Development in Chinese solar and Wind sector

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Environmental challenge:
Driven force for RE



China is the largest energy consumption country in the world

China's energy is 90% self-sufficient

China's per capital energy consumption is about the world average.

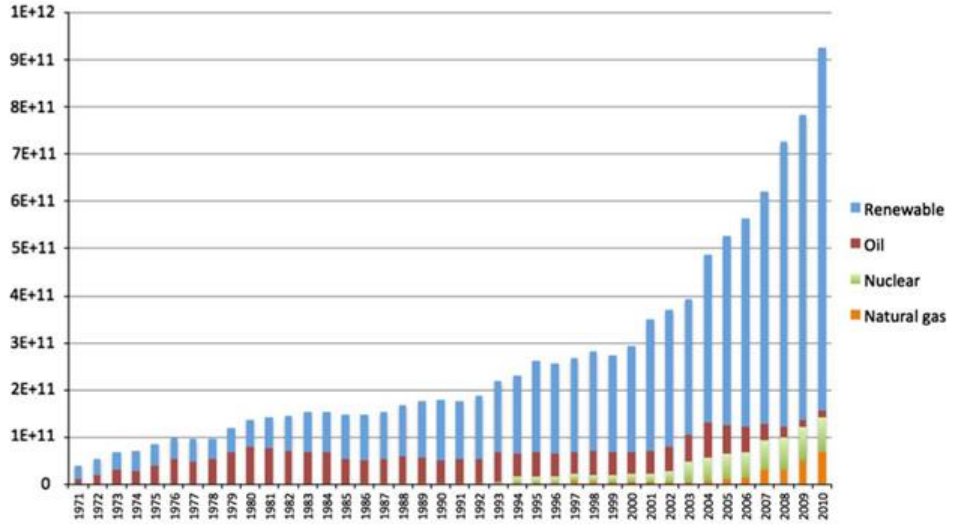
China's energy is heavily relying on coal (1.9 billion TOE , about 50% production of the world)

China is the largest consumer of coal which represents almost 65 percent of the country's total energy consumption.

China's CO2 emission is the largest in the world.

China's cities are badly polluted.

China‘s non-coal energy production



Chinese Solar Development status

☆ 2020 target100GW，potential increase 50—100GW；
estimated 2030 Total PV building capacity 500 -600GW

☆ 2015 Q1+ Q2，China produced 18.2GW cells and 19.6GW panel；

☆ 2015 Q1+ Q2 PV installation 7—8GW，in total 35GW until 2015 Q2；

☆ Big solar companies increase 4.2GW production capacity，Including 1GW oversea；

☆ Central and local governments still owe plants 1.6 billion USD as subsidy

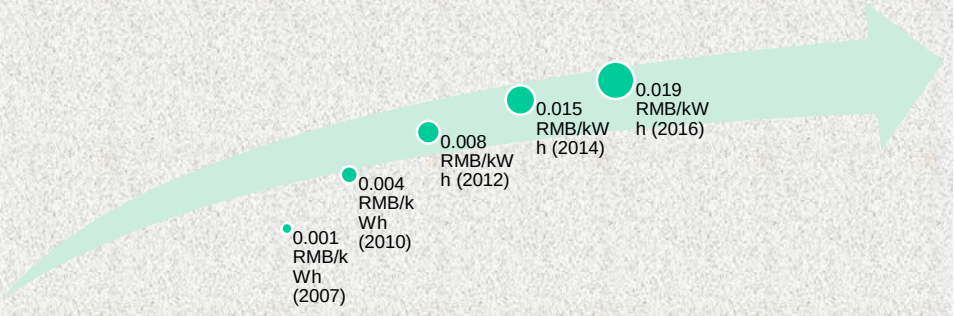
•At $89.5 billion, China has now become the largest market for renewable energy.

• As the global manufacturing hub for solar photo voltaic panels (with nearly 75 percent of total PV panel manufacturing), China is now considered to be the fastest growing market for solar energy for the next five years.

•The approval process for solar projects has been streamlined, with a clearer role for the provinces having been set out; capital markets are warming to PV; some issues relating to property ownership for rooftop installations have been cleared; provincial regimes are themselves becoming more familiar with solar development.

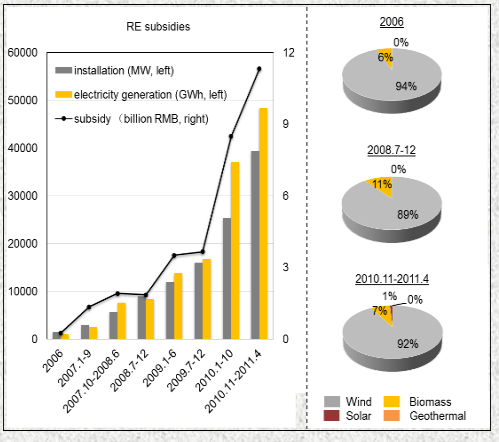
Renewable energy special foundation

- REL established a long-term, stable subsidization system for setting up a public-financed fund for RE development
- The annual total number could be 19 billion RMB



