Our Regional Café Session: Up Close and Personal Perspectives From Asia's Biggest Economies

Regional Café

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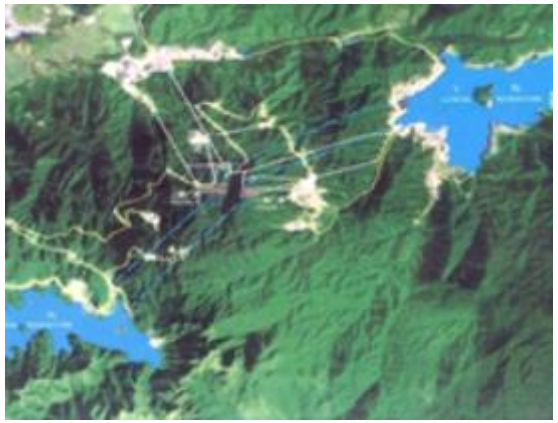
Cleantech innovation in China

Guangdong Guangzhou CongHua pumped storage hydroelectric power plant

- 2400 MW (8 x 300MW) units
- Hydraulic head 535 meters, 23 million m3 water
- Electricity supplies Hong Kong China Light & Power
- Phase 1 imported turbines commissioned in 1994, phase 2 local turbines commissioned in 2000
- Tianjin Alstom hydroelectric joint venture signed at Peoples Hall of China in 1995



China needs advanced technology. Leveraging market power

China world largest onshore wind farms

World's largest onshore wind farms

Wind farm	Current capacity (MW)	Country	Notes
Gansu Wind Farm	6,800	China	[1][8][9][10][11]
Zhang Jiakou	3,000	China	[8]
Urat Zhongqi, Bayannur City	2,100	China	[8]
Hami Wind Farm	2,000	China	[8]
Damao Qi, Baotou City	1,600	China	[8]
Alta (Oak Creek-Mojave)	1,320	United States	[12]
Jaisalmer Wind Park	1,064	India	[13]
Hongshagang, Town, Minqin County	1,000	China	[8]
Kailu, Tongliao	1,000	China	[8]
Chengde	1,000	China	[8]

The Gansu Wind Farm in China is the largest wind farm in the world, with a target capacity of 20,000 MW by 2020.

On parity towards thermal power, subsidy is going away

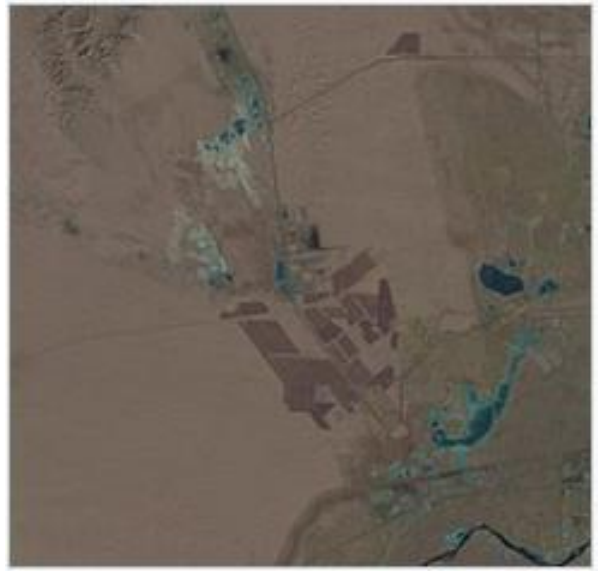
Extracted from Wikipedia

China world largest solar Photovoltaic power stations

World's largest photovoltaic power stations [edit]

Operating solar farms that are 200 MW or larger

Name	Country	Location	Capacity MW_p	Generation GWh p.a.	Size km^2	Year	Remarks
Tengger Desert Solar Park	China	37°33′00″N 105°03′14″E	1,547		43	2016	1,547 MW solar power was installed in Zhongwei, Ningxia by 2015.
Bhadla Solar Park	India	27°32′22.81″N 71°54′54.91″E	1,365		40	2018	The park is proposed to have a capacity of 2,255 MW[11] to be completed by December 2018.
Kurnool Ultra Mega Solar Park	India	15.681522°N 78.283749°E	1,000		24	2017	1000 MW operational as of December 2017
Datong Solar Power Top Runner Base	China	40°04′25″N 113°08′12″E, 40°00′19″N 112°57′20″E	1,000			2016	1 GW Phase I completed in June 2016. Total capacity will be 3 GW in 3 phases.
Longyangxia Dam Solar Park	China	36°10′54″N 100°34′41″E	850		23	2015	320 MW Phase I Completed in December 2013, 530 MW phase II in 2015
Villanueva Solar Park	Mexico	25°35′5″N 103°2′42″W	828		24	2018	828 MW when completed, expected completion in second half of 2018
Rewa Ultra Mega Solar	India	24°28′49″N 81°34′28″E	750			2018	
Kamuthi Solar Power Project	India	9°21′16″N 78°23′4″E	648		10.1	2016	Completed on 21 September 2016
Pavagada Solar Park	India	14°05′49″N 77°16′13″E	600		53	2017	In Karnataka state, total planned capacity 2,000 MW
Solar Star (I and II)	United States	34°49′50″N 118°23′53″W	579	1,664	13	2015	579 MW_{AC} (747.3 MW_p) connected to the grid on June 19, 2015.[30] Consists of Solar Star I (318 MW_{AC} or 397.8 MW_{DC}) and Solar Star II: 279 MW_{AC} or 349.5 MW_{DC}



