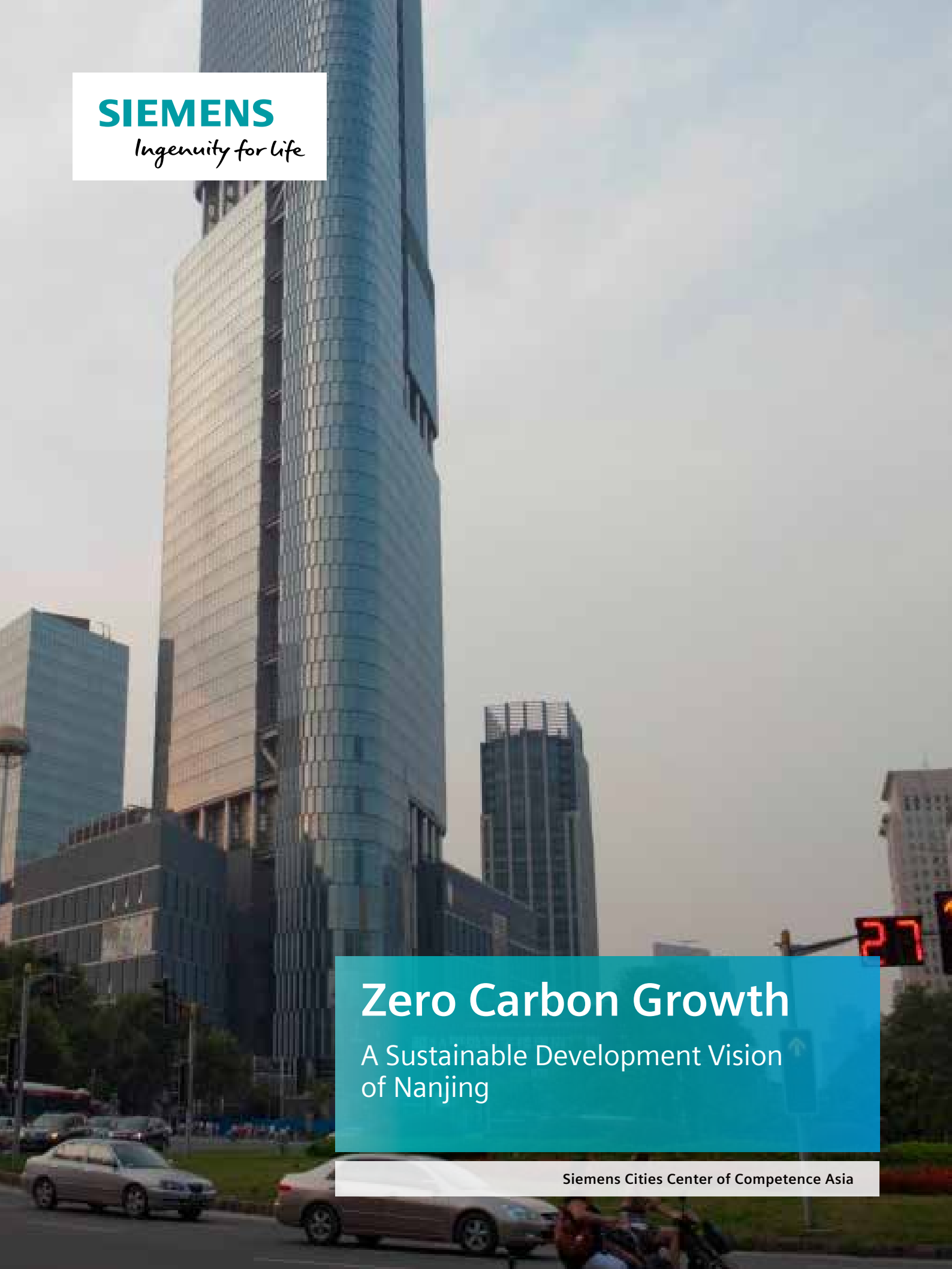


SIEMENS

Ingenuity for life

Zero Carbon Growth

A Sustainable Development Vision of Nanjing

Siemens Cities Center of Competence Asia

"Zero Carbon Growth" – A sustainable development vision of Nanjing

By taking decisive actions and implementing effective technical levers, it will be possible for Nanjing to achieve "Zero Carbon Growth" by 2020. Total CO_2 emission of the city will be lower than that of 2012 and air quality can also be improved consistently.