RE surcharge was set from the nationwide sale of electricity with the goal of supporting RE development

Subsidies

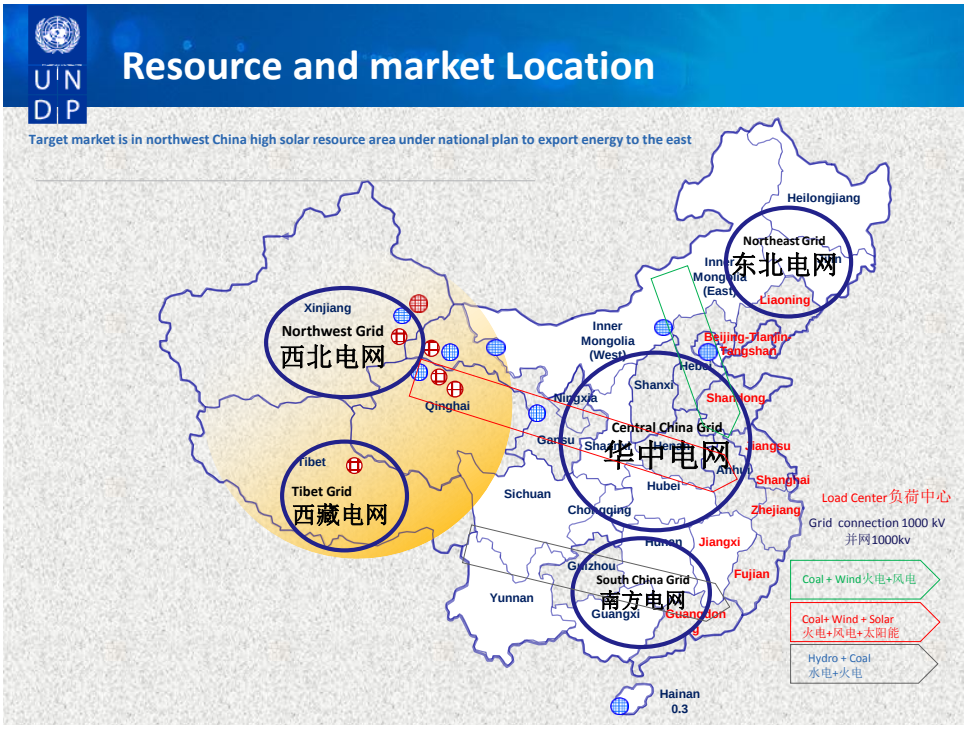


The Subsidies for RE Projects

- Eight installments of subsidies with a total of 32 billion yuan have been distributed for RE power generation projects. As a result, the capacity of RE installations has increased from 1414 to 39,313 MW, while the electricity generated has increased from 1044 to 48,438 GWh
- The structure of RE subsidies also reveals the relatively slow development of solar PV projects and geothermal power projects, which attracted only 1 percent of total distributed subsidies

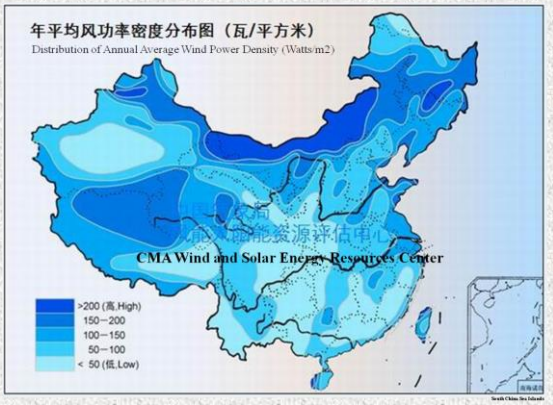
Tax incentives

- Tax incentives used to promote green electricity are mainly designed as **tax exemptions, rebates on taxes, tax refunds or as lower tax rates** on activities promoted
  - **Value added tax (VAT):** Circular on Value Added Tax Policy of Comprehensive Utilization of Resources and Other Products
  - **Corporate income tax (CIT):** Corporate Income Tax Law—energy conservation and water saving conservation projects, environmental protection and clean development mechanism projects are eligible for a three-year CIT exemption, followed by another three-year 50 percent reduction of the CIT rate for income derived from qualified projects
  - **Customs duties:** Import tax policy to encourage the development of equipment manufacturing industry



Wind Power in China

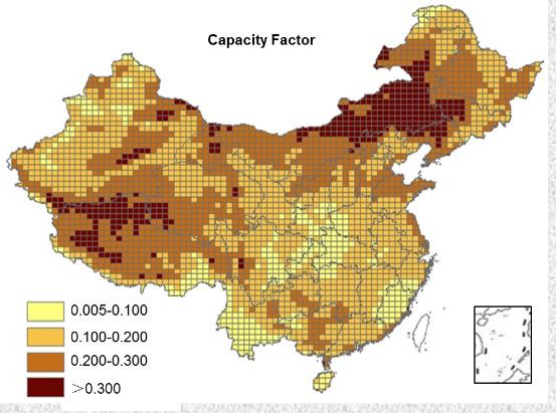
Resources -- wind



- Total technically exploitable capacity of China's wind power resources is 2580 GW
- Given factors like actual area of land available
  - Onshore wind energy reserves available are about 2380 GW
  - Offshore wind energy reserves available are 200 GW.

