

带动绿色经济的美国政策：落后的联邦政策、一马当先的州政策、新兴卓越企业

US Policy for Powering the Green Economy: Lagging Federal Policy, Leading State Policy and Emerging Corporate Excellence

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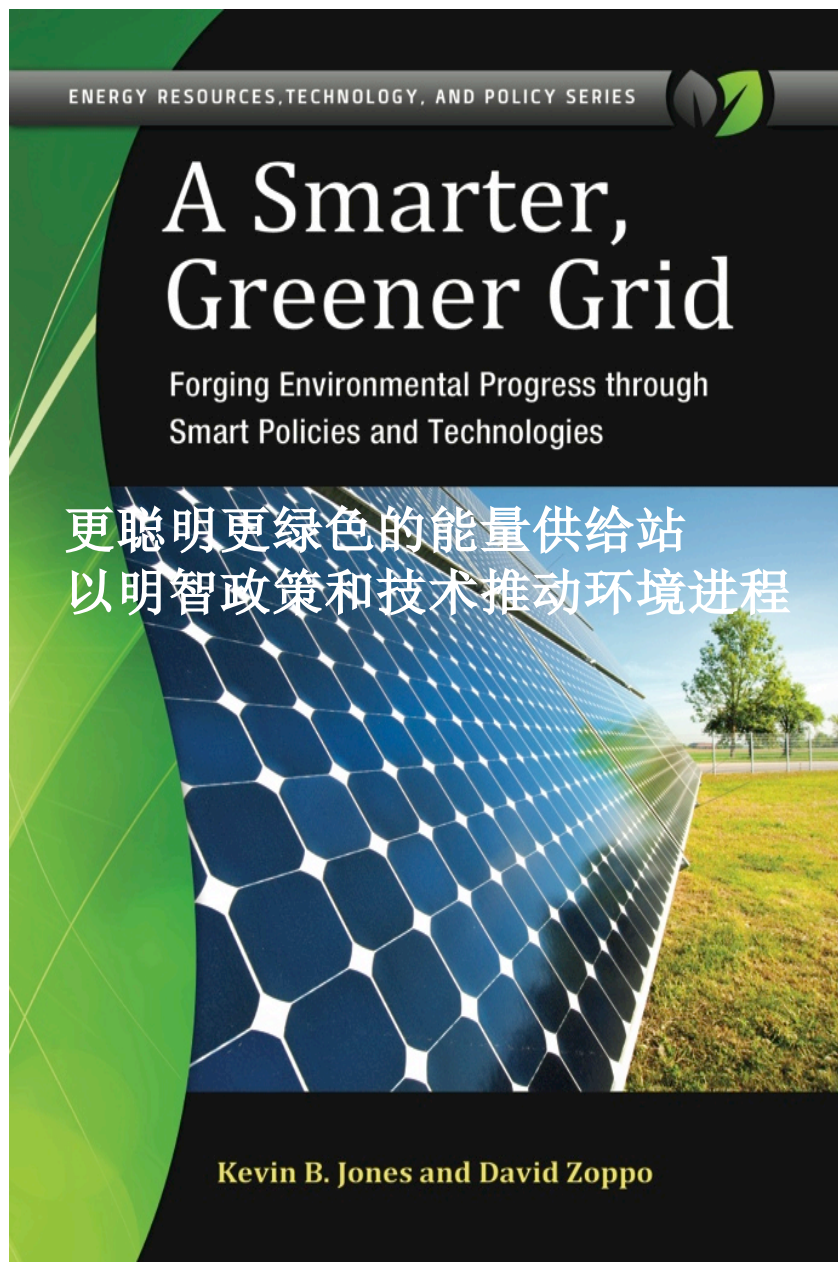
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THE ENVIRONMENT**

LAND USE INSTITUTE

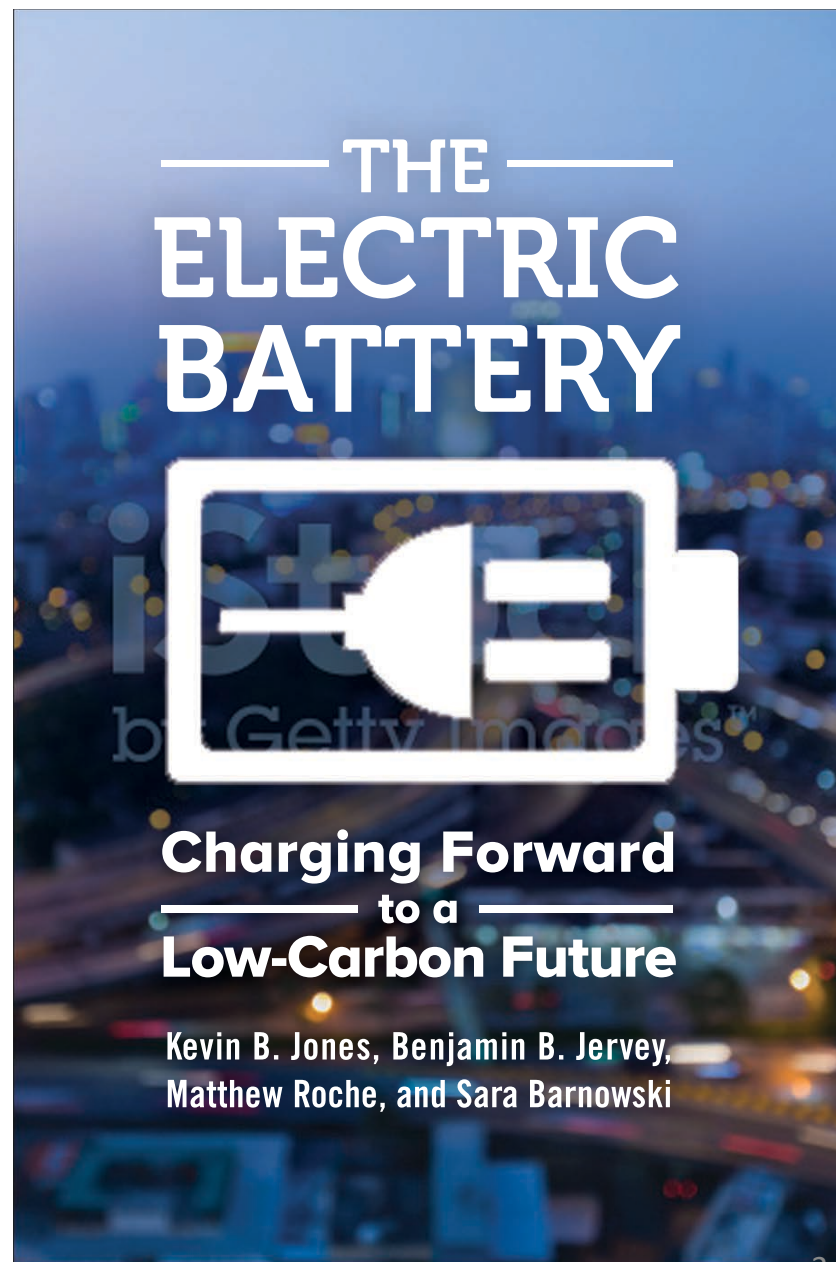
**U.S.-CHINA PARTNERSHIP
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PROGRAM**

最近的工作



冲向低碳未来的电池



US Policy for Powering the Green Economy

推动绿色经济的美国政策

- I. **How Green is the US Grid?** 美国能源供给环保状况如何?
- II. **Lagging Current Federal Policy** 落后的现行联邦政策
 - a) **R&D, + Tax Credits** 科研+抵税额
 - b) **Open Access and Markets (Carbon Pricing)**
开放运营及(碳定价) 市场
 - a) **Trump and Tariffs?** 特朗普与关税?
- III. **Leading State Policy** 一马当先的州政策
 - a) **RPS Requirements** 可再生投资能源标准要求
 - b) **Net Metering** 允许光伏电站所有者在电力消费总账单上扣除用可再生能源发电量的电价结算政策
 - c) **Feed in Tariffs** 强制光伏上网电价
 - d) **Community Choice Aggregation** 社区优选能源组合
- IV. **Emerging Corporate Leadership** 新兴领头羊企业

US Energy Use Basics 美国能源使用基本况

- **More than half of energy is used to make electricity for** 过半能源用于以下领域的供电：
1) homes 家用 **2) business** 商用 **3) industry** 工业
- **One third of energy is petroleum and diesel for cars and trucks.**

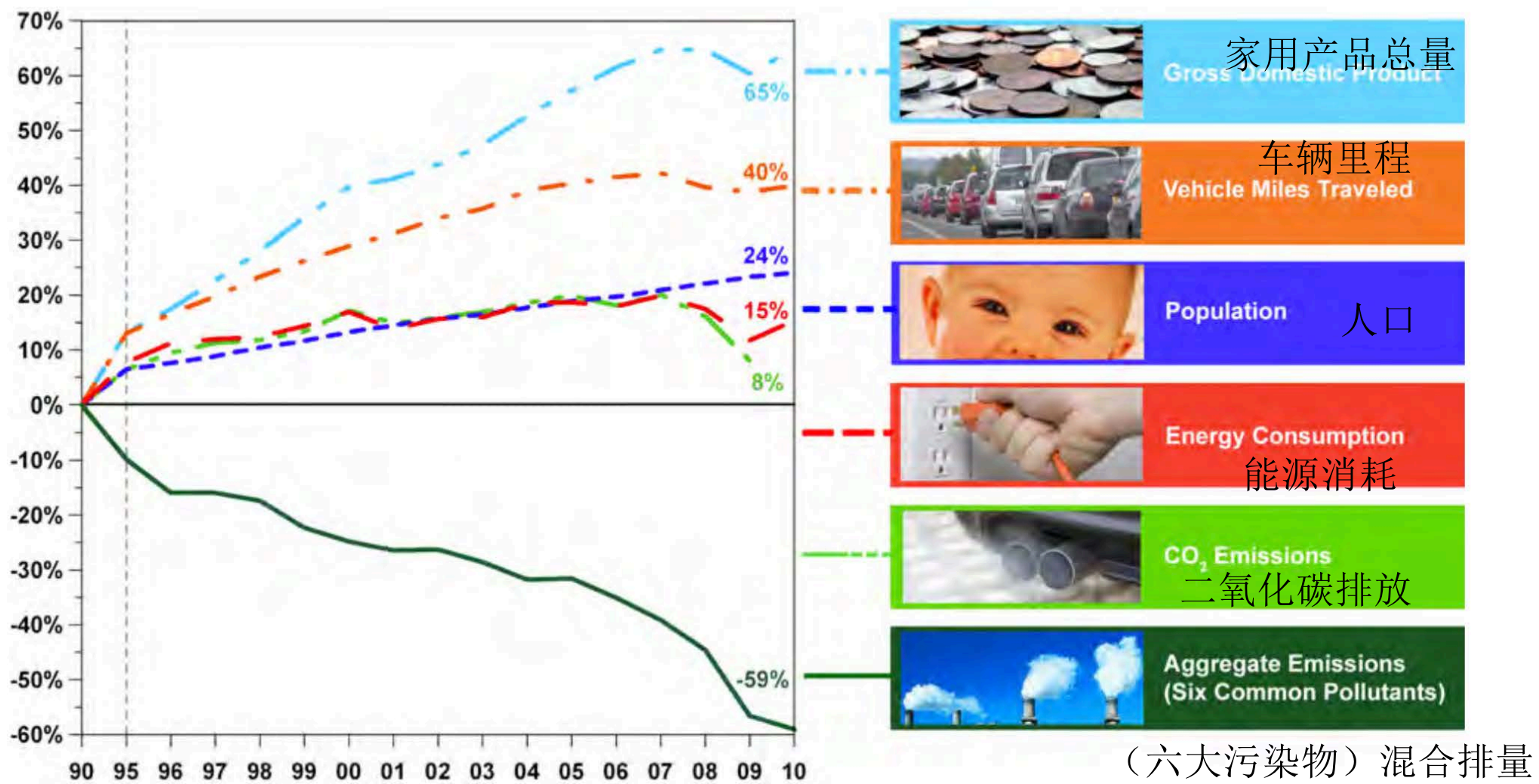
三分之一的能源是汽车和卡车用的汽油和柴油

- **One sixth of energy is for all other uses.**

六分之一的能源用于其它

Energy is not just another commodity, but the precondition of all commodities, a basic factor equal with air, water, and earth. 能源不仅仅是另一种商品，而是所有商品的前提，是和空气、水和土壤一样重要的基本要素。

