

Critical Issues of Energy · Geneva · 1 October 2026

Clean Energy Technologies in China's Energy Transition

Scale · Engineering cases · Quantifiable performance

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Clean Energy Technologies in China

Introduction · Nine technology tracks

Per track: scale → a real project → the numbers

01 Solar PV

Whole supply chain; world efficiency records

35.5% tandem cell record

02 Wind power

World-leading turbine size and floating units

26 MW largest offshore

03 Energy storage

Pumped hydro plus new storage, fast growth

300 MW compressed air

04 The grid

UHVDC: the largest DC platform worldwide

±800 kV / 8 GW

05 Nuclear Gen III/IV

Indigenous Gen III; Gen IV in service

Shidao Bay Gen IV

06 Small modular reactors

Factory-built, flexibly sited small reactors

125 MW Linglong One

07 Thorium molten-salt

The only running thorium reactor worldwide

2 MWt Wuwei TMSR-LF1

08 Electric transport

Scale leader in EVs, cells and charging

48% of new cars

09 Green hydrogen

Cutting industrial carbon; flagship projects

45 kt green H₂ (Songyuan)

Clean Energy Technologies in China

Track 1 · Solar PV

1200GW

TW solar
No.1 world

93%

world poly-Si
made in CN

35.5%

tandem cell
lab record

25%+

n-type mass
mainstream

- Full chain: China makes 93% of the world's polysilicon, 97% of wafers, 92% of cells, 86% of modules.
- Scale: over 1,200 GW of solar installed by end-2025 — more than half the world's total.
- Frontier: mass-produced n-type cells exceed 25% efficiency; a silicon–perovskite tandem hit 35.5% in a lab (LONGi, certified Jul 2026).
- Global benefit: in ten years China cut the world solar cost by over 90%.

Sources: CPIA PV yearbook; NEA; LONGi ESTI (2026-07)

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Talatan, Qinghai: sheep graze under the panels — agrivoltaics

Track 1 · Solar case

35.5%

tandem cell record

28.13%

mono-Si record

406 MW

Red Sea off-grid

24,500 ac

Talatan greened

- Record: LONGi's tandem cell hit 35.5% (certified); mono-Si cell 28.13% world record.
- Abroad: the 406 MW Red Sea project — world's largest 100% off-grid solar city.
- Smart factory: Tongwei No.1 for 9 years; Meishan is solar's first "Lighthouse Factory."
- Ecology: Talatan — panels over grazing land, 24,500 acres greened, 4.35 Mt CO₂/yr.

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Track 2 · Wind

640

GW wind
~half world

47

GW offshore
56% of world

56%

of world offshore
leader

26

MW biggest
world largest

- Total: about 640 GW by end-2025, roughly half the world's wind; 120 GW added in 2025, a record.
- Offshore lead: 47 GW, over half the world's offshore; 78% of new offshore builds in 2025 were in China.
- Bigger machines: the world's largest offshore turbine is 26 MW; in ten years the average jumped from 3 MW to over 10 MW.
- Exports: 7.7 GW of turbines exported in 2025 (+49%), to 28 countries.

Sources: NEA; CWEA 2025; Dongfang Electric

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MingYang OceanX: a 16.6 MW twin-rotor floating wind platform

Track 2 · Wind case

16.6 MW

twin-rotor floating

219 m

rotor top height

26 MW

largest offshore

310 m

largest rotor

- Floating: MingYang OceanX, 16.6 MW twin-rotor — world's largest single floating unit.
- Giant units: Dongfang's 26 MW offshore, rotor >310 m, >100 GWh/yr, cat-17 typhoon-safe.
- Local parts: Goldwind 16 MW all-Chinese bearings and blades; 387 MWh in a day.
- Mega bases: Urat 1.5 GW wind+storage; Kubuqi pairs wind with desert greening.

