Taiwan's Spent Nuclear Fuel Safety Crisis: Will The Taiwan Government Provide Real Solutions to Taiwan's People/Businesses/Society?

By Nicholas V. Chen*

*Special thanks to Jose Ponce

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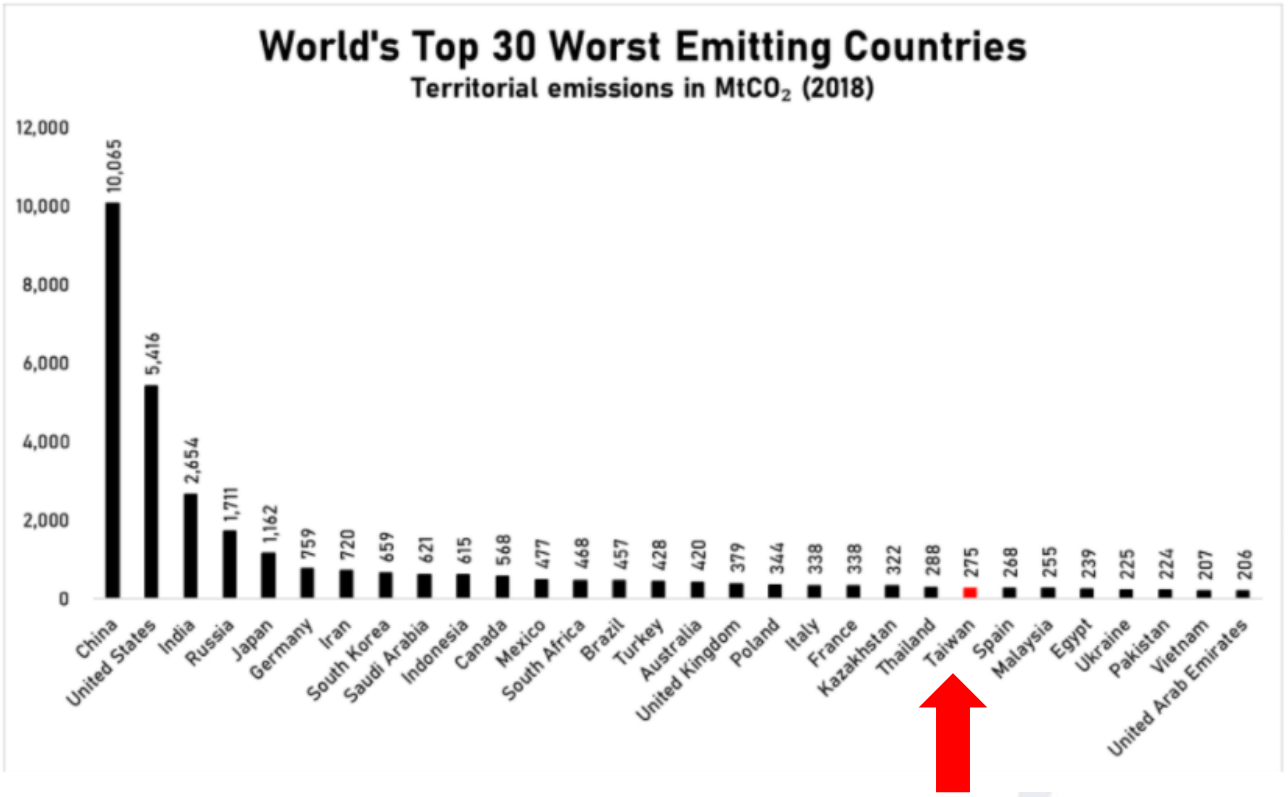
Executive Summary

1. **Has the Taiwan Government managed SNF in accordance to global SOPs for the past 40 years?:**
   - Has the Taiwan Government properly planed and executed the budget to buy dry casks and services from professionals with proven track records to comply with the worldwide SOP for spent nuclear fuel management ?
   - Has the Taiwan government bought enough dry casks to place SNF inside them? Currently SNF is in the congested reactor cores and pools and has not been removed on a regular basis in accordance with the worldwide SOP
   - This apparent management practice has caused the nuclear power plants to prematurely shut down and deprive Taiwan of 40 more years of zero-carbon energy and millions of tons of avoided CO2 emissions
2. **Has the ruling party campaigned against nuclear power in Taiwan to conceal 40 years of other apparent energy management practices that will leave the NPPs prematurely inoperable?**
3. **Are this 40 years of management practices endangering the public safety of the people of Taiwan?**
4. **The Government is in the process of shutting down Taiwan's only baseload, zero-carbon energy source as Taiwan's enterprises are facing new sustainability regulations and UN decarbonization demands jeopardizing their competitive edge and access to major carbon-conscious markets**
5. **Even if the Taiwan Government properly manages SNF in accordance to Global SOPs and keeps the existing NPPs open, it is still not enough for Taiwan to decarbonize and complete the energy transition to avoid massive migration of supply chains and the hollowing out of the economy**
6. **The catastrophic failure to replace fossil fuels with zero-carbon, scalable nuclear energy means the massive migration of supply chains out of the Taiwan, the hollowing out of the economy and a total economic, social and environmental disaster**

Taiwan is a Huge Global Emitter of GHGs

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



Source: http://www.globalcarbonatlas.org/en/CO2-emissions

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Taiwan is a Huge Global Emitter of GHGs

Rank	Country/Territory	CO_2 per capita (t)
21	South Korea	11.9
22	Taiwan	11.9
23	Libya	11.1
24	Saint Pierre & Miquelon	10.5
25	Curacao	9.7
26	Czechia	9.2
27	Anguilla	9.2
28	Iceland	9.1
29	Greenland	9.1
30	Poland	8.6