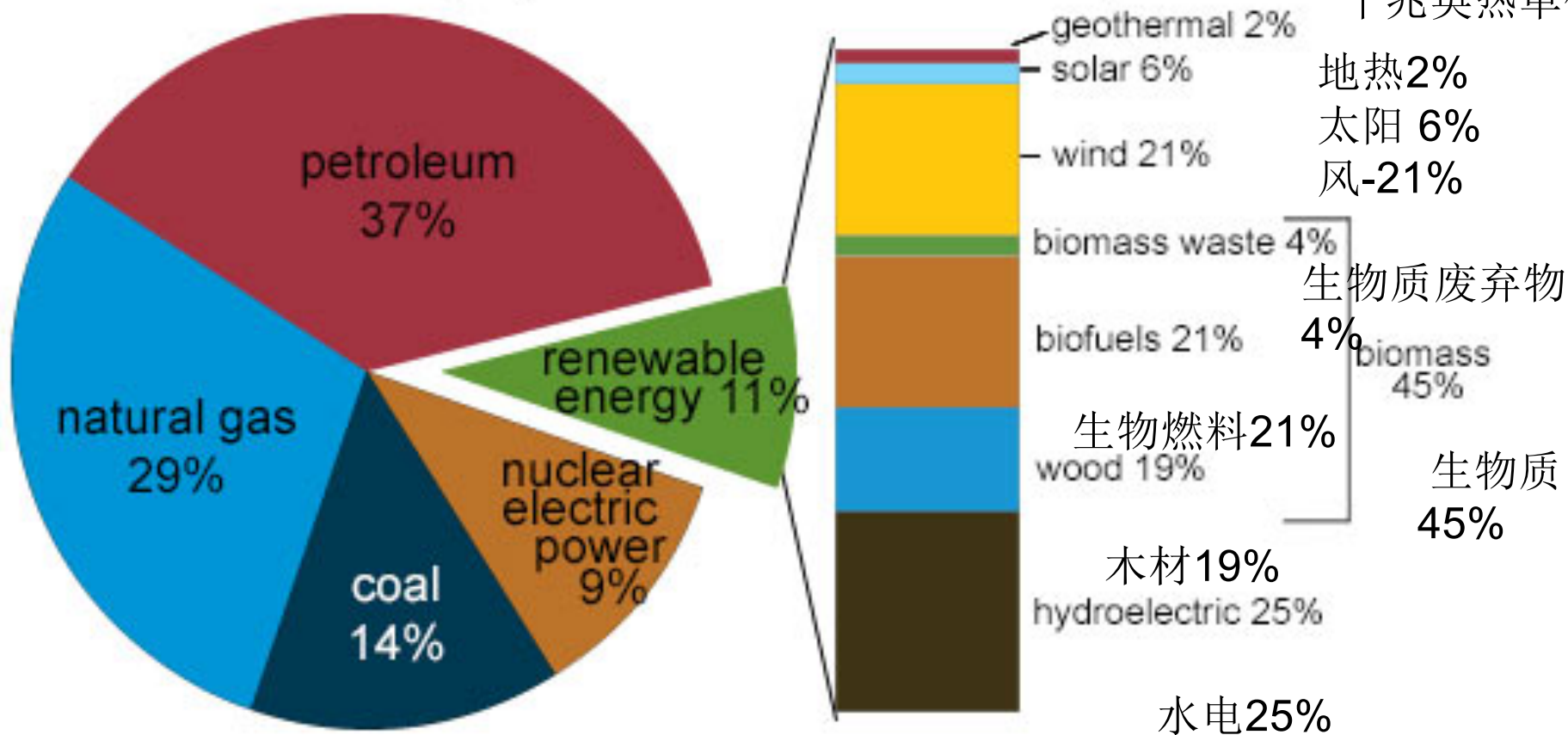
Trends in US Emissions 美国排放趋势



U.S. energy consumption by energy source, 2017

总量 = 97.7 quadrillion qu, 千兆 2017年美国能源消费
 British thermal units (Btu) 英热单位

Total = 11.0 quadrillion Btu 千兆英热单位



Note: Sum of components may not equal 100% because of independent rounding.
 Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2018, preliminary data



注：各组成总和可能不是100%，因为都单独进行凑整。

资料来源：美国能源信息管理《每月能源评论》，表1.3和10.1，2018年四月，初步资料

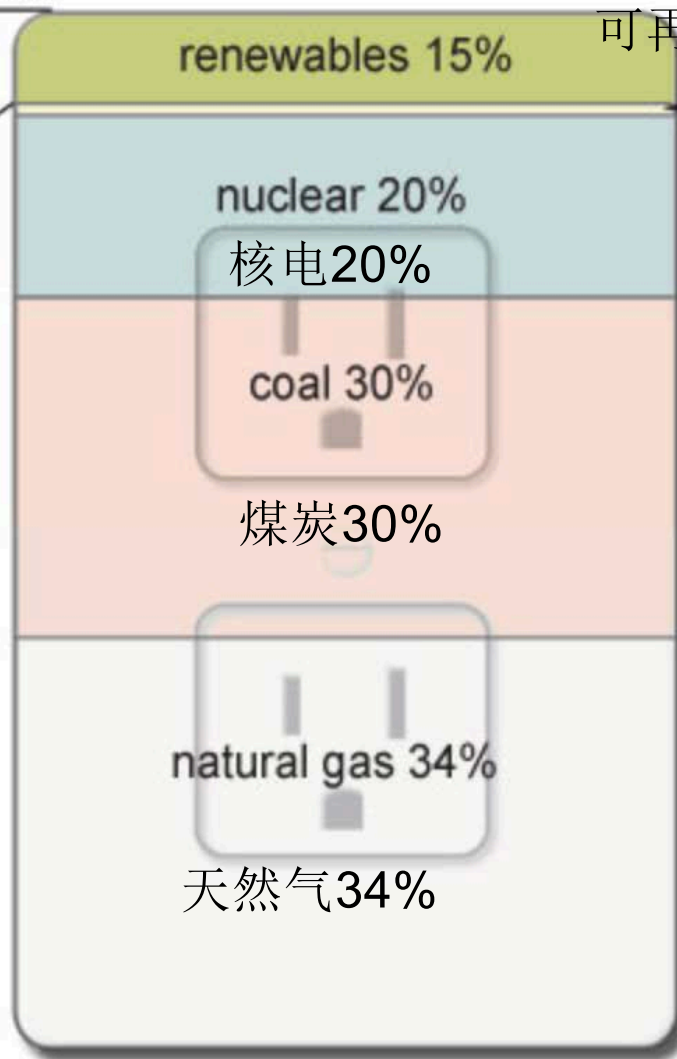
2016年美国电力来源

Sources of U.S. electricity generation, 2016

Total = 4.1 trillion kilowatthours 总量为41000亿 千瓦

水电
风电
生物质、
太阳能
地热

hydro	6.5%
wind	5.6%
biomass	1.5%
solar	0.9%
geothermal	0.4%



可再生能源 15%
石油 1%
汽油 1%

Note: Electricity generation from utility-scale facilities.

注：公用事业规模的设备发电

Source: U.S. Energy Information Administration, *Electric Power Monthly*, February 2017, preliminary data for 2016

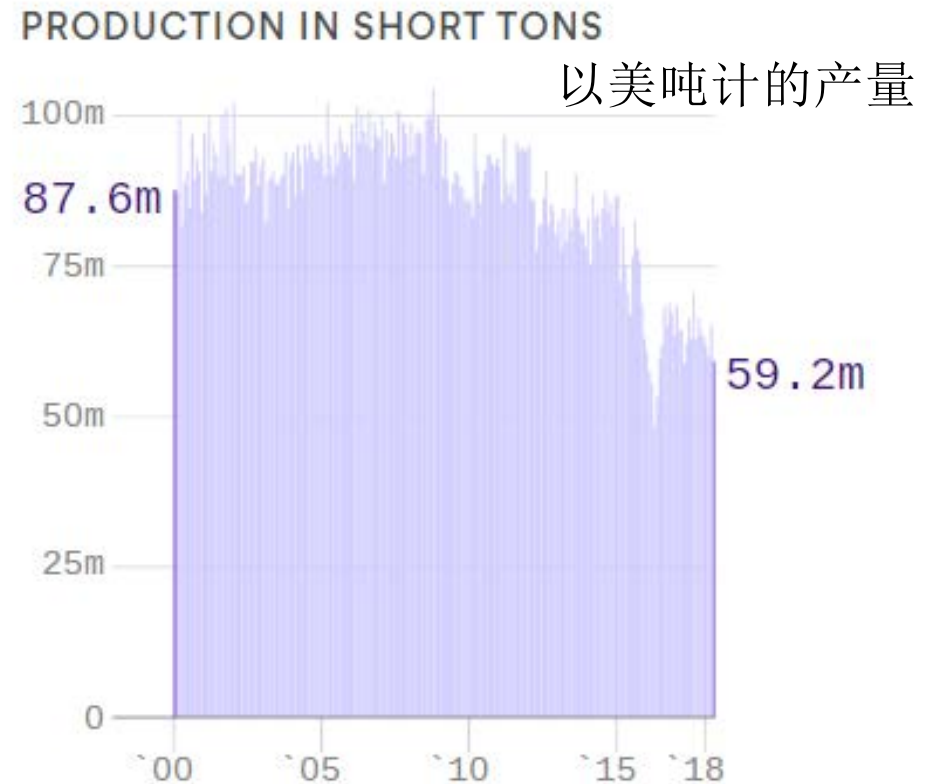
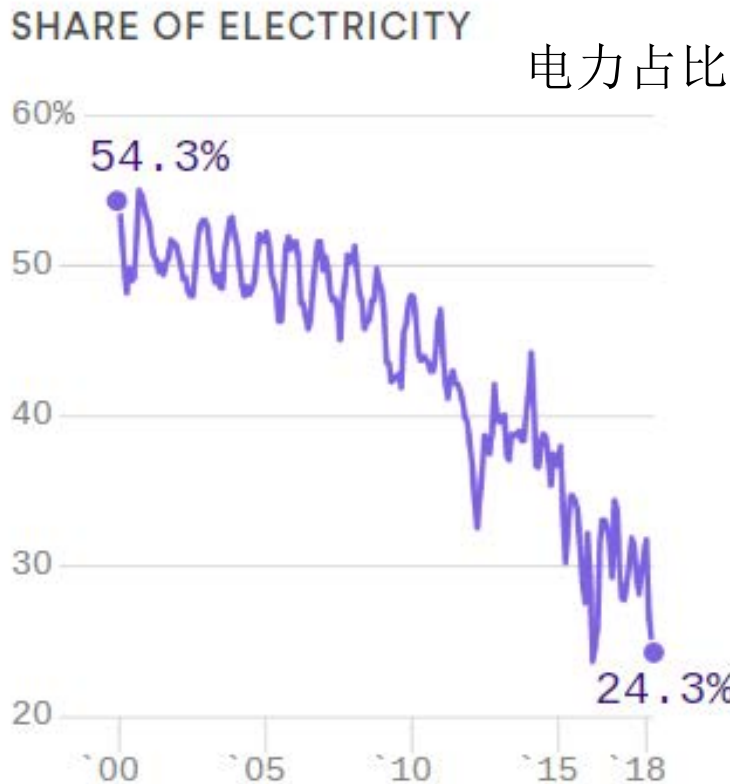