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Track 3 · Storage

~200

GW total
PHS + new

136

GW new
fastest

96%

lithium
daily peak

40×

in 5 yrs
5-yr surge

- Two pillars: 65.9 GW pumped hydro + 136 GW new storage ≈ 200 GW. Pumped hydro is cheapest and most mature; new storage grows fastest.
- Pumped hydro: 75–85% efficient, 50-year life; another 100 GW under construction.
- New storage: 136 GW by end-2025, up 84% in a year and over 40× since 2020; about 168 GW by mid-2026.
- Role: lithium (96%) covers daily peaks; compressed air and flow batteries cover 4–6 h. Storage is now core support, not just backup.

Sources: NEA 2026; CREPW; CNESA

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Yingcheng “Energy Storage No.1”: 300 MW / 1500 MWh compressed-air

Track 3 · Storage case

300 MW

Yingcheng CAES

1500 MWh

plant capacity

200 MW

Dalian flow

148 m

Rudong tower

- Compressed air: Yingcheng 300 MW / 1500 MWh — world-first 300-MW class, ~70% efficient.
- Flow battery: Dalian 200 MW / 800 MWh — world’s largest; safe, 0.1 s switch, black-start.
- Gravity: Rudong 25 MW / 100 MWh — world-first tower; 148 m, 12,600 blocks of 25 t.
- Sodium-ion: Guangxi 22.5 MW — China’s first large Na-ion station, >92% efficient.

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Track 4 · The grid

45

UHV lines
W to E

340

GW W→E
backbone

1800+

GW renewables
largest

94/95%

use rate
high use

- UHV backbone: 45 ultra-high-voltage lines (24 DC + 21 AC); west-to-east delivery 340 GW.
- Largest grid: connects over 1,800 GW of wind and solar; 94% wind and 95% solar used in 2025 despite fast growth.
- Flexibility: pumped hydro + new storage + flexible coal give over 800 GW of flexible resources.
- Digital: smart meters and AI forecasting make the variability predictable and dispatchable.

Sources: NEA 2026; CEC

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Kunliulong ± 800 kV UHV VSC-HVDC · 8 GW · 19 world-firsts

Track 4 · Grid case

± 500 kV

Zhangbei DC grid

4.5 GW

Zhangbei power

± 800 kV

Kunliu/Qingyu

40 TWh

clean/yr

- DC grid: Zhangbei ± 500 kV, 4.5 GW — world's first DC grid; 100% RE Winter Olympics.
- Multi-terminal: Kunliulong ± 800 kV, 8 GW, 19 world-firsts, 33 TWh/yr to Guangdong.
- Green line: Qinghai–Henan ± 800 kV, 8 GW — first DC only for clean power, 40 TWh/yr.
- Grid-forming: Zhangjiakou 1 GW wind–solar–storage actively supports the grid, not just follows.

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Track 5 · Nuclear (Gen III/IV)

112

units
pipeline #1

125

GW approved
largest

62

GW running
#3 world

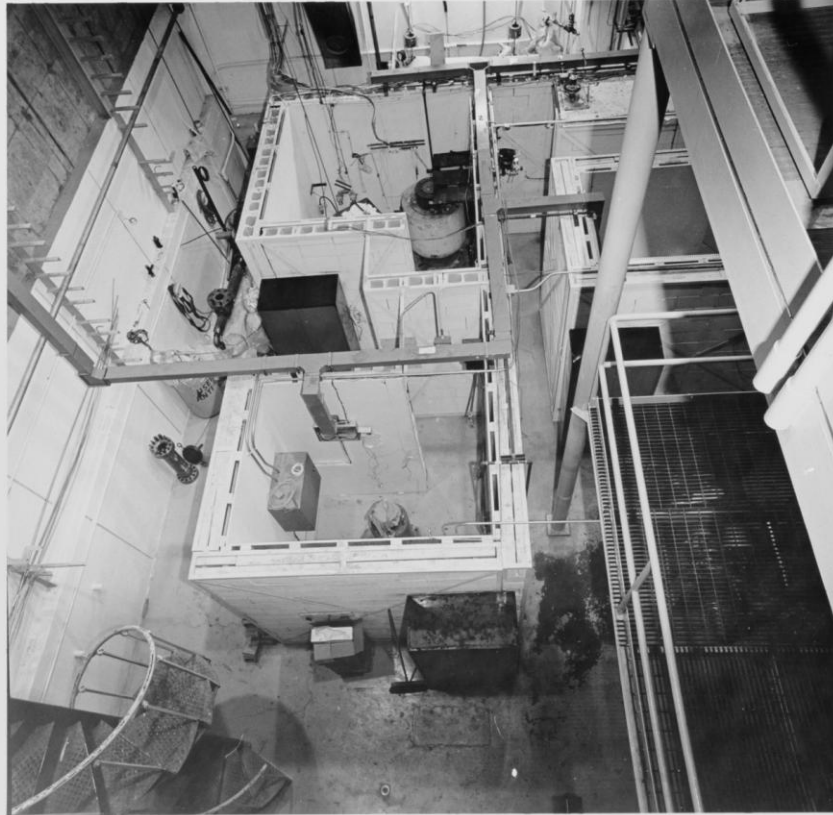
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yrs WANO #1
safety

