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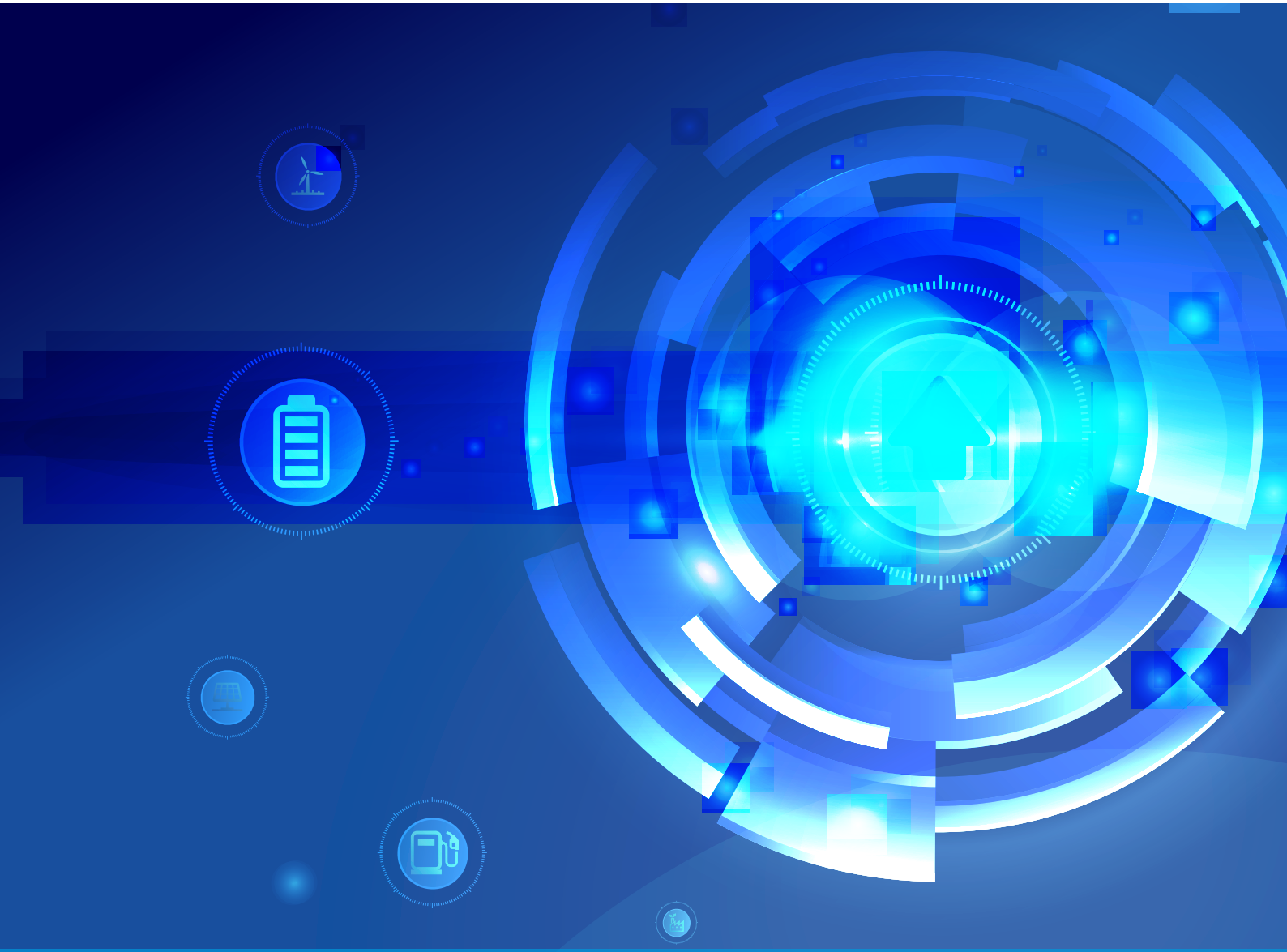
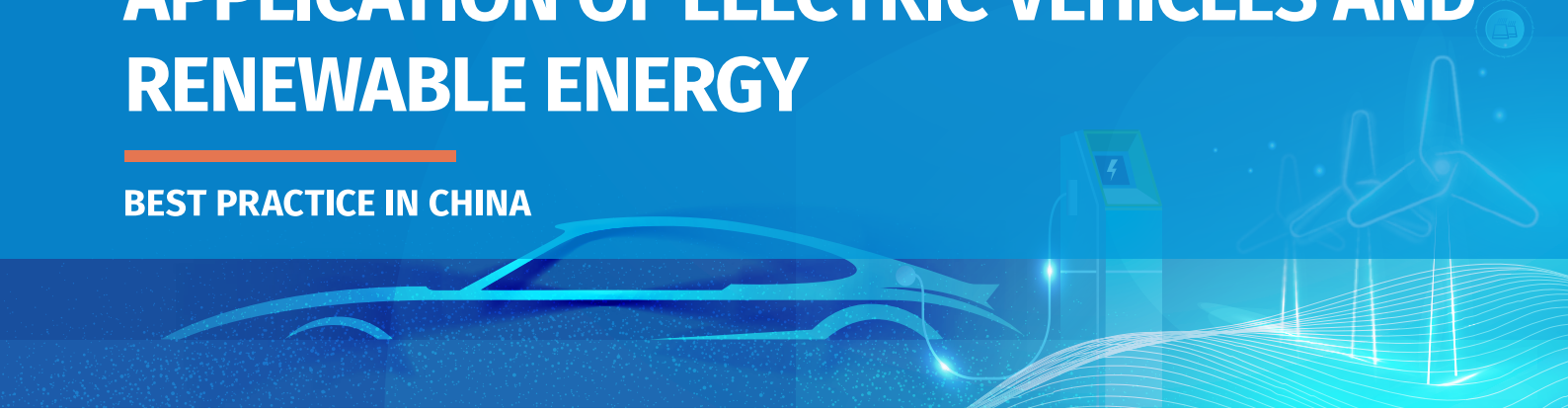


