Best Practices on Sustainable Energy in Cities in China

WANG Zhigao, Program Director, Energy Foundation China
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Renewable Energy Installed Capacity (By 2020)

In China, electricity generated by renewable energy reached 2,200 billion kWh in 2020, accounting for 29.5% of the total electricity consumption.

The renewable utilization scale in China reached 680 million tce.

In 2020, China installed a total of 925,119 MW of renewable energy capacity, accounting for 33% of the world total renewable energy installed capacity. The composition of the renewable energy capacity is as follows:

- Hydro: 370GW
- Wind: 280GW
- Solar: 250GW
- Bioenergy: 19GW
- Other: 6GW

In China, with the use of renewable energy, the following reductions were achieved:

- 1.79 billion tons of CO₂
- 865,400 tons of SO₂
- 798,000 tons of NOx

Source: NEA

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Since the 1990s, China has successively promoted initiatives such as “Clean Energy City”, “Ecological City”, “Renewable Energy Building Application Demonstration City”, “Low Carbon City” and “Green City”, which all included renewable energy utilization as part of the demonstration.

Renewable Energy Building Application Demonstration City Implementation Plan, MOHURD
- Specify the requirements for applying to be the demonstration city such as minimum application area (2-3 million m²) for renewable energy building
- Fiscal incentives for each demonstration city (¥ 50-80 million)

Announcement for List of New Energy Demonstration Cities/Industrial Parks (First Batch), NEA
- Announce 81 cities and 8 industrial parks to be the first batch of pilots with its development focus
- Urge the cities to further increase its renewable consumption, to improve its grid infrastructure, to develop the pilot plan that incorporated with the urban development plan as well as local FYPs
- Encourage the cities to carry out pilot to financing the renewable projects

Energy Development 12th FYP, State Council
- Plan to establish 100 new energy demonstration cities to scale up the application of renewable energy technology
- Effort should be made to promote solar water heating system, distributed PV power generation, ground-source heat pump technology and the use of biomass

National New Type Urbanization Development Plan (2014-2020), State Council
- Promote the construction of new energy demonstration cities and smart micro-grid demonstration projects
- Select counties to carry out renewable energy heat utilization demonstration projects

Renewable Energy Development 13th FYP, NDRC
- Continue to plan and construct the new energy demonstration cities, and put forward the higher goals for pilot cities (50% renewable)
Resource-based City: Turpan

It is the first city that kick off the construction of new energy demonstration pilot in China.

- Climate
  - 3,200 hours of sunshine per year, which is 1,000 hours more than that of the same latitude, annual accumulated temperature is 5,300℃
  - 270 days of frost free period with annual evaporation of 3000mm

- Practices
  - 8.81km² area with population of 60 thousands
  - It is the first commercial operated micro-grid pilot in China which integrated urban planning, PV building integration, ground-source heat pump for cooling and heating, smart microgrid, climate and power prediction, as well as green transportation
  - By August, 2013, 370 million dollar has been invested for the demonstration project.

- Estimated Outcome
  - By 2015, renewable energy consumption accounted for 33% of the total energy consumption in the pilot area, replacing 6 thousand tce of fossil fuel per year
  - Installed capacity of distributed solar power reached 13.4MW
Resource-based City: Turpan

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Figure 1. Turpan New Energy Demonstration Area

Figure 2. Bus Charging Station

Figure 3. Solar panel on the rooftop

Source: passivehouse.org.cn & iGDP

Figure 4. Ground-source Heating Pump System for Cooling and Heating
Resource-based City: Ruicheng

Photovoltaic-Energy Storage-Direct Current-Flexibility (PEDF) Pilots
(Ongoing project supported by Tsinghua University and Energy Foundation China)

- **Resource**
  - Total rooftop area **22.86 million m²** with electricity generation potential of **2.88 billion kWh** per year (For reference, the total electricity use in 2019 for Ruicheng is 0.85 billion kWh)

