage – can participate and get paid for providing services that keep the grid stable and secure. The days of relying solely on the synchronous generation for everything are over."

That situation has not yet arrived in Australia. Promoters of battery storage, inverter technology and other "smarts" are trying to get rules changed so they no longer favour incumbent fossil fuel generators – setting the price of electricity every 5 minutes instead of every 30 minutes (and so favouring fast response technology) is key among them.

But these changes are being fought vigorously by the owners of gas and diesel generators who profit from the status quo, even though the principal regulator and the market operator agree that they distort the market at the expense of consumers.

"The good news is that inverter connected technologies like wind and solar can provide some excellent grid support services. A key objective is to improve performance standards and get greater participation from the whole system," Miller says.

"We've built our grids around synchronous generation which has good and bad properties, but we've gotten used to it for 100 years. We've now got rapidly rising levels of increasingly sophisticated asynchronous technologies. While they have their good and bad features, the trick is to take advantage of all of these technologies.

“Every technology can contribute – you have to keep re-looking at the rules to build a modern energy system.”

Miller says storage will likely be one of the technologies to assist in grid stability “but by no means is it the only – or even the main – option.

“The first thing we need is to make better use of what we already have. We need flexibility in the grid – that means physical flexibility and rules flexibility. There will be situations at the extremes of grid conditions where storage may be the best answer.

“For example, batteries provide some unique, quick ancillary services. They are being used to provide some specific grid services because they do them very well. These uses are quite tailored.

“We are far from the penetration and equipment prices that warrant large-scale energy storage for backup and massive shifting of generation from hours of plenty to hours of scarcity. There are niches today, where it makes sense, and we need to keep thinking and looking.”

Behind the meter – in homes and businesses – may be different because where there are high retail prices, battery storage is already likely to make sense. “There is a lot of debate in the industry about whether this is, in the holistic sense, the most economic direction to go. Time will tell.”

Miller said he was not in a position to comment directly on the recent state-wide blackout in South Australia.

“What I can tell you from my experience throughout the US, including places like Texas, is that it has been demonstrated that highly satisfactory levels of stability are regularly achieved in grids with a high penetration of renewable energy.

“The behaviour of the grid changes, and you may need to run it differently – in other words, it may need new rules and approaches. But technology has moved forward a long way, and grids like Texas has evolved their operating rules to take advantage of what renewable generation can do for grid stability, with great results.”

## GE：为什么电网不需要依赖“同步”发电

GE 是世界上最大的工业集团和最大的能源机械供应商。该公司认为，世界不再需要依靠煤和天然气工厂提供的所谓“同步”发电来确保电网的稳定性和可靠性。

GE 能源咨询公司高级技术总监 Nick Miller 说：“完全依赖同步发电的时代完全结束了，”替代品如逆变器连接的太阳能可以执行许多相同的功能，而且更有效率。

这是重要的，特别是在澳大利亚，围绕着应该开发多少可变的可再生能源的问题，展开了一场大规模的政治辩论和媒体辩论，如风和太阳能是否应该被允许进入系统，以及它是否可靠、是否会影响电网安全。

但辩论不只是政治性的。CSIRO 和网络所有者设想了一个以太阳光能，风能和存储为基础的未来，以及很少或没有煤和天然气的“同步”发电，这一愿景得到了首席科学家 Alan Finkel 的支持，他还指出了取代许多已有技术的替代品。

然而，化石燃料游说和管理电网运行的保守机构，即澳大利亚能源市场运营商和澳大利亚能源市场委员会，却又他们自己的说辞。他们警告说，如果同步发电（煤和天然气工厂）被可再生能源取代，那会增加发电中断的几率。他们想象不出那个没有大型纺纱机的未来。所以，AEMO 的董事长托尼·马克森坚持认为这种备选方案应该在几年甚至几十年后才会用得上。