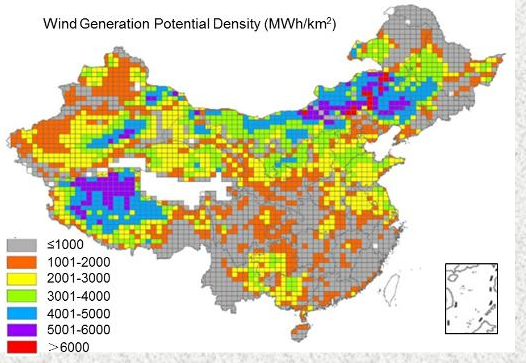
Wind Resources

- **Wind resources analysis**
- Annual capacity factor for each grid cell is calculated by averaging capacity factors from 1979 to 2009, in order to eliminate yearly variation



Wind Resources

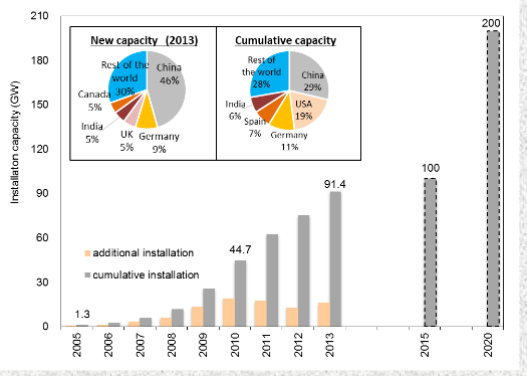
- Wind turbine density is another significant factor to determine the physical upper limit of wind power capacity installation, which ranges from 2 MW to 5 MW per square kilometers in previous studies
- We used NASA's Shuttle Radar Topography Mission and land-cover categories of China to remove unavailable areas for turbine siting



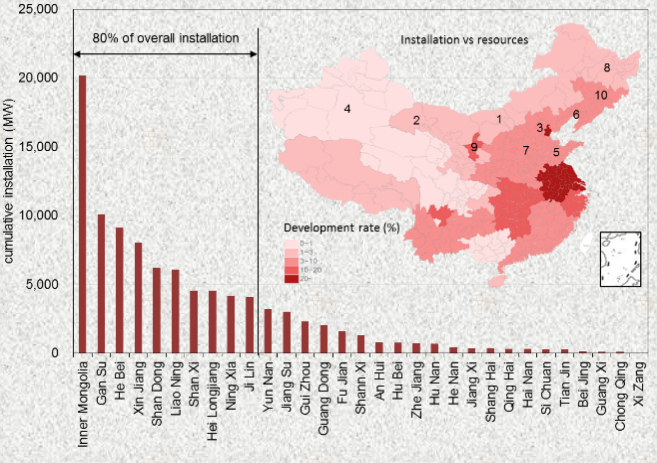
Wind Power Development

- Wind power has seen a significant progress in China since 2005.
  - By the end of 2015, cumulative installation was 129 GW, generated 168 TWh electricity.

- Wind power ranked third in China's power sector, after coal-fired power and hydropower
  - 8% of total capacity
  - 3% of total electricity generation



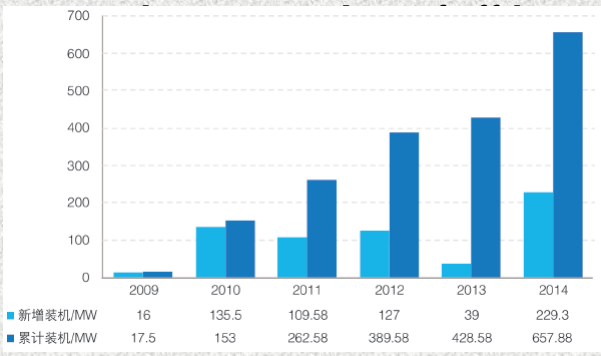
Wind Power Development

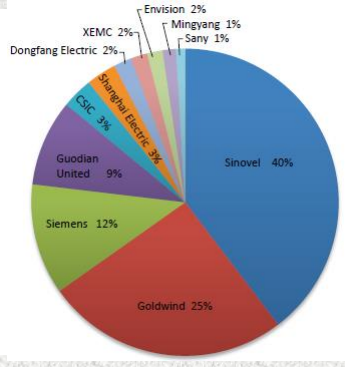


Provincial accumulative on-grid wind capacity by the end of 2014

Wind Power Development

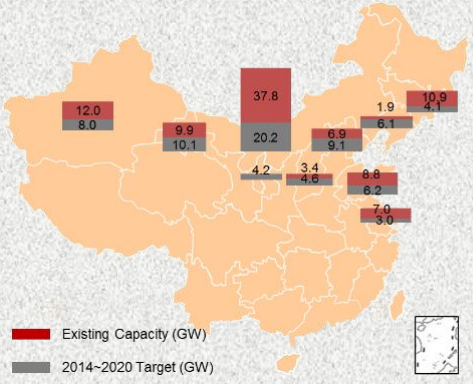
- Off-shore wind power
  - Inter-tidal projects accounted for 66% in off-shore wind power