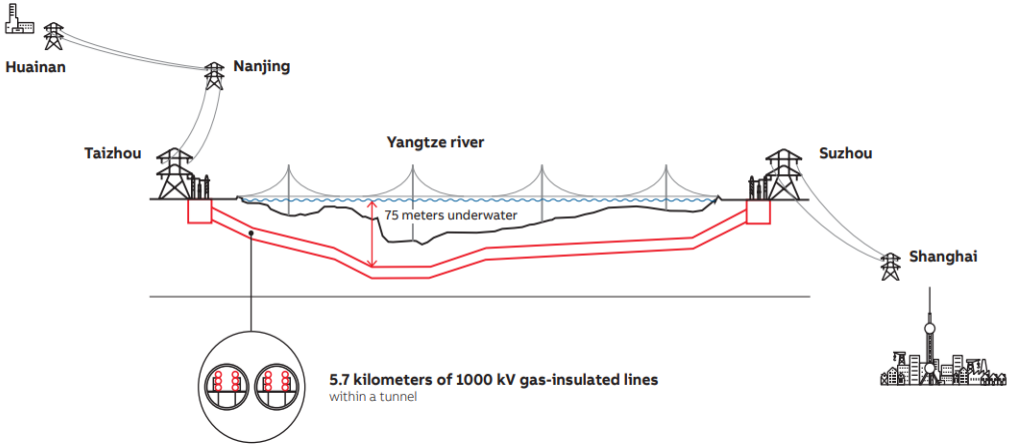
Tengger Desert Solar Park is the world's largest solar park since 2016, with 1,547 MW installed capacity.

On parity towards thermal power, subsidy is going away

Extracted from Wikipedia

China ultra high voltage transmission – world records

- 1,000 kV AC transmission
- Huainan Nanjing Shanghai - Yangtze river crossing using SF6 gas insulated line
- ABB Hitachi participation



- 1,100 kV ± DC transmission
- Changji Guquan 3,284 kM
- Siemens participation

20 years on, China has not changed its Play Book

China high speed train – Golden Decade to world longest and fastest

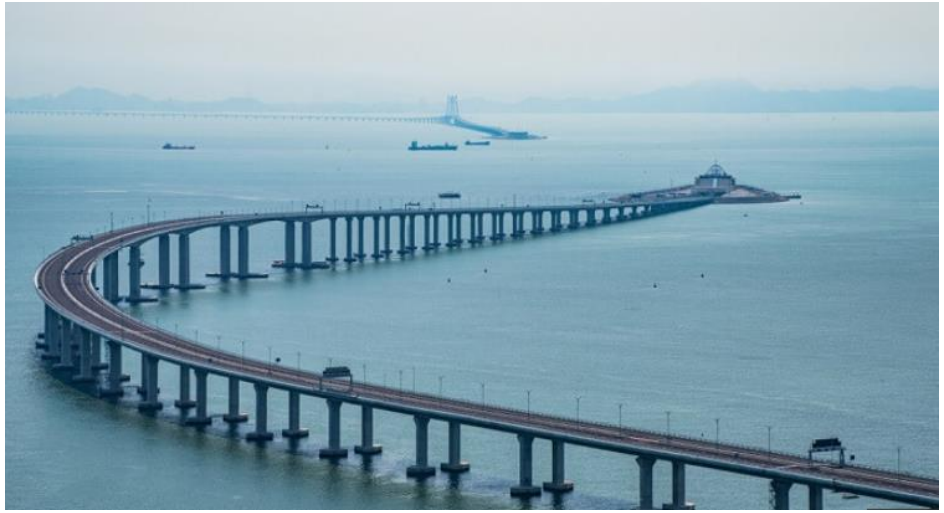
- First line between Beijing and Tianjin started operation in 2008
- 10 years on 25,000 km in operation, another 15,000 km under construction
- Represents 2/3 of world total high speed train network

- CRH 380A train, standard average operating speed 350 km/hour
- Maximum operating speed 486 km/hour
- Maximum speed tested 605 km/hour