然而，GE 的 Miller 支持 Finkel 的观点，他认为即便有些还是假设，但那种技术完全可以随时用于执行目前只能由化石燃料发电机提供的功能。

他选中了加利福尼亚的一个新的 300MW 太阳能光伏电站，它刚刚与 GE 逆变器连接成功。作为同一电网上的热同步发电机，它提供的高频率兼顾“多倍快速和准确性”。

在德克萨斯州，他说，所有的风力发电机都需要提供主要的频率响应。

“他们的市场正在调整，以确保每一种技术，比如风能，太阳能，能源存储，都可以参与其中并获得

利润，并且在提供服务的同时，还能保持电网的稳定和安全。这种情况下，就不需要单纯依靠同步发电了。

这种技术虽然还没有在澳大利亚被应用，但电池存储，逆变器技术和其他“智能”的推动者却在尝试改变之前的旧规则。相比较于新技术，他们不再喜欢现有的化石燃料发电机，最主要的一个原因是因为现有的技术需要每 5 分钟而不是每 30 分钟设置一次电价（因此赞成快速响应技术）

但是，即使主要监管机构和市场运营商想要以牺牲消费者的方式来扭转市场，但燃气和柴油发电机的所有者也因为可以从现状中受益，所以这项技术正在被大力争取。

“好消息是，逆变器连接的技术，如风能和太阳能可以提供一些优秀的电网支持服务，而且只要能再提高性能标准，就可以被更大范围地在整个系统中被应用。”Miller 说。

“我们已经建立的这种网格围绕同步发电的技术有优势也有缺点，但因为我们已经习惯了它，所以并没有觉得不妥。但现在我们已经开发出了更先进的异步技术，它虽然也是优缺点共存，但我们只要善于利用它的优点便足以解决很多旧技术不能解决的问题了。

“只要你能够根据现状建立新的能源系统的规则，每一种技术都可以起到很重要的作用。”

Miller 表示，存储将可能是协助电网稳定的技术之一，但绝不是唯一的，甚至算不上是主要的选择。

“我们需要的第一件事是更好地利用我们已经有的东西。我们需要网格中的灵活性，也可以说是物理灵活性和规则灵活性。所以在电网条件不太乐观的情况下，存储可能是最好的答案。

“例如，电池可以提供一些独特的，快速的辅助服务，所以就被用来提供一些特定的网格服务，因为这是它的优势。这些用法都是依据各自特点被相对制定的。

“我们的目的并非是为了暂时的市场渗透和获取利益，而是想要保证既有大规模的能源储存备份又能保证小范围的能源富足，不至于稀缺。现在是小众市场，这些想法是很有道理的，但我们仍需要继续思考和观察。

应用背景不同——在家庭和在企业中——可能情况会有所不同，但无论如何，因为有价格优势，电池存储成为现实已经有可能了。“在行业中有很多争论，能够顾全大局，这是最需要思考的方向。相信时间会证明一切。”

米勒说，他不能直接解释最近在南澳州全州出现停电的情况。

“我可以依据从美国获得的经验跟你这样解释，包括德克萨斯州在内，事实已经证明，在具有高可再生能源渗透的电网中，电网稳定性已经达到令人非常满意的水平了。

“网格行为的改变，需要不同的运行方式，即需要一套新的规则和方法来确保技术能被更好应用。以德克萨斯州为例，电网技术的应用已经影响了他们的运营规则，而且因为可再生能源发电的高稳定性，它因此从中获利颇丰。

## Hydro expansion will fail without energy market reform

China's government must tackle wastage in the energy sector before bringing more hydropower online, writes Liu Qin

Energy demand in China is slowing. This is causing a major headache for the hydropower sector, which has invested heavily in new projects in recent years. The continued construction of hydropower, as with coal, has led to surplus capacity, tumbling profits and an unbalanced national energy system.

Rather than address this problem, the government's new 13th Five-Year Plan for the energy sector, may actually make it worse. The plan proposes to halt the construction of small- and medium-sized hydropower plants while adding new mega hydropower projects in the country's western provinces. It hopes to solve overcapacity by transmitting more electricity from the west to the energy-hungry cities of the east. But experts say this will be difficult to achieve in practice.

### Cutting back on small hydro

The southwest provinces of Yunnan and Sichuan have particularly rich hydropower resources because they are located where several of Asia's major rivers flow. The Jinsha, which becomes the Yangtze further downstream, flows through Sichuan. In Yunnan, two of Indochina's most important rivers, the Lancang (which becomes the Mekong) and the Nu (the Salween) flow almost parallel through deep mountain gorges.

In July, Yunnan indicated that no more hydropower plants of less than 250 megawatts would be built and that existing ones would not to be expanded. Sichuan followed in October, announcing that until 2020 projects of 50 to 300 megawatts would only be approved if they helped alleviate poverty and energy shortages in remote areas.