- Scale: 112 units operating or approved, 125 GW — the world's largest pipeline; 59 units (62 GW) running, 3rd in the world.
- Gen III: Hualong One (HPR1000) in serial build and export; Guoneng One (CAP1400) complete.
- Gen IV: Shidao Bay's high-temperature gas-cooled reactor is the world's first commercial Gen IV plant; fast reactors move to a closed fuel cycle.
- Safety: WANO index No.1 worldwide for 10 years; over 90% of equipment is local.

Sources: NEA 2026; China Nuclear Energy Assoc.

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Shidao Bay: the world's first commercial Gen IV nuclear plant

Track 5 · Nuclear case

177

Hualong core

72 h

no action needed

93.4%

Shidao local

750°C

helium exit

- Hualong One: fully Chinese Gen III; 177-assembly core, double containment, quake/typhoon-proof.
- Guoneng One: passive-safe; no human action for 72 h after accident; >90% local gear.
- Shidao Bay Gen IV: commercial since 2023; pebble fuel, He at 750°C, 93.4% local.
- Why it matters: full chain test→commercial done, paving way for high-temp heat/H₂.

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Track 6 · Small Modular Reactor (SMR)

125

MW Linglong
commercial

1

GWh/yr
~526k homes

90%+

local
indep.

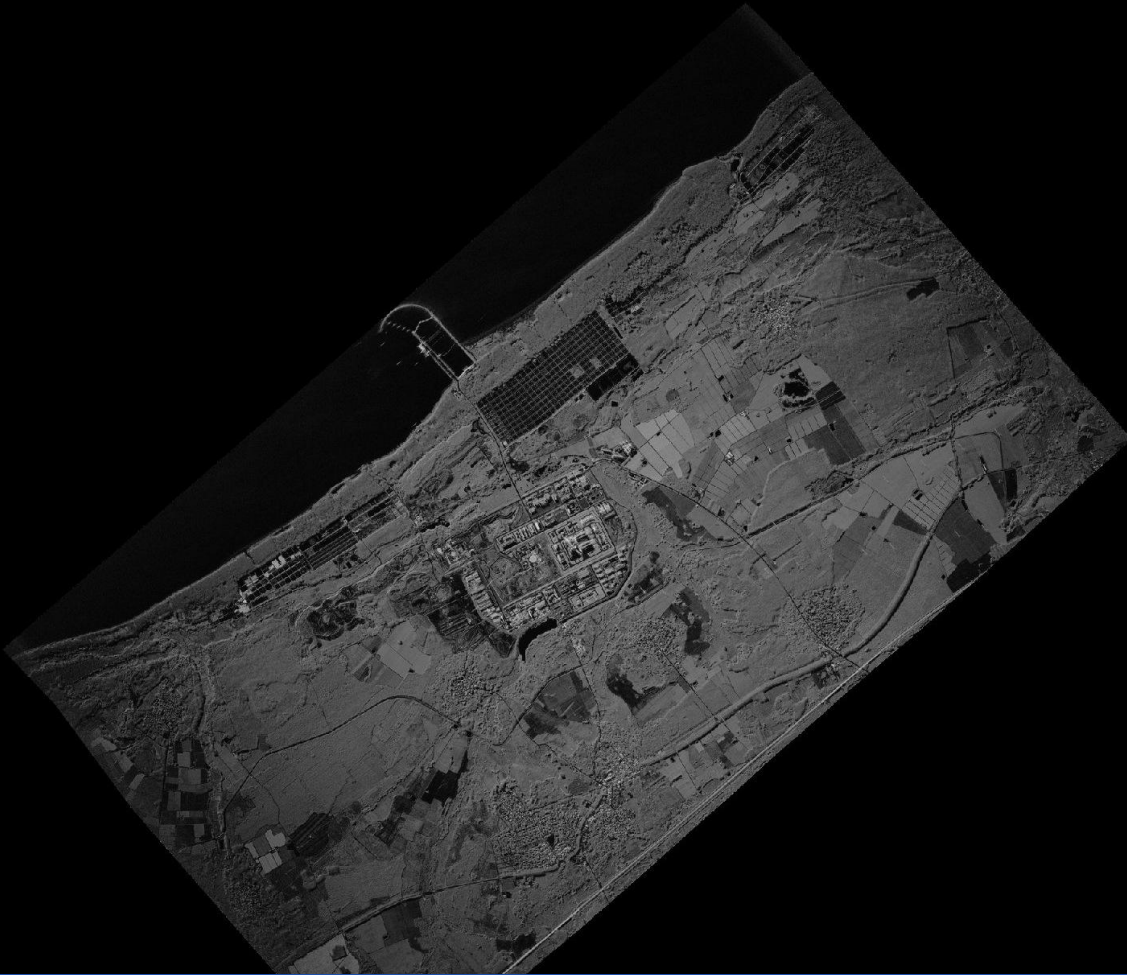
2026

grid
grid 2026

- What is an SMR? A small modular reactor — built in factories, shipped in modules, safe without power, small and quick to deploy.
- Many uses: besides power, it can heat cities, supply steam to industry, make fresh water from the sea, even help oil recovery.