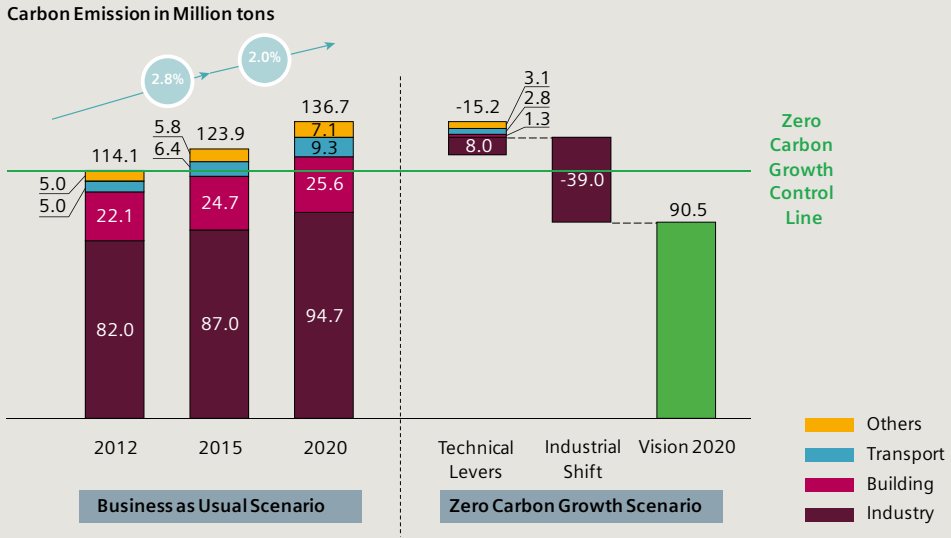


Figure 1: "Zero Carbon Growth" Vision for Nanjing

Action Plan

- **Further optimize industrial structure in the city to match the needs of social and economic development;**
- **Enhance institutional framework for emission reduction, such as energy monitoring and verification of key enterprises, establishment of carbon trading scheme;**
- **Fully leverage technology levers to reduce emission with enhanced regulations, focusing on:**
  - Industrial energy-saving
  - Coal-fired power plant retrofitting
  - Distributed energy supply (CCHP)
  - Green and intelligent building (building automation, efficient lighting, building envelop etc.)
  - New metro lines, intelligent traffic management and e-vehicles

Background

Considering future economic development and transition, population growth, progress in technology deployment and changes in consuming-style, it is predicted that the GHG emission in Nanjing will keep increasing but the growth rate will be slow down. Even though, 136.7 million tons GHG emission will be emitted from the city in 2020, which is almost 20% more than its emission level in 2012.

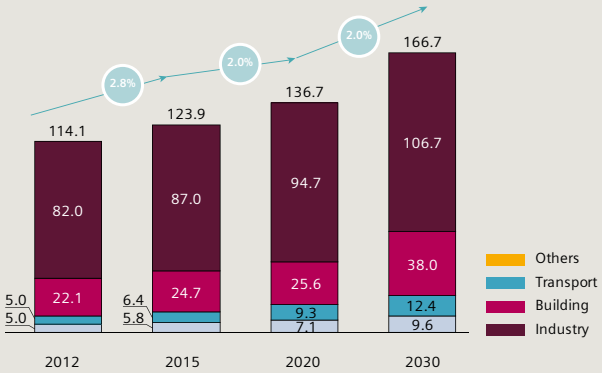


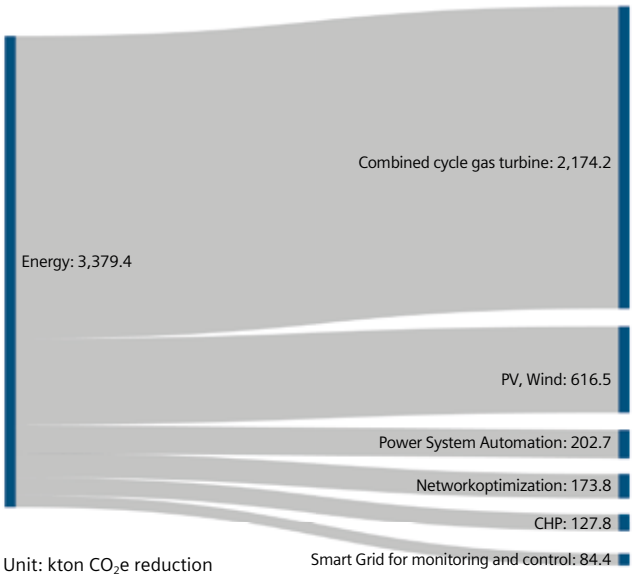
Figure 2: Forecast of energy consumption in BaU scenario