TECHNICAL GUIDELINES FOR INTEGRATED APPLICATION OF ELECTRIC VEHICLES AND RENEWABLE ENERGY

BEST PRACTICE IN CHINA



GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

TECHNICAL GUIDELINES FOR INTEGRATED APPLICATION OF ELECTRIC VEHICLES AND RENEWABLE ENERGY

United Nations Industrial Development Organization

China Society of Automotive Engineers

With Special Support from Global Environment Facility

Disclaimer

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Preface

Our global community continues to face an unprecedented convergence of challenges, many of which are disproportionally impacting the world's most vulnerable people. Developing countries, which have contributed the least to global greenhouse gas emissions and climate change, continue to grapple with record heat waves, flooding and drought, even as they attempt to grow their economies, create jobs and recover from the COVID-19 pandemic. Moreover, rising fuel and energy prices place increasing pressure on families and small businesses.

At the heart of these crisis is our global "economies" reliance on fossil fuels for energy and the urgent need to transition to clean and sustainable energy. Although the challenge is great, many of the solutions we need to achieve a just and inclusive energy transition already exist. This is particularly the case in the transportation sector where electric vehicle adoption has emerged as a key strategy for countries to meet ambitious climate targets in line with the Paris Agreement.

There is reason to be optimistic. The last decade has seen tremendous growth in electric vehicle use, especially in China. Advances in battery technology and manufacturing have helped reduce costs while forward thinking government policy has helped make electric vehicles more affordable and accessible to the public. Investment by governments and the private sector in necessary charging infrastructure has also helped accelerate adoption by reducing potential owners concerns related to finding a place to charge their new vehicle.

While current growth in electric vehicle use is encouraging, we know that adoption is not enough. To realize the full benefits of electrifying our transportation system, the energy infrastructure and related supply chains supporting electric vehicles must also be clean and sustainable.

