

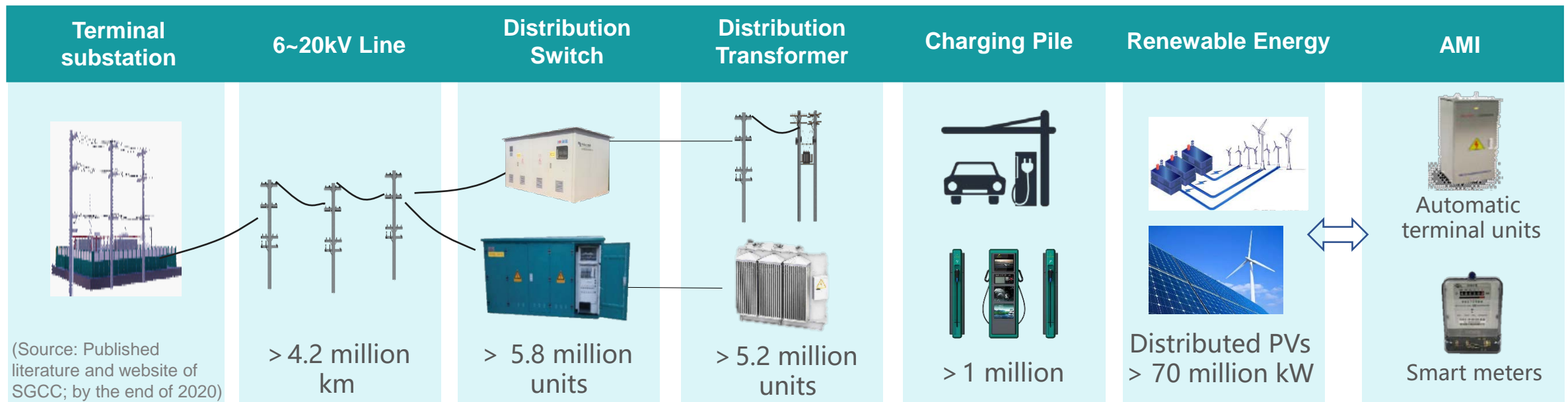
Consideration of Technical Challenges for DSO Operation Management in China

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Short Introduction of electricity distribution systems

Distribution systems (DSs) are the central platform of urban-rural green energy transformation. After years of development, significant progresses have been achieved for improving the power supply capacity, reliability, efficiency, service quality, access capability of distributed energy resources (DERs), etc., which leads to the formation of an innovative Energy Internet.



Safe & Efficient

Green & Intelligent

Reliable & Resilient

Flexible & mutually Beneficial

...

Some key challenges faced by DSOs towards zero-carbon emissions

Abundant customer devices such as distributed generators, charging piles are connecting to DSs, which fundamentally changes the one-way, definite, closed-form system architecture, greatly increases the complexity and difficulty of system operation management (OM). Series of advanced models and tools for DS planning, operation and maintenance are needed.

Development prospects of the entire power system

Year	2020	2030	2060
Total installed capacity (hundred million kW)	22	36~41	78~82
Proportion of installed capacity for Coal-fired power station (%)	49.1	31~36	4
Proportion of installed capacity for Conventional power station (%)	76	59	23
Proportion of installed capacity for non-fossil energy (%)	44.8	52~59	88~89
Proportion of electricity generation for non-fossil energy (%)	33.9	39~45	86~87

Wind and solar energy is estimated to become the main power supply:

- Proportion of installed capacity > 60%
- Proportion of electricity generation > 55%

(Source: State Grid Energy Research Institute)

Development prospects of the DS sector

The National Energy Administration issued to develop PVs by county, and 676 counties were approved in 2021.