2018 is a record year for Retirement of Coal-fired Generation

2018年是煤炭发电退出历史的创纪录的一年

U.S. coal, Jan. 2000 to April 2018

2000年1月到2018年4月的煤炭使用情况



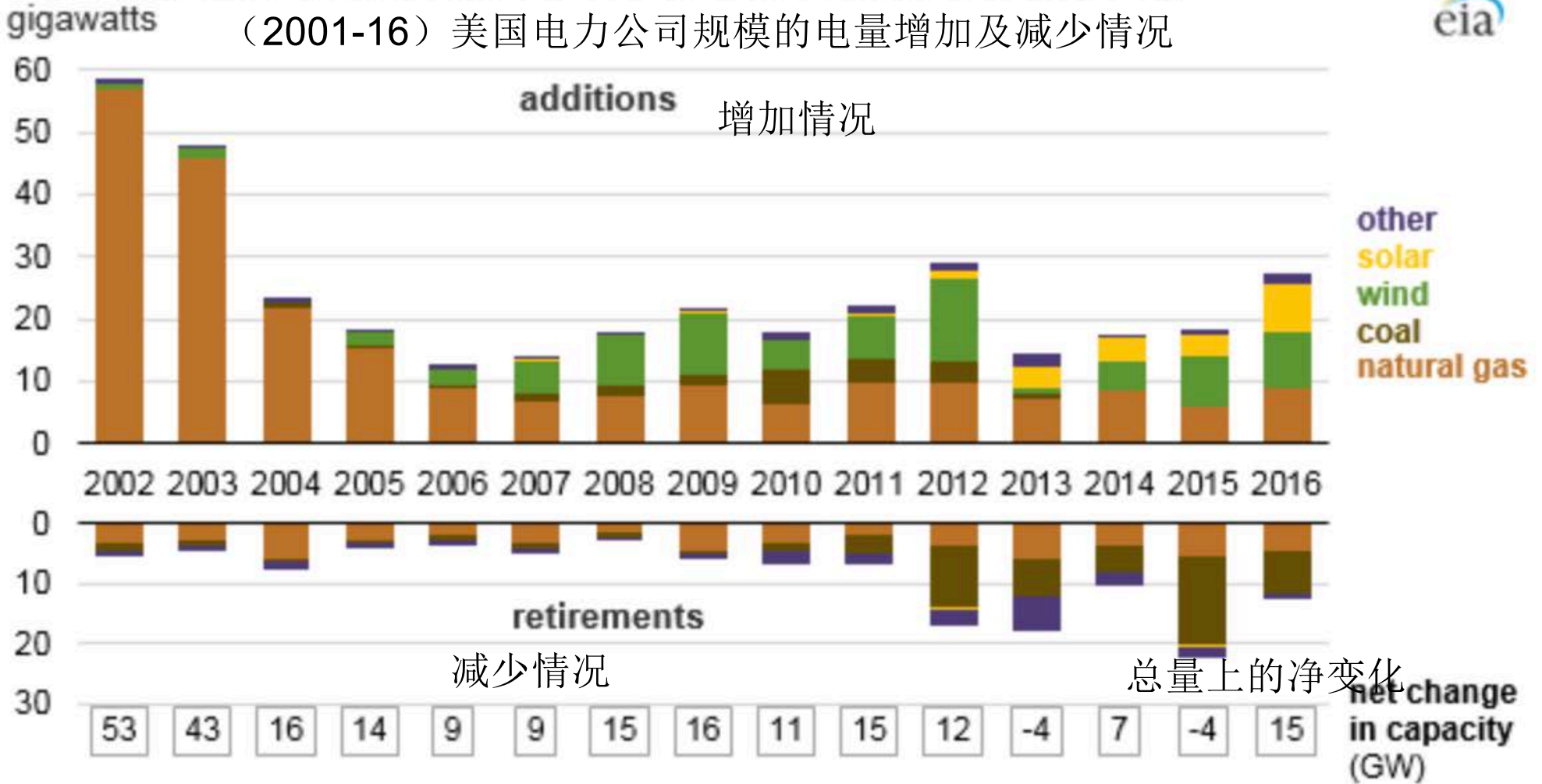
Share of electricity: [EIA](#), Production: [EIA](#); Chart: Andrew Witherspoon/Axios

电力占比: EIA, 产量: EIA; 图表来自Andrew Witherspoon/Axios

U.S. electric generating capacity increase in 2016 was largest net change since 2011

2016年是2011年后发电总量净变化最大的一年

U.S. utility-scale electric capacity additions and retirements (2002-16)



Lagging Federal Policy

落后的联邦政策

1. Tax Credits (being phased out) 抵税额（正逐渐退出）

a) 30% Investment Tax Credit for Solar

使用太阳能可抵30%投资额

b) Federal R&D + Subsidies (US Dept. of Energy)

联邦科研+（美国能源部）补贴

2. Electric Grid - Open Access and Competition

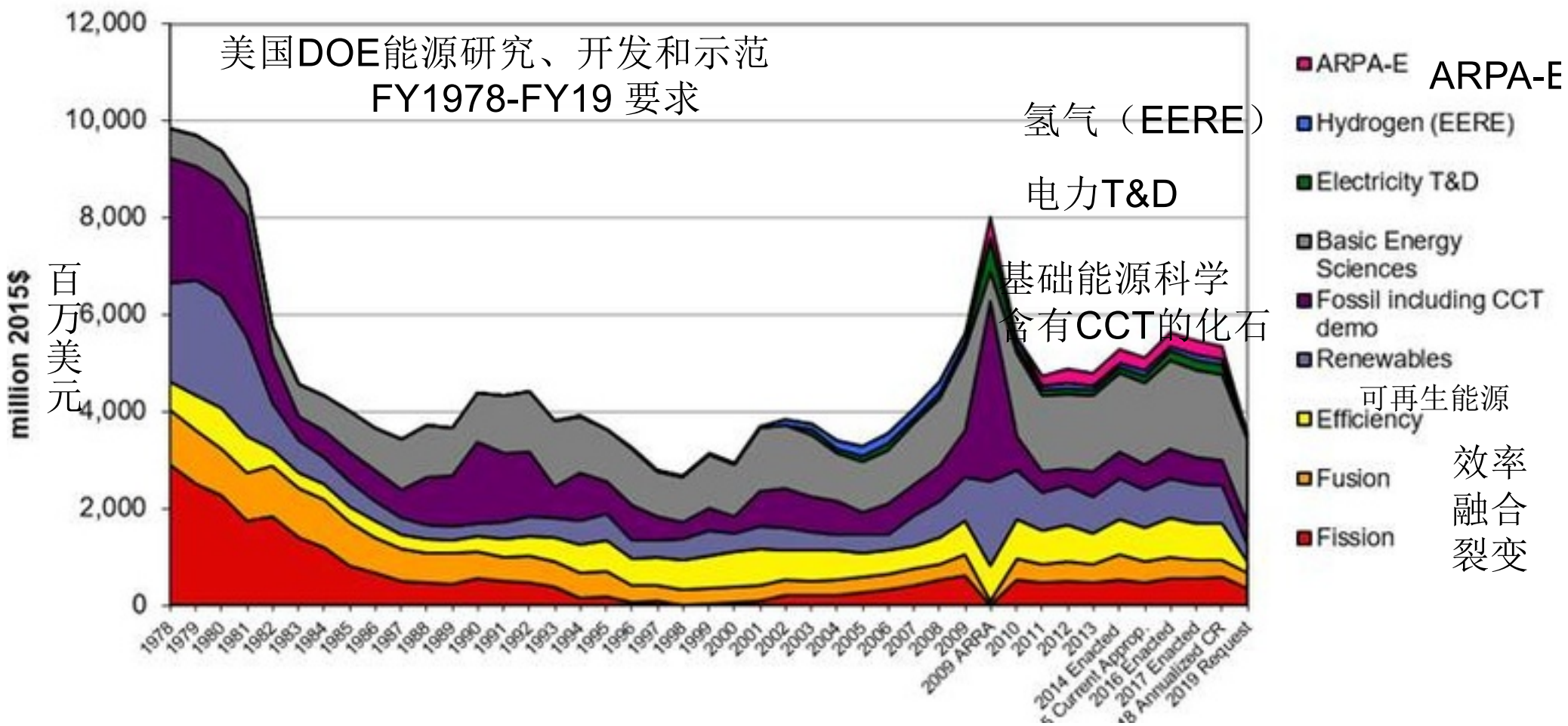
电网 -- 开放运营及竞争

a) Federal Energy Regulation Commission Orders, 888, 2000, 1000

联邦能源控制委员会法令，888，2000，1000

U.S. DOE Energy Research, Development & Demonstration FY1978-FY19 Request

美国DOE能源研究、开发和示范
FY1978-FY19 要求

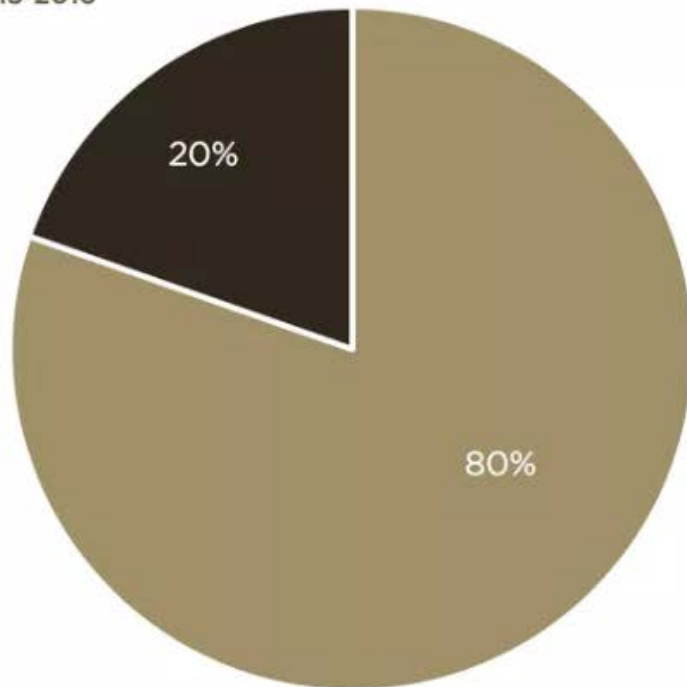


Federal Policy Continues Fossil Fuel Subsidies?

联邦政策持续提供化石燃料补贴？

2015-2016根据能源类型提供的美国化石燃料补贴

Figure 4: U.S. Fossil Fuel Subsidies by Energy Type, 2015-2016



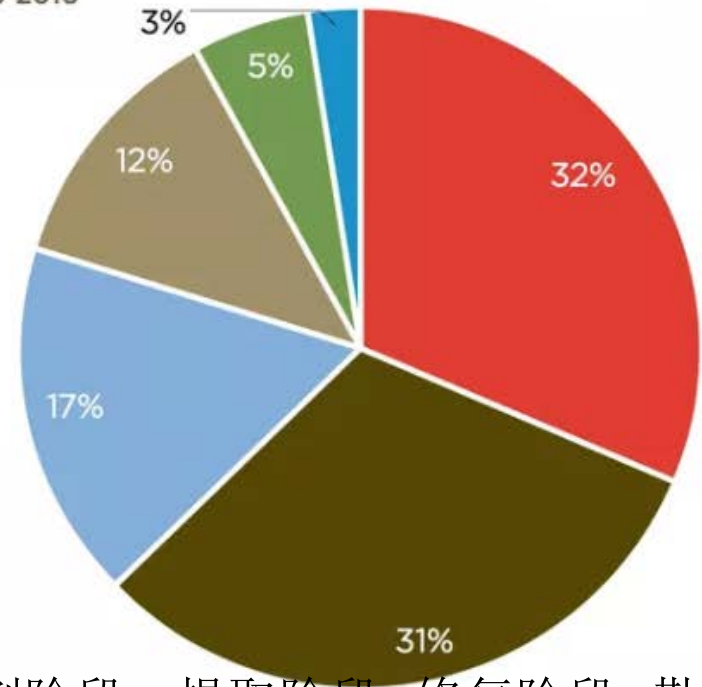
Oil & Gas Coal

石油和燃气 煤

(OSI)

2015-2016根据生产阶段提供的美国化石燃料补贴

Figure 5: U.S. Fossil Fuel Subsidies by Stage of Production, 2015-2016



切割阶段 提取阶段 修复阶段 勘探阶段

Cross-cutting Extraction Remediation* Exploration

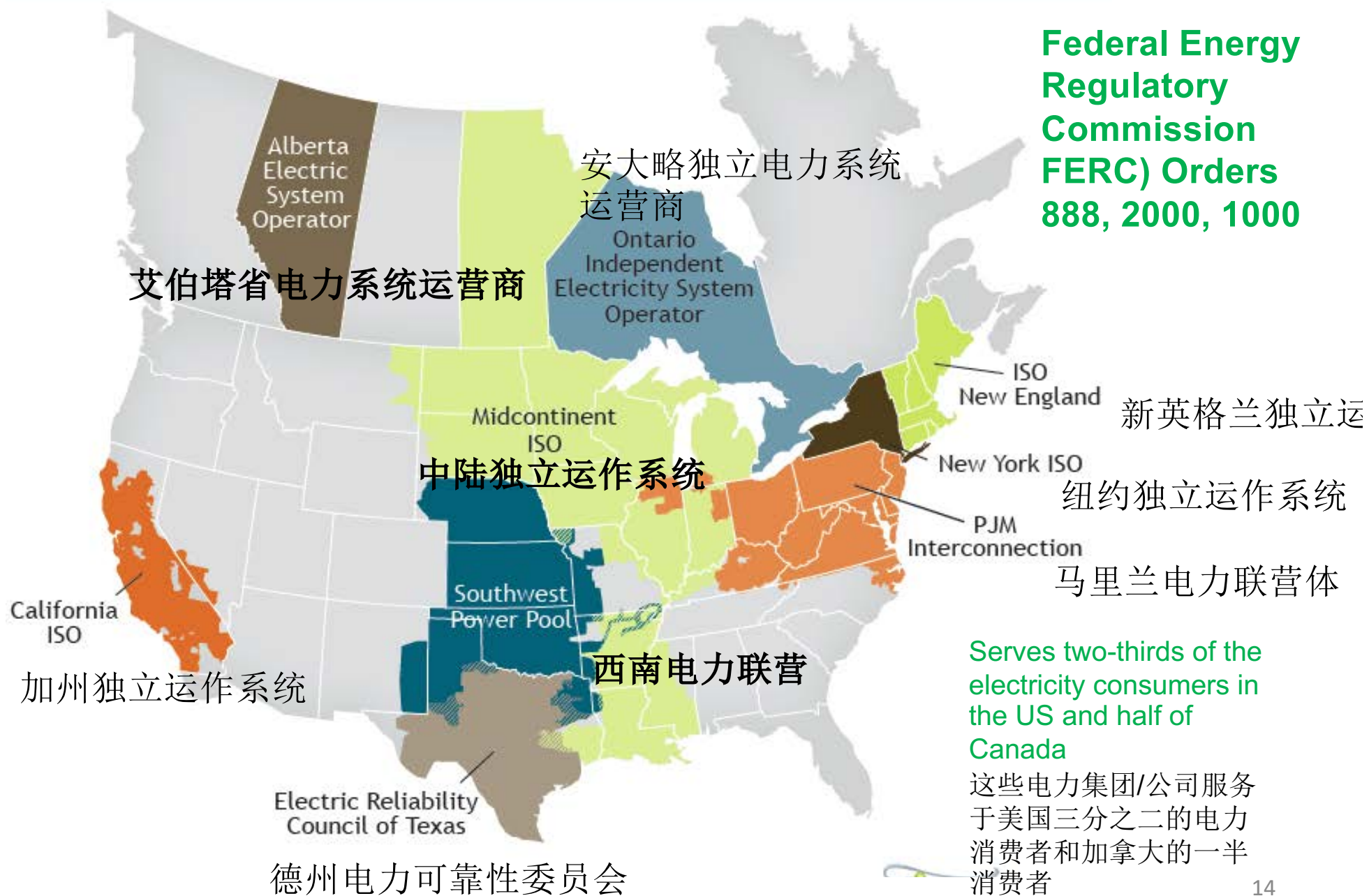
Electricity Production & Distribution Transport & Processing