The decision to curb small-scale hydropower generation in these provinces is motivated by economic concerns. China's hydro sector is suffering from a glut of capacity nationally, and there is little incentive to connect additional small hydro plants to the grid. Without the means to export power, water that could be channeled into turbines to produce power just flows away.

"By halting [construction] we can make better use of existing capacity," said Zhang Boting, deputy secretary of the China Society for Hydropower Engineering.

Yu Xiaogang of Yunnan environmental independent organisation Green Watershed told chinadialogue that small-scale hydropower has already reached its peak potential in the province.

"Smaller facilities face specific technical issues. The fact that grid operators are unwilling to hook up to smaller plants means that the electricity generated can't be sold," said Yu.

"In the past, [hydropower producers] would make their money back in the first decade, now it generally takes two. [The sector] is much less profitable for incoming investors, nowadays," he added.

However, smaller plants do have some advantages over larger mega projects; their environmental impact is smaller, and if located appropriately, they can supply power to remote areas in need of energy. The government has acknowledged these factors in its plan, which supports "the use of small-scale hydropower in remote off-grid areas, for poverty-relief and development".

### Caught out by the market

Experts argue the government's focus on halting small-scale hydropower projects is misplaced and that it will have a limited effect on alleviating the problem of surplus capacity.

China is the world's largest producer of hydropower, with 80% of potential hydropower resources concentrated in Yunnan, Sichuan and Tibet. Together with Guizhou and Guangxi, these southwestern provinces are where the government is calling for the development of major "hydropower hubs" (areas of rich hydro resource that will be prioritised for the construction of mega hydropower plants). The 13th Five Year Plan for the hydropower sector names six hubs or areas. These include the upper streams of the Yangtze and Yellow River, Wu River, Yalong River and Dadu River, etc., with a total expected capacity of over 100 gigawatts.

Construction of these hubs has been encouraged in the 13th Five Year Plan that was released early in 2016, the sub plan for energy development approved on November 17, and the National Energy Administration's guidance for 2016.

### Hydropower wastage

The proposals to develop hydropower hubs and increase total hydropower capacity come at a time when China's economy is slowing down and energy demand is flattening. Existing hydropower projects are already underutilised in provinces such as Sichuan and Yunnan.

Figures from the Sichuan office of the National Energy Administration (NEA) show that 9.7 billion kilowatt hours were wasted in 2014, up from 2.6 billion kilowatt hours in 2013, an increase of almost 400%. If the situation does not improve then wastage in 2020 is projected to be 35 billion kilowatt hours, 8.6% of total hydro production for

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that year, according to the Sichuan NEA.

The situation in Yunnan is similar. Data from CNEnergy.org, the official site of China Energy News, shows that wasted hydropower capacity in the province is expected to rise ten-fold between 2013 and 2015, reaching more than 10 billion kilowatt hours.

The flood season of 2014 saw sustained daily losses of 330 million kilowatt hours, which cost Yunnan almost 100 million yuan (US\$14 million) a day in lost revenues.

The latest figures from the National Energy Administration show growth in energy demand fell from 12% in 2011 to less than 1% in 2015. The coming five years are expected to see growth in demand of between 3.6% and 4.8%. This is partly a result of ongoing efforts to shed excess capacity in many industries, which represent the bulk of China's electricity consumption.

But both Yunnan and Sichuan have expanded hydropower at a breakneck pace in recent years. Installed hydropower capacity in Yunnan quadrupled from 9.9 gigawatts in 2009 to 43 gigawatts in 2015. Since 2010, Sichuan has seen annual increases in hydropower capacity of over 20%. This expansion has coincided with the slump in electricity demand, resulting in wasted capacity.

Fan Xiao, chief engineer of the Sichuan Geology and Mineral Bureau Regional Geological Survey Team, told chinadialogue that because the construction of hydropower plants is a lengthy process it is not possible to react quickly to shifts in demand. This means that projects started during a time of economic growth are coming online even though new electricity supply is outstripping demand.

### Solving the problem

Despite the lack of demand for new hydropower, the 13th Five-Year Plan still includes plenty of large-scale hydropower projects.