Target broke down

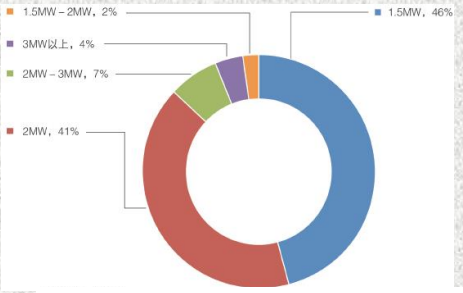
- Development planning for seven 10-GW large-scale wind basements by the end of 2020
- No new projects would be arranged in Xinjiang, Jilin, Liaoning and other provinces with high rate of wind curtailment in the first quarter of 2015



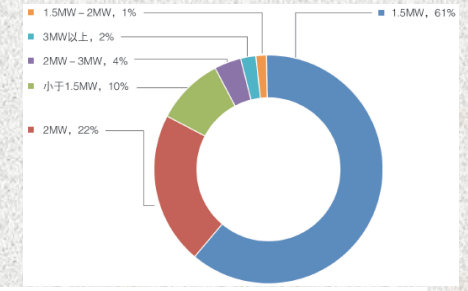
Planned large-scale wind basements towards 2020

Development

- The size of the machine installed in most number in 2014 was the 1.5 MW turbine, accounting for 46% of total; 41% of new machines were 2 MW turbine; and 11% were multiple MW turbines exceeding 2 MW
- The size of machine installed in most number cumulated was 1.5 MW turbine, accounting for 61% of total.



New installation



Cumulative installation

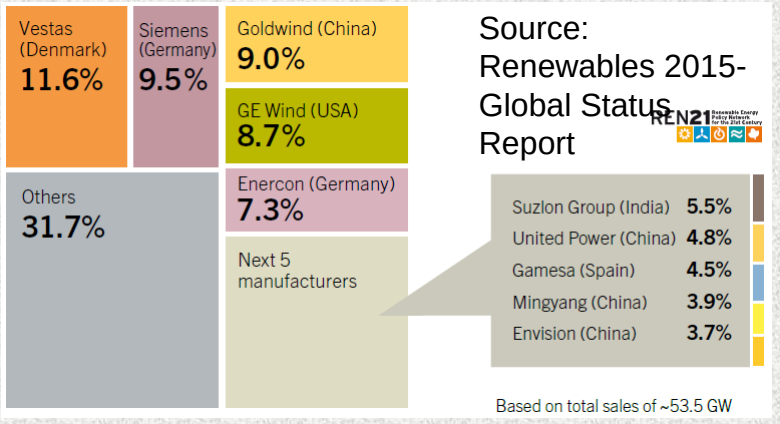
Wind Power Development

- In 2013, China's top 15 enterprises in terms of new installed capacity accounted for around 90% of the national market.
- With the heating up of the market in 2013, enterprises received larger orders, and prices also rebounded. At present, the most popular 1.5MW turbines (tower excluded) are sold at around 4000 RMB or a bit higher per KW.

NO.	Enterprise	Installed Capacity（MW）	Market share
1	Goldwind	3750.25	23.31%
2	United Power	1487.5	9.25%
3	Mingyang Wind Power	1286	7.99%
4	Envision Energy	1128.1	7.01%
5	XEMC Wind Power	1052	6.54%
6	Shanghai Electric Group	1014	6.30%
7	Sinovel Wind Power	896	5.57%
8	Chongqing Haizhuang	786.7	4.89%
9	Dongfang Electric	573.5	3.56%
10	Zhejiang Windey	538.75	3.35%
11	Vestas	507.7	3.16%
12	China Creative Wind Energy	474	2.95%
13	CSR	343.45	2.13%
14	Zhejiang Huayi	314.1	1.95%
15	Taiyuan Heavy Industry	293	1.82%
	Others	1643.65	10.22%
	Total	16088.7	100%

Wind Power Development

- Market share top 10 wind turbine manufacturers, 2014



Policies

- The 'Renewable Energy Law' (REL)
  - The implementation of REL is an important milestone for RE development, which legally establishes legal status, basic system and policy framework for RE development, making it a prioritized area, and is of great significance to RE development. Recent RE development is closely linked to the legislative process of REL.
  - The development of manufacturers and developers was beyond what was anticipated when the law was enacted, which meant that the REL could not keep up with the actual pace of RE development. Therefore, in 2009, an amended version was enacted to address problems existing in prevision version.
    - Scientific planning
    - Power grid connections
    - RE subsidies