Key Findings

Energy

Due to its heavy reliance of electricity grid on coal consumption, our result shows that the largest contribution in energy sector to reduce GHG emission comes from **combined cycle gas turbine**. Other technical levers which will increase the use of clean and renewable energy from generation side are also working well, such as **PV, wind and CHP**.

In addition, **distributed energy** and **smart grid application** will also contribute to GHG emission reduction and further enhance overall energy efficiency.

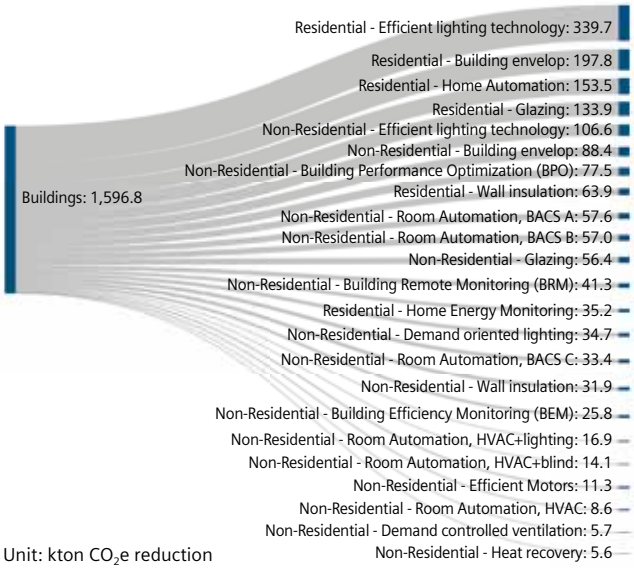


Unit: kton CO_2e reduction

Building

Efficient lighting and **building envelop** are top performers in building sector, while enhancing the application of **building automation** and **building performance optimization** will also contribute to GHG emission reduction significantly.

It will be important to secure green building implementation from design stage, and promote **demand-oriented energy supply** by integrating its development with distributed energy in district level.

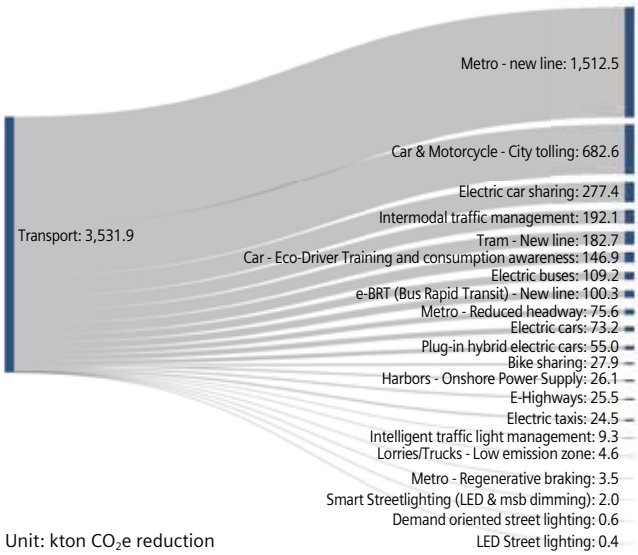


Unit: kton CO_2e reduction

Transport

New metro lines provide the most significant impact in GHG emission reduction, due to Nanjing's ambitious plan on rail-bound transportation.

Other technical levers with less impact but also very significant come from intelligent traffic management and e-vehicle, including **intermodal traffic management**, **intelligent traffic light control, city tolling** and **e-car sharing** etc.



Unit: kton CO_2e reduction

Industry

The energy saving performance and competitiveness of industrial enterprises is highly relying on the level of energy management and process automation. Isolated measurements to improve productivity in the past need to be integrated toward Industry 4.0, in terms of automation, electrification and digitalization.