发电和配电阶段

运输和加工阶段

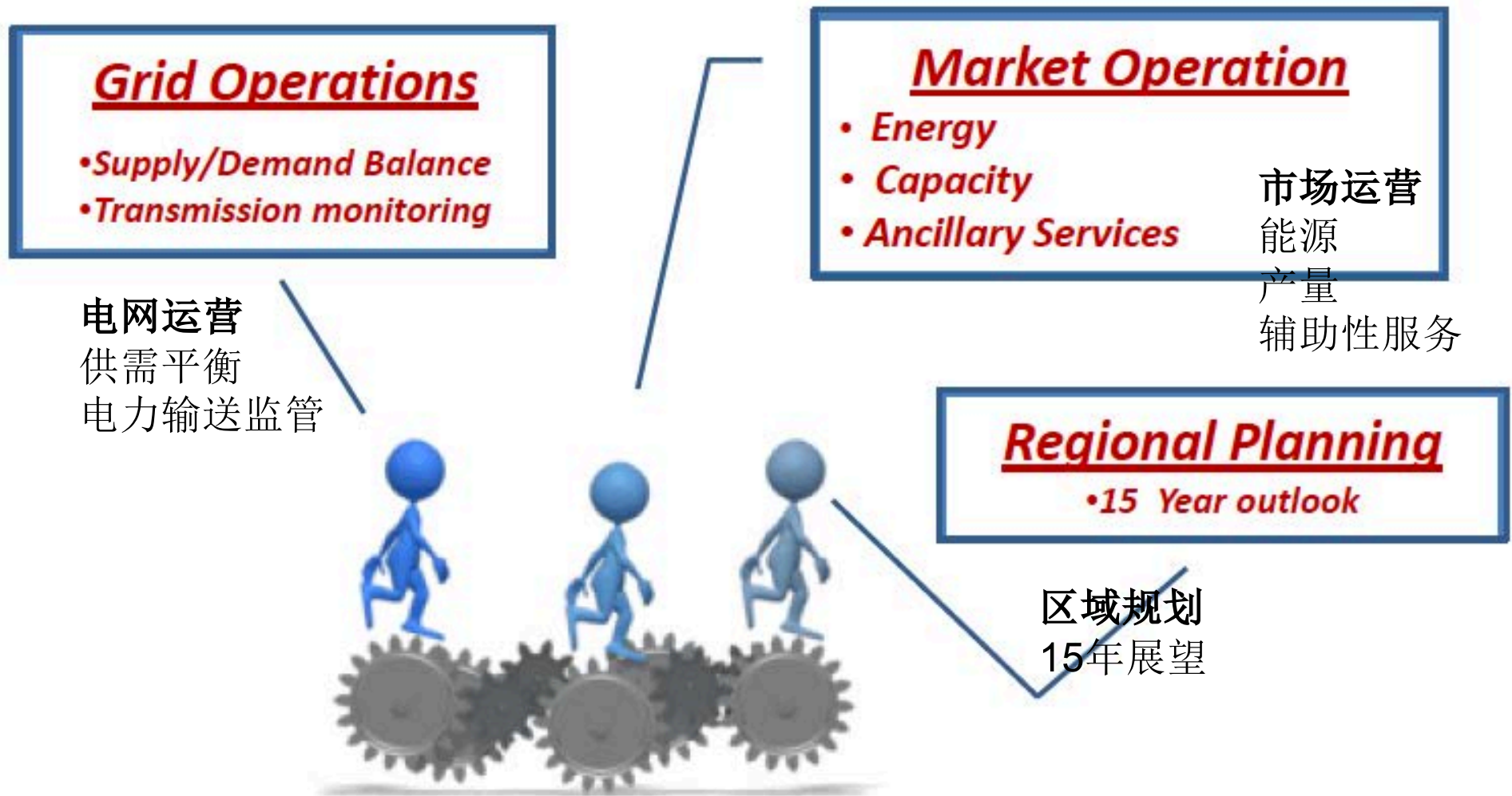
2/3 of US has Electric Wholesale Competition

美国的三分之二国土上存在电力批发竞争



Open Access and Competitive Generation Markets.

开放运营和充满竞争的电力市场



- ✓ Growth of Renewables in Western US is driving market expansion. 西部可再生能源的增长推动市场扩大
- ✓ New York is investigating adding carbon pricing into energy market. 纽约正在考量将碳定价引入能源市场

Lagging Federal Policy Since Trump

特朗普上台后联邦政策跟不上

- ✓ **Planned Withdrawal from Paris Agreement** 计划从《巴黎协议》中退出
- ✓ **Cancelled Obama's Clean Power Plan** 取消奥巴马《清洁能源计划》
- ✓ **Trying to Roll Back Auto Fuel Economy and Electric Vehicle Standards** 试图重启汽车燃料经济和电动车辆标准
- ✓ **Attempting to Subsidize Uneconomic Coal and Nuclear Generating Plants** 试图给不经济的煤炭发电厂和核电厂提供补贴
- ✓ **Tariffs?** 关税?

Nevertheless, markets, state policy & corporate leadership continue growth of renewables and decline of coal! 尽管如此，各类市场、州政策和企业领袖仍持续增加可再生能源并减少碳的使用。

Leading State Clean Energy Policies

一马当先的清洁能源州政策

1. **Renewable Portfolio Standard (RPS)** 可再生能源发点配额制度/标准
2. **Feed-in Tariff (FiT)** 强制上网电价/电价补贴上网电价
3. **Net Metering** 是一项电价结算政策，要求电力公司以一定价格从安装了可再生能源发电技术的用户买回多余的电力，或者从消费者总账单上扣除用可再生能源发电数量
4. **Solar Purchased Power Agreement (PPA)** 收购太阳能电力协议
5. **Green Power Program** 绿色能源计划
6. **Utility Green Source Riders** 公用事业绿源乘客
7. **Community Choice Aggregation** 社区精英团体

What Is a Renewables Portfolio Standard?

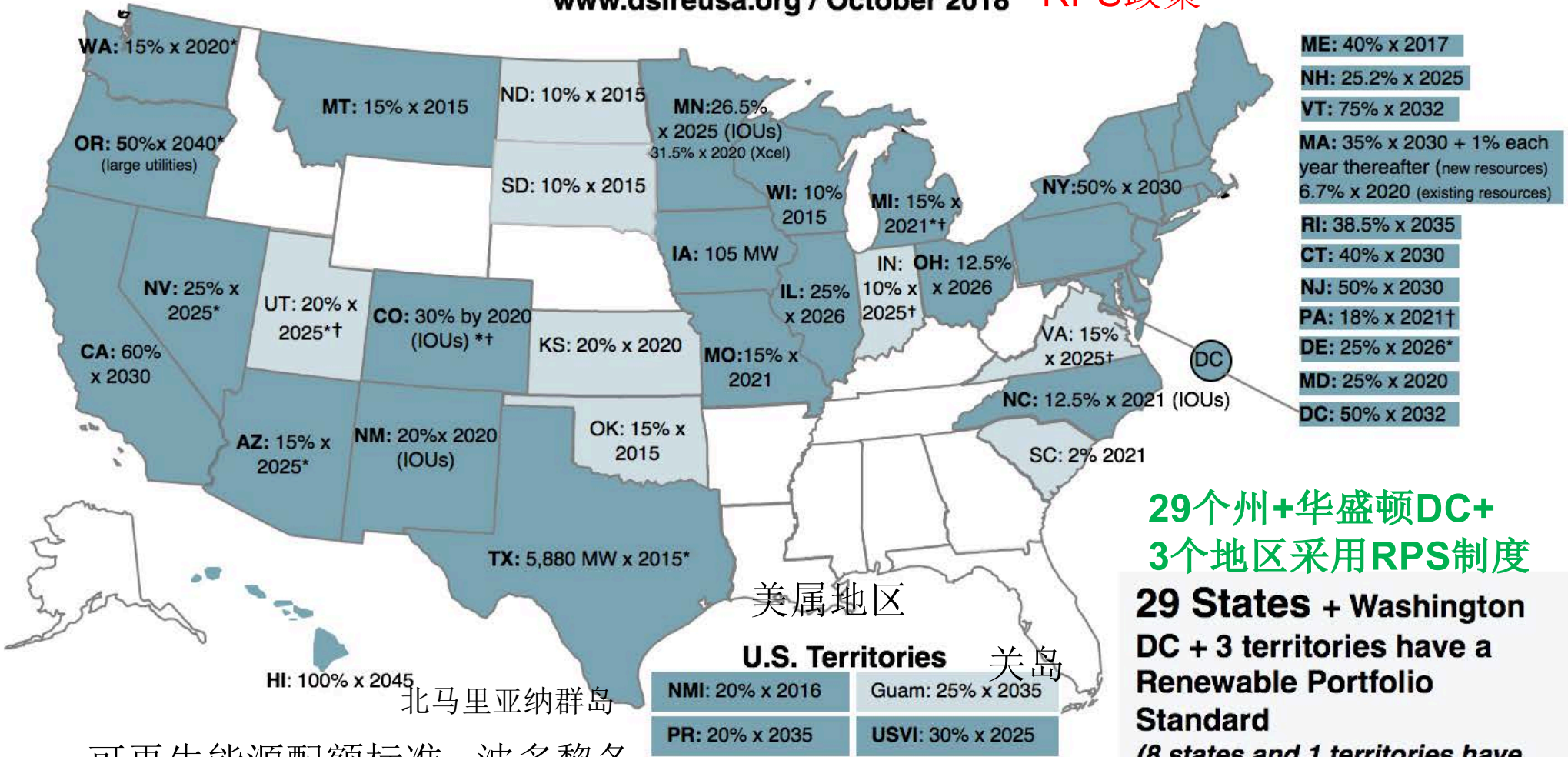
何为RPS?