Pricing mechanism

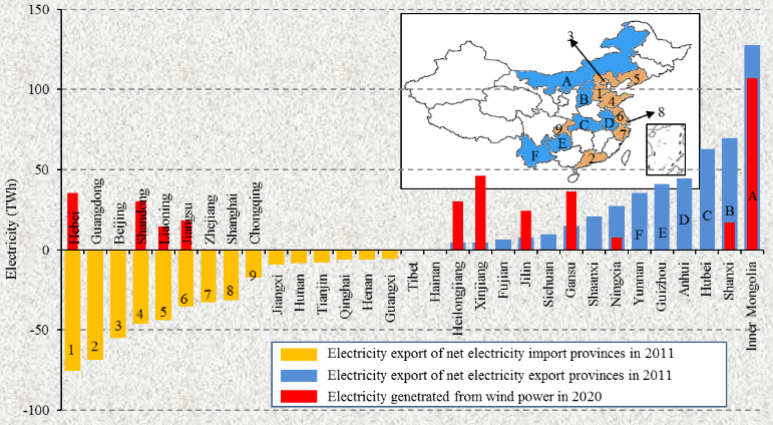
Pricing Mechanisms for RE

	Pricing	Comments
Wind, onshore	Concession bidding (from 2003) to FIT (from 2009)	Benchmark onshore on-grid wind power prices were set from 0.51 yuan/kWh to 0.61 yuan/kWh depending on the specific resource area (NDRC, 2009). The benchmark prices were adjusted 2 cents lower in 2014.
Wind, offshore	Concession bidding/auction (from 2008)	The ultra-low price of the four 2010 projects has been blamed on a faulty bidding process. Low price reflected overly optimistic forecasts of both national incentives for offshore wind development and large scale cost decreases in the future.

- In late 2014, NDRC decided that benchmark prices for Categories I, II and III were decreased to 0.49 yuan/kWh, 0.52 yuan/kWh and 0.56 yuan/kWh, and that for Category IV remained unchanged.

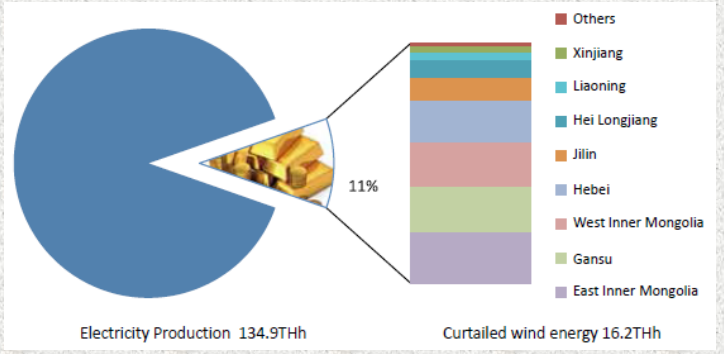
Wind Power Development Challenges

- **Lack of Scientific and Concrete Planning**



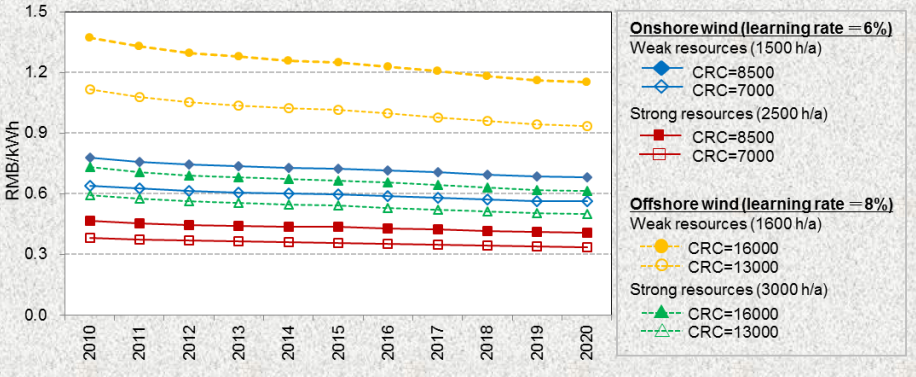
Challenges

- **High Wind Curtailment Rate**



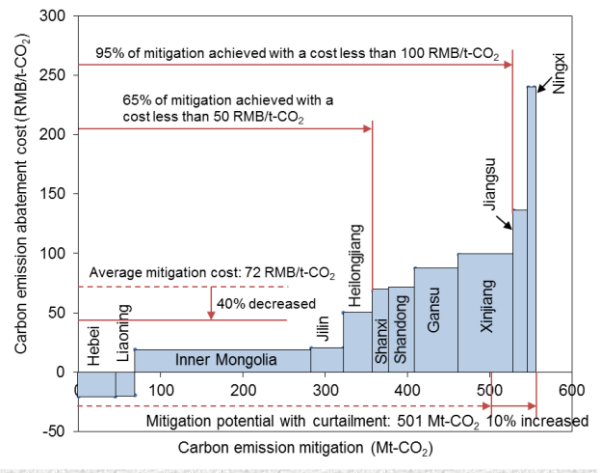
Challenges

- **Problem of Power Generation Cost**



Mitigation potential of wind power

- The total abatement potential could reach 550 Mt-CO_2
- The averaged abatement cost could decreased to 44 RMB/t-CO_2.
- 95% of mitigation achieved with a cost less than 100 RMB/t-CO_2