Cement & Glasses	Steel	Petro & Oil	Chemical
➢ Improve productivity • Increase mill efficiency • Optimize driving system • Shifting peak production ➢ Energy recovery • Waste fuelfor kiln • Optimize burner • Electricity from waste heat ➢ Process automation and management optimization • Reduce excess oxygen concentration by 2% • Production process prediction control • Energy management	➢ Enhance production integration • Avoid unnecessary cooling and heating • Reduce energy demand • Saving electricity ➢ Energy recovery • Electricity from waste heat • Increase heat efficiency ➢ Process automation and management optimization • Energy management	➢ Optimize powerand heating supply • Local heating/power generation • Heat recovery • Optimize steam electricity system • Utilize low-temperature heat • CHP ➢ Enhance maintenance • Leakage prevention ➢ Upgrade and improve equipment and process	➢ Enhance production integration • Ionic membrane cathode technology • Ionic membrane oxidation to reduce energy by 25% • Improve cooling facility, reduce use of cooling water ➢ Renewable energy • Use of renewable energy • Use of by-product in CHP ➢ Process automation and management optimization

Key technical levers in industry

Summary

	Levers	Action Plan	Projects
Industry	▪ Energy saving revamping forexisting factories ▪ Industrial shift and restructuring	▪ Fully enhance the technical measures to secure GDP growth and employment ▪ Shift and restructure industry following “Industry 4.0”	▪ Energy saving retrofit for typical plants in key industries
Energy	▪ Deploying clean energies ▪ Existing power plant upgrade ▪ Grid optimization	▪ Promote the use of clean and renewable energies, apply CCHP in new district ▪ Close down inefficient boilers and coal-fired plants, while upgrade plants and grid	▪ CCHP applications ▪ Upgrade to combined cycle power plant ▪ Smart grid deployment
Transport	▪ Further extending rail-bound transportation network ▪ Further advancing ITS ▪ Deploying electric vehicles	▪ Extend rail-bounded public transport network with more coverage/ convenience ▪ Extend ITS, launch feasibility study for congestion charging, promote eVehicles	▪ ITS ▪ eBus,eCarcharging network, eHighway and off-shore power to ship
Building	▪ Promoting efficient lighting ▪ Enhancing building envelop ▪ Scaling up Intelligent buildings	▪ Implement low-carbon standards for new residential and commercial buildings when issuing land plots ▪ Scale up building energy saving retrofit	▪ Low-carbon technologies on landmark buildings ▪ EPC for government and public buildings