- A requirement on retail electric suppliers...
- to supply a minimum percentage or amount of their retail load...
- with eligible sources of renewable energy.
- 要求零售电力供应者在零售总量中必须提供最少百分比的合法可再生能源

1. **Typically backed with penalties of some form** 通常情况下会有某种形式的惩罚
2. **Often accompanied by a tradable renewable energy credit (REC) program, to facilitate compliance** 经常会伴有一个可交易的可再生能源抵税额计划，以促进对该制度的遵守。
3. **Never designed the same in any two states** 制定标准时，任何两个州的标准**从不**相同。
4. **To comply with an RPS you must retire the REC** 要遵守RPS， 可再生能源抵税计划就必须退出

Renewable Portfolio Standard Policies

www.dsireusa.org / October 2018 RPS政策



29个州+华盛顿DC+
3个地区采用RPS制度

29 States + Washington DC + 3 territories have a Renewable Portfolio Standard
(8 states and 1 territories have renewable portfolio goals)

可再生能源配额标准 波多黎各

Renewable portfolio standard
Renewable portfolio goal

* Extra credit for solar or customer-sited renewables
† Includes non-renewable alternative resources
使用太阳能或客户所在地的可再生能源的额外配额包括不可再生的可替代资源

可再生能源配额目标

8个州和一个地区有
可再生能源配额目标)

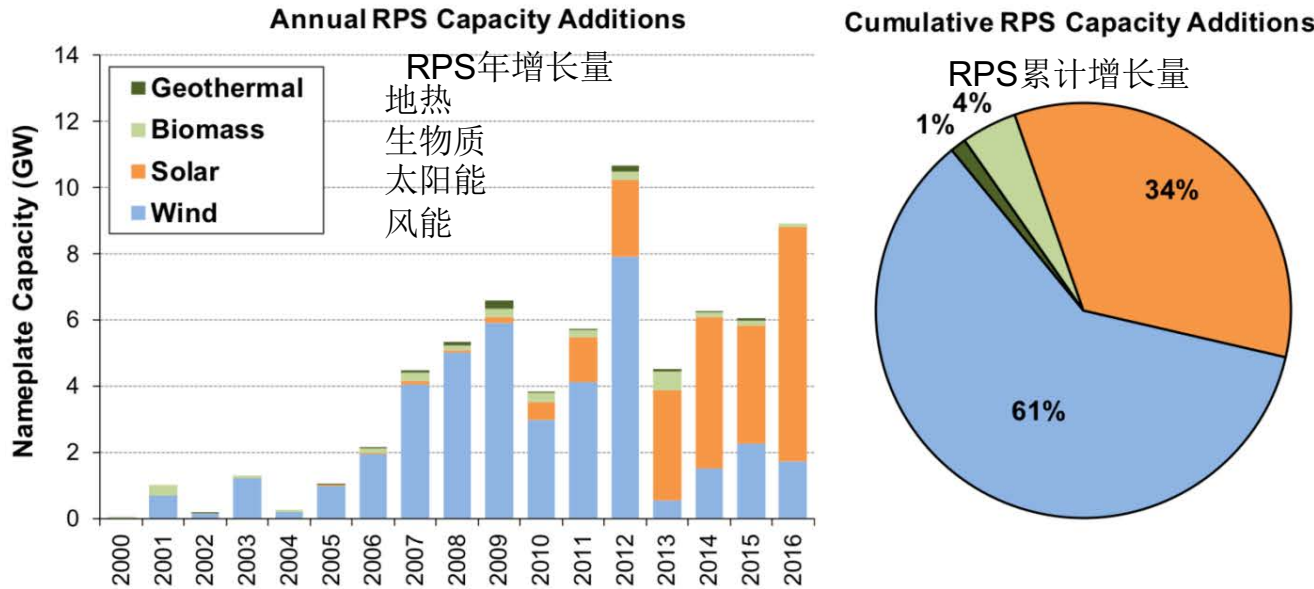
Wind has been the dominant RPS resource by Solar is catching up!

风能已经成为最主要的RPS资源，但是太阳能正向它逼近

根据技术类型而产生的RPS能力增加

到目前为止，风能占有所有RPS61%，而太阳能在2016年占79%

RPS Capacity Additions by Technology Type



Wind is 61% of all RPS builds to-date, but solar was 79% of 2016 RPS builds

- Growing role of solar for RPS reflects:
 - Ramping up of solar carve-out requirements
 - Increasing cost-competitiveness of utility-scale solar vis-à-vis wind
- Wind capacity growth still strong, but recent additions primarily not for RPS

太阳能在RPS中越来越重要，它反映了：
 太阳能开拓需求的大幅上升
 公共事业规模的太阳能与风能的竞争

Notes: "RPS Capacity Additions" represent RE capacity contracted to entities subject to an RPS or sold on a merchant basis into regional RPS markets. On an energy (as opposed to capacity) basis, wind represents approximately 75%, solar 16%, biomass 5%, and geothermal 4% of RPS-related renewable energy growth.

风能产量仍稳步上升，但是最近增加的部分不是主要由于RPS



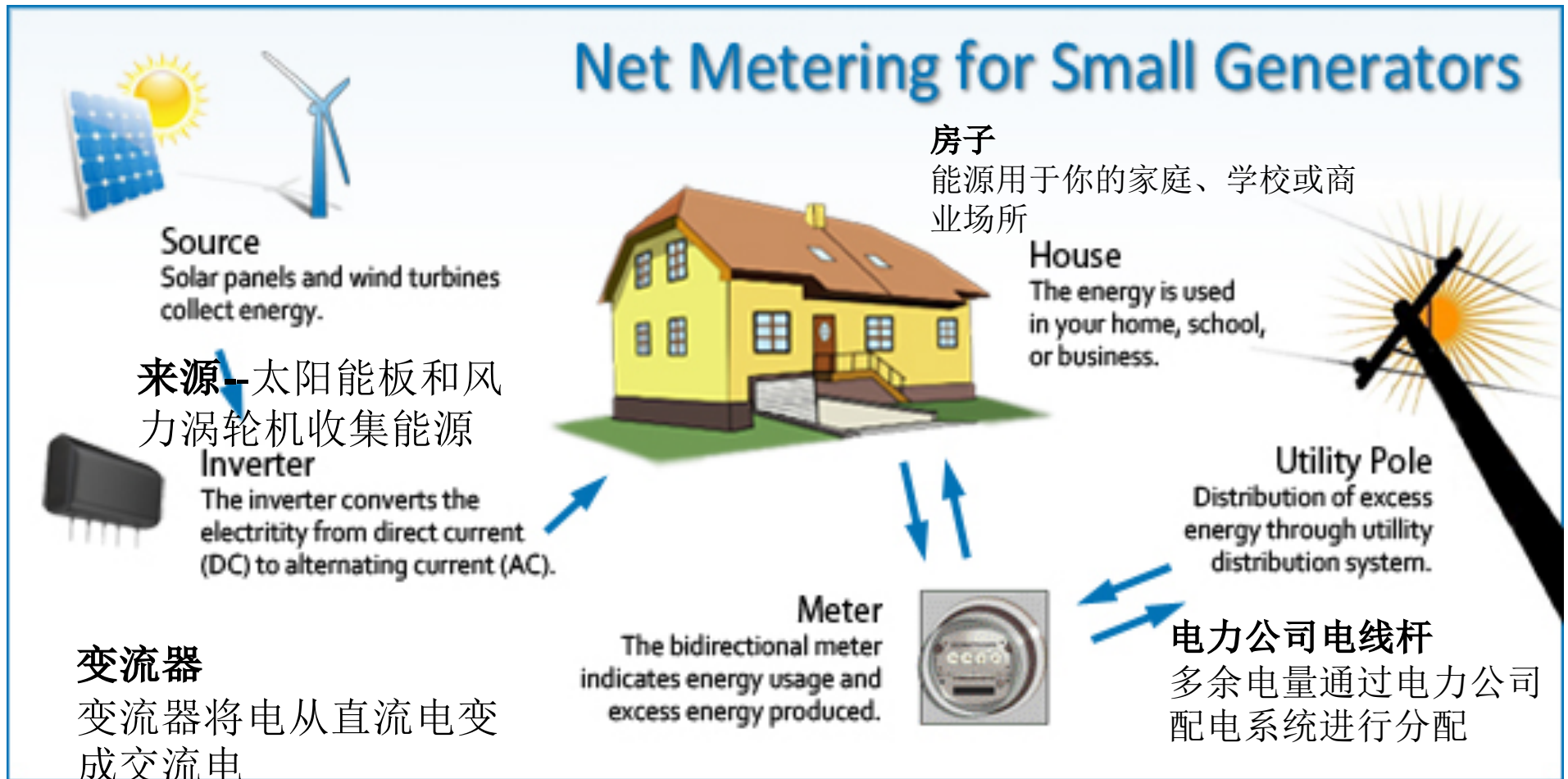
Trends in RPS Programs

RPS项目的趋势

- **Increased stringency of RPS renewable energy purchase targets RPS**
可再生能源购买目标会愈加严格
- **Expanded use of resource-specific set-asides, especially for solar power**
具体能源的储备将会扩大使用，尤其是太阳能
 - ✓ **Utility-scale solar appears competitive against other renewables in the Southwest**
在西南部，公共事业规模的太阳能似乎比其它可再生能源更有竞争力
- **Cost caps/funding limits may become binding**
成本上限/资金限制可能会变得有约束力
- **Fate of in-state geographic requirements unclear under the interstate commerce clause**
在州际商务条款的约束下，不清楚在州内商务在地理上的要求未来会怎么改变

Net Metering – How it Works?

电价结算政策如何运作？



电表
这个双向电表显示电力使用量及生产的多余电量

Net Metering 电价结算政策

- Utility required to credit customer's electric bill for qualified onsite generation (typically solar pv or small scale wind turbine)

要求电力公司从安装了可再生能源发电技术（以太阳能光伏或小规模风力涡轮机为典型）的消费者总账单上扣除用可再生能源发电数量

- Historically implemented without an additional meter – onsite generation spins meter backwards or feeds excess generation to grid

传统做法是无需安装额外电表--现场发电会让电表读数往后退或者将多余电力输送到电网。

- limited to small size (<1mW, in VT it is 500 kW) and practically limited by consumer's energy consumption

仅限于小型，（<1mW，用VT表示是500千瓦），基本受限于消费者的用电量。

Net Metering & Group/Virtual Net Metering

电价结算及集体/虚拟电价结算?

Net Metering & Virtual Net Metering Explained

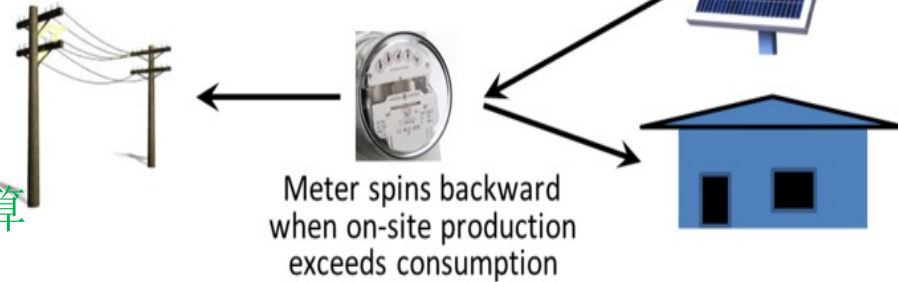
电价结算政策及虚拟电价结算政策的解释

System located on-site

发电系统安装地址

1

Conventional Net Metering



传统的电价结算

Meter spins backward when on-site production exceeds consumption

电表读数在电力产出超过消费时会向后退

虚拟的电价结算

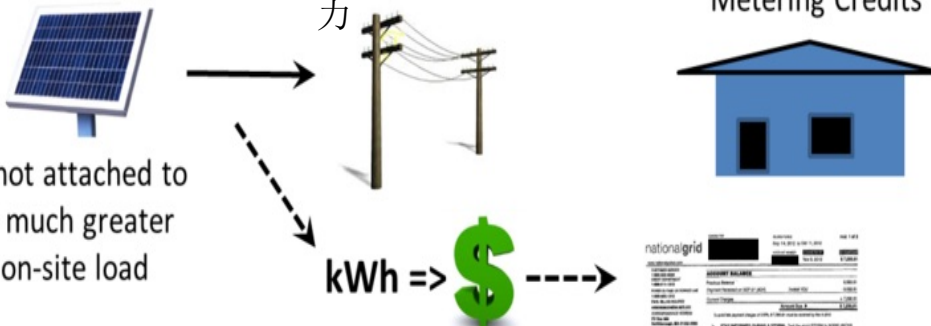
2

Virtual Net Metering

Exports power to local dist. system
向当地电力系统输出电力

Purchaser of Virtual Net Metering Credits

购买虚拟电价结算余额



没有与用电负荷或比安装的系统或者比负荷大得多的系统

System not attached to load or much greater than on-site load

Metered solar output is converted to a dollar value based on a formula

Dollar value of solar output is allocated to purchaser's utility invoice as a credit