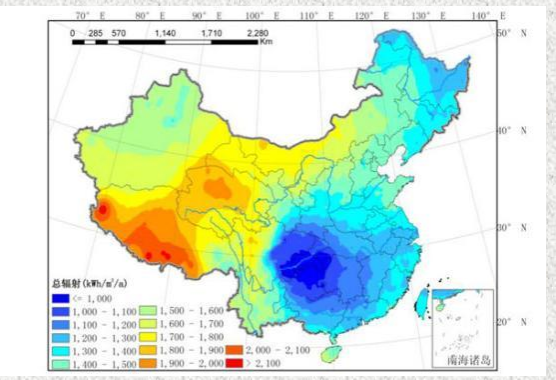


CO2 mitigation potential and abatement cost without wind curtailments

Solar PV in China

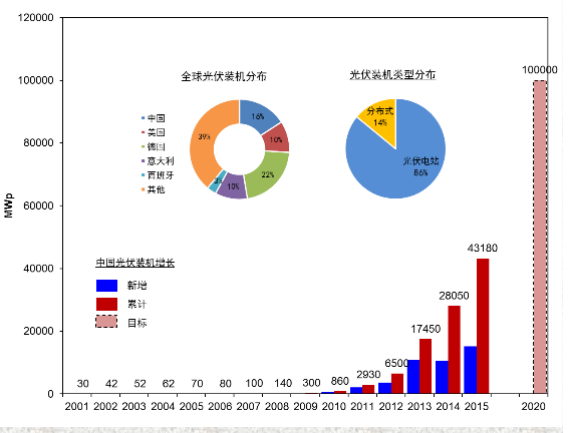
Resources -- solar

- The annual amount of radiation is 5000 MJ / m^2, equivalent to 2400 billion tce.
- The total area of more than 2000 hours of annual sunshine hours account for more than two-thirds of national land.



Solar PV Development

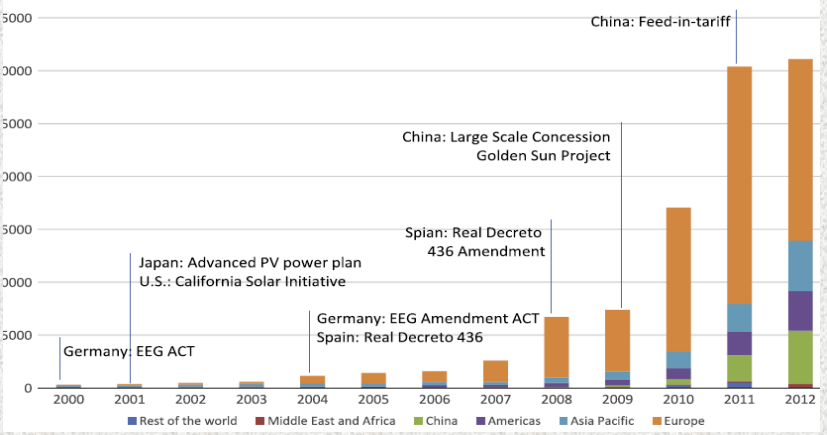
- Solar PV installed more capacity than any other renewable technology since 2013.
- Total capacity reached 45 GW, ranked first in the world.
- The target for PV keeps raising to 150 GW.



