

Taiwan's Decarbonization Conundrum

**Taiwan Needs More Zero-Carbon Energy
to Meet Growing Demand,
to Replace Fossil Fuel
and
to Fulfill Net-Zero Emissions Pledges and Requirements**

By [Nicholas V. Chen](#)*

*Special thanks to Victoria Lee, Jose Ponce, Juan Madrigal
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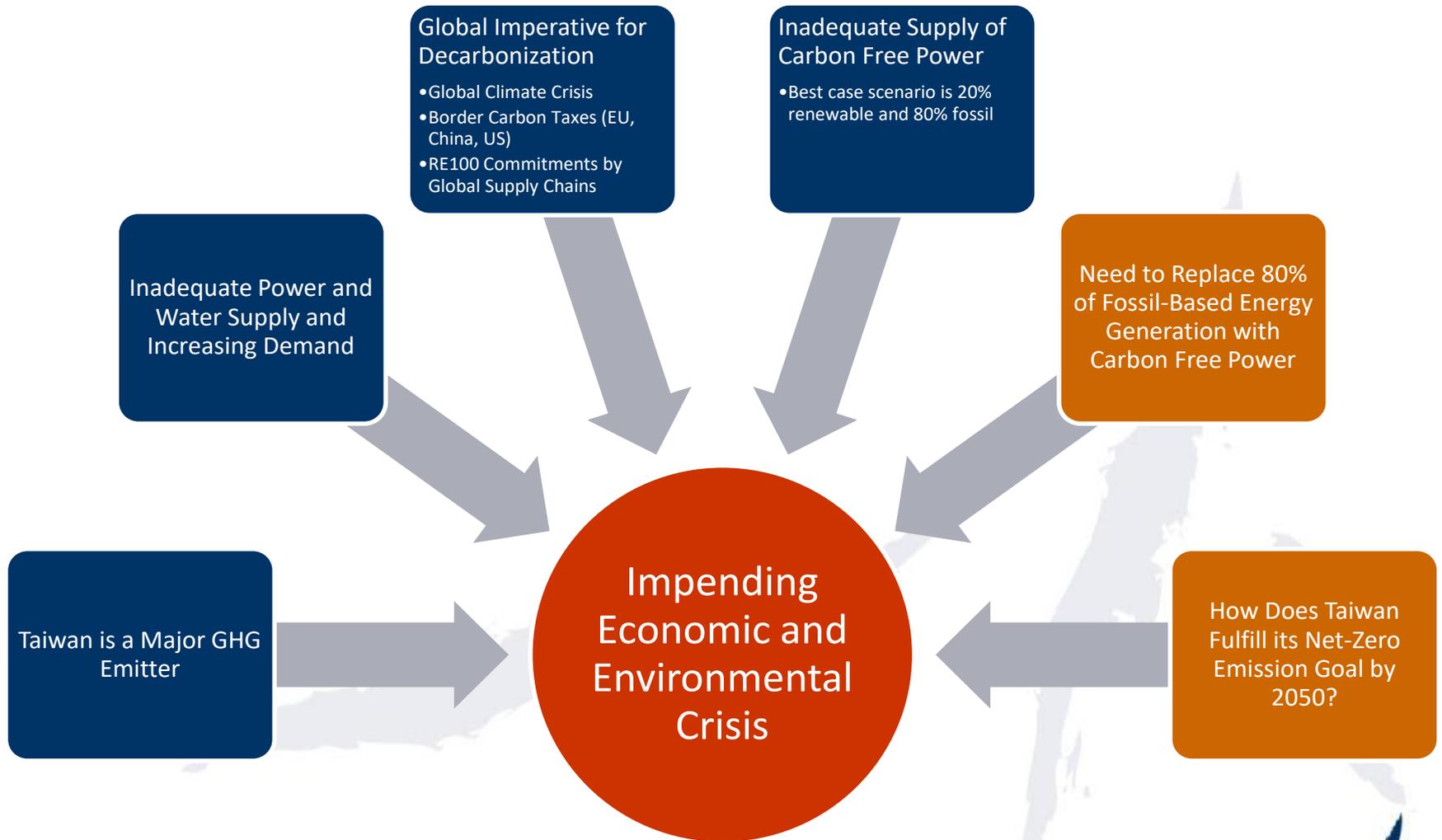
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The Problem: Inadequate Supply of Carbon Free Power



Taiwan is a Major GHG Emitter

Taiwan is a Major Industrialized Economy

- ▶ 17th largest global exporter (US\$286.49bn in 2020)
- ▶ Exports account for 52% of GDP
- ▶ 98% of exports are industrial goods
- ▶ TSMC is the third largest semiconductor company in the world



Taiwan accounts for ~25% of all semiconductors exported worldwide

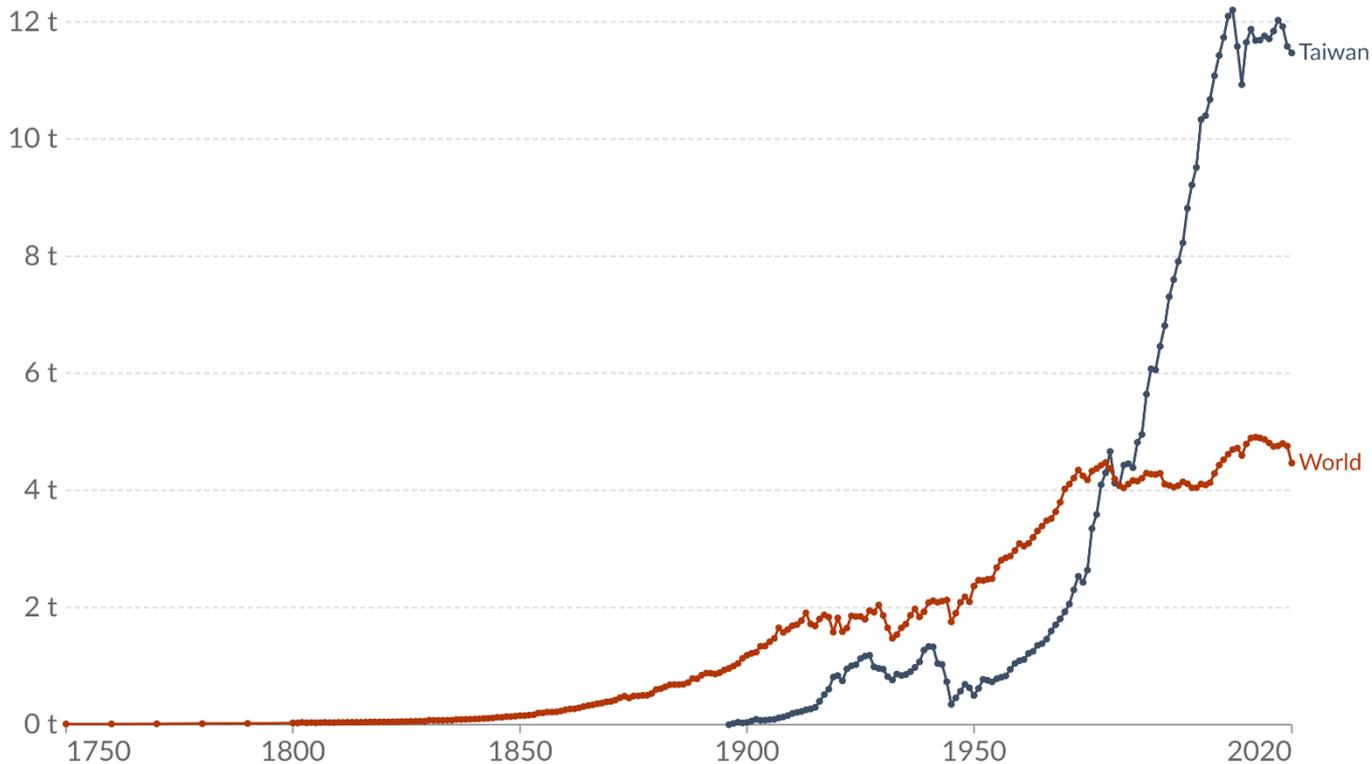
Taiwan is a Major GHG Emitter

As Economic Activity Grows, So Do GHG Emissions

Per capita CO₂ emissions

Carbon dioxide (CO₂) emissions from the burning of fossil fuels for energy and cement production. Land use change is not included.