- **Practices**
  - Research on technique scheme for “PEDF” distribution system
  - Analyze on variance between power supply and demand across seasons and feasibility analysis on flexible supply with electrification of building, vehicle and agricultural machinery
  - Pilots on rural and urban buildings with PEDF system
  - Local government is committed to invest around 1.4 billion dollar for “PEDF” system
City Practices

Industry-based City: Dezhou
“Solar City in China”

- **Industry**
  - More than 120 solar related companies based in the city of Dezhou, covering manufacture, packaging and transport, which forming a complete supply chain for solar industry.
  - Near 5 billion dollar of revenue, which account for 20% of the city’s GDP
  - 3 out of every 10 jobs in the city are related to solar energy

- **Practices**
  - Practices were focused on solar, geothermal for cooling and heating and waste incineration for power generation

- **Estimated Outcome**
  - By 2015, renewable energy consumption accounted for 7.8% of the total energy consumption, compared to 3% in 2010
  - The utilization of renewable energy reached 351,300 tce
  - The area for using solar collectors reach 920,000m² (1.12m² per capita)
  - Ground-based heat pump covering the floor area of 2.14 million m² for heating and cooling
  - Incineration power generation consumed 600 tons of waste per day, with the installed capacity reached 15,000kW and electricity generation reached 80 million kWh
Industry-based City: Dezhou
“China Solar Valley”

Figure 1. Solar Valley-1

Figure 2. Solar Valley-2

Source: Dezhou.gov.cn
Policy-based City: Beijing

• Policy
  - "Beijing City Master Plan”
    ▪ By 2020, the proportion of renewable energy consumption reached 8%, 20% in 2035
  - "Beijing New Energy and Renewable Energy Development Plan during 13th FYP”
  - "Beijing 2022 Winter Olympics and Winter Paralympics Sustainability Commitment Task Decomposition List (Beijing Part)”
    ▪ Renewable energy accounted for more than 10% of total energy consumption by 2022
  - “Implementation Instruction on Further Accelerating the Application of Heat Pump Systems to Promote Clean Heating”
    ▪ Heat pump as the major area for Beijing’s clean energy development
    ▪ By 2022, heat pump covering heating area accumulatively reached 80 million m² (50 million m² in 2015), accounting for 8% of the total heating area
  - “Further Supporting the Promotion and application of Photovoltaic Power Generation System”
    ▪ Historical strongest fiscal subsidies for solar power

• Outcome
  - The installed capacity of PV power generation reached 600,000kW during 13th FYP period, which is around 4.5 times of the amount by the end of 12th FYP period
  - The proportion of renewable energy consumption reached 7.9% in 2019, compared to 6.6% in 2015
Policy-based City: Beijing

Figure 1. Ground-source heat pump in Beijing Daxin International Airport

Figure 2. Air source heat pump for central heating in Haidian District

Figure 3. Rooftop solar PV in Yanqing

Source: Energy news, China Solar Thermal Alliance,
Technology-based City: Chongqing

- Practices
  - Research and demonstration of key technologies for high-efficiency application of ground-source (surface water) heat pump system in Yangtze River, launched by the Municipal Science and Technology Commission.
  - Numerous engineering standards for ground-source heat pump system has been compiled by City of Chongqing, forming a systematic standard framework for the application of ground-source heat pump.

- Outcome
  - 27 demonstration projects were conducted for renewable energy building application, covering technology of heat pump (surface water, sewage, soil etc), solar PV and solar thermal.
  - The total demonstration area reached 3.44 million m².
  - 2.7 million dollar subsidies provided by central government.
**RESOURCES**

City should fully explore its local asset and potentials, either natural resources such as solar, wind, geothermal or other resources such as rooftop.

**INDUSTRY**

Renewable industry can be an important stimulus for city economy. It is important for local government to guide and motivate the development of RE enterprises.

**POLICY**

It is necessary to synergize different plans regarding to renewable energy development. And provide all aspects assistant (finance, capacity building, technology, city planning, etc) for its development.

**CROSS-SECTOR**

The development of renewable energy needs to integrate power, building and transportation sector together for achieving carbon neutral in the near future.
THANK YOU