Solar PV Development

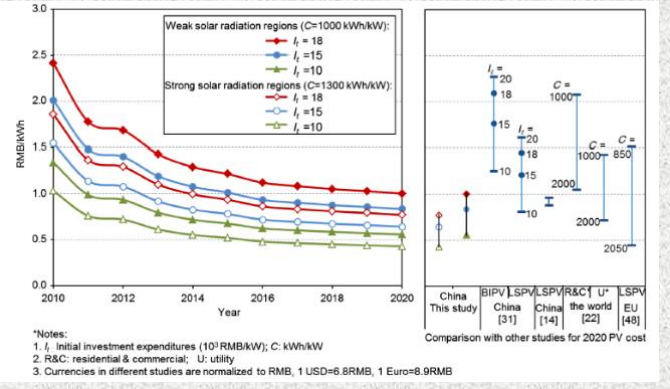
Period	Key policies	Important policy instruments and contents
1980–1995	Outline for New Energy and Renewable Energy Development	*Planning*: Popularize the application of energy-saving solar buildings, solar heaters and PV power generation systems nationwide *R&D Grants*: 4.86 million RMB for Renewable Energy Technology *Investor subsidy*: At 50% of the commercial bank interest for PV cell production lines
1996–2000	2000–2015 Key Points of Development Planning of New Energy and Renewable Energy Industry	*Planning*: Establish the solar cell and application system production lines; expand the market to 2 MW; promote commercialization of second generation solar PV industry
	Interim Provisions on Capital Construction Project Management of New Energies	*Demonstration project*: 100 KW installed power generation capacity; control foreign capital
	Notice on adjusting the tax policy on Imported Equipment	*Equipment duty-free*: Exempt from custom duties and value-added taxes on imports
2001–2005	"Tenth Five-Year" Plan for the Development of New Energy and Renewable Energy Industry	*Planning*: Popularize the solar PV power generation system; promote the market development in the western region; improve the technical and equipment levels; organize demonstration projects; cultivate the market
	Renewable Energy Law of the People's Republic of China	*Renewable portfolio standard*: Build total renewable energy amount target system *Feed-in-tariff*: Build feed-in tariff and cost allocation system *Public investment*: Build Renewable Energy Development Funding sourced from user side electricity prices
	Directory of High and New Technology Products Encouraging Foreign Investment	*Tax concessions*: Encourage foreign investment in manufacturing
	Program of Electrification in Western Villages and Towns	*Public investment*: Investment of up to 2.6 billion RMB and a PV module installed capacity of 19.6 MWp
2006–2010	Interim Management Rules for Renewable Energy Development Funding	*Public investment*: Use part of user terminal electricity income to develop renewable energy. Levy rate: 0.002 RMB per kWh from 2006; 0.004 RMB per kWh from November 2009; 0.008 RMB per kWh from December 2011; 0.015 RMB per kWh from August 2013
	Interim Method for Renewable Energy Generated Power Pricing and Cost Allocation Management	*Feed-in tariff*: Benchmark Feed-In Tariff use Renewable Energy Development Funding
	Accelerating the Implementation of Solar PV Building	Public investment/demonstration: investment on solar PV buildings.
	Large-Scale PV Power Station Concession Bidding	*Demonstration project*: Installed 4.3 GW large-scale solar power stations between 2009 and 2012
	Notice on Implementation of Golden-Sun Demonstration Project	*Demonstration project*: Installed over 5.8 GW in mainland China
After 2011	"Twelfth Five-Year" Plan for the Development of Renewable Energies	*Planning*: Propose development targets of solar power installed capacity up to 21 million kilowatts by 2015 and up to 50 million kilowatts by 2020
	Notice on Perfecting Feed-In Tariff Policy of Solar PV Power Generation	*Feed-in-tariff*: Benchmark Feed-In Tariff nationwide; feed-in tariff for distributed PV power generation projects
	China and Europe Cooperative R&D Funding Project for Energy Conservation and Emission	*Research and Development Grant*: 30 million RMB budget for small and medium enterprises projects
	Code for Operation and Maintenance of Building Mounted PV System	*Technology standard*: Technical standard for the construction industry formulated under the leadership of PV enterprises in China

