China VFB Installations

Yang Xiongfei, Pangang

Chinese vanadium market update and VRB installations

Yang Xiongfei

Pangang Group Chengdu Vanadium & Titanium Resources development Co., Ltd

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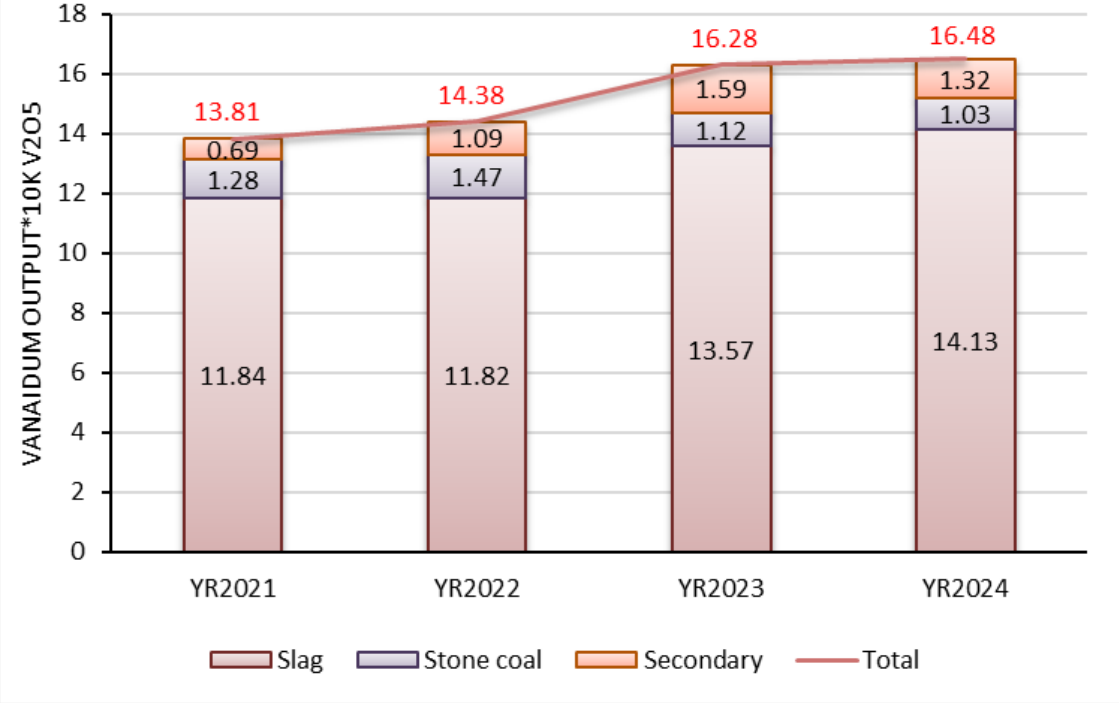
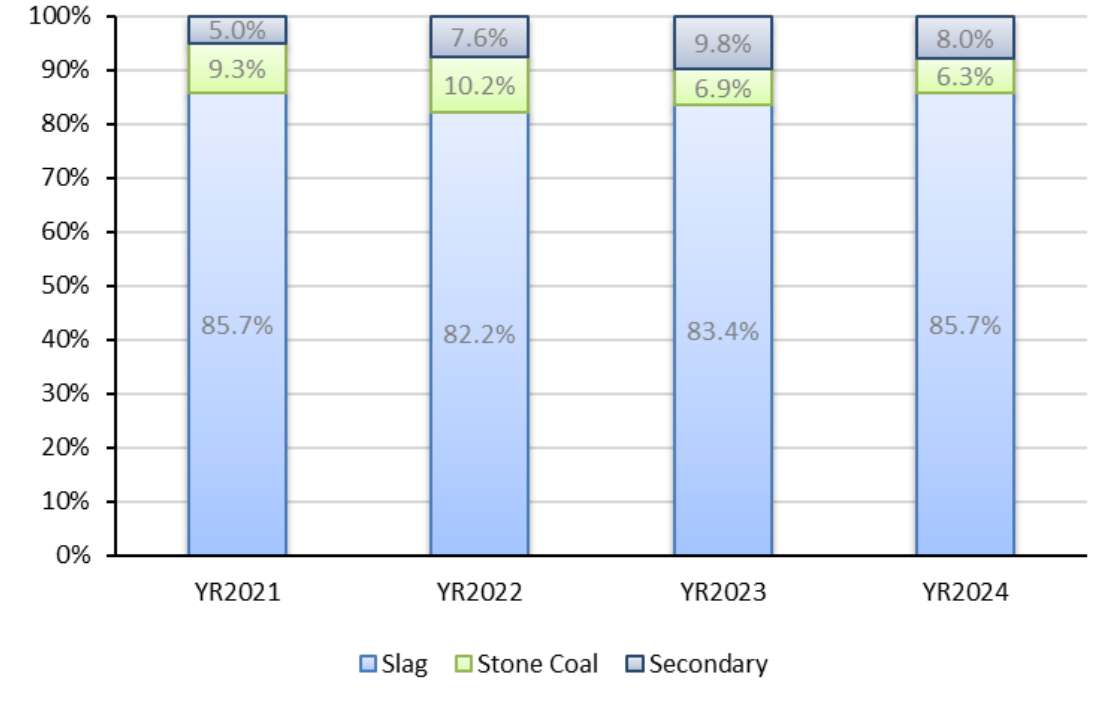
a year earlier