- Linglong One: CNNC's design — the world's first land-based commercial SMR cleared by the IAEA. Built in Changjiang, Hainan since 2021.
- Progress: hot tests and fuel loading in 2026, grid connection planned for late 2026; 90% of installation done.

Sources: CNNC; Haikou Sci. (2026-03)

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Linglong One (Changjiang, Hainan): a window into China's small reactors

Track 6 · Linglong One case

125 MW

electric power

1 GWh

per year

526k

Hainan homes

90+

countries

- Specs: 125 MW, ~1 GWh/yr, ~526,000 Hainan homes, ~0.88 Mt CO2 cut yearly.
- Roles: with Hualong One, a “twin-dragon” base for Hainan’s clean free-trade port.
- Soft power: 90+ countries, 1,000 visitors; IAEA’s first SMR capacity-build deal.
- Export: ~10 countries signed SMR intent — “affordable nuclear” for smaller economies.

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Track 7 · Thorium Molten-Salt Reactor

2

MWt Wuwei
runs now

Nov'25

Th→U
world first

100%

local
all-Chinese

Mt

Th reserve
Th edge

- Why it matters: China has little uranium but abundant thorium — a thorium reactor is a path to energy independence; thorium could power reactors for centuries.
- Wuwei test: a 2 MWt liquid-fuel thorium molten-salt reactor in Gansu's desert; critical in 2023, full power in 2024, first thorium-to-uranium conversion in Nov 2025.
- How it works: thorium as fuel, molten fluoride salt as coolant — runs at normal pressure, needs no water, gives high heat; liquid fuel can be topped up without shutdown.
- Only one: it is the only molten-salt reactor in the world that runs and has thorium inside; all key parts are Chinese-made.

