Taiwan’s Pathway to Net-Zero Emissions in 2050

March 30, 2022
Climate emergency: a global challenge
Global temperature will rise by 1.5 degrees within 20 years

Net-zero emissions: an international trend
136 countries around the world have declared net-zero emissions targets

Green supply chain and carbon tariff
As an export-oriented country, Taiwan’s total value of exports in 2021 reached US$446.3 billion, accounting for about 57% of GDP.
Decoupling Economic Growth from GHG Emissions

Since 2005, Taiwan’s GDP has increased by 64%, while the GHG emission intensity (CO$_2$e/GDP) decreased by 34%.
Long-term Path for National GHG Emissions Reduction

Amendments to the GHG Act: setting target for net-zero emissions by 2050

[Base Year] 268.63

[2020] [2% under] [2025] [10% under] [2030] [20% under]

[2035] [50% under]

ΔT < 2°C

New Goal

ΔT < 1.5°C
Energy and Electricity Demand

- Electrification being the trend for Net-Zero, energy demand slows down
- Growth in ICT and livelihood products drives up electricity demand

Major investment projects + sectoral electrification demands

- A major investment project: more than 20 TWh

2012-2021
Average annual growth 1.6%

2021-2030
Average annual growth 0.7% ± 0.1%

2031-2050
Average annual growth -0.2% ± 0.3%

2021-2050
Average annual growth +0.3%

MLOE 80,000

Energy Demand

Electricity Demand

- Increasing fuel substitution rate
- New business models will emerge, and energy-intensive industries will transform
- Electrification of vehicles (electric vehicles account for about 90%)

- The electrification of people's lifestyles and transportation is expected to increase (electric vehicles account for more than 95%)
- Rapid growth in energy demand from economic activities

2021-2030
Average annual growth 2.6% ± 0.1%

2031-2050
Average annual growth 1.7% ± 0.7%

2021-2030
Average annual growth 0.7% ± 0.1%

2031-2050
Average annual growth -0.2% ± 0.3%

2021-2030
Average annual growth +0.3% ± 0.1%

2031-2050
Average annual growth 0.2% ± 0.3%

2021-2030
Average annual growth +0.5% ± 0.1%

2031-2050
Average annual growth -0.3% ± 0.3%

2021-2030
Average annual growth 2.0% ± 0.1%

2031-2050
Average annual growth -0.5% ± 0.3%

2021-2030
Average annual growth 573.1 TWh

2031-2050
Average annual growth 427.5 TWh

Energy Demand:
- 2012-2021: Average annual growth 1.6%
- 2021-2030: Average annual growth 0.7% ± 0.1%
- 2031-2050: Average annual growth -0.2% ± 0.3%

Electricity Demand:
- 2012-2021: Average annual growth 1.3%
- 2021-2030: Average annual growth 2.6% ± 0.1%
- 2031-2050: Average annual growth 1.7% ± 0.7%
2050 Net-Zero Emissions Plan

**2019**

- **Electricity**
  - 139 Mt

- **Non-electricity**
  - Industrial manufacturing, commercial and residential buildings: 86.6 Mt
  - Transportation: 35 Mt
  - Non-Energy: 26.4 Mt

**2050**

- **Electricity**
  - 139 Mt
  - 8.7 Mt
  - 3.3 Mt
  - 10.5 Mt

- **Non-electricity**
  - Hydrogen, bioenergy: 8.7 Mt
  - Electrification: increased demand > 50%
  - Decarbonized electricity:
    - 0 Mt
    - Renewables 60-70%
    - Hydrogen 9-12%
    - Gas + CCUS 20-27%
    - Pumped storage 1%

**Offsetting about 22.5 Mt from refractory emissions by Carbon Sinks**

- Hydrogen, Biomass, CCUS
  - Steelmaking, chemical materials, cement industry and other process emissions

**2050 Electricity Demand Scenario**

- Average annual growth: 2 ± 0.5%
- Demand: 427.5 – 573.1 TWh

**Emissions and absorption achieve the Net-Zero target**

- Base Year (2005): 268.6 MtCO₂e
- Peak (2007): 280.0 MtCO₂e

**Unit**: MtCO₂e

**Net Emissions**: 265.6 Mt
2050 Net-Zero Pathway (Key Milestones)

Buildings
Improving in exterior design, energy efficiency and appliance energy efficiency standards.

Transportation
Changing in travel behavior, reducing demand for transportation, and electro-mobility.

Industry
Improving in energy efficiency, fuel switching, circular economy, and innovative technologies.

Electricity
Scaling up renewable energy, developing new energy technologies, energy storage, and power grid upgrade.

Negative emissions technologies
Demonstration by 2030. At scale by 2050.