Vanadium output from various sources

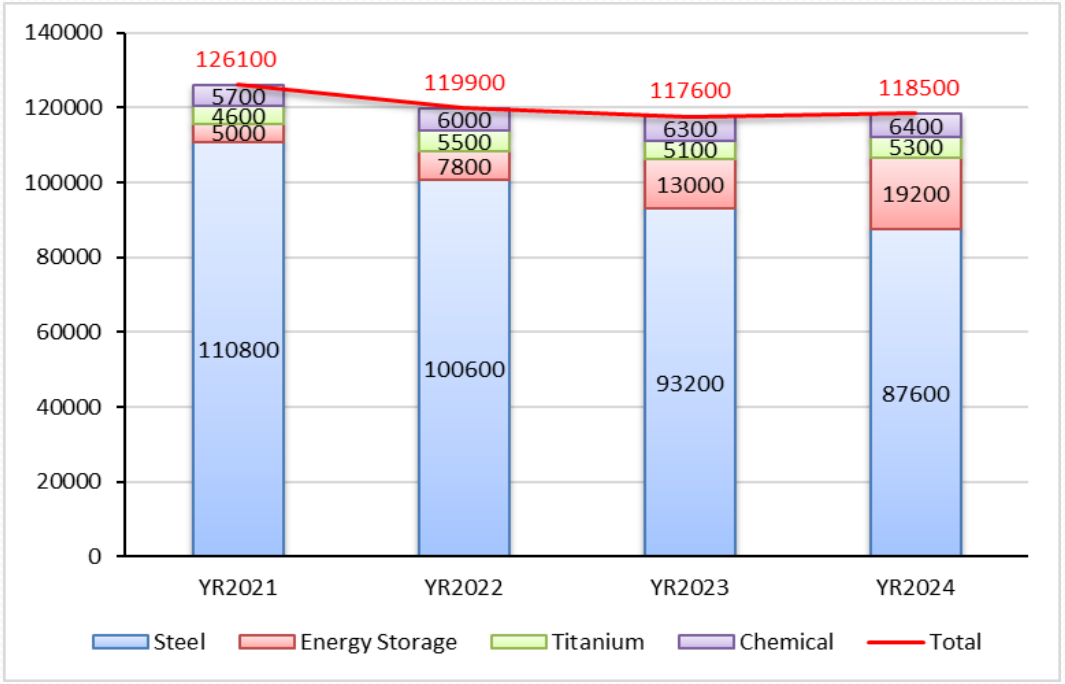
- Vanadium output of 164,800t V2O5 equivalent in 2024 in China, an increase of 2,000t compared with 2023.
- Slag: 141,300 ton or 85.7pc of total output in 2024, a rise of 5,600t compared with previous year.
- Stone coal: 10,300 ton or 6.3pc of total output in 2024, a decrease of 900 ton compared with a year earlier.
- Secondary sources including spent catalyst, alumina process and emerging titanium pigment: 13,200t or 8.0pc of total output in 2024, a decrease of 2,700t compared with previous year.