Our World
in Data



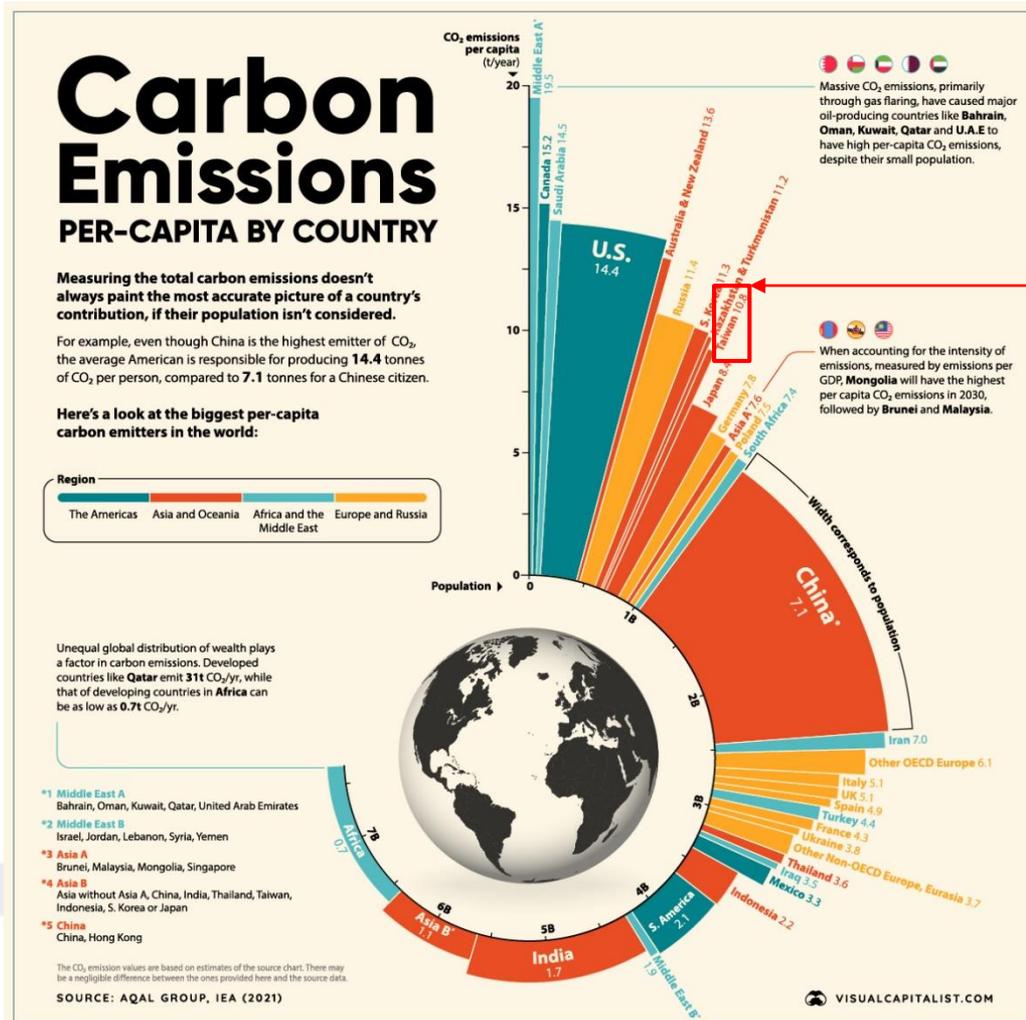
Source: Our World in Data based on the Global Carbon Project

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

Note: CO₂ emissions are measured on a production basis, meaning they do not adjust for emissions embedded in traded goods.

Taiwan is a Major GHG Emitter

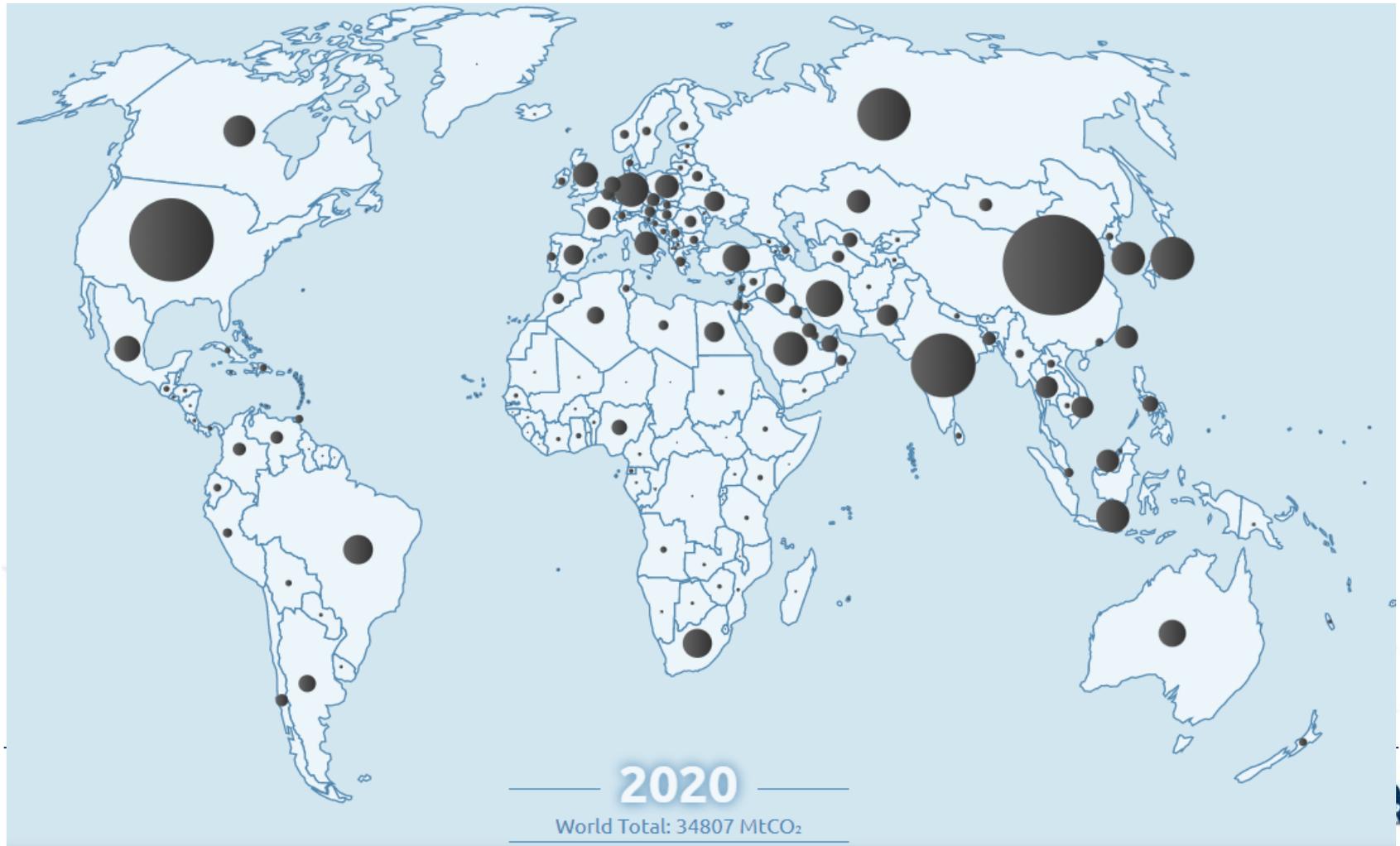
As Economic Activity Grows, So Do GHG Emissions



Taiwan is the 10th Largest Emitter Per Capita (10.8 Tons per Year) of Carbon Emissions

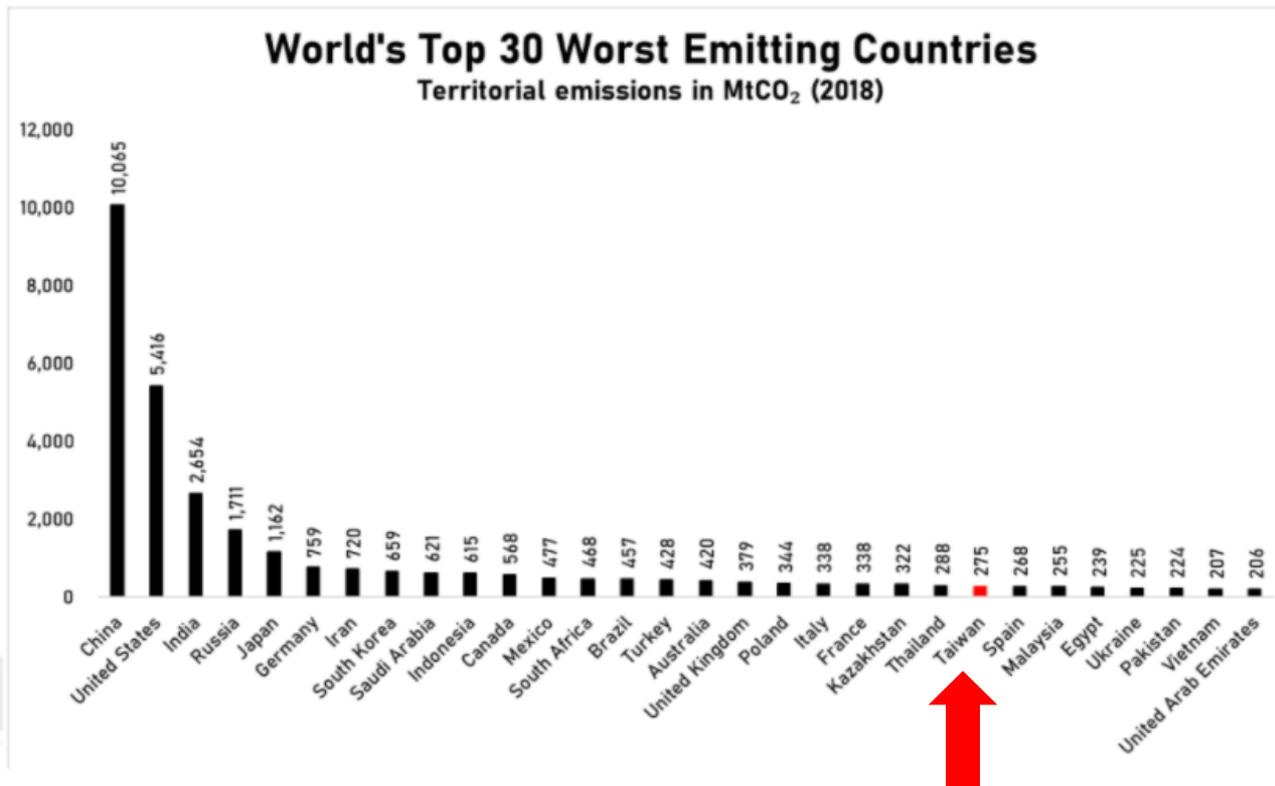
Taiwan is a Top Global Emitter of GHGs

Taiwan consistently ranks in the **top 25 global CO₂ emitters** (regardless of dataset used)