New public buildings are energy efficiency class 1 or nearly zero-emission.
All urban public buses and official cars are electric.
30% of car sales are electric
35% of scooter sales are electric

The manufacturing industry gradually replaces the equipment.
15% of electricity consumption in the industry is green.
100% LED lights in commercial buildings.
60% of air conditioner are operated optimized.

50% of existing buildings are upgraded to building energy efficiency class 1 or nearly zero-emission.
100% of car sales are electric
100% of scooter sales are electric
Introduce low-carbon process into industrial demonstration.
(Ironmaking using hydrogen energy, recycle CO₂ to synthesize hydrocarbon fuel)

100% of new buildings and over 85% of existing buildings are nearly zero-emission.
Widely replace equipment in Industry
(80-90% in steel industry, 100% in textile industry)
Fully adopt low-carbon process

No new coal-fired power plants.
40GW of wind and solar power capacity.
Installation of smart meters reaches 100%.
Installation of CCUS in coal and gas-fired power plants.
Renewable electricity accounts more than 60%
Installation of smart substations reaches 100%.
Taiwan’s 2050 Net-zero transition

4 strategies + 2 foundations

- Energy transition
- Industrial transition
- Lifestyle transition
- Social transition

Technology R&D
- net-zero technology
- negative-emission technology

Climate legislation
- regulation and policy
- carbon pricing and green finance
Energy Transition

3 aspects - 9 measures

Building a zero-carbon energy system

• Maximizing renewable energy: Expanding mature wind and solar PV deployment, with cutting-edge geothermal and ocean energy
• Decarbonizing Thermal Power Development: Hydrogen and Gas-fired Power plant with CCS
• Phasing out of coal: co-burning with ammonia in the short-term, converted to safe backup in the long-term
• Building a zero-carbon fuel supply system: Providing hydrogen, ammonia and biomass fuel for industry and transportation
• Introducing advanced technologies in a timely manner to increase the space for zero-carbon energy utilization

Improving energy system resilience

• Prioritizing the expansion of renewable energy grid infrastructure
• Expand energy-storage facilities for renewable energy

Creating green growth

• Creating a green energy industry ecosystem: Port Wind Power Zone, Green Energy Innovation Industry
• Promoting decarbonization investment and international cooperation: promoting green energy investment in public and private sector, establish international partnerships to introduce key technologies, and creating opportunities for exporting Taiwan’s advantageous decarbonization technologies
Industrial Transition

Manufacturing Sector

3 aspects - 11 measures

**Process Improvement**
- Replacement of old appliances
- Energy saving (Digitalization)
- Development of hydrogen technology
- Reduction of F-gases

**Fuel Switching**
- Expanding usage of natural gas
- Expanding usage of bioenergy
- Adopting clean energy/hydrogen

**Circular Economy**
- Raw material replacement
- Refuse Derived Fuel (RDF)
- Energy Resources Integration
- CCU technology
Commercial Sector

4 aspects - 4 measures

**Improvements in Equipments or Operational Behavior**
- Energy efficiency of air conditioning and refrigeration (to gradually achieve level 1 for all)
- Air conditioning system optimization
- Adopt LED lights and high-efficiency lamps

**Low-carbon Energy**
- Conversion to gas and high efficiency boilers
- Green electricity for large energy consumption
- Electrification of commercial vehicles

**Business model with low-carbon transition**
- Gradually import intelligent management system
- Reduce electricity and energy consumption

**Green Buildings**
- New buildings to be enveloped with thermal insulation
- Improvement in thermal insulation in existing buildings
By 2050, 100% of new buildings and more than 85% of existing buildings will be nearly zero carbon buildings.

Multiple-Stage Policies

1. New buildings
   - Establish energy efficiency evaluation systems
   - Strengthen building energy efficiency regulations

2. Existing buildings
   - Improve energy efficiency of existing public and private buildings

3. Home appliances
   - Raise the energy efficiency benchmark for home appliances
   - Reserve power-charging parking spaces

4. Technologies and construction methods
   - Energy-saving technologies for buildings
   - Research and development of low-carbon construction methods

Promote the popularization of policy

Public buildings lead the low-carbon transition of private buildings.
By 2040, 100% of cars and scooters are to be electric.