The *Technical Guidelines for Integrated Application of Electric Vehicle and Renewable Energy* is an outcome of the innovative project, *Integrated Adoption of New Energy Vehicles in China*, led by UNIDO in partnership with China's Ministry of Industry and Information Technology, the China Society of Automotive Engineers and the Global Environment Facility. The project has been instrumental in piloting different applications of renewable energy integrated with charging infrastructure within China. The Technical Guidelines build on the success of these demonstrations and provide an outline for how electric vehicle and renewable energy integration can be accomplished and thereby scaled-up in China and around the globe.

My sincere thanks and gratitude to our partners and the stakeholders that contributed to this publication. UNIDO remains fully committed to supporting countries accelerate their adoption of low carbon mobility and I am certain the Technical Guidelines will be a valuable resource for advancing electric vehicle use that is truly sustainable.

Gerd Müller
DIRECTOR GENERAL, UNIDO

Climate change is a universal challenge for all mankind. Accelerating the innovation, promotion, and application of green and low-carbon science and technology have become the choice of an increasing number of countries. The integrated development of New Energy Vehicles (NEV) and Renewable Energy (RE) is the main path of low-carbon transformation in the transportation sector, and it is also an important engine to enhance the economical sustainability. As the world's largest NEV market, the total stock of China's NEV has exceeded 10 million this year. Such a large-scale market has become a vital driving force for accelerating the green and low-carbon energy transformation and increasing the proportion of clean energy consumption, which will in turn promote the development of green and low-carbon society.

Under the guidance and support of the Global Environment Facility, the Ministry of Industry and Information Technologyof the People's Republic of China, and the United Nations Industrial Development Organization (UNIDO), the China Society of Automotive Engineers (China-SAE) implementedthe project "*Integrated Adoption of New Energy Vehicles in China*". By focusing on fusion technologies such as unidirectional smart charging, vehicle-to-grid bidirectional smart charging, integrated microgrid powered by PV with energy storage system and EV charging facilities, and downcycing utilization of retired EV power batteries etc., the project has carried out a two-year demonstration of multi-scenario applications in nine cities including Shanghai, Qingdao, Yancheng, Beijing, Shenzhen, Baoding, Zhenjiang, Tianjin, Lianyungang, and Shanxi Province.

In order to fully summarize the project progress and achievements, China-SAE and UNIDO jointly compiled the "Technical Guidelines for Integrated Application of Electric Vehicles and Renewable Energy". The Guidelines systematically sorts out the application of various fusion technologies in different scenarios from ten typical demonstration projects and condenses the relevant fusion technical requirements and guidelines from the perspectives of technical solutions, construction requirements, business models, and operational effects. It is our hope that it will provide relevant data, experience, and practical reference for the integrated application of EV and RE across the globe.

As the integrated application of NEV and RE is a new trend and new opportunity for future industrial development, we expect that the Technical Guidelines can provide a Chinese solution for the development of the global new energy automobile industry. We also hope that international exchanges and cooperation will be further strengthened in the future, and more suitable regions around the world will be promoted to carry out demonstration and applications of EV-RE integration. This will contribute to the green and low-carbon development in the fields of transportation and energy, and to the goal of global carbon neutrality.

ZHANG Jinhua
Secretary General of China Society of Automotive Engineers

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Abbreviations and Acronyms

BMS	Battery Management System
BSS	Battery Swapping Station
CA	Certification Authority
CO_2	Carbon Dioxide
C-V2X	Cellular Vehicle-to-Everything
DOD	Depth of Discharge
EMC	Electromagnetic Compatibility
EMS	Energy Management System
ESS	Energy Storage System
EV	Electric Vehicle
GEF	Global Environment Facility
IEC	International Electrotechnical Commission
IOV	Internet of Vehicle
LTE	Long Term Evolution
NDRC	National Development and Reform Commission
NEA	National Energy Administration of China
NIST	National Institute of Standards And Technology
PCS	Power Conversion System
PHEV	Plug-in Hybrid EV
PKI	Public Key Infrastructure
PMU	Power Management Unit
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
SAE	Society of Automotive Engineers
SOC	State of Charge
SOH	State of Health
UNIDO	United Nations Industrial Development Organisation
UPS	Uninterruptible Power Supply