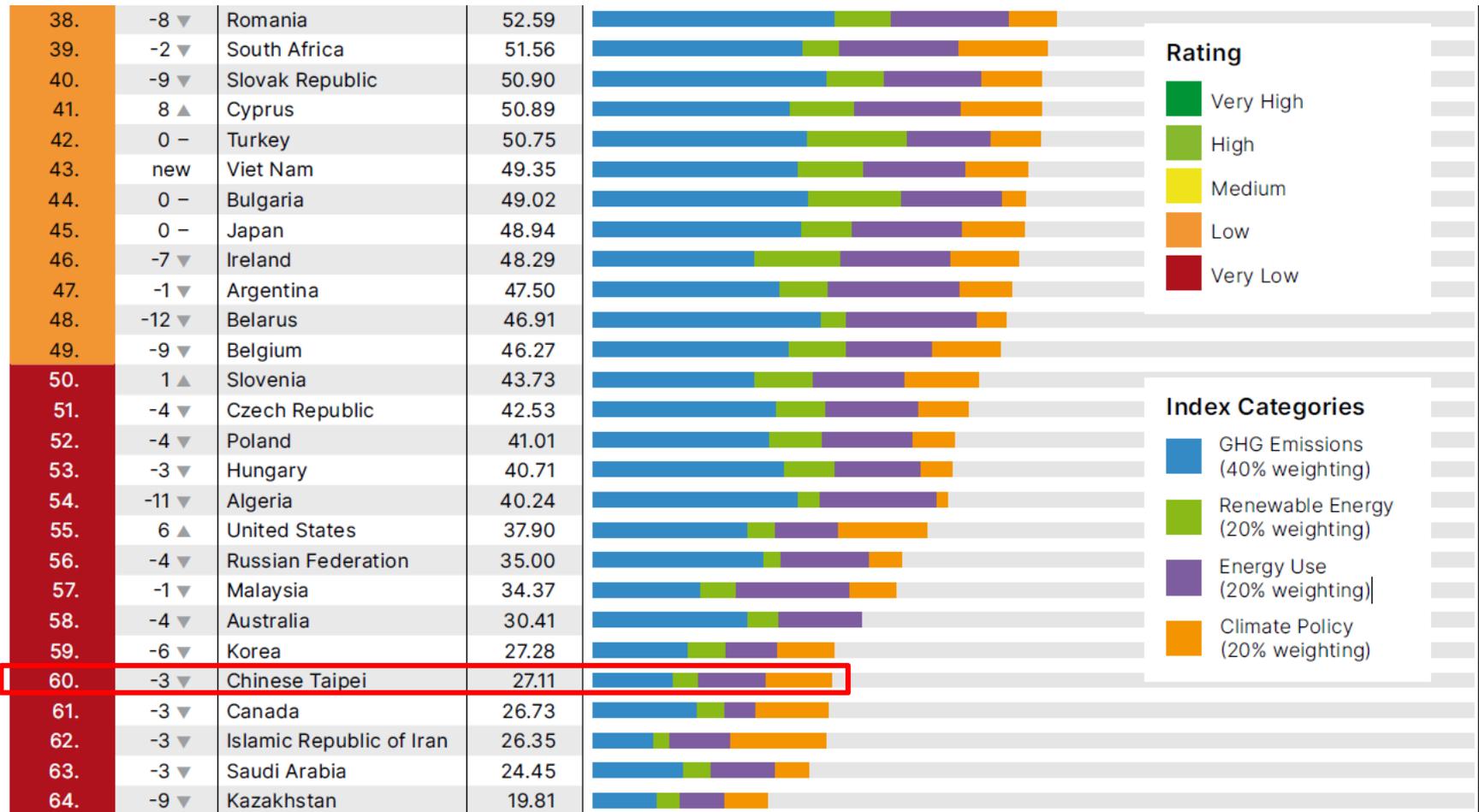
Taiwan is a Top Global Emitter of GHGs

Taiwan is the **world's 23rd largest emitter** of greenhouse gas emissions



Taiwan is a Laggard in Environmental Performance

The Climate Change Performance Index (“CCPI”), which ranks countries on their climate policies and GHG emissions placed **Taiwan 5th from the Bottom** Among 64 Countries.



Taiwan is a Major GHG Emitter

- If Taiwan fails to decarbonize its electricity supply, its economic competitiveness could be severely damaged
 - Currently Taiwan has no viable pathway to decarbonize its electricity supply
 - ▶ The best case scenario under current policies is 20% renewable and 80% fossil fuels (50% carbon-emitting LNG and 30% coal)
 - ▶ Lin Por-fong (林伯豐), chairman of the Chinese National Association of Industry and Commerce said:
 - ▶ Use of natural gas has fallen around the world in line with various methods for emissions reduction, but Taiwan is still opting to increase its use of gas.
 - ▶ This means the government must reflect on its energy policy and that Taiwan should not be overly reliant on natural gas, which is not carbon-free.
-

Taiwan is a Major GHG Emitter

- Mark Liu (劉德音), chairman of Taiwan Semiconductor Manufacturing Co. (TSMC), the world's largest contract chipmaker, said that **reaching zero greenhouse gas emissions is a global trend that Taiwan should adhere to**
- TSMC 2020 energy consumption was **4.8% of Taiwan's total energy supply, which is equivalent to ~90% of the total renewable energy available in Taiwan**
- **There is not enough carbon-free electricity to meet TSMC's needs, let alone the other RE100 companies**
- **There is not enough carbon-free electricity in Taiwan to meet the needs of the entire economy**

The Problem: Inadequate Supply of Carbon Free Power

Bloomberg: [“TSMC Leads Rush for Renewables Ahead of Taiwan Energy Vote”](#)

- “Energy security and reliance on imported fossil has long been key issues,” reports Cindy Wang, Bloomberg Taiwan reporter
 - The electronics plants (such as TSMC’s) that drive the economy need to find new sources of no carbon and green energy soon to be able to expand production
 - Power demand is expected to grow by 2.5% every year, according to a [forecast](#) by the Bureau of Energy
 - TSMC’s expected power use could double within three years, according to Bloomberg Intelligence analyst Charles Shum
 - TSMC’s projected power consumption for 2022 is expected to rise to 7.2% of the nation’s total consumption
-

The Problem: Inadequate Supply of Carbon Free Power

Bloomberg: ["TSMC Leads Rush for Renewables Ahead of Taiwan Energy Vote"](#)

- “Companies in science parks added diesel generators in addition to **uninterruptible power supply to contingency plan after blackouts in May,**” said Hander Chang, president of the Allied Association for Science Park Industries. **“Power shortage is more important than national security.”**
 - Taiwan could potentially generate as much as 32 GW of **geothermal power,** according to the Taiwan Geothermal Association. But so far, **only one plant is operating, a privately built 4.2 MW facility** that started in October in Yilan County.
 - Taiwan’s **lack of land** and policy of promoting self-sufficiency also **create hurdles for solar.** While companies like TSMC are adding panels to facilities, **large-scale solar farms compete for space with agriculture.**
-

The Problem: Inadequate Supply of Carbon Free Power

Bloomberg: [TSMC Leads Rush for Renewables Ahead of Taiwan Energy Vote](#)

- Even if Taiwan can ramp up the share of wind and solar power, both are **weather dependent**, which could make the **supply unstable** without more traditional sources. “This is a universal problem,” Citigroup said in a July report. **To meet rapidly rising demand, “more baseload capacity and delays in the decommissioning of power plants may be required,”** the bank said.
- **Taiwan needs more energy, specifically renewable and zero carbon energy, to keep up with growing demand and keep in line with the net zero emissions pledges and requirements**

The Problem: Inadequate Supply of Carbon Free Power

Hon Hai Group founder Terry Gou (郭台銘) that "there will be a shortage of electricity next year."