Annual increase of global solar PV market and key policy milestone

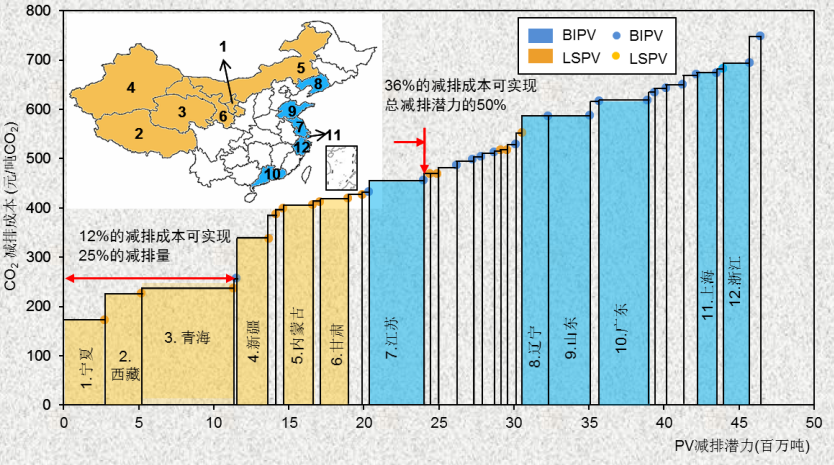


Cost of solar PV

- Capital cost decreased to 6800~8500 RMB/kW



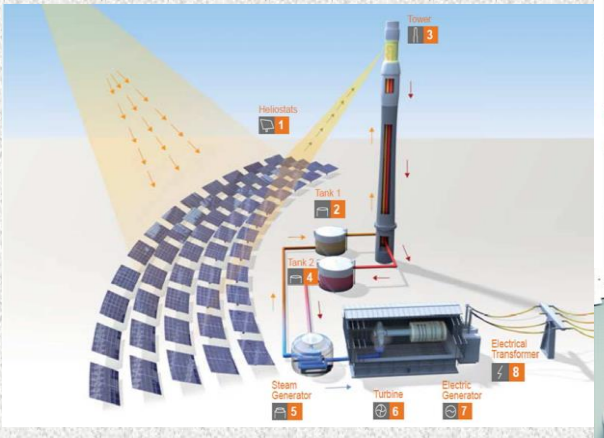
Mitigation cost curve of solar PV

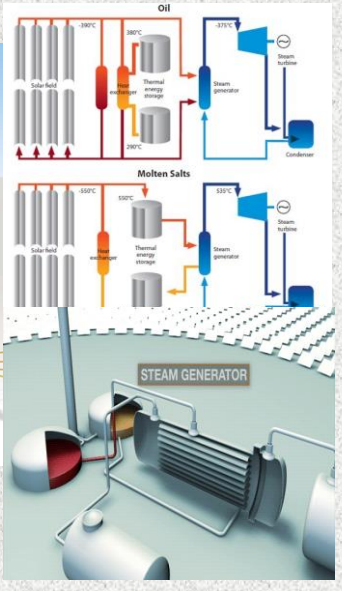


China's on-grid PV solar development

on-grid Concentrated Solar Power CSP development

Molten Salt Solar Energy Thermal Storage with Concentrated Solar Power





Solar heating development

Solar water heating development

Building integrated PV (BIPV)

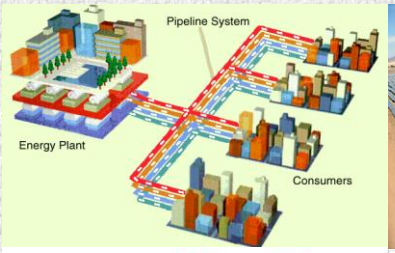
PV work together with rural sectors

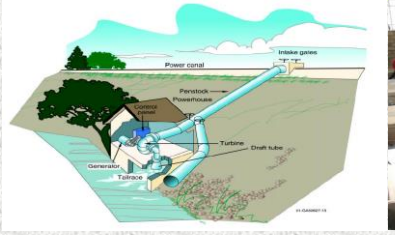
Solar stove

Solar stoves which cost 120 USD, give away to farmers for free (Ningxia China) in mountain area, saving tons of wood per year.
Is climate change funds sleeping?

Global solar industrial use distribution

System integration PV with mini-grid





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Solar heating for food processing

- **Shanghai Cookie Factory**
- Panel area：1000m2
- Daily hot water ： 200ton
- Annual hot water ： 34000ton
- Annual power saving：417500 kwh
- Annual cost saving：40,000 USD
- Equipment investment：200,000 USD
- Pay back period ： 4 years

- **Kunming corn storage : Heating with solar**
- Annual power saving：2/3
- Pay back period ： 5 years

Solar heating solution for Dyeing industry

Chaoshu Dyeing Factory

Solar heating in oil industry

Heat exchanger

Liaohe Oild field
China

ESCO

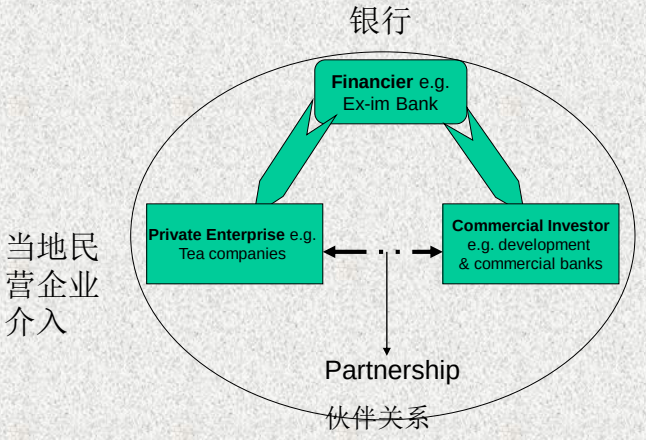
China energy saving through industrial solar use

Year	sectors	Heat consumption (10^4 tons)	Coal saved (10^4 tons)	Solar heating panel needed (10^4 m^2)
2012	tobacco	77.486	7.75	74
2012	Food processing	900	90	860
2012	paper	3303.8642	330.4	3,157
2012	Textile	4635.4165	463.5	4,425
2012	chemical	16917.34	1691.73	16,151
2012	Wood processing	774.8139	77.5	740
2012	Plastics	1442.3301	144.2	1,378
2012	medicine	1154.1292	115.4	1,103
total				27888

Challenges for China's solar PV power development

Deficiencies of the national FiT scheme;
Weak and incomplete incentives and supervision mechanisms;
Poor policy coordination and consistency;
Conflicts between renewable energy power generators and grid companies; and
Poor coordination of Research and development, demonstration and development (R&DDD) on renewable energy and regional policy.
Over production in equipment
Power grid reform slow

商业模式很重要
Business model is key important



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Africa-China cooperation on solar and wind

Project meet Ghana Policy and Strategy development
项目符合所在国国家发展战略

Co-financing
Project Development and Implementation

Enterprise CSR
企业社会责任

中非合作推动可持续发展
ACCA21/Ghana/UNDP demo program for SDG

Identify market potential and investment opportunities;

环境保护作用关键
Environmental safeguard

Thanks!

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