1. **Strengthen urban planning**
   - Transit-oriented Land Use Planning

2. **Green transport lifestyle**
   - Reduce unnecessary travel
   - Online meetings
   - Remote education

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**Vehicle electrification**

- Increase the market share of electric vehicles.
  - All urban public buses to be electric by 2030
  - All passenger car and scooter sales to be electric by 2040
- Create domestic market demand
- Localize Manufacturing
- Complete Infrastructure
- Strengthen vehicle carbon emission management

**People-oriented green transportation**

- Promote public transportation
- Complete sidewalks
- Complete bicycle paths

**Private car and scooter management**

- Promote vehicle usage management
- Promote car and scooter sharing

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**Auxiliary measures**
Lifestyle Transition

**Future Lifestyle**

- **Zero-waste, low-carbon diet**
  - Reasonable buying
  - Zero waste catering
  - Highly efficient production, sales and delivery
  - Regenerative agriculture

- **Use rather than own**
  - Light-weight design
  - Easy repair, upgrade and maintenance for products
  - Increase of service life
  - Recycling of components

- **Net-zero circular buildings**
  - Passive design, adopting smart control system, developing deepened energy savings, applying highly efficient appliances, diversifying power and system integration & carbon storage in building materials

- **Low-carbon transportation**
  - Avoid unnecessary commuting
  - Accessible transportation
  - Convenient public transportation

- **Dialogue with citizens**
  - Common goal
  - Common responsibility
  - Collective action
Social Transition

Social support system: Realizing just transition and civic engagement

Net-zero transition: a social engineering that turns conflicts into opportunities

Just Transition

- Identify and mediate conflicts and disputes arising from transition
- Improve mechanisms for resolving conflicts and disputes
- Establish tools and strategies for the support system
- apply public-private partnerships to increase resilience of a transitioning society

Leaving No One Behind

Civic Engagement
Technology R&D

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Avant-garde Technology

Target-oriented

Public-private Partnership

International Cooperation

Rolling Review

Low Carbon

• Low-carbon Process
• Green Buildings
• Green Transportation

Sustainable Energy

• Power Grid System Integration
• Power Storage
• Hydrogen Fuel
• Other Frontier Technologies

Social Science

• Net-Zero Policy Impact Assessment
• Adaptation and Local Planning

Circularity

• Energy/Resource Recycling

Carbon Negative

• Carbon Capture and Storage
• Natural Carbon Sinks

Review in every five years
Amending the Greenhouse Gas Reduction and Management Act to the Climate Change Act
- To set up 2050 Net-zero emissions as long-term goal
- To address the needs for GHG emission survey, statistics compiling, validation, and verification
- To cope with global carbon border adjustment trends, promoting carbon tariff and carbon market

Reviewing the Energy Administration Act, the Electricity Act, and the Renewable Energy Development Act

Proposing hydrogen management regulations according to hydrogen development trends

Promoting central air-conditioning and efficient envelope insulation designs for new buildings
Proposing mandatory solar PV installation

Initiating amendments to regulations related to promotion of vehicle electronification

Capitalize on financial sector’s capacity to achieve 2050 net-zero emissions target

Core strategies
- Promoting climate-related information disclosure
- Helping businesses mitigate risks and grasp new opportunities
- Using market mechanisms to guide sustainable development

Create Sustainable Development Roadmap for TWSE- and TPEx-Listed Companies

Assist enterprises in setting GHG reduction targets
Taiwan’s 2050 Net-Zero Transition

12 Key Strategies

1. Just Transition
2. Wind/Solar PV
3. Hydrogen
4. Innovative Energy
5. Power Systems & Energy Storage
6. Energy Saving & Efficiency
7. Carbon capture, utilization & storage (CCUS)
8. Carbon-free & electric vehicles
10. Carbon Sinks
11. Green Lifestyle
12. Green Finance
A Budget of Nearly NT$900 billions by 2030 for Major Plans of 2050 Net-zero Transition

- Renewables and hydrogen: NT$210.7 billion
- Grid and energy storage: NT$207.8 billion
- Low carbon and negative carbon technology: NT$41.5 billion
- Energy saving and boiler replacement: NT$128 billion
- Electrification of transport vehicles: NT$168.3 billion
- Resource circulation: NT$21.7 billion
- Forest carbon sinks: NT$84.7 billion
- Net-zero living: NT$21 billion

Budget Source:
- Existing Plans: NT$120 billion
- New Plans: NT$320 billion
- State-run: NT$440 billion
2050 Net-Zero Transition

Promoting economic growth, stimulating private investment, and creating green jobs

- Energy Transition: More Secure
- Industrial Transition: More Competitive
- Lifestyle Transition: More Sustainable
- Social Transition: More Resilient

- Reversing the risk of high dependence on imported energy
- Accelerating industrial transformation and creating green growth momentum
- Driving private investment by increasing public spending
- Improving the quality of life and environmental sustainability

From 97.4% in 2021 to below 50% in 2050

By 2030, drive private investment of over NT$4 trillion

By 2030, the air pollution will be reduced by about 30%, compared to the level in 2019
Transition Assistance for Industries

Four major aspects

1. Carbon quantification and reporting
2. Improving mitigation capabilities
3. Updating information
4. Capacity building in financial industry

Two major cooperation modes

- Major emitters take the lead and then help others comply with the transition policy
- Engaging with all sectoral associations, while making state-owned enterprises serve as examples
Thank you