Lin Por-fong (林伯豐), chairman of the Chinese National Association of Industry and Commerce said:

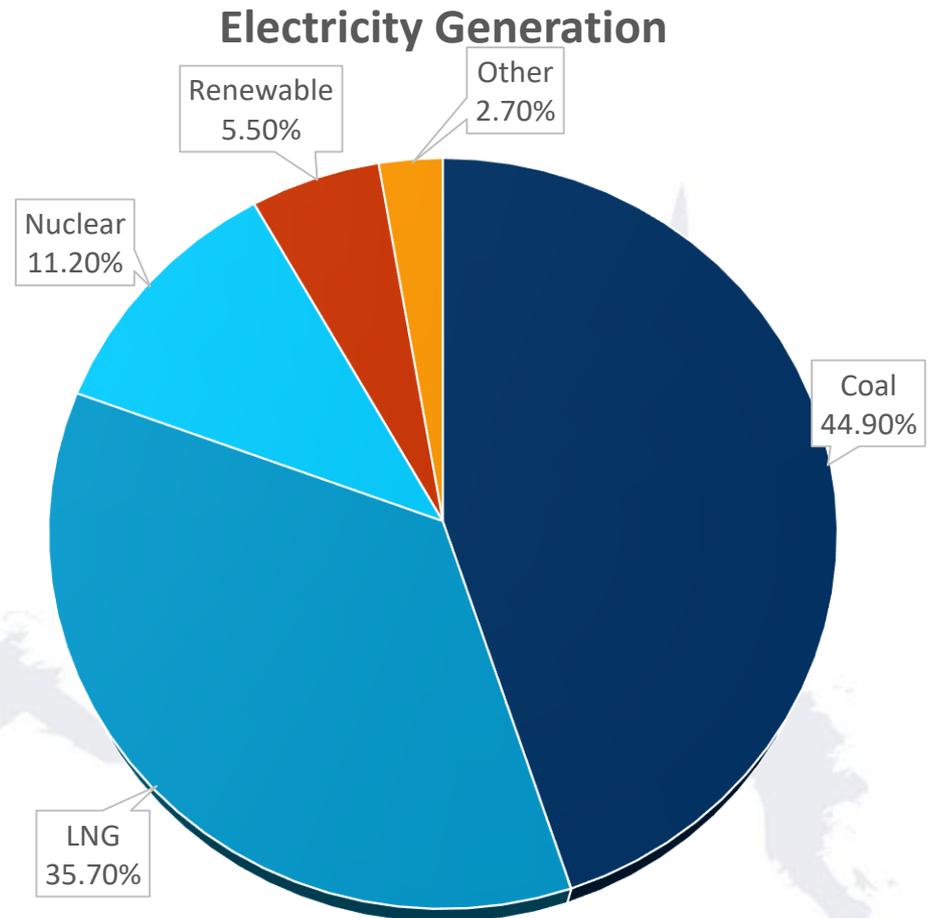
- "In order to optimize low-carbon infrastructure, the government should establish a carbon pricing and greenhouse gas inventory system."
- "The government should also review its energy transition initiative to guarantee stable power supply and install renewable energy facilities to expand power generation capacity and rationalize the price of electricity."

Inadequate Power Supply and Increasing Demand

- **Taiwan's power needs are not met. The island consumes as much electricity as it can produce**
 - ▶ See next slide. Consumption practically mirrors generation considering transmission loss
- **Actual industrial demand is unknown. Government reports demand growth rates as slightly higher than planned generation growth**

Taiwan Key Electricity Statistics (2020)

- **Total Installed Capacity:**
 - ▶ 57.738 GW (2020)
- **5.5% renewable supply vs 94.5% non-renewable**
- **Electricity Generation:**
 - ▶ 280,140 GWh (2020)
- **Electricity Consumption:**
 - ▶ 271,247.1 GWh (2020)
- **Generation Growth Rate:**
 - ▶ 2.1338% (2000-2020 avg.)
- **Consumption Growth Rate:**
 - ▶ 2.2047% (2000-2020 avg.)



Taiwan Electricity Demand is Not Being Met (Artificially Low Consumption Constrained by Generation)

Year	Total Generation	Generation Growth Rate	Total Consumption	Consumption Growth Rate
2000	184,841		176,503.40	
2001	188,530	1.9958%	180,494.00	2.2609%
2002	198,829	5.4628%	190,257.70	5.4094%
2003	209,072	5.1517%	200,464.60	5.3648%
2004	218,397	4.4602%	209,889.20	4.7014%
2005	227,512	4.1736%	218,457.50	4.0823%
2006	235,530	3.5242%	225,966.80	3.4374%
2007	243,117	3.2212%	233,482.70	3.3261%
2008	238,305	-1.9793%	229,685.90	-1.6262%
2009	230,037	-3.4695%	220,715.00	-3.9057%
2010	247,059	7.3997%	237,407.30	7.5628%
2011	252,167	2.0675%	242,086.30	1.9709%
2012	250,373	-0.7114%	241,111.60	-0.4026%
2013	252,341	0.7860%	245,123.40	1.6639%
2014	259,964	3.0209%	251,100.40	2.4384%
2015	258,142	-0.7009%	250,019.30	-0.4305%
2016	264,108	2.3111%	255,420.10	2.1602%
2017	270,256	2.3278%	261,394.60	2.3391%
2018	275,549	1.9585%	266,568.20	1.9792%
2019	274,191	-0.4928%	265,720.00	-0.3182%
2020	280,140	2.1697%	271,247.10	2.0800%

Inadequate Water Supply and Increasing Demand

- **Water supply is dependent on seasonal typhoons**
 - **Precipitation rates have decreased in recent years, with the last 2 years recording no typhoons landing on the island**
 - **Despite recent efforts to tap into groundwater and other resources, the government is unable to meet industrial, agricultural and consumer demand for water**
 - **Next slide shows the state of Taiwan's major reservoirs during the worst part of the drought in May 2021**
-



NORTHERN

(Location: Baoshan Reservoir)



CENTRAL

(Location: Sun Moon Lake)

Industrial Demand Exacerbates Water Shortages



Can Taiwan quench TSMC's thirst for water?



Source: Pei-Yin Hsieh

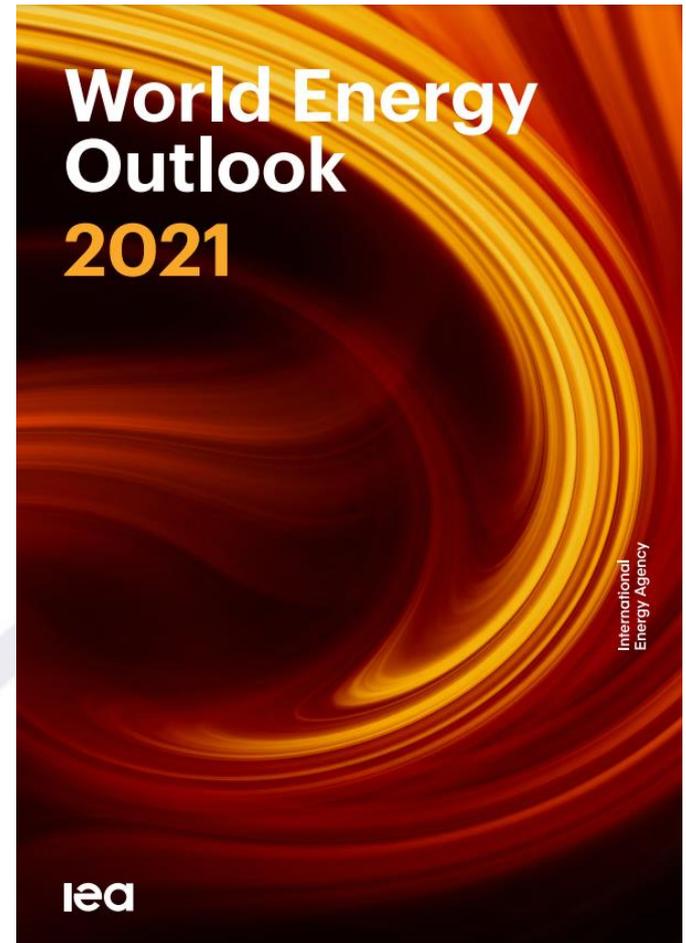
TSMC is planning a 2nm wafer foundry complex that could substantially increase the demand for water in a part of Taiwan that frequently goes dry. Can enough water be found for the project, or will it be derailed by an environmental impact assessment?

The Global Imperative for Decarbonization

- The global economy is going carbon free. **Taiwan will be left behind if it fails to decarbonize its electricity supply**
- **Taiwan's economy will be severely damaged if Taiwan is unable to export to global markets**
- **Most Taiwanese manufacturers currently face an existential threat from the “perfect storm” combination of:**
 - ▶ Global Climate Crisis
 - ▶ Global Border Carbon Taxes (Public Sector Push)
 - ▶ RE100 Commitments by MNC Supply Chains (Private Sector Push)
 - ▶ Global Supply Chain
- **Current best case scenario: 20% renewable**
- **Taiwan has no plan to replace 80% of its fossil fuel-generated electricity with carbon-free sources**

Global Climate Crisis

“It is hard to understate the dangers inherent in today’s shortfall in spending on clean energy transitions, compared with the levels required. If we do not correct it soon, the risks of destabilising volatility will only grow as we move forward.”