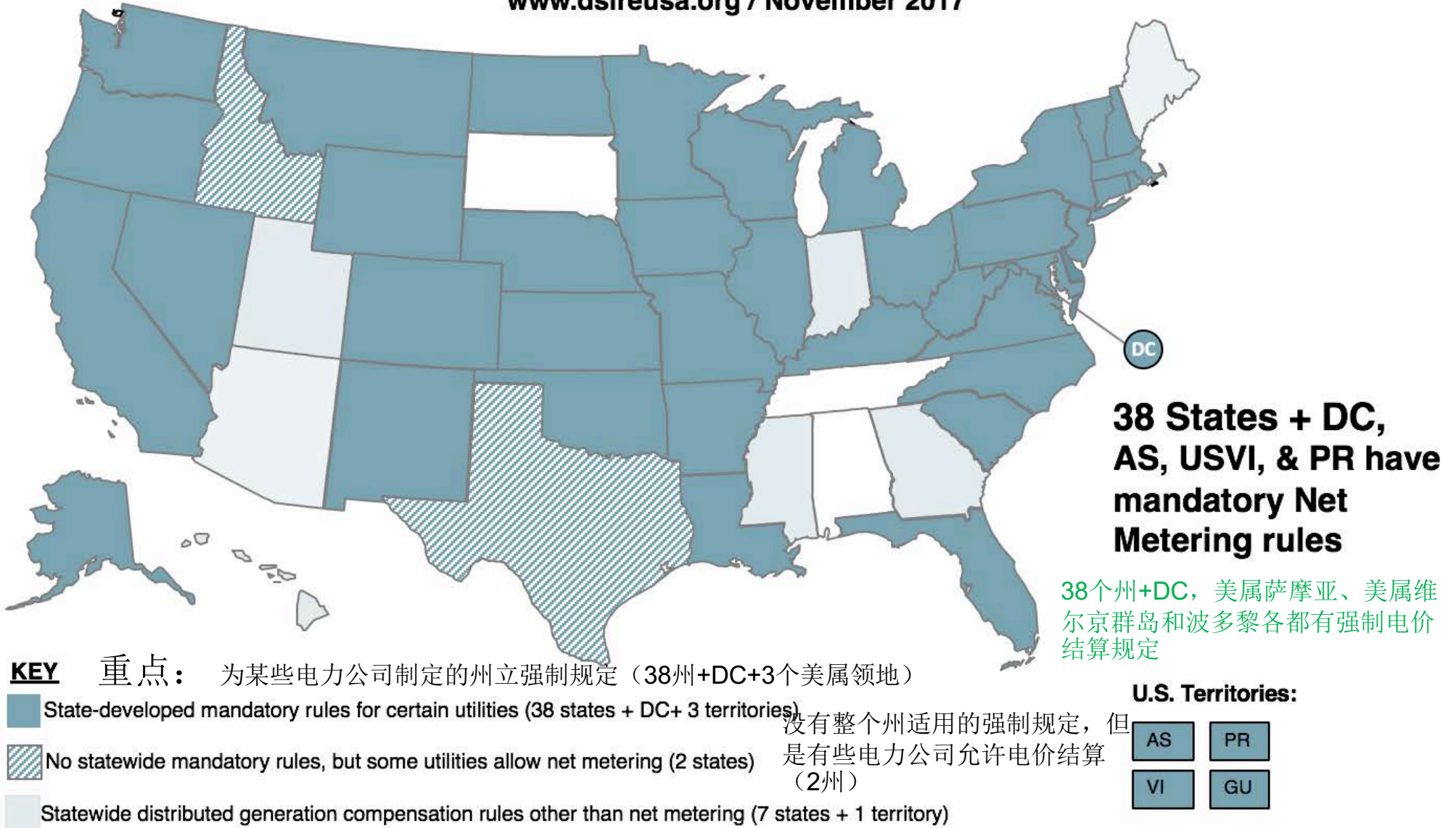
在购电者账单上会显示可扣除的太阳能发电的美金价值

通过一个公式来将表盘上的太阳能电力换算成美金价值

Net Metering

电价结算

www.dsireusa.org / November 2017



除了电价结算政策之外的整个州范围内的电力补贴分配规定 (7个州+一个美属领地)

Feed in Tariff 强制光伏上网电价

- **A set price/mWh for a particular source of renewable or distributed generation.**

给某种特定可再生或分配的电力的固定价格

- **Set purchase term, typically through a contract long enough to finance the energy source**

制定购买条件，通常是通过制定一个长期合同以资助能源来源。

- **Guarantees access to the grid** 保证接入电网

- **Typically, tariff is stepped down as economies of scale develop.**

通常情况下，当经济规模发展壮大时，关税就逐步走低。

- **Popular in Europe but increasingly controversial as resource grows transitioning to Feed-in premiums.**

在欧洲盛行，但随着资源增长向固定上网溢价制度过渡，变得越来越有争议。

- **In US can be a carve out under a larger RPS**

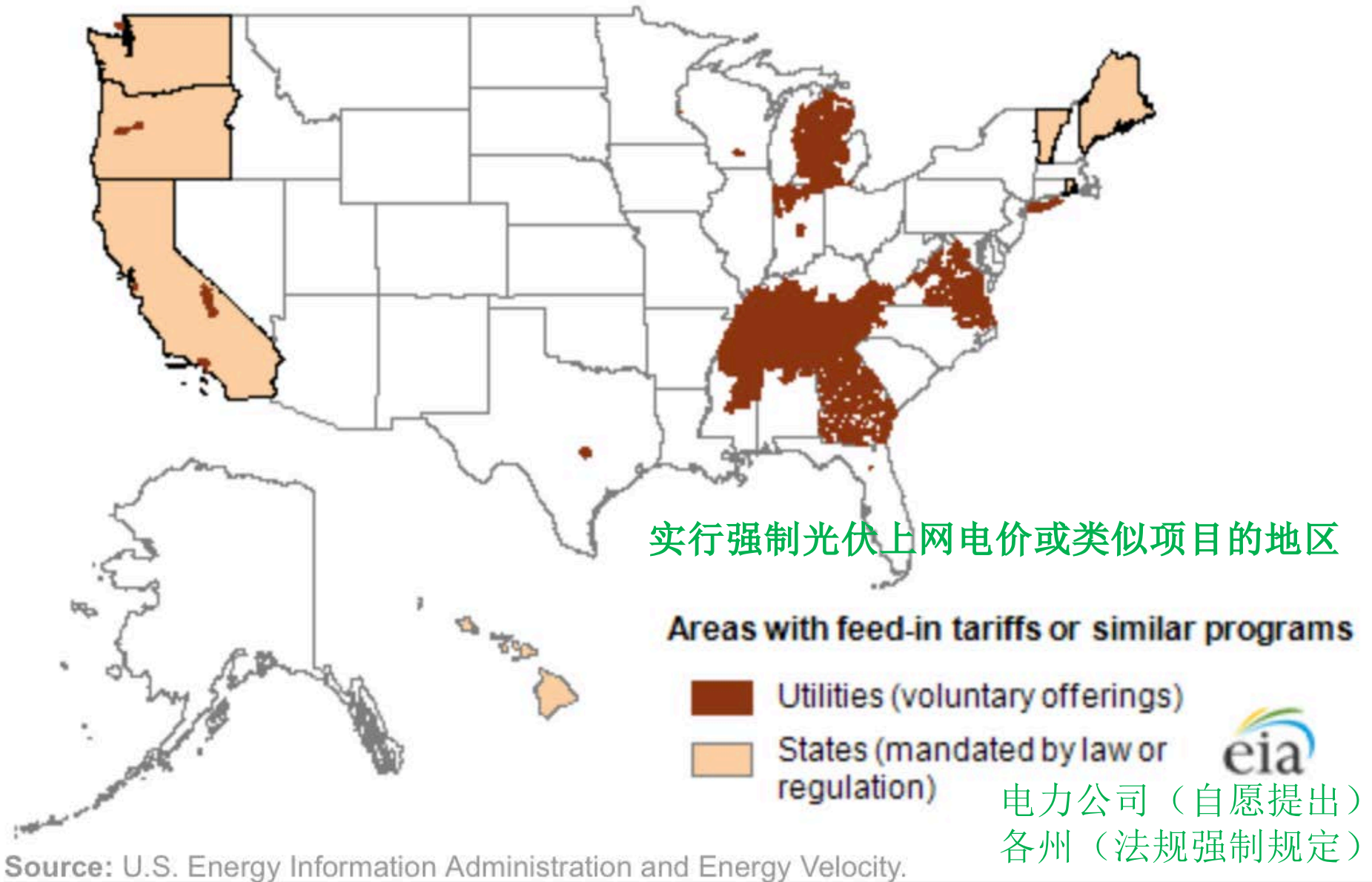
在美国，它可能是在一个较大的RPS制度下的一种开拓。

- **FERC preemption concerns. What are they?**

2 FERC强制购买的问题，它们是什么？

实行强制光伏上网电价或类似项目的美国各州和电力公司项目

U.S. states and utilities with feed-in tariffs or similar programs



强制光伏上网电价制度提供了投资保证，促进成本降低

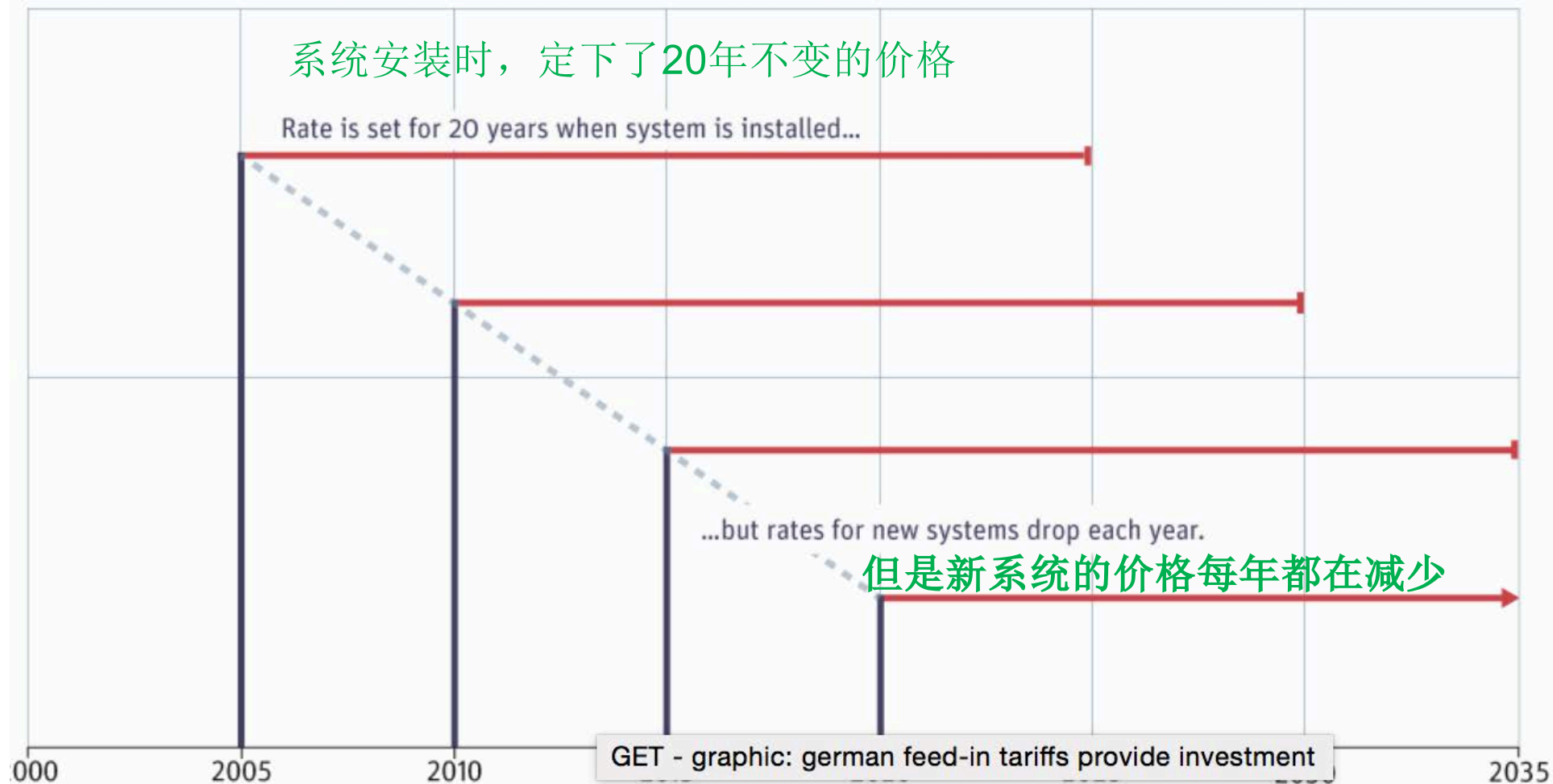
Feed-in tariffs provide investment certainty and drive costs down

Simplified generalization of feed-in tariff with 20 year duration

Source: Own estimates based on WFC

长达20年的强制光伏上网电价制度的简化概述

Rate level



Vermont's Standard Offer Program

佛蒙特的“标准优惠项目”

30 V.S.A. §8005a

- ◆ **DG Program** 项目 **Project Cap 2.2 MW**
- ◆ **Feed-In-Tariff** 强制光伏上网电价制度:
- ◆ **First in Country** 全国首例
- ◆ **Solar, Wind, Hydro, Farm Methane**, 太阳能、风能、水电、农田沼气
- ◆ **Landfill Methane, Biomass, Food Waste** 废物填埋场沼气、生物质、食物残渣
- ◆ **Standard Offer Facilitator Purchases Electricity from Producers & Distributes to Utilities**
标准优惠推动者从电力生产者和分配者到电力公司购电。
- ◆ **Market Based Mechanism: Annual RFP**
以市场为基础的机制：一年一度RFP

Vermont's Standard Offer Program

佛蒙特的标准优惠项目

30 V.S.A. §8005a



White River Junction Solar – 2.2 MW

White River 交界太阳能电厂



Whitcomb Solar – 2.2 MW

53 Projects Online	项目在线	=	56 MW
9 Projects Pending	项目待定	=	14 MW
Solar Rate	太阳能美元比值	=	<u>\$0.30/kWh</u> (2009) down to <u>\$0.07/kWh</u> (2016) 从2009年 <u>\$0.30/kWh</u> 降到2016年 <u>\$0.07/kWh</u>