Sources: CAS SINAP (2025-11); Science & Tech Daily

Clean Energy Technologies in China



The Wuwei thorium molten-salt reactor: a hard-won breakthrough in the desert

Track 7 · Wuwei thorium case

2 MWt

Wuwei test

2023

first critical

>1 Mt

Th reserve

10 MW

by 2030

- Roadmap: sited 2017 → critical 2023 → full power 2024 → Th added 2024 → data 2025.
- Resource: Bayan Obo holds ~220 kt Th, surveys >1 Mt — China top reserve holder.
- Standards: China leads writing build/safety rules for thorium MSR, fills Gen IV gaps.
- Next: 10 MW electric modular reactor in design; 10 MW research at full power by 2030.

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Track 8 · Electric transport

16.5

M NEV sales
48% new

47.9%

of new cars
market-led

23

M chargers
+43%

19

GW V2G
mobile store

- Market: 16.5 M new energy vehicles sold in 2025 — 47.9% of all new cars, over half of domestic sales; growth is now market-led.
- Exports: 2.6 M exported in 2025, doubled; plug-in hybrids led the rise.
- Charging: 23 M charging points by mid-2026 (+43%); over 98% highway coverage.
- Vehicle-to-grid: 19 GW of EVs can feed the grid — cars are becoming mobile storage.

Sources: CAAM (2026-01); NEA (2026-07)

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多面挤压 针刺贯穿 电钻

不起火

Track 8 · EV case

12C

Shenxing peak

520 km

5-min charge

3 min

NIO swap

99.6%

recovery rate

- Ultra-fast: CATL Shenxing (LFP) 12C — 5 min gives 520 km; 425 Wh/L.
- Blade battery: BYD cell-to-pack, +50% space, no fire even when pierced (30–60°C).
- Swap: NIO 3,662 stations, 90 M+ swaps, full charge in 3 min.
- Recycling: CATL Bangpu recovers 99.6% Ni/Co/Mn, 93.8% Li — urban mine.

CATL 2nd-gen Shenxing: 12C peak charging, 5-min charge adds 520 km

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Track 9 · Green hydrogen

20

kt Kuqa/yr
flagship

¥18

/kg
competitive

¥7k

/kW unit
cheaper

70%

steel cut
industry

- Kuqa flag: Sinopec's 20,000-tonne/year solar hydrogen plant (300 MW solar) started in 2023; all 52 electrolyzers at full load by Jul 2026.
- Cost turning point: electrolyzer cost fell from ¥15,000 to ¥7,000 per kW; with cheap solar, green H2 costs about ¥18/kg — now competitive.
- Routes: alkaline (ALK) leads, PEM responds fast, AEM and SOEC are efficient frontiers — several routes at once.
- Uses: hydrogen steel (HBIS cuts 70% emissions), green ammonia and methanol, heavy transport.

Sources: Sinopec (2026-07); NEA 2026; HBIS

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Songyuan: the world's largest green hydrogen–ammonia–methanol complex

Track 9 · Green H2 case

800 MW

Songyuan RES

45 kt

green H₂/yr

200 kt

NH₃/MeOH

70%

steel cut

- Songyuan: 800 MW wind–solar makes 45 kt H₂ and 200 kt NH₃/MeOH — world's largest.
- Da'an: 32 kt H₂ / 180 kt ammonia (2025) — world's largest single ammonia unit.
- Hydrogen steel: HBIS 1.2 Mt demo cuts 70% emissions vs blast furnace.
- Honest note: alkaline electrolyzers start slowly — a global bottleneck, not China-only.

Clean Energy Technologies in China

Conclusions

1

It is a combination, not a single tech: solar + wind + storage + grid + nuclear + electrification and green H2 together build the new energy system; no single one explains the speed.

2

Cost came from three forces: manufacturing, market size and policy cut global solar cost by over 80% and wind by over 60%, helping access worldwide.