Fan offers two reasons for this: first, local governments hope the projects will boost the local economy and increase tax receipts. Second, the projects are usually built by large state-owned firms that have deep pockets and strong lobbying power. Major hydropower projects are needed to keep their operations going.

In an effort to tackle the wastage problem, the new plans propose linking hydropower hubs to Guangdong and southeast China, to provide consumer markets for the electricity.

This is part of the West-East Electricity Transfer Project, a national strategy to bring power generated from coal and hydropower in the west to the developed east of the country where demand is much greater. In so doing, the initiative seeks to boost economic development in the west.

The problem with this initiative is that hydropower is competing with cheap coal-fired power. "Electricity sector reforms and the development of the market economy means that thermal power plants are being built everywhere; they are so cheap that hydropower can't compete," explained Fan Xiao.

"And [hydropower] only gets more expensive when you have to transport it all the way across the country," he added.

There is also resistance by local governments in the east to importing power from the west. For local governments, buying local thermal power is cheaper and easier to manage than long-distance power transmission, and building thermal power stations can also drive investment and GDP growth, according to one industry insider. Also, as demand for energy slows, eastern provinces simply have less need for additional sources of electricity.

Zhang says that the current market is encouraging over-expansion of hydropower whilst failing to address excess thermal-power capacity. Unfortunately, the current market structure does not provide a level playing field for different forms of generation. Instead, it is encouraging over-supply of all forms of power generation.

"If China's energy structure doesn't change, there's a good chance new hydropower projects will lose money," says Zhang, adding that China is now a market economy and the state controls needed to make the West-East

Electricity Transfer scheme viable are long gone.

China's electricity market would benefit from policies that reduce incentives for polluting forms of power generation such as coal, and encourage renewable alternatives. For example, by imposing a high carbon tax on polluting coal-fired generation or establishing strict emissions standards for coal-fired power stations. Recent regulations offering preferential purchase prices for renewables power exclude hydropower.

## 中国大小水电面临不同命运

“十三五”期间，中国仍将大力发展大水电项目，但西南地区的小水电发展却面临重重阻力。

在弃水问题引发的担忧中，中国《水电发展“十三五”规划》在2016年底发布，为2020年之前的中国水电发展定调。规划提出“十三五”期间建设六大水电基地，增加“西电东送”规模。但中小水电却遭遇截然不同的命运，规划提出严格控制中小流域、中小水电开发。

### 严控中小水电

云南和四川是中国西南部的水电大省，处于几条亚洲大河的中上游：别名金沙江的长江上游流经四川，而云南西部的崇山峻岭中，中南半岛最重要的河流澜沧江（湄公河）和怒江（萨尔温江）沿着几乎平行的方向奔流。

早在2016年7月，云南省就表示，原则上不再开发建设25万千瓦以下的中小水电站，已建成的中小水电站不再扩容。四川省紧随其后，于10月发文，明确到2020年，除特别用途的中型（5万千瓦至30万千瓦）水电项目外，其余暂停核准；小型（5万千瓦以下）水电项目全面停止核准建设。

多位专家告诉中外对话，叫停中小水电，根本原因还是经济问题。水电送不出去，弃水问题难以解决。中国水力发电工程学会副秘书长张博庭告诉中外对话：“叫停增量恰恰可以保护存量。”弃水是指原本应该经过机组用来发电的水流不用于发电而白白流走。

云南民间组织绿色流域负责人于晓刚告诉中外对话，云南小水电资源基本开发完毕，剩下的就是不宜开发的。“再加上小水电本身的技术问题，电网公司不愿意专门为小水电建输电线路，发了电也上不了网，送不出去。”他说，“过去投资10年就能收回成本的，现在一般要20年。当地政府在招商引资时许下的营利空间大大降低。”

但上述专家都认为，小水电对环境的影响较小，如能引导得当，可以帮助贫困偏远地区发展。这一点也在“十三五”水电规划中得到体现。规划提出“支持离网缺电贫困地区开展小水电扶贫开发工作”，而开发程度较高的东、中部地区原则上不再开发中小水电，弃水严重的四川、云南两省，除水电扶贫工程外，暂停小水电和无调节性能的中型水电开发。