What is Community Choice Aggregation? 何为社区优选能源组合



An Example of Community Choice

社区优选能源的例子

ECO+

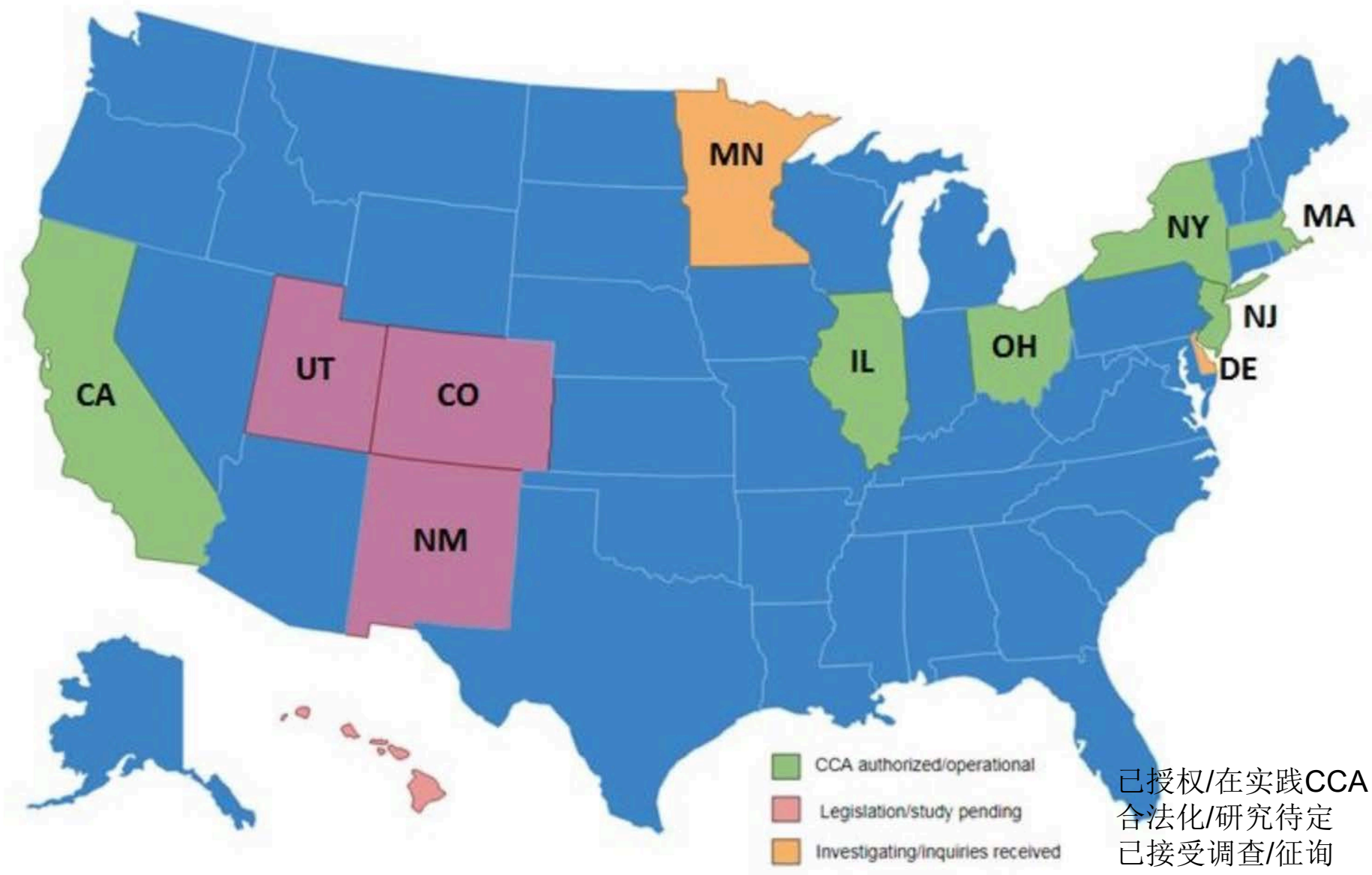
 <p>ECOplus is at least 50% renewable and 75% carbon-free</p>  <p>ECOplus rates are 5% lower than PG&E's electric generation rates</p> 	 <p>ECO100 is 100% renewable and carbon-free</p>  <p>ECO100 will cost the average residential customer only \$4.45 per month more than ECOplus</p>
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至少50%可再生，75% 无碳。
ECOplus的费用比PG&E的电
费低5%。

100%可再生并无碳
平均每个居民只需每月比ECOplus多
花\$4.45

States with Community Choice Aggregation

有优选能源组合的州



已授权/在实践CCA
合法化/研究待定
已接受调查/征询

State Leadership - Massachusetts

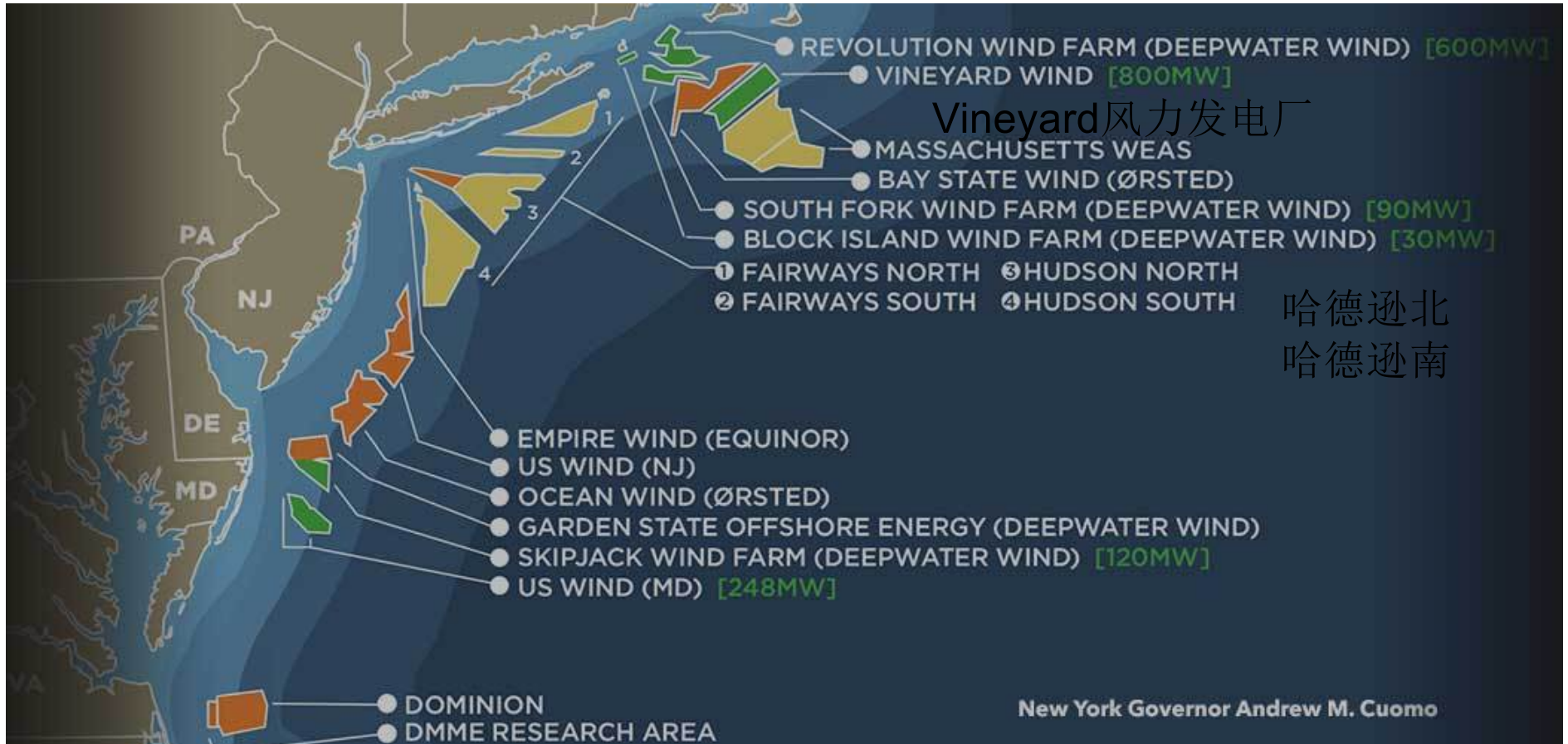
州领头羊-马塞诸塞

- **Transmission for Canadian Hydro - New England Clean Energy Connect transmission project would deliver up to 1,200 MW of Canadian hydropower to the New England grid via a 145-mile transmission line. The partners estimate the project to cost \$950 million.**
- 加拿大水电输送---新英格兰清洁能源联网（NECEC）输送工程将通过一个145英里长的输电线输送高达120亿（12billion)瓦的加拿大水电至新英格兰电网。合作伙伴估计该工程将耗资95亿美元。
- **Offshore Wind - Avangrid Inc. and Copenhagen Infrastructure Partners jointly won a Massachusetts auction to build an 800-megawatt wind farm south of Martha’s Vineyard and a transmission line to bring the power to shore. Overall 3,300 MW state goal.**
- 沿海风力--Avangrid公司和哥本哈根基础设施合作伙伴共同拿下了马塞诸塞的一次竞拍，在马大葡萄园的南部建立一个800兆瓦特的风力农场，并将电力输送到岸上的电线。全州的总体目标是330亿瓦。
- **Energy Storage Target - State established an energy storage target of 1,000 MWh by Dec. 31, 2025, the legislation authorizes state agency to implement a range of policies to achieve the 1,000 MWh target and to “encourage the cost-effective deployment of energy storage systems.”**
- 能源储备目标---该州设立了一个能源储备目标，即到2025年12月31日之前达到100亿瓦，立法机构授权州机构执行一系列政策来实现该目标，并“大力推广使用低成本的能源储备系统“

What is our progress on the renewable energy transition? 我们在向可再生能源过渡上有何进展



Revolution 风力农场 (深水风)



Emerging Corporate Excellence

新兴优秀企业

“Many corporate buyers are interested in the “additionality” of their purchase—whether their action caused more renewable energy to be added to the grid.”

许多企业买家对购买之后的“附加性结果”很感兴趣，即他们的购买行为是否会促使更多的可再生能源进入电网。

- ✓ “Additionality means that, “but for my action, a specific outcome would not have occurred.”
“附加性结果“的意思“如果我不做，就不会有某个具体结果”
- ✓ In the context of green power generation, additionality indicates that without a green power purchase or investment, new renewable energy would not have been financed, developed, and added to the national grid.
论及绿色能源发电，附加性结果表明，如果不购买或投资绿色能源，新的可再生能源就得不到资助、开发并补充到国家电网中。
- ✓ Additional green power is renewable energy that wouldn't have happened otherwise.”
额外的绿色能源是换一种情况就不会有的可再生能源。

Corporate Procurement of Renewable Energy

企业对可再生能源的采购

- 1. Corporations accounted for more than 2,000 MW of the 5,496 MW of wind capacity contracted for in 2017 and grew to 9.6% of the total installed U.S. capacity for wind.**