Developing non stop passenger exchange system

Tremendous successes in past two decades

- Engineering Innovation
- Commercial Deployment
- Complex Mega scale Project Management
- Global participations
  - manufacturing supply chain localization,
  - joint ventures,
  - technology transfer,
  - joint research development programs



How about scientific innovation? Policy driven

China Electric Vehicle – perfect example

	Passenger EVs	E Bus	
<2013	60k		
2013	80<R<150 35k, 150<R<250 50k, R>250 60k	300k-500k depending vehicle length 6-12m	Massive LFP & Ebus growth
2014	5% off year 2013		LFP & Ebus continued growth
2015	10% off year 2013		LFP & Ebus continued growth
2016	100<R<150 25k, 150<R<250 45k, R>250 55k	120k-500k range, unit mass energy consumption & vehicle length dependent*	Ebus peak at 110,000 vehicles per annum, NMC development
2017	100<R<150 20k, 150<R<250 36k, R>250 44k Minimum specific energy 90Wh/kg	60k-200k, vehicle length dependent, specific energy factor Wh/kg 85<p<95 0.8, 95<p<115 1.0, p>115 1.2; Fast charge C rate 3C-5C 0.8, 5C-15C 1.0, >15C 1.4	EV sales hit 500,000 vehicles, Ebus started decline. Demand higher energy density (RMB 129 Billion in subsidy)
2018	150<R<200 15k, 200<R<250 24k, 250>R>300 34k, 300<R<400 45k, R>400 50k Specific energy factor Wh/kg 105<p<120 0.6, 120<p<140 1.0, 140<p<160 1.1, p>160 1.2	40k-180k, vehicle length, specific energy factor Wh/kg 115<p<135 1.0, p>135 1.1; Fast charge C rate 3C-5C 0.8, 5C-15C 1.0, >15C 1.1	Ebus declined sharply, short range EV phasing out. NMC dominate, LFP phasing out
2019+	?	Zero?	

* Vehicle length factors <6m 0.2, 6-8m 0.5, 8-10m 0.8, 10-12m 1.0, >12m 1.2

Impact by change in subsidy policy

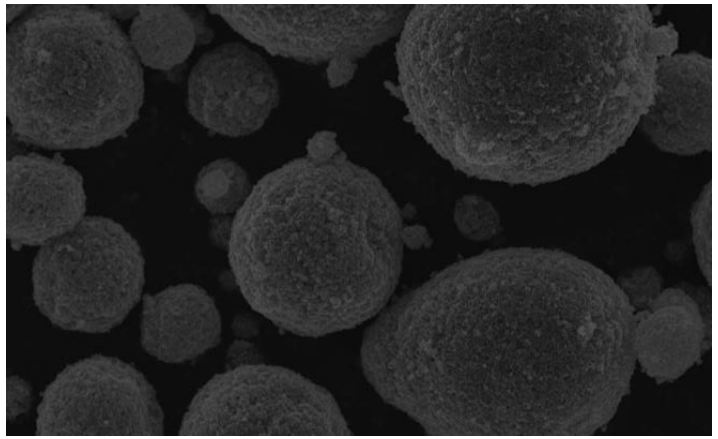
- Favor medium to high end vehicle
- Phase out Lithium Ion Phosphate
- High performance BMS, light vehicle technology
- CATL BYD leadership in NMC
- BYD drops own usage strategy

Type	Range (km)	Energy density (Wh/kg)	Subsidy (RMB)
BYD Qin EV450	400	140.97	55k
BYD Song EV400	360	140.97	49.5k
BYD Yuan EV350	305	126.91	45k
Geely EV450	400	142	55k
BAIC EX360	318	122.68	45k
Chery 3xe	351	125	45k
Denza 500	451	105.75	30k
Roewe Ei5	301	140	49.5k

Companies need differentiating technologies to compete

Technology development

- Higher nickel lower cobalt NMC 532, 622, 811
- Silicon anode, coating
- Nano materials, crystal structure
- Microstructure, sizing and shape
- Thermodynamic,
- Electrolyte analysis



Opportunities for foreign technologies but speed is critical

China continued to leverage policy to address energy and environment issues

- Feed in Tariff for Concentrated Solar Power @ 1.25 RMB/kWh remains attractive
- Gas, water, solid discharge high standards, zero emissions
- Trace NH3, TN, TP, Zero Liquid Discharge, Sox, Nox, PMs, VOCs
- Tightening governance compliance, shutting down non compliance power, treatment and industrial plants

Innovative technologies deployment opportunities in China

Summary

- China continues to import advanced technology on a commercially win-win agreement
- China is driving domestic innovation by leverage subsidy policy
- Opportunities for innovative differentiating foreign technology companies but has to move fast

Cross-border innovation and market entry strategies, including the dos and don’ts and the pros and cons of joint ventures, licensing, going it alone and so on

<u>That’s another discussion in Nanjing</u>