Economics

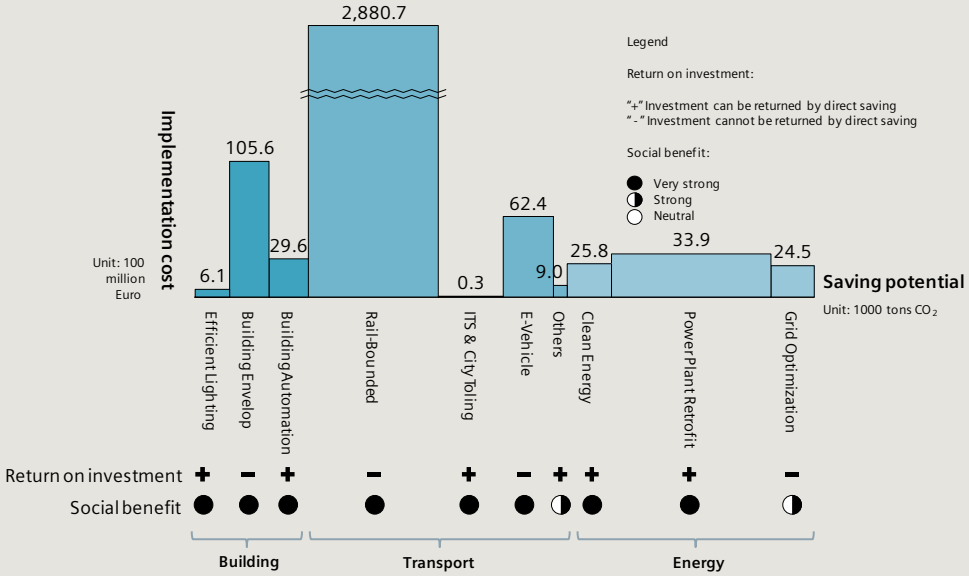


Figure 3: Economic analysis of technical levers

Implementation Rate

Technical levers	Implementation rate 2020	
Combined cycle gas turbine	20%	CCGT: 1,500 MW PV: 400 MW Wind: 200 MW CHP: 200 MW
CHP	2%	
Wind	2%	
PV	4%	
Network optimization	40% of grid	
Smart Grid for monitoring and control	70% of grid	
Power System Automation	60% of user	
Residential - Wall insulation	2% stock/year	All new residential building (10,000,000 m^2 per year) will meet the basic green building requirements of building envelop and efficient lighting. All new public and commercial building (3,500,000 m^2 per year) will meet the basic green building standard (1 star), of which 30% will achieve at least 2 star local green building standard. 500,000 m^2 public and commercial building will be upgraded and retrofitted every year, to achieve higher level of energy efficiency.
Residential - Glazing	2% stock/year	
Residential - Efficient lighting	2% stock/year	
Non-Residential - Wall insulation	1% stock/year	
Non-Residential - Glazing	1% stock/year	
Non-Residential - Efficient lighting	1% stock/year	
Non-Residential - Demand oriented lighting	0.5% stock/year	
Non-Residential - Building Efficiency Monitoring (BEM)	0.5% stock/year	
Non-Residential - Building Performance Optimization (BPO)	0.5% stock/year	
Non-Residential - Demand controlled ventilation	0.5% stock/year	
Non-Residential - Heat recovery	0.5% stock/year	
Residential - Home Energy Monitoring	1% stock/year	
Residential - Home Automation	1% stock/year	
Residential - Building Envelope	2% stock/year	
Non-Residential - Building Envelope	1% stock/year	
Non-Residential - Room Automation, BACS C	0.4% stock/year	
Non-Residential - Room Automation, BACS B	0.3% stock/year	
Non-Residential - Room Automation, BACS A	0.2% stock/year	
Non-Residential - Efficient Motors	0.5% stock/year	

Technical levers	Implementation rate 2020	
Non-Residential - Room Automation, HVAC	0.4% stock/year	
Non-Residential - Room Automation, HVAC+lighting	0.3% stock/year	
Non-Residential - Room Automation, HVAC+lighting+blind	0.2% stock/year	
Non-Residential - Building Remote Monitoring (BRM)	0.5% stock/year	
Metro - new line	10 lines	10 new metro lines with more than 350 km will be implemented. Headway during peak time will be further reduced to 120s. 1,500 new E-buses and 1,000 E-taxies will be applied. 10,000 E-cars will be applied for city wide E-car sharing program.
Hybrid electric buses	20% replacement	
Electric taxis	10% replacement	
Bike sharing	7/ 1000	
Tram - New line	2 lines	
Automated train operation (ATO) Metro	100%	
Intelligent traffic light management	30%	
Intermodal traffic management	70% of user	
LED Street lighting	20% replacement	
E-Highways	10% of highway	
Demand oriented street lighting	30%	
Electric car sharing	2 / 1000	
Electric cars	5%	
Plug-in hybrid electric cars	5%	
e-BRT (Bus Rapid Transit) - New line	2 lines	
Car - Eco-Driver Training and consumption awareness	30%	
Metro - Reduced headway	120 seconds	
Car & Motorcycle - City tolling	20% reduction of traffic	
Lorries/Trucks - Low emission zone	Euro 4	
Smart Streetlighting (LED & msb dimming)	30%	
Harbors - Onshore Power Supply	40%	

Introducing CyPT

The City Performance Tool is a dynamic simulation tool which studies a series of more than 70 technologies from Building, Transport and Energy Technologies – at different time periods and implementation rates. It is designed to reduce the environmental impact of everyday activities in your city. It covers GHG emission from buildings and transport, as well as air pollutants such as particulate matter (PM) and nitrogen oxides (NOx). The model is based on life cycle assessment methodology and builds upon Siemens' technology expertise and global databases of deep vertical process knowledge, calculates the environmental and economic impacts of individual technologies at different implementation levels.

Nanjing

Geographical Area

6587 km²

Population

8.2M

Energy (% of Electricity Mix)

Hardcoal	**87%**
Hydro	**7%**
Nuclear	**5%**
Wind	**1%**

Buildings (Area Per Capita)

40.1
(m²/person)
Residential

19.3
(m²/person)
Commercial

Passenger Kilometer

17.98
(KM/person/day)

Xu Li

Business Developer, Cities Center of Competence Asia

Tel: +86 (0) 21 38892046

Email: xu_li@siemens.com

www.siemens.com