Application patterns of DGs



Rooftop PV



Industrial parks' PV



Villages' centralized PV



micro PV stations



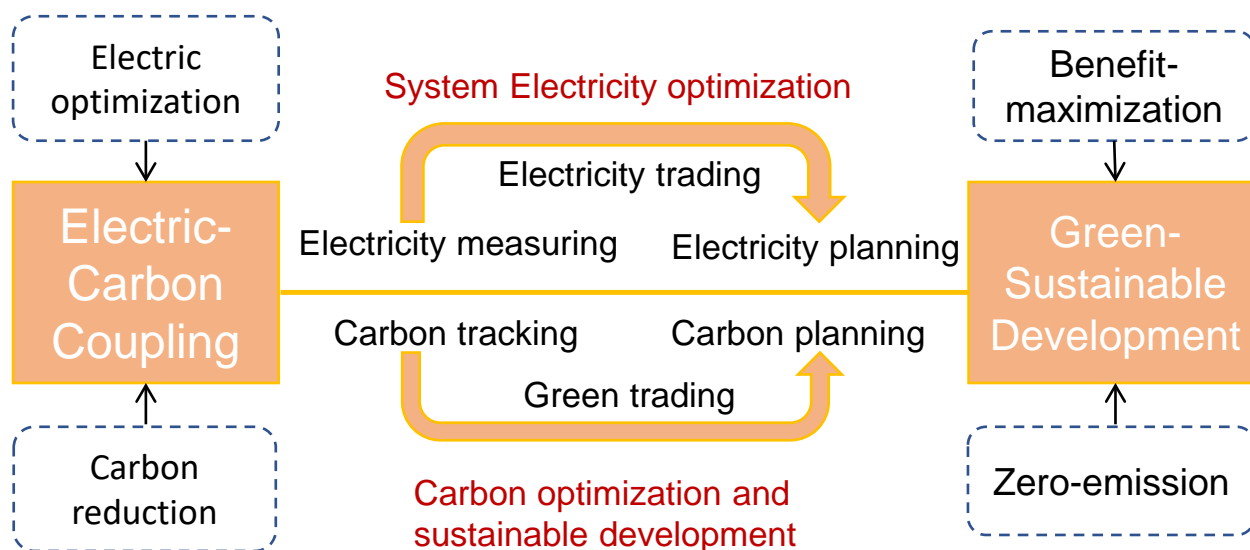
Centralized PV stations

By the end of 2025, total installed distributed PV generators is estimated to reach 180million kW, an increase of 200%

Technical challenges of system planning considering carbon reduction

With large-scale DERs access and multiple stakeholders, DSs planning requires the Electric-Carbon coupling model and probabilistic optimization tools. Besides traditional technical and economic objectives, more attention must be paid to market factors (e.g., green electricity trading) and sustainability targets (e.g., system security, resilience and assets efficiency).

“electric” vs “carbon” planning model



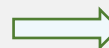
“deterministic” or “probabilistic” planning tool



multi factors,
complex model



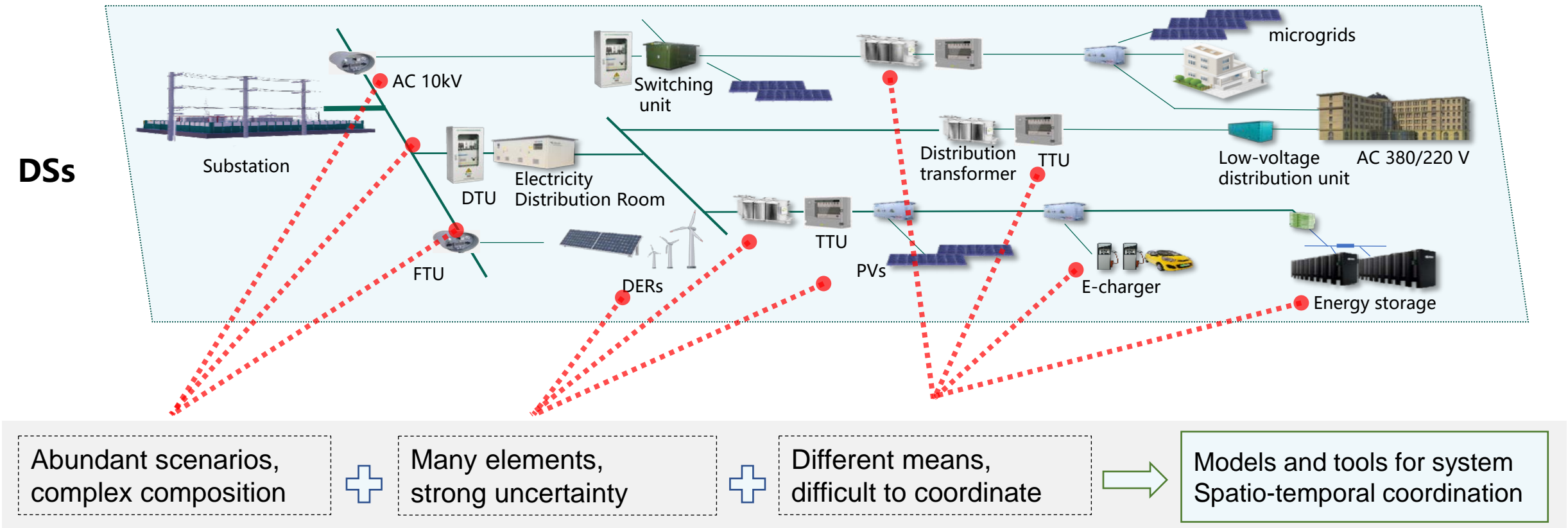
different options,
Low optimization efficiency