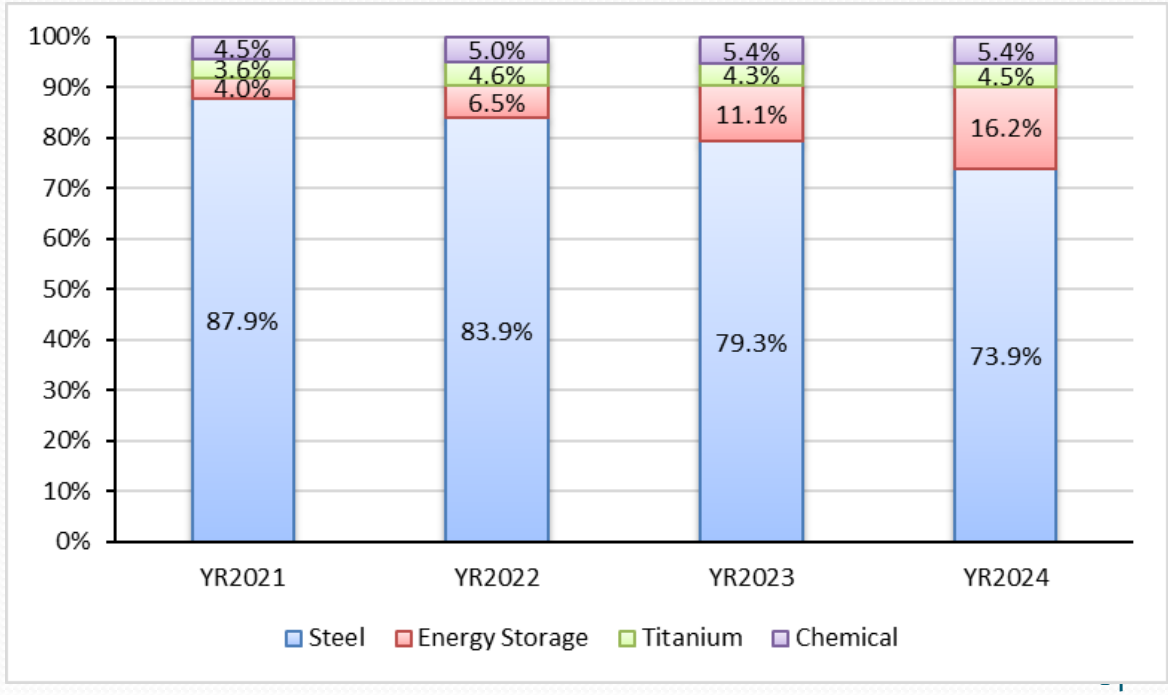




Main downstream users

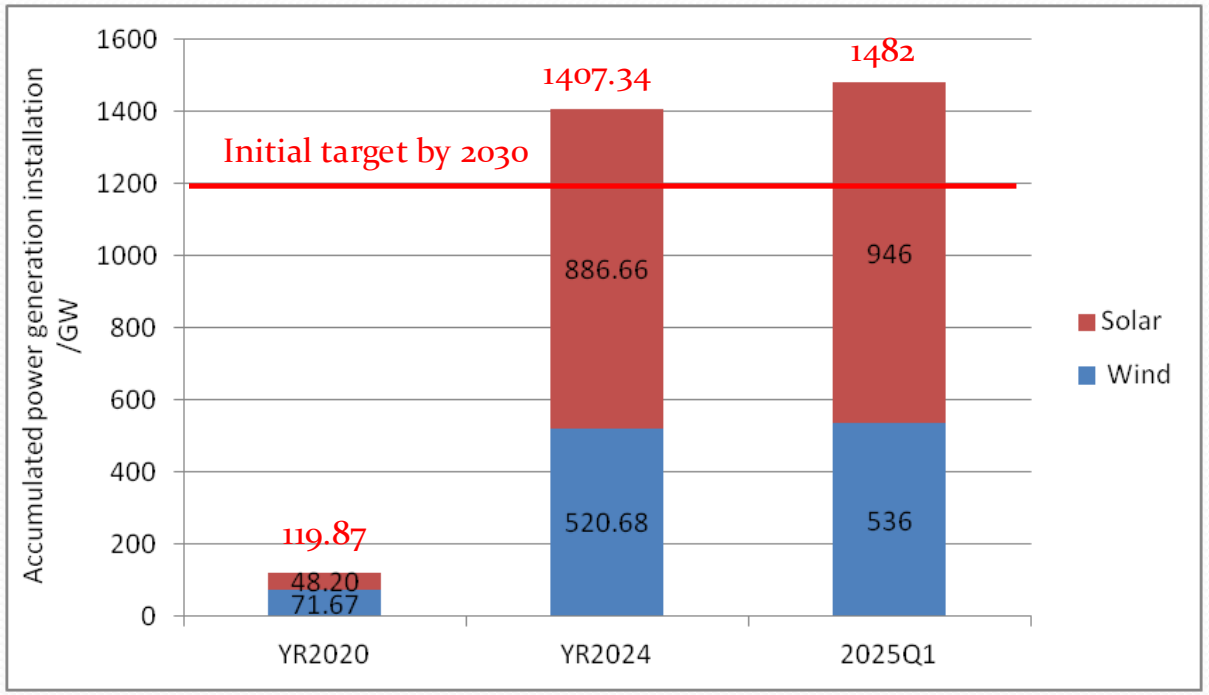
- China's vanadium consumption was118,500t V2O5 equivalent in 2024, basically consistent with 2023.
- However, consumption structure changes significantly. Vanadium consumption by steel sector fell to 87,600t from 93,200t in 2023, down by 6.0pc,while energy storage sector increased to 19,200t from 13,000t in previous year, up by 47.7pc.
- In YR2024 consumption from the steel industry accounted for 73.9pc of total consumption, VRB at 16.2pc, titanium and chemical at 4.5pc and at 5.4pc respectively.





China Power Output of Various Generation Modes in YR2024

- In 2024 China already achieved the initially-set target 1200GW of wind+solar power generation installation for 2030. New target has been yet reported but is estimated to be far higher than this level.
- In 2024 total output of electricity generation was 10,086,880 GWh. Sum of wind and solar power was 1,836,080 GWh, or 18.2pc of total electricity generation.