### 发展大水电

四川省地矿局区域地质调查队总工程师范晓告诉中外对话，两省叫停小水电，对于中国水电发展来说无足轻重，因为大水电才是重头戏。

中国是世界第一水电大国。其中，西南地区的四川、云南、西藏三个省份所拥有的水能资源共占到全国80%以上。《水电发展“十三五”规划》提出，在这些地区要以重大项目为重点，推进长江上游、黄河上游、乌江、雅砻江、大渡河等六大型水电基地开发，总装机要达到1亿千瓦。

不仅是《水电发展“十三五”规划》，包括2016年年初出台的中国“十三五”规划、11月17日通过的《能源发展“十三五”规划》、国家能源局的《2016年能源工作指导意见》也在鼓励水电基地重大项目建设。

### 弃水严重

但事实上，除西藏尚待开发外，四川、云南大规模开发后现已出现严重弃水情况。

据国家能源局四川办公室2015年统计数字，全省弃水由2013年26亿千瓦时增加到2014年97亿千瓦时，情况如不改善，2020年可能将弃水约350亿千瓦时，占当年水电发电量的8.6%。云南情况也不妙，据中国能源网综合信息，从2013年到2015年，云南全网年度弃水电量预计增长10倍，超过100亿千瓦

时。2014年汛期，单日弃水电量持续达到3.3亿千瓦时，按照全国水电平均价格，相当于云南一天白白流失近1亿元。

弃水的一个重要原因是水电超速发展却遇上中国经济放缓。国家能源局发布的最新数字显示，由于电力需求放缓，全国用电增速从2011年的12%下降到2015年的不到1%，未来5年用电年均增速预期为3.6%-4.8%。

然而，过去几年云南和四川两省的水电装机增长迅猛，2013年和2014年，云南水电投产规模均保持两位数增长。而2010年以来，四川水电装机容量年增长率超过20%。水电的扩张赶上了电力市场的持续低迷，结局只能是大量弃水。

范晓告诉中外对话，水电站建设有其特点，如周期长、市场反应滞后。这使得在经济上升时上马的大批水电项目，投产时却已面临市场饱和、供过于求的困境。

但根据“十三五”规划，未来五年中国大水电的建设力度仍较大。

对此，范晓认为，地方政府希望通过大水电建设来发展当地经济，增加税收；其次，承接大水电项目的一般都是大型国有企业，他们拥有强大的经济实力和话语权，需要依托大工程、大项目来运转。

新形势下的“西电东送”

为应对事实存在的大量弃水问题，新规划提出“配套建设水电基地外送通道”，通过建成投产至广西、广东等东南地区的外送输电通道，落实西南水电的消纳市场。

谈到外送输电通道建设，不得不提“西电东送”，就是指把煤炭、水能资源丰富的西部省区的能源转化成电力资源，输送到电力紧缺的东部沿海发达地区。这是中国的一项国家战略。

“西电东送”为东部地区提供了重要电力支撑，同时也推动了西部地区能源、资源的开发，拉动了当地经济、社会的大发展。

“但随着电力改革和市场经济的发展，各地都在积极发展火电。水电反而没有火电便宜，失去了竞争优势。”于晓刚告诉中外对话，“跨越千山万水的西部水电通过长距离运输到南方，成本却在上升。”

一位业内专家在谈到云南弃水问题时告诉《中国能源报》说，云南现有的水电都是之前按照“西电东送”规划建设的。然而现在火电审批权下放到地方之后，东部省份为了提振当地经济上马大批火电项目，对西部地区水电资源接受意愿大大降低。随着中国电力消费增速下降，东部省份本地电力消纳都已成为问题，更是只能拒绝外来水电。

张博庭认为，现在已经是市场经济时代，提出“西电东送”的计划经济时代已经回不去了，所以只有通过市场的手段来推动能源结构改革，比如对高污染的煤电业征收高额碳税。

包括范晓在内的多位专家也认为，现在更需要靠市场手段来调节中国的能源结构。

张博庭认为，弃水现象的出现，并非水电建设规模的大扩张导致的，而是由于中国不合理的能源结构。国家压缩过剩火电产能力度不够，又让水电、风电、光电同台竞争，并强力刺激非水可再生能源发展。最近出台的可再生能源配额制和优先上网的规定，就把水电排除在外。

尽管“十三五”仍鼓励大水电建设，但张博庭对此并不乐观，他说：“只要中国的能源结构不改变，上项目就赔钱的水电风险很大。”