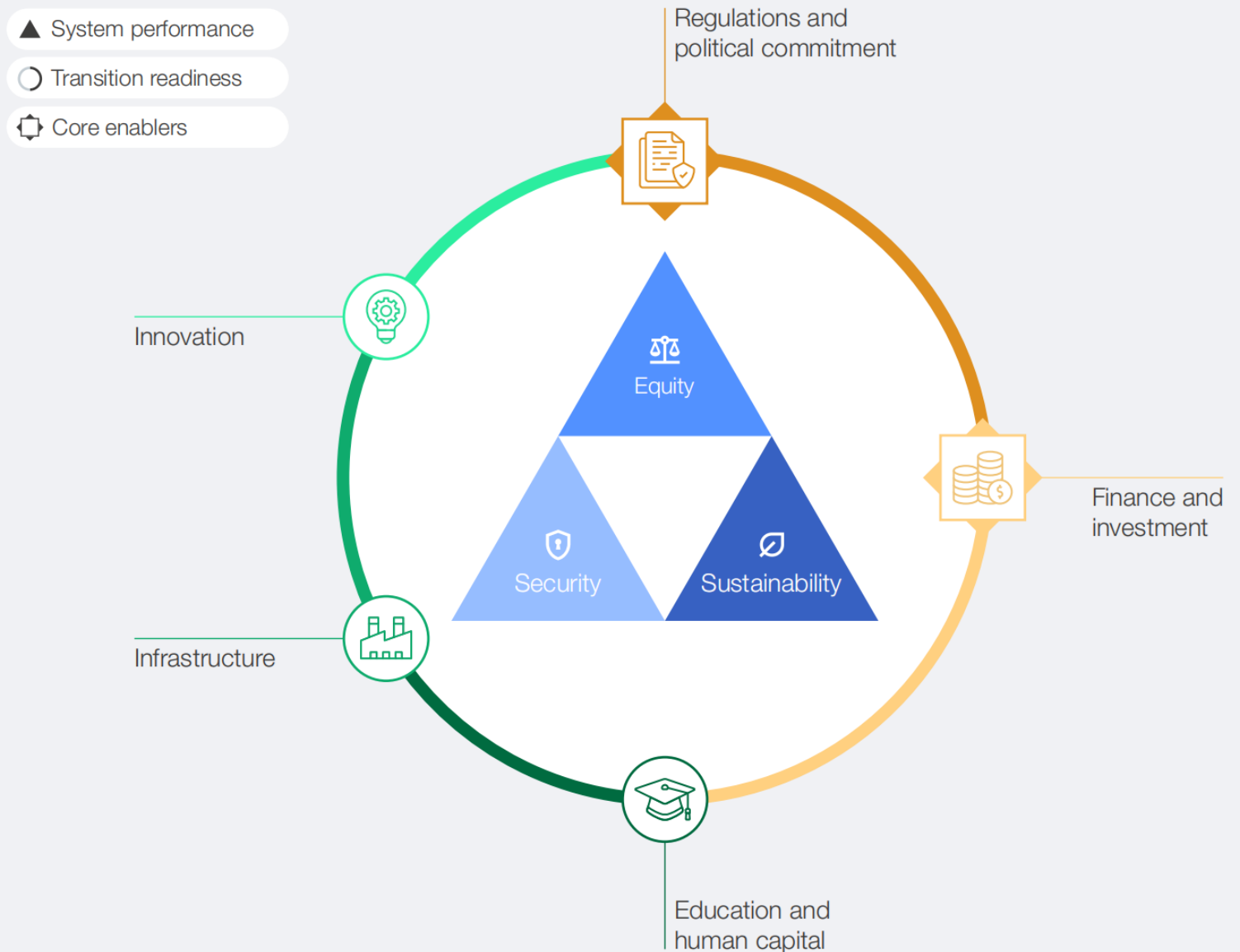
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Next is the system: the race moves from “how much” to “how stable, how efficient” — integration and markets are the bottleneck; SMRs and thorium are China’s frontier edge.

Critical issues of energy in my opinion



The ETI signals that global energy transition progress has lost momentum, not because deployment is slowing, but because the conditions sustaining it are eroding.



Critical issues of energy in my opinion

1

Continuous scale
installation of wind and
solar

2

Power grid technologies
innovation to
accommodate intermittent
renewable

3

Favorable policies to
maintain the sustainable
development of
renewable energy and its
manufacturing industries