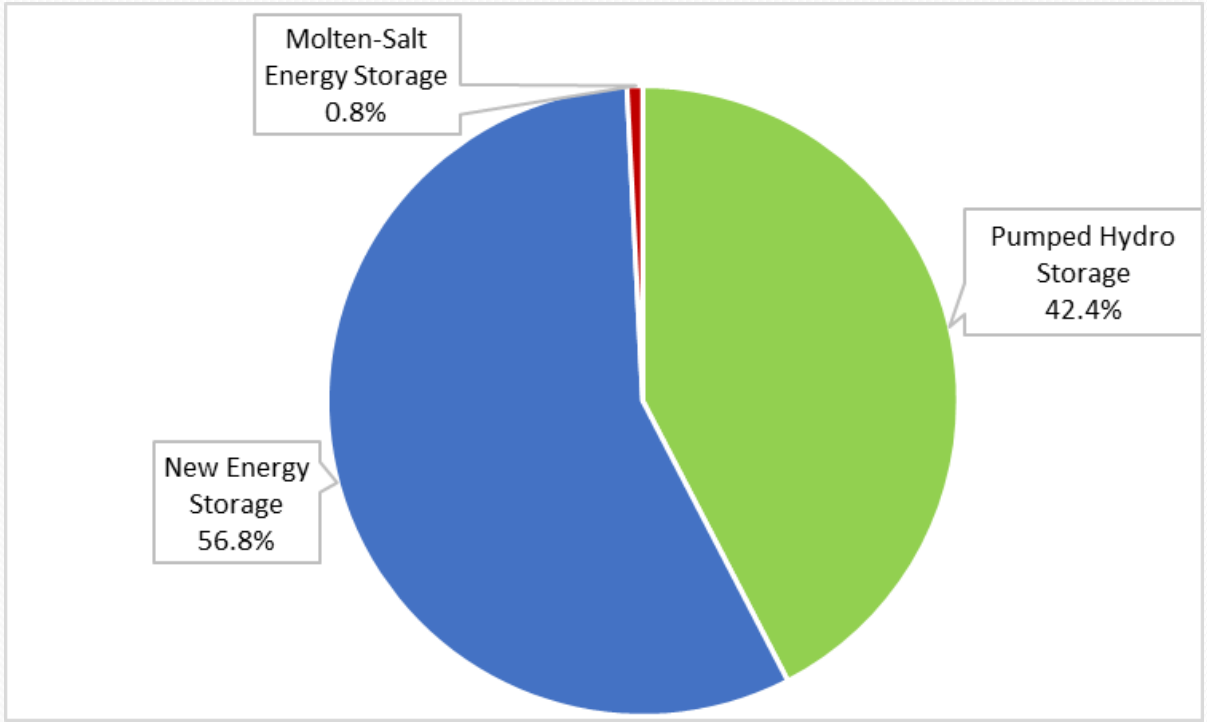
Item	Power generation (GWh)	Percentage (%)
Total	10,086,880	100
Thermal power	6,374,260	63.20
Hydropower	1,425,680	14.13
Nuclear power	4,508,080	4.47
Wind power	9,97,040	9.88
Solar power	839,040	8.32
Wind+Solar power	1,836,080	18.2

Source: National Energy Administration

Energy storage approaches in YR2024

- By end of 2024 total accumulated power installation of New Energy Storage was 78.3GW, taking 56.8pc share of energy storage market, and for the first time exceeding the pumped hydro share.
- Among the new energy storage approaches, lithium-ion battery dominates 97.1pc of share.
- Flow battery takes 0.7pc of market share, an increase of 0.2pc compared with previous year.