Global Carbon Taxes

- **The European Union’s Carbon Border Adjustment Mechanism (“CBAM”) will effectively levy a carbon tax on products with high carbon footprints**
 - ▶ Certain products will require disclosure of “embedded emissions” in 2023, and tariffs will enter into effect in 2026
 - ▶ The list of “in-scope” products will likely expand over time
- **The U.S. is behind, but moving in the same direction**
 - ▶ There are currently over 10 bills introduced to the House of Representatives authorizing different forms of carbon taxes
- **China recently launched a national emissions trading scheme**
 - ▶ It has been criticized for not being ambitious enough, however it shows the government’s intention to move in this direction

RE100 Commitments

- **Over 300 global companies have made public commitments to source 100% renewable energy in the next decade (RE100)**
 - ▶ Including **11 Taiwan-based companies** and **over 100 MNCs active in Taiwan**
 - ▶ **38% of RE100 members will depend on Taiwan to achieve 100% renewable electricity globally**
- **Taiwan RE100 Members**
 - ▶ TCI, Tridle, Hair O'Right, Grape King, TSMC, Kingwhale, Delta Electronics, Jola Lab, Acer, UMC, KYF
- **TSMC 2020 energy consumption was 4.8% of Taiwan's total energy supply, which is equivalent to ~90% of the total renewable energy available in Taiwan**
- **TSMC's projected power consumption for 2022 is expected to rise to 7.2% of the nation's total consumption**
- **There is not enough carbon-free electricity in Taiwan to meet the needs of the entire economy**
- **It will be impossible for RE100 members to reach their commitments with the current and planned electricity mix in Taiwan, which relies heavily on fossil fuels**

The Best that Taiwan Can Do is 80% Fossil and 20% Renewable Energy by 2025

	% Renewable	% Fossil	% Non-Renewable Carbon Free (Nuclear)
2020	5.5%	83.3%	11.2%
2025 (Best case scenario under current policies)	20%	80%	0%



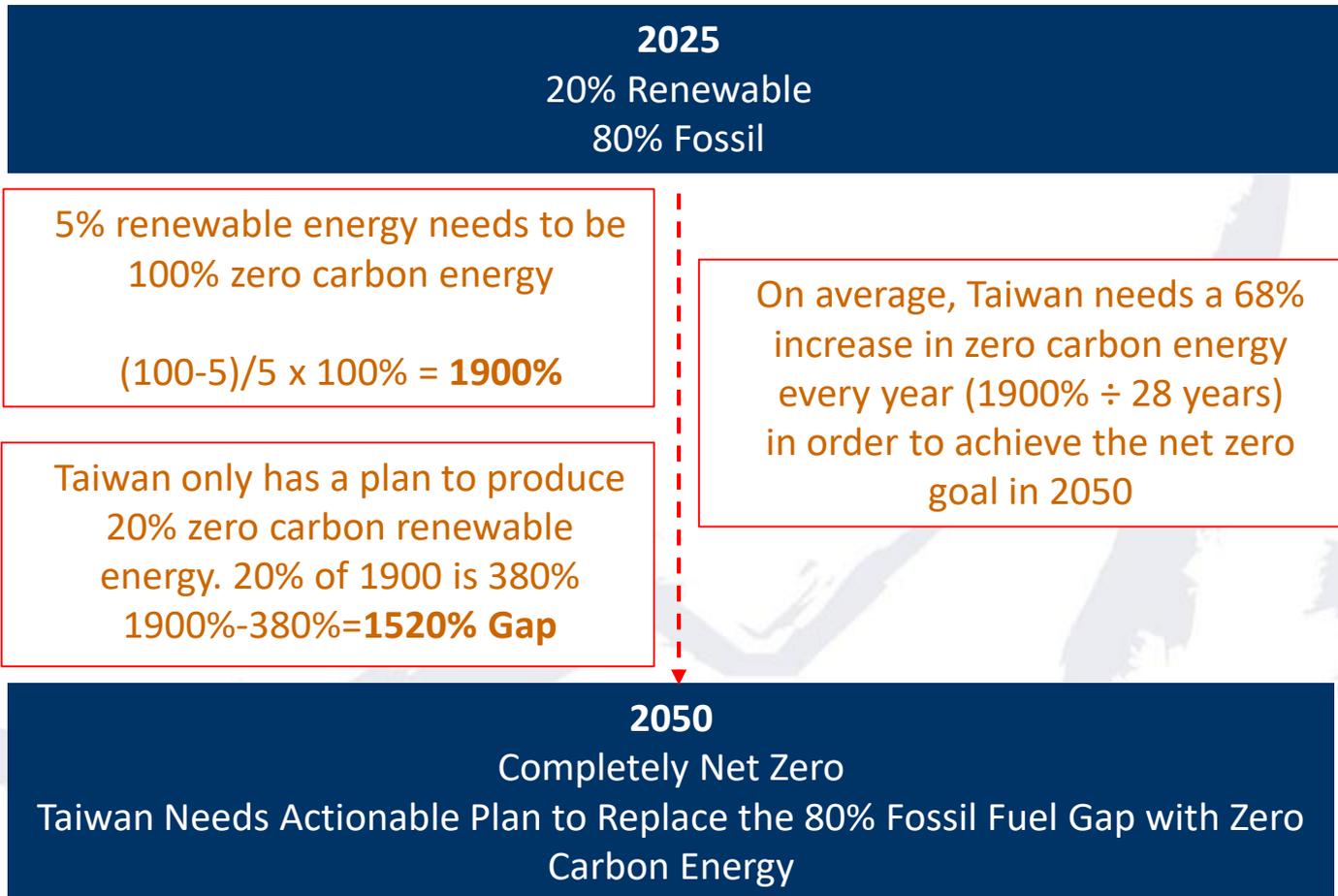
How does the government plan to get to net-zero without any regulations or plans for implementation?

Taiwan needs a **1900% increase**
(68% average annual increase)
of zero carbon energy needed to get to net zero emissions by 2050

2050 (Stated Zero Emissions Goal by Government)	100%	0%	0%
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The Best that Taiwan Can Do is 80% Fossil and 20% Renewable Energy by 2025

How Does the Government Plan to Achieve the 2050 Net Zero Emissions Goal?



*Calculations assume no growth in demand for energy from 2021~2050 27

Current Energy Policy is Misguided and Counterproductive

- It is impossible for Taiwan to reach its zero emissions goal by 2050 using solely renewable sources
- Any functioning electric grid needs a certain level of continuous baseload power, which renewable sources simply cannot provide given their intermittent nature
- Utility-scale battery storage solutions will be unavailable or prohibitively expensive for the foreseeable future
- This has led to a considerable increase in the use of LNG (fossil) to substitute for traditional nuclear and oil sources
- The reality is that **nuclear is the only existing reliable carbon-free source of baseload power**. Taiwan must consider the pros and cons of nuclear power as an integral part of its decarbonization strategy, especially given recent advances in small modular reactor technology with passive cooling, removable spent fuel and “walk away” safety features, which address many of previous safety and spent fuel removal fears
- Taiwan's economy will not be able to survive without carbon-free nuclear replacing the current 80% generation from fossil fuels. There is no way around this **basic arithmetic reality**

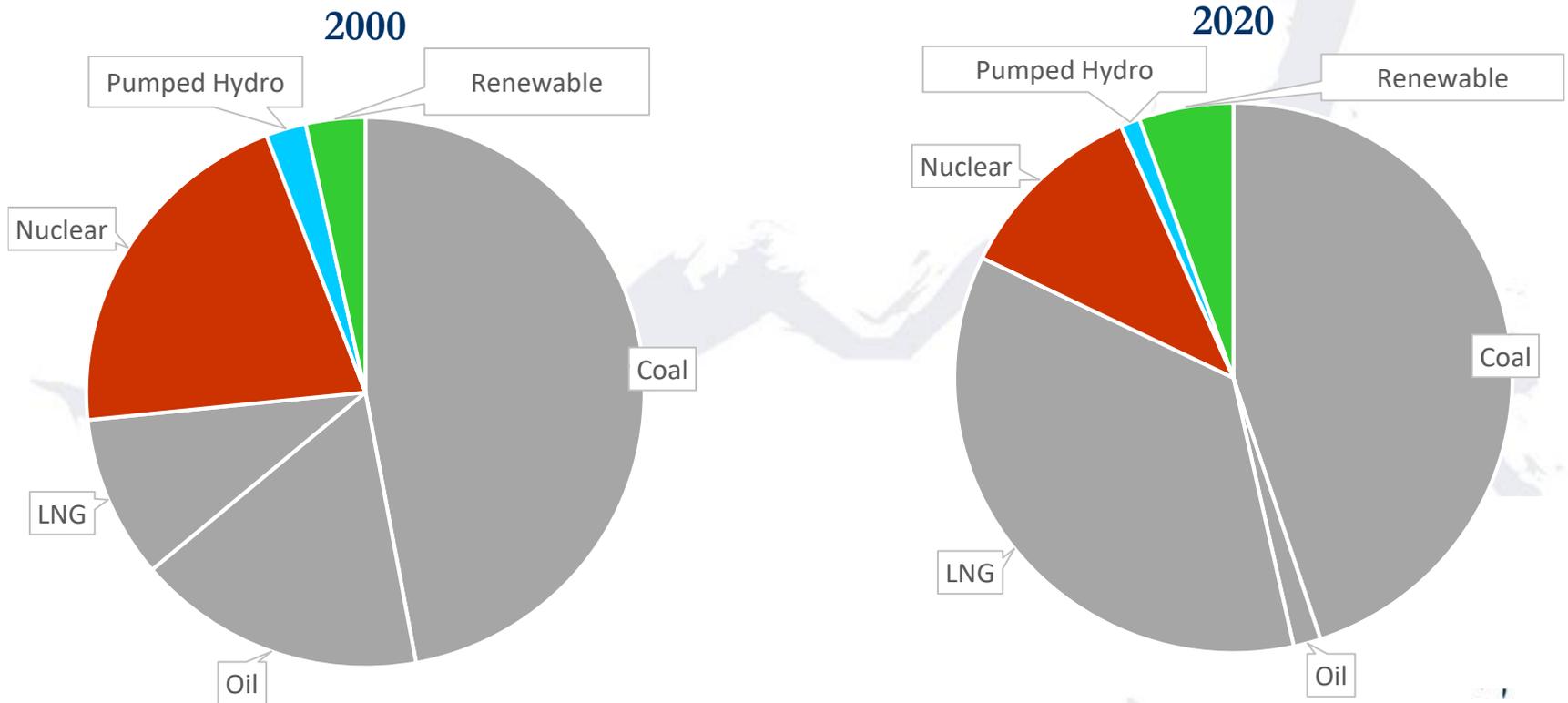
Current Energy Policy is Misguided and Counterproductive