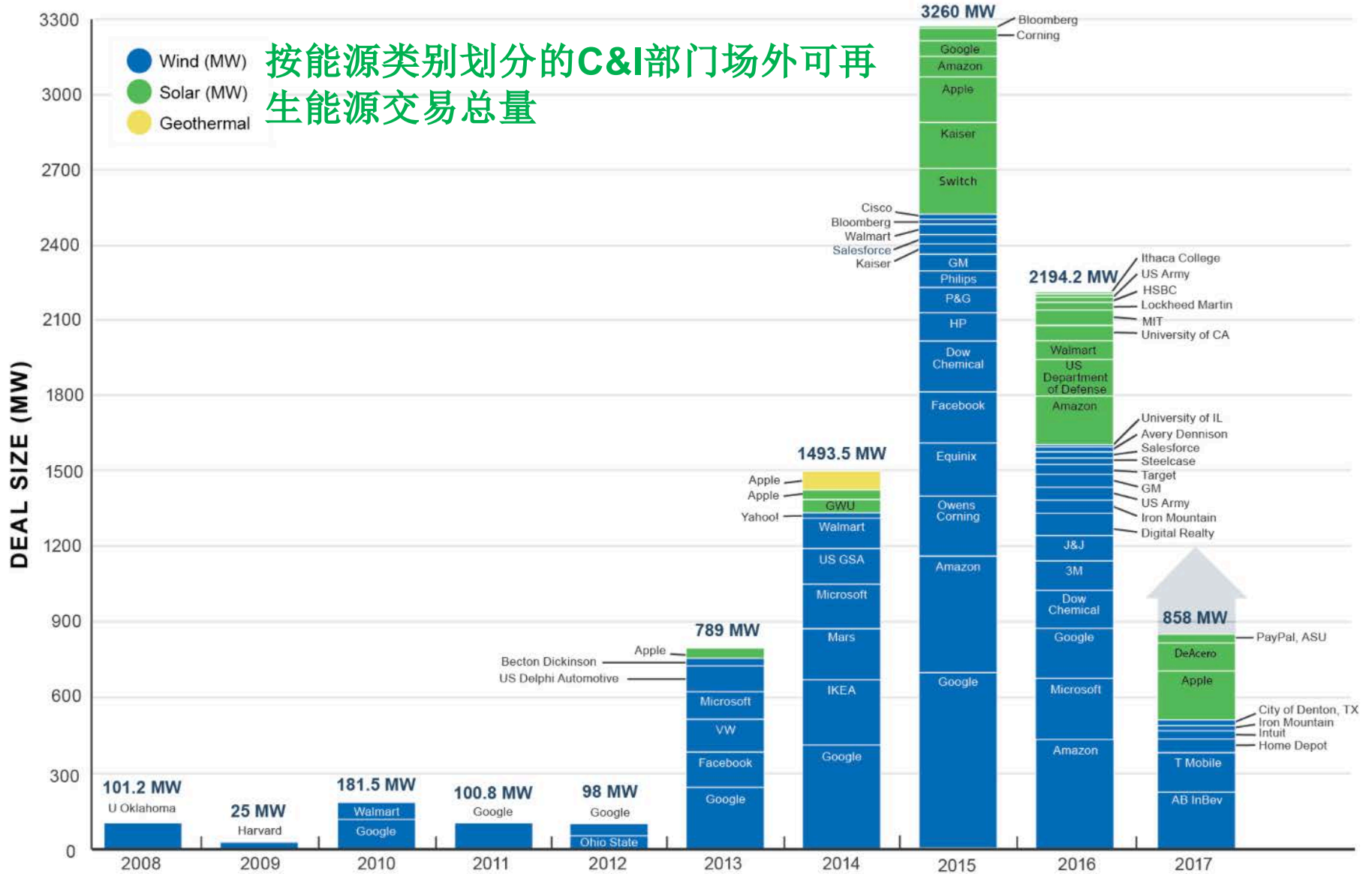
2017年，在合同定下的54.96亿瓦风能中，企业超过20亿，并且达到美国安装的总风能的9.6%。

- 2. Corporate procurement of solar grew from 10% of 2016's installed capacity to 16% in 2017.**

企业购买的太阳能产能占比从2016年的10%增加到2017年的16%。

AGGREGATE OFFSITE RENEWABLE DEALS IN THE C&I SECTOR BY ENERGY TYPE*

交易规模



*Based on publicly announced C&I offsite renewable energy deals (financial, virtual, green tariff, tax equity, etc.) in the U.S. and Mexico. Excludes onsite PPAs. Last updated 04.19.17.

WHAT IS A GREEN PPA?

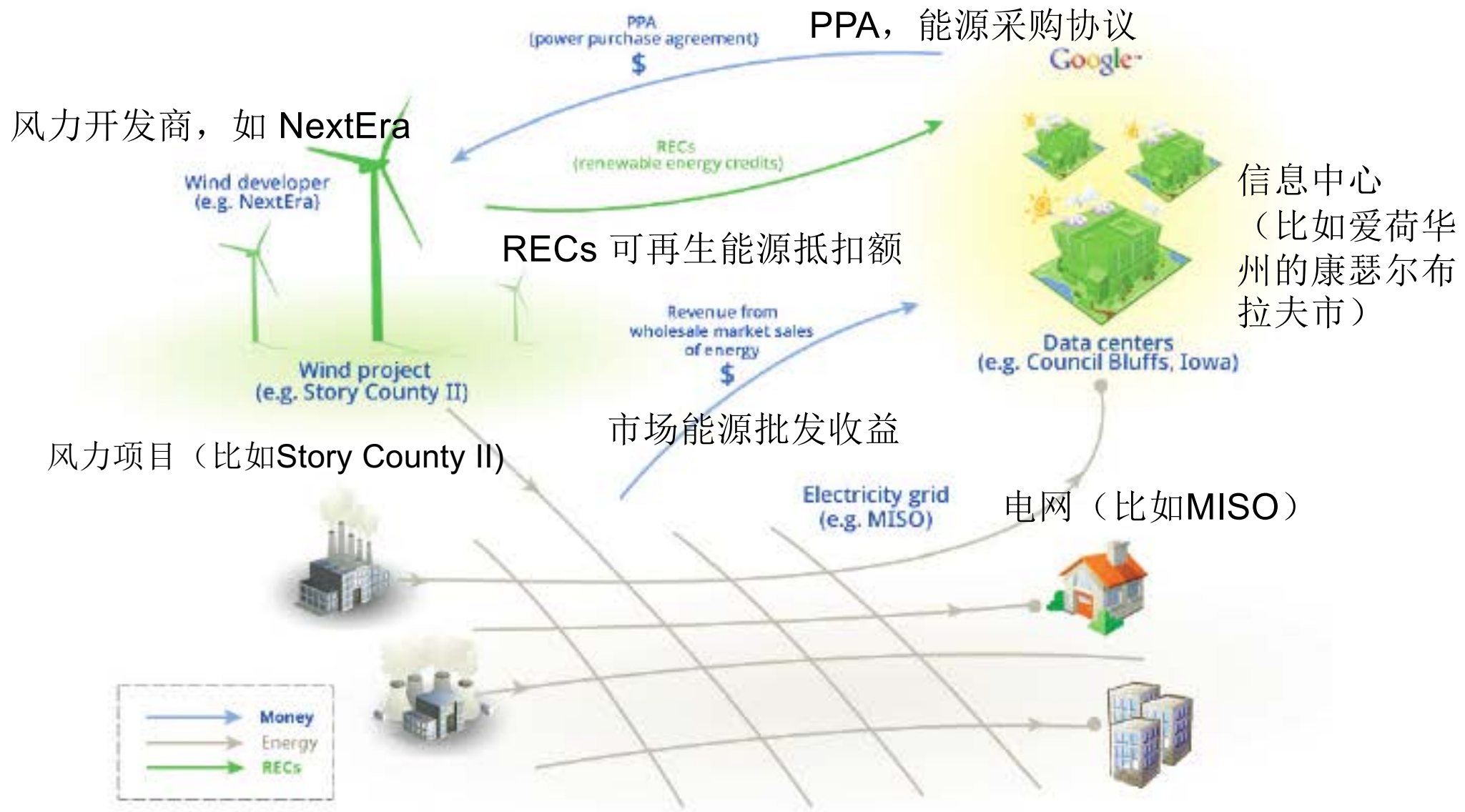
何为绿色PPA?

A green power purchase agreement, at its core, is a contract between two parties where one party sells both electricity and renewable energy certificates (RECs) to another party. In corporate renewable energy PPAs, the “seller” is often the developer or project owner, the “buyer” (often called the “oftaker”) is the Commercial entity. The best structure depends on the markets where the oftaker and projects are located, as well as the goals, priorities, and risk tolerance of the oftaker.

绿色能源采购协议的核心是合同的一方出售电力和可再生能源执照（RECs）给另一方。在企业可再生能源PPAs中，卖方经常是电力开发商或项目持有者，而买方（经常被称为承购商）是商业实体。最好的机构要看卖方和项目所在地的市场，以及买方的目标、优先考虑事项和风险承受力。

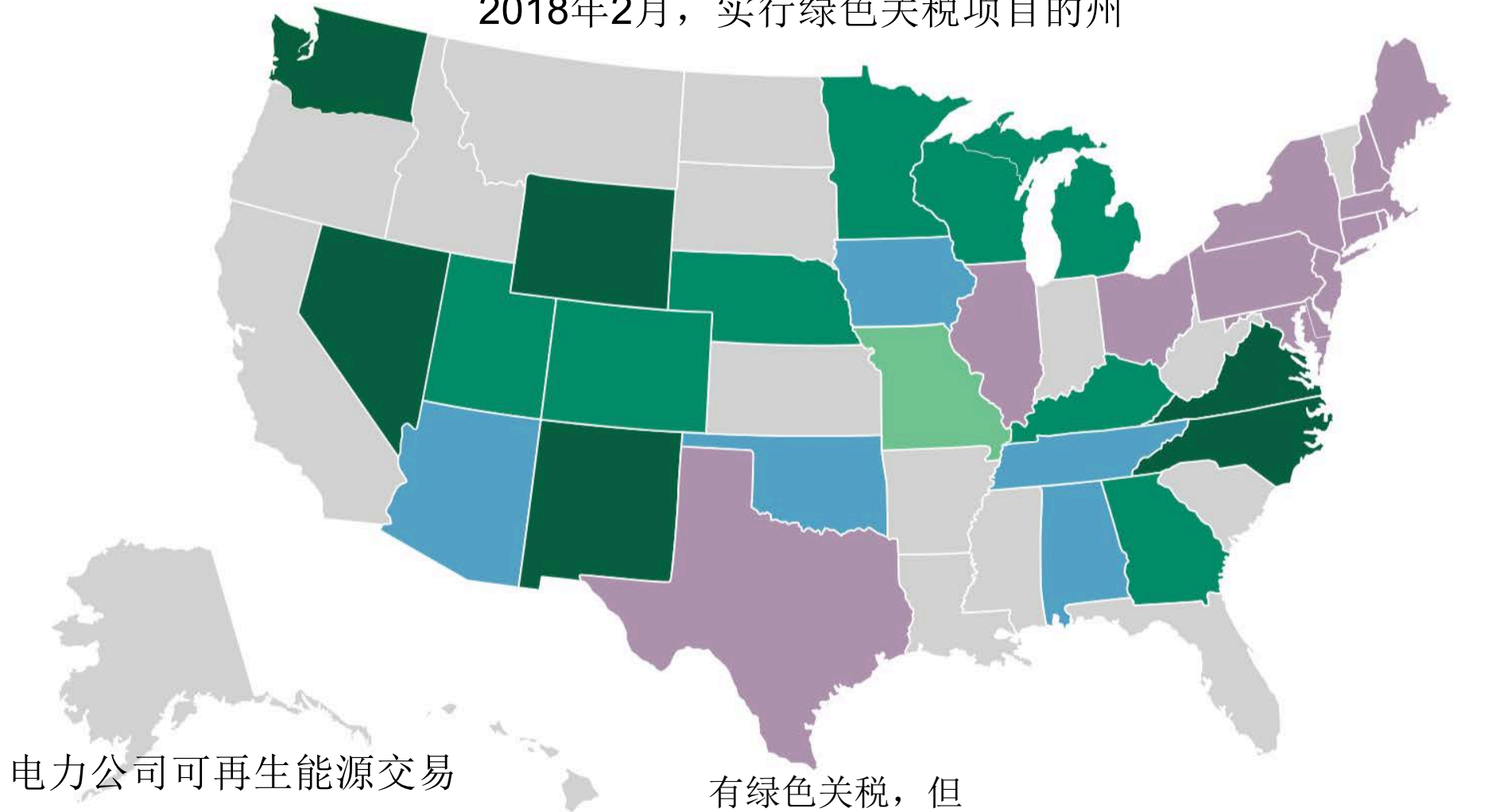
Google Green Purchase Power Agreements

谷歌绿色能源采购协议



STATES WITH GREEN TARIFF PROGRAMS, FEBRUARY 2018

2018年2月，实行绿色关税项目的州



电力公司可再生能源交易

Utility Renewable Energy (RE) Deals

- Dark Green:** Green tariff(s) and executed RE deal(s) through tariff. 绿色关税及通过关税实施的可再生能源交易
- Medium Green:** Green tariff(s) but no deal(s) through tariff to date. 绿色关税及通过关税实施的可再生能源交易
- Blue:** One-on-one RE deal(s) between companies and utilities, but no green tariff to date. 企业与电力公司之间的可再生能源交易，尚无绿色关税

有绿色关税，但是尚无通过关税达成的交易

Green tariff(s) but no deal(s) through tariff to date

Electric retail choice easily available

正在考虑绿色关税（与PUC公司共同提议）

Considering a green tariff (proposal with the PUC). 没有可以直接获取的大规模可再生能源 RE access available

电力零售选择很多

US Policy for Powering the Green Economy

美国推动绿色经济的政策

- I. Lagging Current Federal Policy 落后的当前联邦政策
 - a) R&D, + Tax Credits 科研+抵税额
 - b) Open Access and Markets (Carbon Pricing)
开放精英和市场（碳定价）
 - c) Trump and Tariffs? 特朗普和关税？
- II. Leading State Policy 一马当先的州政策
 - a) RPS Requirements RPS要求
 - b) Net Metering 电价结算政策
 - c) Feed in Tariffs 强制光伏上网电价
 - d) Community Choice Aggregation 社区优选能源组合
- III. Emerging Corporate Leadership 新兴领头羊企业

Questions or Comments? 欢迎提出问题和建议!