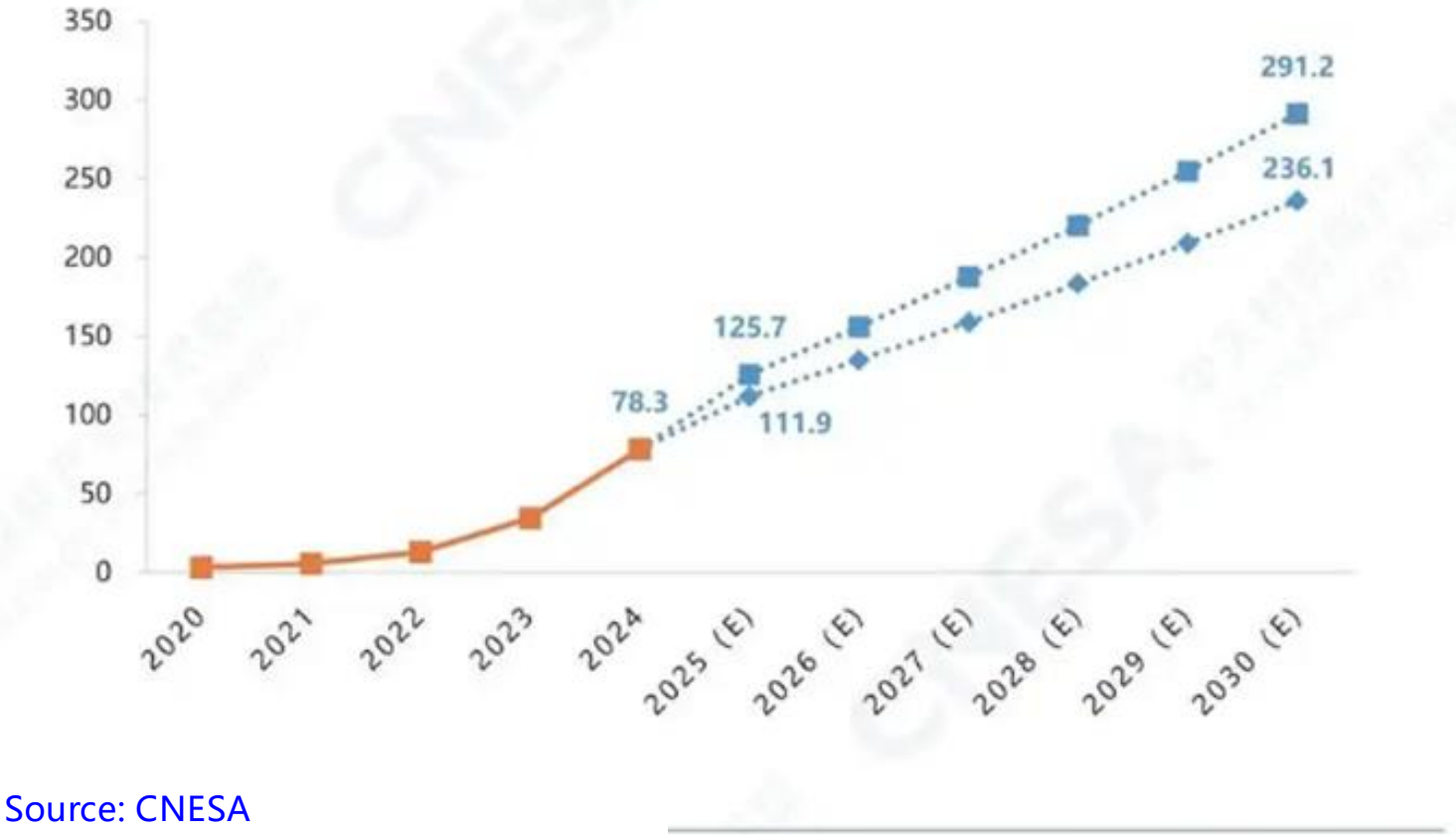
Lithium-ion Battery	**97.1%**
Flow Battery	**0.7%**
Lead Acid Battery	**0.7%**
Supercapacitor	**0.1%**
Compressed-Air	**1.0%**
Flywheel	**0.2%**
Others	**0.2%**



Source: CNESA

New Energy storage installation forecasting