- The ruling party has been engaged in an anti-nuke campaign, trying to phase it out in Taiwan for political reasons. However, the November 2018 referendum showed that 59% of citizens voted against the government's policy to phase out the use of nuclear energy by 2025.
- According to Chapter 4, Article 30, Section 3 of the Referendum Act, “for a proposal of referendum of an important policy, the President or the authority shall take necessary disposition to realize the content of the proposal of referendum.” **This means the government should implement the result and utilize nuclear power.**
- In contrast to the law, the DPP government still plans to eventually phase out nuclear power. One might wonder if this is **illegal**.

Ambitious Renewable Push Has Resulted in No Reductions in Fossil Fuel Use

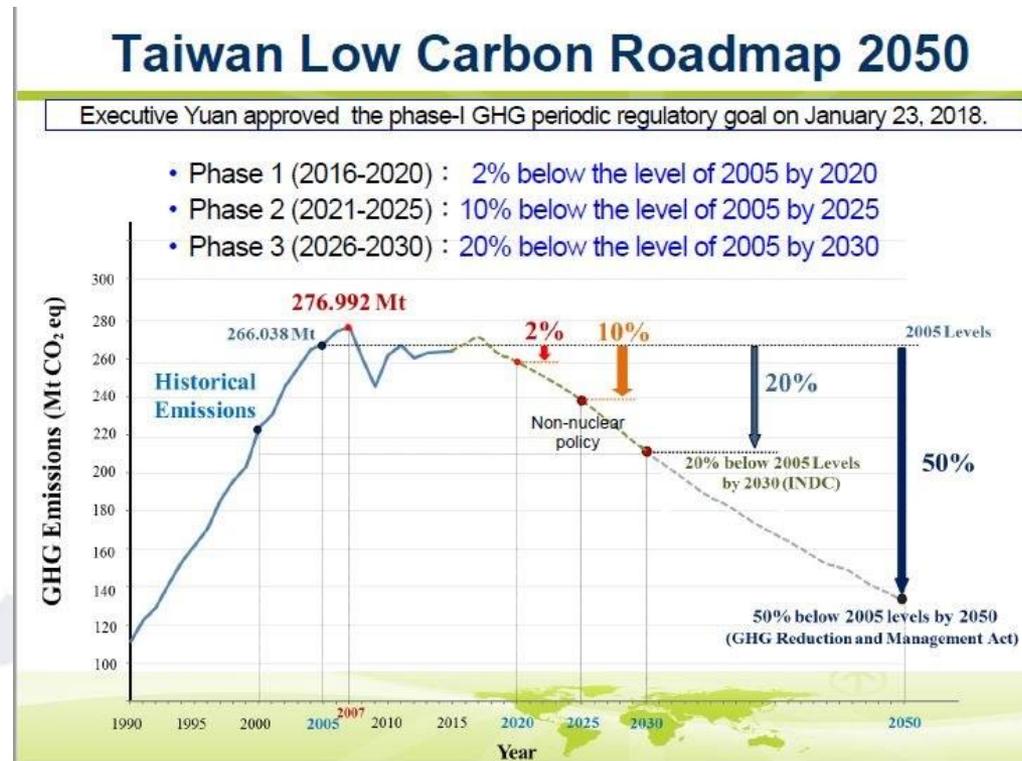
- **2000:** 73.4% of electricity from fossil sources
- **2020:** 83.3% of electricity from fossil sources
- **2025:** 80% of electricity from fossil sources (best case scenario estimate)

Coal has remained constant, LNG has expanded to reduce oil and nuclear, with renewables increasing slightly

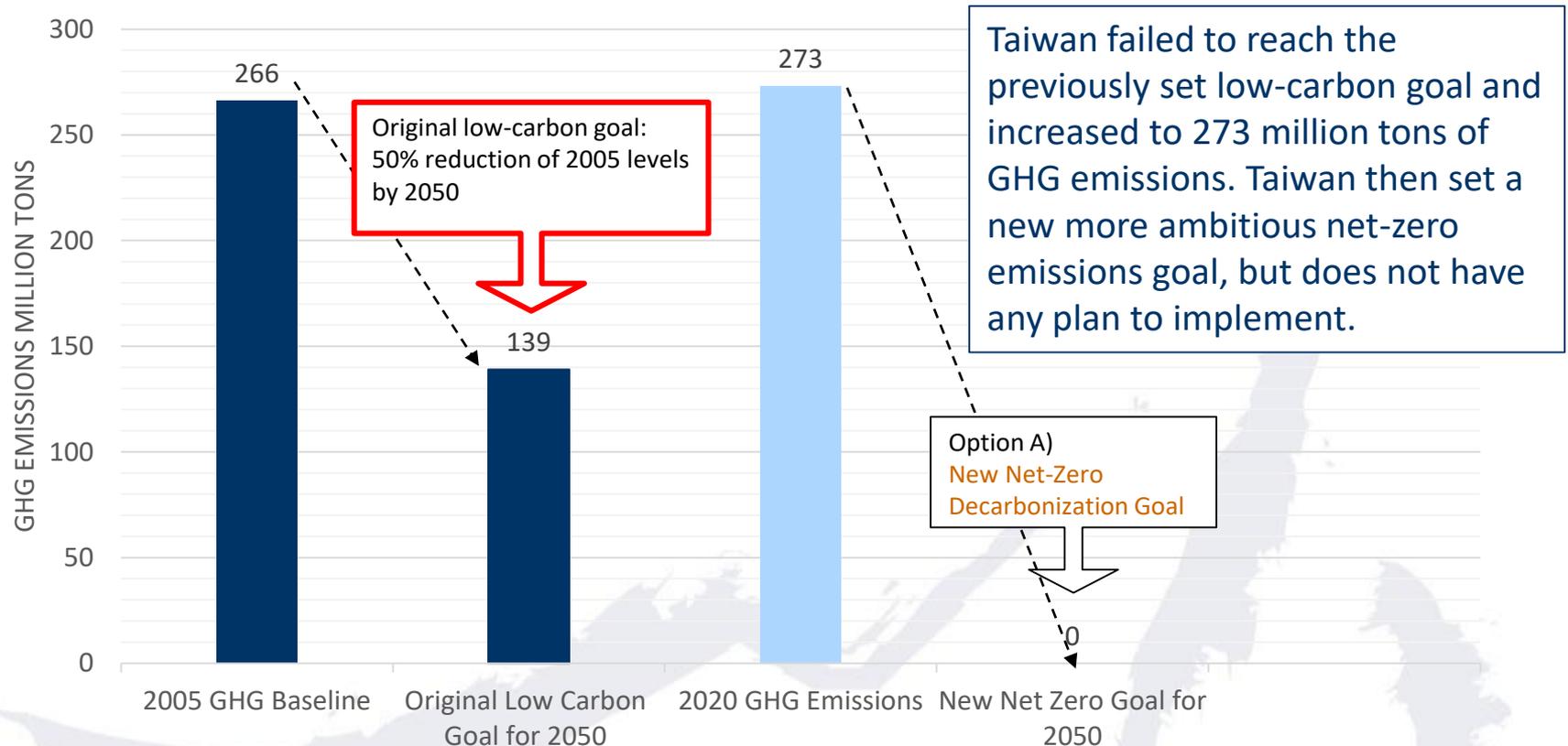


Taiwan's Original 2015 Goal of 50% of 2005 GHG Emissions by 2050

In April 2021, Taiwan upgraded its carbon emissions goal to become net zero by 2050, which is **more ambitious than the previous goal** to reduce emissions to 50% of the levels in 2005 by 2050. However, **there is no detailed plan on how to do this.**