Models and tools for multi-scenario
multi-objective probabilistic planning

Technical challenges of power dispatching and control considering uncertainties

DSs with large-scale DGs integration require wide-area, distributed dispatching and control capability, yet the observability, controllability, and resilience capabilities of some DSs are insufficient, with weak information interaction between DSOs and customers, which hardly meet the demands of maximum local consumption and intelligent management of DERs.



Technical challenges of maintenance considering complex operation modes

DERs connected to DSs leads to a surge in the number of point of common coupling, increasing safety risks, workloads and costs for system maintenance and asset management. Traditional maintenance strategy focuses on historical indicators such as reliability indices, which limits the accuracy of equipment health assessment and the optimality of system maintenance strategy.



DER interconnection results in a surge in maintenance workload



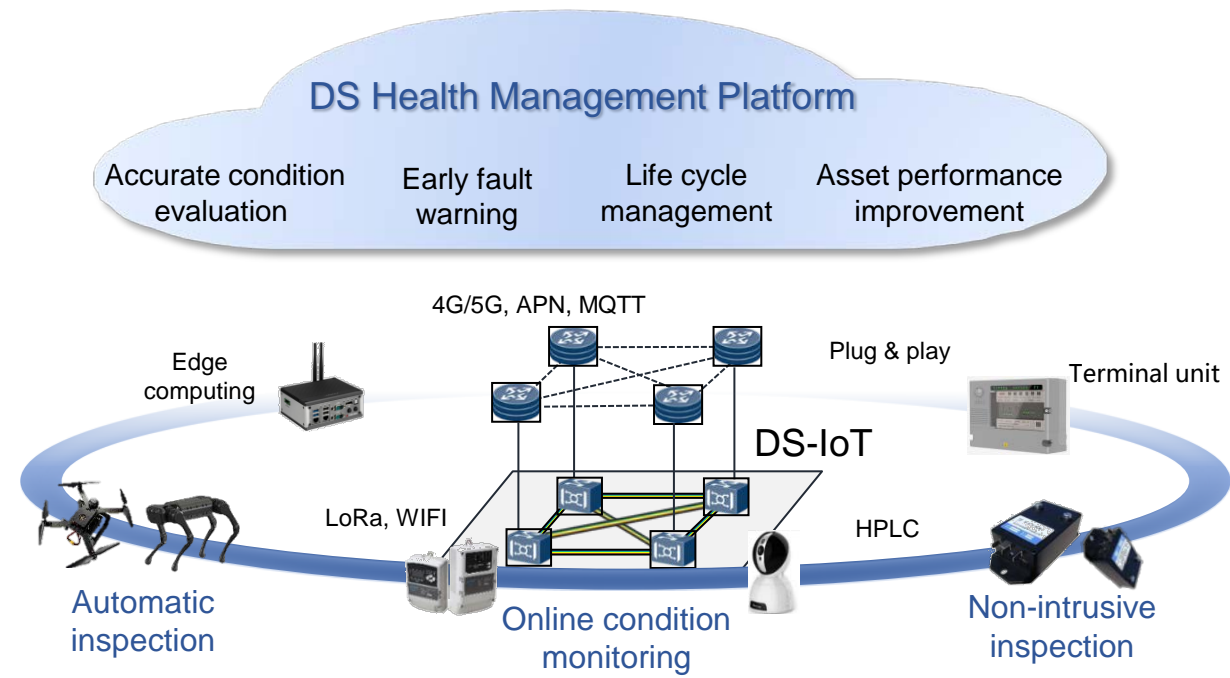
Increasing power electronic devices complicate maintenance process



Maintenance risks introduced by DG islanding



Information security problems aroused by digital maintenance



More complex failure mechanism,
Increasing risks of fault

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Models and tools for system-level health management

Thank you!