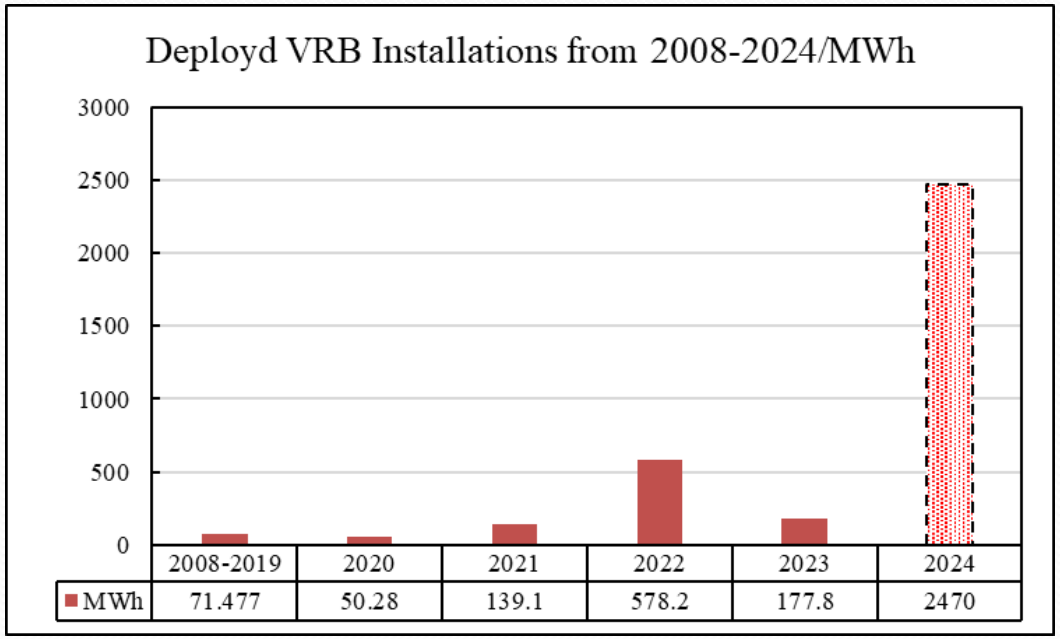
- CNESA's estimates the accumulated installation of new energy storage solution by the end of 2030 based on two scenarios.
- Conservative estimate of 236.1 GW and Ideal estimate of 291.2 GW
- Additional 157.8-212.9 GW will be required during 2025-2030 period.