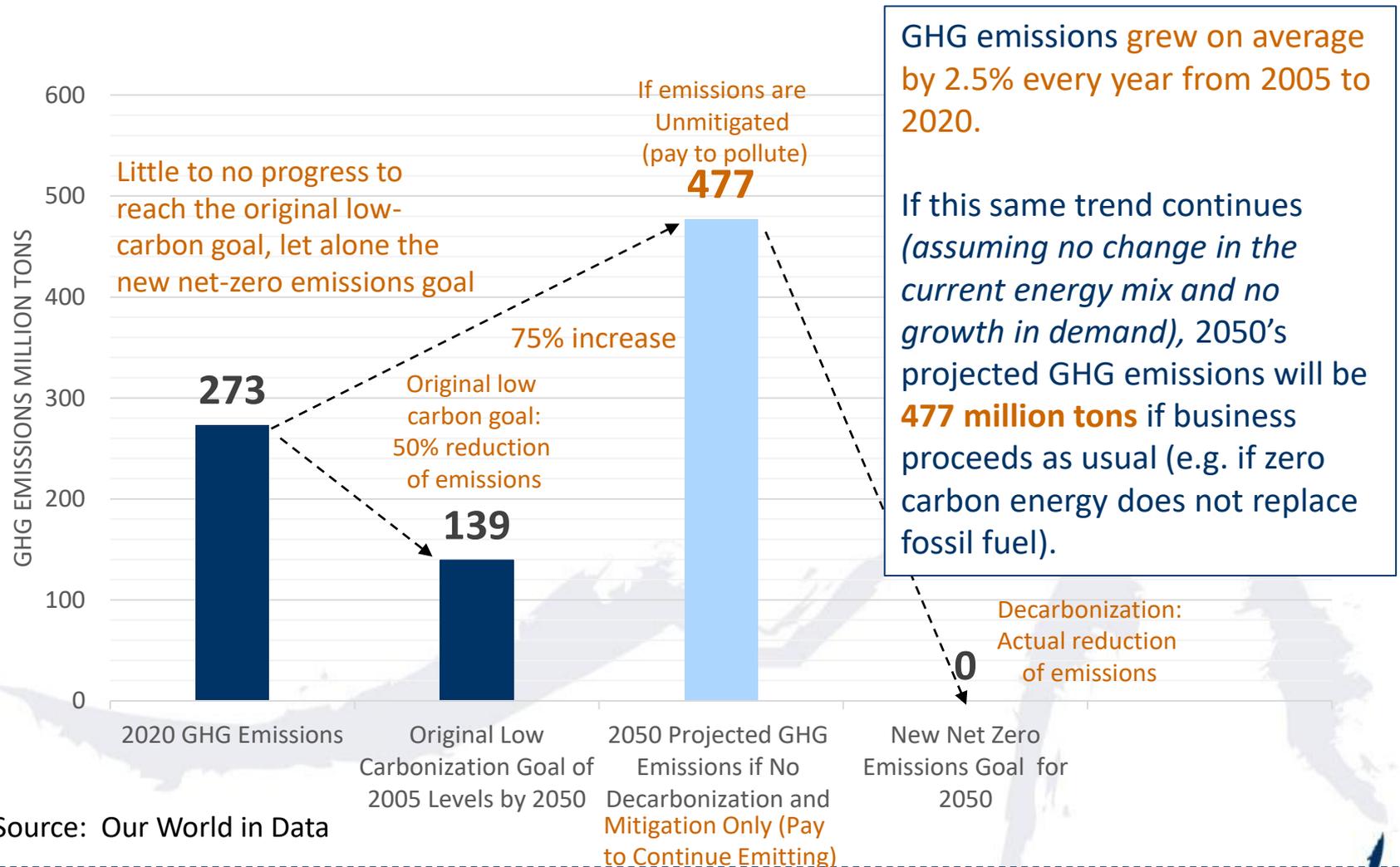
Taiwan's Original 2015 Plan (see red box) New Net Zero* Goal With No Plan



*Net Zero is defined as:

- A) Reduce GHG emissions to zero, which is **decarbonization**, OR
- B) GHG emissions are mitigated (**pay to pollute**) 1-for-1 with **offsets**, which is **not decarbonization**

Projected GHG Emissions by 2050 if No Decarbonization But Mitigation (Pay-to-Pollute) with Offsets Only





Greta Thunberg  @GretaThunberg · 23h ...

"We don't prioritize the climate today. Our goal isn't to lower emissions. Our goal is to find solutions that allow us to continue life today. Of course you can ask "Can't we have both?" But the uncomfortable truth is that we've left it too late for that."



[washingtonpost.com](https://www.washingtonpost.com)

Greta Thunberg on the state of the climate movement and the roots of...
The Swedish activist discusses being catapulted to the world stage, and how Asperger's has helped her stay so focused.

 567

 5.8K

 23.9K



Taiwan is Part of the Global Climate Problem: Inadequate Actions to Address the Lack of Supply of Carbon Free Power

Taiwan has two options:

- 1) **Actually decarbonize energy by reducing emissions to zero = replace fossil with zero carbon energy**

- 2) **Use offsets to mitigate emissions on paper to get to net zero calculation (pay to continue polluting—doesn't actually mean decarbonization)**
 - ▶ Renewable Energy Certificates

 - ▶ Carbon Credits

 - ▶ Carbon Capture and Storage

 - ▶ Forestry Conservation

LNG is Not the Answer

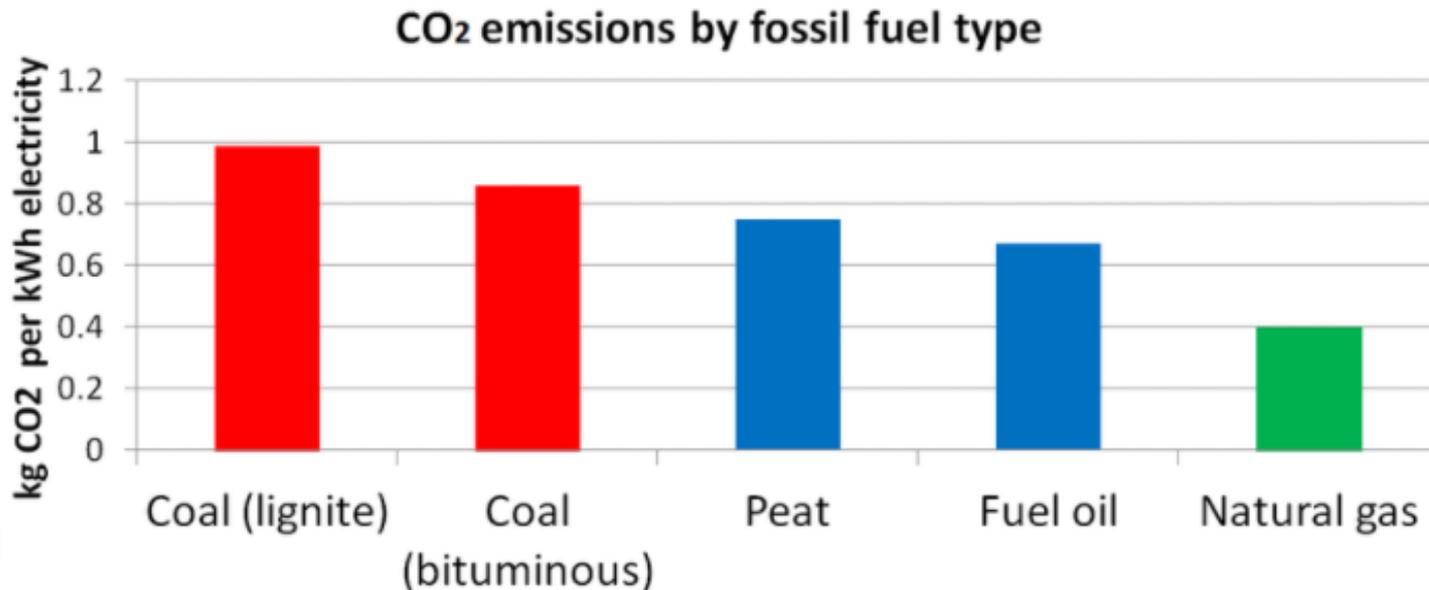
- The government's focus on **LNG** is misguided as it is **fossil fuel** and **not decarbonization**
- Renewables will fulfill 20% of capacity in a best case-scenario
- Taiwan cannot decarbonize its economy if 80% of its energy comes from fossil fuels
- Alternative carbon-free sources must be considered and implemented



Datan LNG terminal, which recently failed to pass its environmental impact assessment

LNG is Not the Answer

The current plan is to replace “dirty” fossil sources (oil/coal) with “less dirty” fossil (LNG), which still emits considerable amounts of carbon



Source: [https://www.researchgate.net/figure/Comparison-of-carbon-dioxide-CO₂-emissions-per-kWh-electricity-for-different-fossil-fuel-types-fig1_329680852](https://www.researchgate.net/figure/Comparison-of-carbon-dioxide-CO2-emissions-per-kWh-electricity-for-different-fossil-fuel-types-fig1_329680852)