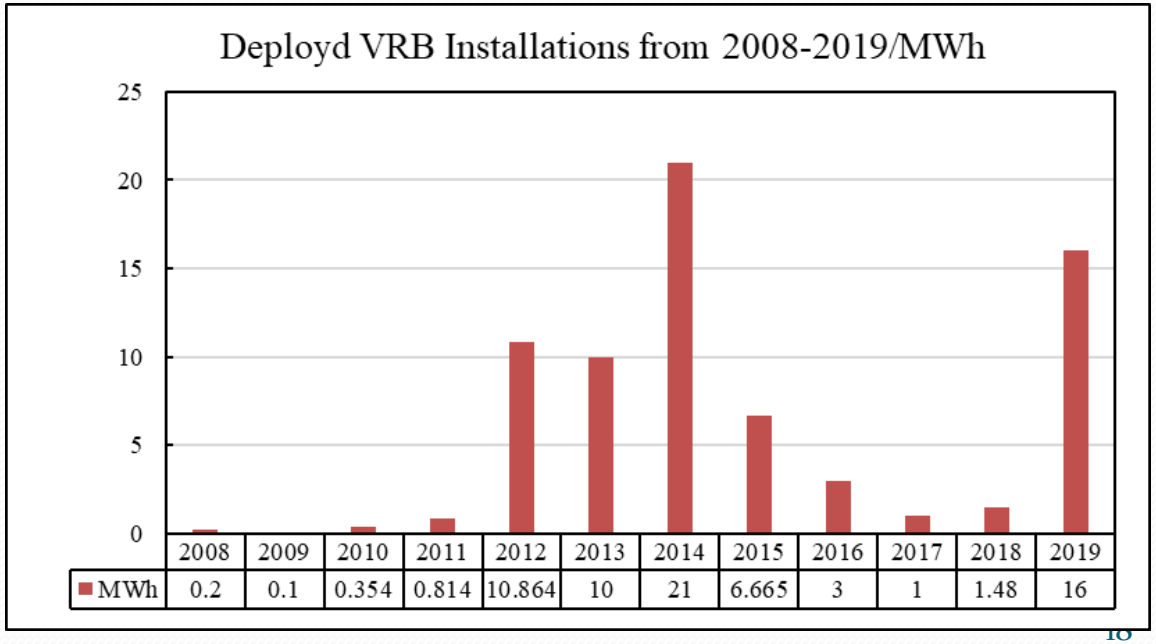


Source: CNESA

VRB installations in China Market

- From very beginning of 5KW/0.05MWh to latest 250MW/1GWh project, around 99 VRB installations with total capacity 3486MWh had been deployed in China.
- During 2008-2019 total installation was only 71MWh.
- Recent years VRB installation speed up as result of compulsory deployment of accessory energy storage facility when a wind/solar power generation project is approved.
- In 2024 new installation of 2.47GWh, taking 71pc of accumulated installations since 2008.