Nuclear Is a Reliable Source Baseload of Carbon-Free Energy

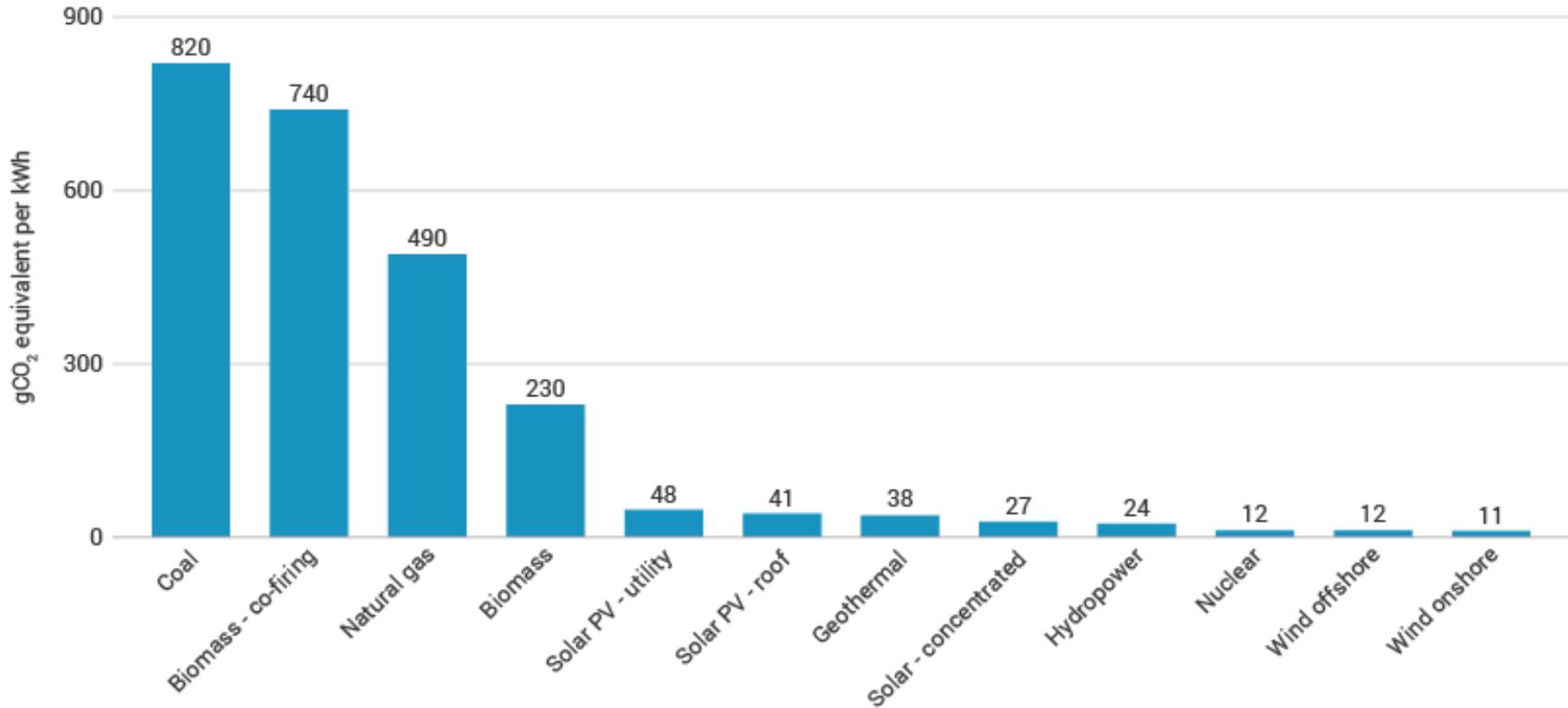
Nuclear is being added to the EU's green energy taxonomy.

Draft regulations state that nuclear power is to be considered a sustainable economic activity as long as:

- EU countries that host power stations **can safely dispose of toxic waste** and
- Meet a criteria to cause **“no significant harm”** to the **environment.**

The construction of new nuclear plants will be **recognized as green for permits granted until 2045.**

Nuclear Is a Reliable Source of Baseload Carbon-Free Energy Like Wind and Better than Solar



Average life-cycle CO₂ equivalent emissions (source: IPCC)

Source: <https://www.world-nuclear.org/information-library/energy-and-the-environment/carbon-dioxide-emissions-from-electricity.aspx>

Nuclear Is a Reliable Source of Baseload Carbon-Free Energy



Press release | 1 January 2022 | Brussels

EU Taxonomy: Commission begins expert consultations on Complementary Delegated Act covering certain nuclear and gas activities

January 2, 2022
1:46 AM CST
Last Updated 2 days ago

Commodities



EU drafts plan to label gas and nuclear investments as green

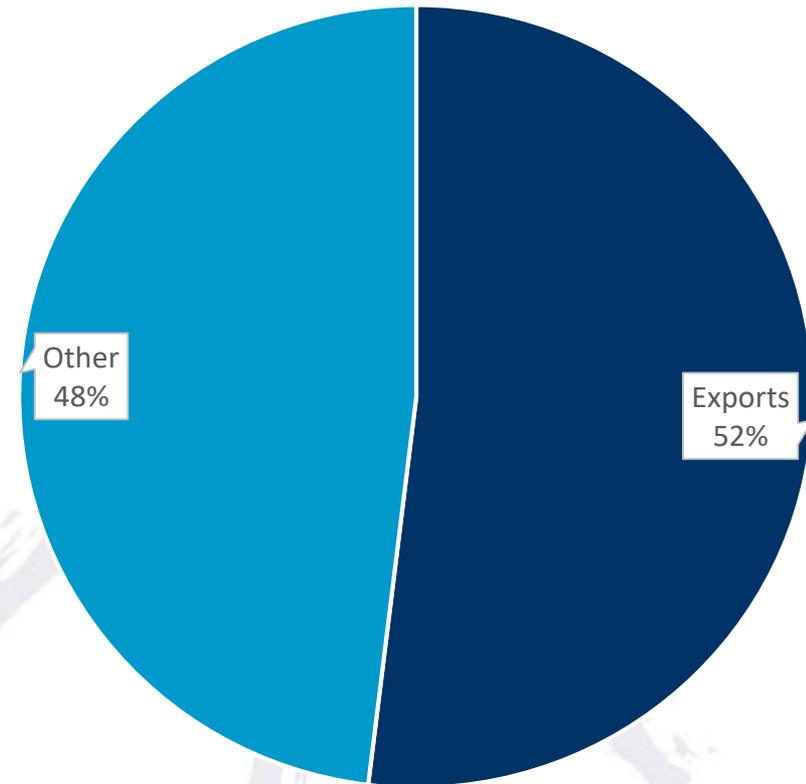
Sources: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2
<https://www.reuters.com/markets/commodities/eu-drafts-plan-label-gas-nuclear-investments-green-2022-01-01/>

Failure to Decarbonize Has Disastrous Consequences

- With governments and MNCs in developed markets demanding that supply chains reduce their carbon footprints, **Taiwan will have to decarbonize its electricity supply, or lose access to these markets**
- **Losing access to developed markets** could jeopardize Taiwanese suppliers' place in global supply chains including:
 - ▶ Computing Devices (Apple, Dell, HP, Blackberry, Amazon, Google, Lenovo, Samsung, Xiaomi, Oppo)
 - ▶ Semiconductors (Qualcomm, Broadcom, Intel)
 - ▶ Video Game Consoles (Microsoft, Sony, Nintendo, Sega)
 - ▶ Networking Equipment (Cisco, Huawei)
 - ▶ Display Manufacturers (Sony, Toshiba, Vizio)
 - ▶ EV Manufacturers (Tesla, Fisker and others)
- **Losing access to developed markets would jeopardize the viability** of some of the island's **largest electronics manufacturers**, including:
 - ▶ TSMC, Foxconn, Compal, Quanta, ASE Group, Pegatron, NVIDIA, AMD, Acer, Asus, Delta, Mediatek, Formosa Plastics and others

Over Half of Taiwan's GDP is at Risk If Electricity Supply is Not Decarbonized

- **Taiwan Cannot Ignore the Current Global Imperative for Decarbonization**
 - ▶ Major Supply Chains Demand It
 - ▶ Consumers and Governments in Developed Markets Demand It
- **If Taiwan fails to decarbonize its electricity supply, it will lose the ability to export to developed markets within a decade**
- **Taiwan Industry Supply Chains Will Migrate to Green Energy Jurisdictions to Survive (Like China)**



Over Half of Taiwan's GDP is at Risk If Electricity Supply is Not Decarbonized

- **Failure to Decarbonize Energy Will Wreak Havoc With Taiwan's Global Supply Chain**
 - **Loss of Access to Developed Markets Would Cause a Complete Societal and Economic Disaster from Which Taiwan Might Never Recover**
 - **Even if Renewable Targets are Met, How Can Taiwan Decarbonize its Economy with at least 80% of its Electricity Coming From Fossil Fuels in the Best Case Scenario?**
 - **Taiwanese Companies will Relocate to Green Power Jurisdictions (Like China)**
-

The Opportunity

- **How Can Taiwan replace 80% of its electricity generation with a source which is:**
 - ▶ Carbon-Free
 - ▶ Reliable (produces baseload power)
 - ▶ Safe
 - ▶ Affordable
 - ▶ Scalable
 - ▶ Resilient (resistant to natural disasters or armed conflict)
 - ▶ Able to produce enough residual energy to power water desalinization plants
- **This is the largest supply/demand gap opportunity for the next century in Taiwan**
- **If the green energy conundrum is not solved, Taiwan's supply chain will migrate to green energy jurisdictions (like China)**

The Opportunity

- Taiwan's installed capacity is roughly 60GW
- About 50GW (80%) is generated with fossil fuels
- If 50GW of installed capacity is replaced with carbon-free electricity, 477 million tons of CO₂ emissions* per year can be prevented

**GHG emissions grew on average by 2.5% every year from 2005 to 2020. Assuming no change in the current energy mix and no growth in demand, 2050's projected GHG emissions will be 477 million tons if business proceeds as usual (e.g. if zero carbon energy does not replace fossil fuel).*

- The buildout of 50GW of carbon-free power infrastructure is the largest financing opportunity for the private sector in this century
 - Taiwan's economy needs to be saved or the supply chain will migrate
-



For More Information

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