Example: Some 100MWh-scale VRB delivered/construction in 2024/2025

China's VRB projects delivered in 2024			
Operators	Capacity	Location	Delivered dates
CECEP	75MW/300MWh	Chabuchaer County, Xinjiang	June 2024
CNNP Rich Energy	50MW/200MWh	Shangdan County, Gansu Province	August 2024
Xinhua Hrdropower	250MWh/1000(700)MWh	Akus Ush County, Xinjiang	December 2024
State Grid Jilin Branch	100MW/400MWh	Songyuan County, Jilin Province	December 2024

China's VRB projects in pipeline			
Operators	Capacity	Location	Progress
China Three Gorges Renewables	200MW/1000MWh	Jimsar County, Xinjiang	August 2024/start construction
Hami Dongtianshan Power Generation	100MW/400MWh	Hami, Xinjiang	June 2025/commissioning
Chuxiong Jinjiang Energy Group	100MW/400MWh	Chuxiong County, Yunnan Province	May 2025/commissioning
Jiyuan Yuzong Power Storage	100MW/600MWh For heavy truck charging	Jiyuan, Henan Province	Bid

VRB installations in China Market

- Around 23 installations with capacity 230MWh is residential batteries (industry and commercial use).

Some Examples-Residential VRB projects delivered			
Capacity	Location	Purpose	Delivered dates
6MW/36MWh	Zongyang, Anhui Province	Conch Cement manufacturer Profit from peak-valley price difference	2022
1 MW/6MWh	Ningbo,Zhejiang province		2022
6MW/24MWh	Kaifeng,Henan Province	China Pingmei Shenma Energy Chemical Group Electricity security for production &Profit from peak-valley price difference	2023
24MW/96MWh	Pingdingshan,Henan Province		2023
2MW/12MWh	Wenzhou, Zhejiang Province	Special material manufacturer Profit from peak-valley price difference	2023
2MW/12MWh	Neijiang, Sichuan Province	DEMO	2023
0.5MW/5MWh	Maanshan,Anhui Province	Forging factory Profit from peak-valley price difference	2024
0.5MW/5MWh	Hanzhou, Zhejiang Province	Cloth manufactures Profit from peak-valley price difference	2024

Short-term projection of VRB installations

- **Policy changing:** a new regulation issued on February 9, 2025 removes the preconditions of energy storage installation shall be required when wind/solar power generation project is approved.
- Short term(2025):no impact, most of large-scale VRB installation have been already-scheduled
- Middle term(2026-2027): negative impact because of no compulsory deployment.
- Long term(2028-2030):positive(benefit) impact due to the well-known advantages of VRB compared with other kinds of battery. VRB development will be driven from policy to market requirement.

China's VRB projection in 2025-2027	
Year	Capacity
2025	1.6GW/6.25GWh
2026	2.2GW/8.84GWh
2027	2.9GW/12.0GWh

Outlook of Vanadium demand for 2025

unit: t V2O5

Sector	2023	2024	2025f		Change Compared with previous year	
			conservative	optimistic	conservative	optimistic
Steel	92,400	87,580	92,600	100,500	5,020	12,920
Chemical	6,300	6,400	6,500		100	
Titanium	5,200	5,300	5,800		500	
Energy Storage	13,000	19,200	40,000	50,000	20,800	30,800
Total	**116,900**	**118,480**	**144,900**	**162,800**	**26,420**	**44,320**

Vanadium electrolyte suppliers and its capacity

Suppliers	Capacity/m3	Feedstocks	Operation
Rongke Power	150,000	HP V2O5	Full
Hunan Yingfeng	66,000	HP V2O5	Partial
Hunan Huifeng	5,000	HP V2O5	Stop
Pangang Group	1,000	HP V2O5	Stop
Joint venture of Pangang & Rongke power	2,000	Leaching solution	Full
Tranvic	2,000	HP V2O5	Stop
Huaqin Energy Storage	60,000	HP V2O5	Stop
Shaanxi Wuzhou Mining	1,000	HP V2O5	Partial
Chengde Xinxin Vanadium and Titanium	3,000	HP V2O5	partial
Shandong Yeliuhai Technology	24,000	HP V2O5	partial
Tranvic	1,500	Leaching solution	Stop
Tranvic	60,000	Leaching solution	close to full
Chengde Vanadium Titanium New Materials	5,000	HP V2O5	partial
Subtotal	380,500		
Wantai Power Gansu Branch	20000	HP V2O5	Construction
Big Power	60000	HP V2O5	Construction
Shaanxi Jinfeng Vanadium Energy Storage	10000		Construction
Subtotal	90000		
Chengde Jianlong	10000		Plan
Pangang	60000		Plan

Thank you!