Source: https://www.visualcapitalist.com/visualizing-global-per-capita-co2-emissions/?fbclid=IwAR392aPK6gnHQ542nvrtLnMiHJct85tmlUwNG5Yz-N8deVi6AxQU04c00p8

Taiwan is a Huge Global Emitter of GHGs

- **Taiwan ranks 7th from the bottom according to the 2023 Climate Change Performance Index ("CCPI") which ranks territories based on their climate performance**
- **Taiwan scores poorly in the climate policy categories, GHG emissions, energy use, and renewable energy**

57.	△ Chinese Taipei	28.35
58.	△ Canada*	26.47
59.	▽ Russian Federation*	25.28
60.	— Korea	24.91
61.	△ Kazakhstan*	24.61
62.	△ Saudi Arabia*	22.41
63.	▽ Islamic Republic of Iran*	18.77

Source: Climate Change Performance Index https://ccpi.org/

Taiwan Cannot Achieve Decarbonization and Energy Transition without Relying on Nuclear Energy

- **The UN has stated that decarbonization and energy transition are required now to reach net-zero by 2050. All jurisdictions must peak emissions by 2025 and reduce emissions by at least 43% by 2030***
- **Why is the Taiwan government not replacing fossil fuel, (high polluting energy sources) with baseload, zero-carbon nuclear energy like the rest of the world?**
- **Decarbonization and the energy transition means the reduction of carbon emissions and the replacement of fossil fuels with zero-carbon energy sources**

Fossil Fuel Energy Sources (need to be replaced with zero-carbon):

- **Coal**
- **Oil**
- **Natural Gas (LNG)**
- **Methane**

Zero-Carbon Energy Sources (must replace fossil fuels):

- **Nuclear (Baseload and Scalable)**
- **Solar (Not Baseload)**
- **Wind (Not Baseload)**
- **Hydro (Not Possible in Taiwan)**
- **Hydrogen (Non-Existent)**

- **Why is the Taiwan government replacing baseload zero-carbon nuclear energy with non-baseload wind and solar and polluting LNG?**
- **This is NOT Decarbonization, NOT Energy Transition, NOT Zero-Emissions**
- **Taiwan needs nuclear energy to provide baseload, zero-carbon power to replace 50GW (80%) of fossil fuels and achieve net zero (2022 installed capacity, assuming no growth)**

* Source: United Nations Climate Action https://www.un.org/en/climatechange/net-zero-coalition

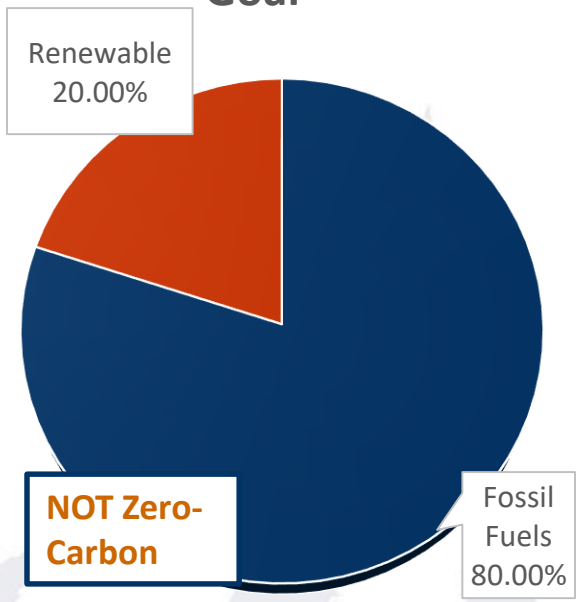
The Best the Taiwan Government Can Do is Achieve 20% Renewable Energy by 2027

- **The Best the Taiwan Government can do is Achieve 20% Renewable Energy by 2027* this is far behind the UN goal of reducing emissions at least 43% by 2030**

- **The government has not presented any verifiable, scalable options to replace 80% of fossil fuels with zero-carbon sources after 2027**
  - **No decarbonization**
  - **No reduction of emissions**
  - **NOT carbon-neutral**
  - **Fails energy transition**

- **Why is the DDP phasing out nuclear energy from the mix? Nuclear is the only scalable zero-carbon energy source and 59% of voters approved nuclear energy in the 2018 referendum**

Electricity Generation 2027 Goal



Fossil 2027	Zero-Carbon 2027
Coal: 30% LNG: 50%	Nuclear: 0% Renewable: 20%
Total: 80%	**Total: 20%**

- Source MOEA: Taiwan to reach 20% green energy target in 2026 at earliest https://www.taiwannews.com.tw/en/news/4489552

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The Best the Taiwan Government Can Do is Achieve 20% Renewable Energy by 2027

According to the UN, the World, Including Taiwan, MUST:

- Start drastically cutting emissions
- Peak GHG emissions by 2025
- Reduce GHG emissions 43% by 2030
- Reduce GHG emissions at least 84% by 2050

Climate Action Must be Taken Now:

- A major energy transition must take place immediately to halve emissions by 2030
- The Taiwan Government is failing at meeting UN GHG reduction goals, it is the 10th largest per capita GHG emitter and ranks 7th from the bottom according to the 2023 CCPI which ranks territories based on their climate performance
- Instead of actually decarbonizing and completing energy transition the Taiwan Government has been engaged in a massive greenwashing public relations campaign

Source: IPCC, 2022*: Climate Change 2022: Mitigation of Climate Change:* https://www.ipcc.ch/working-group/wg3/

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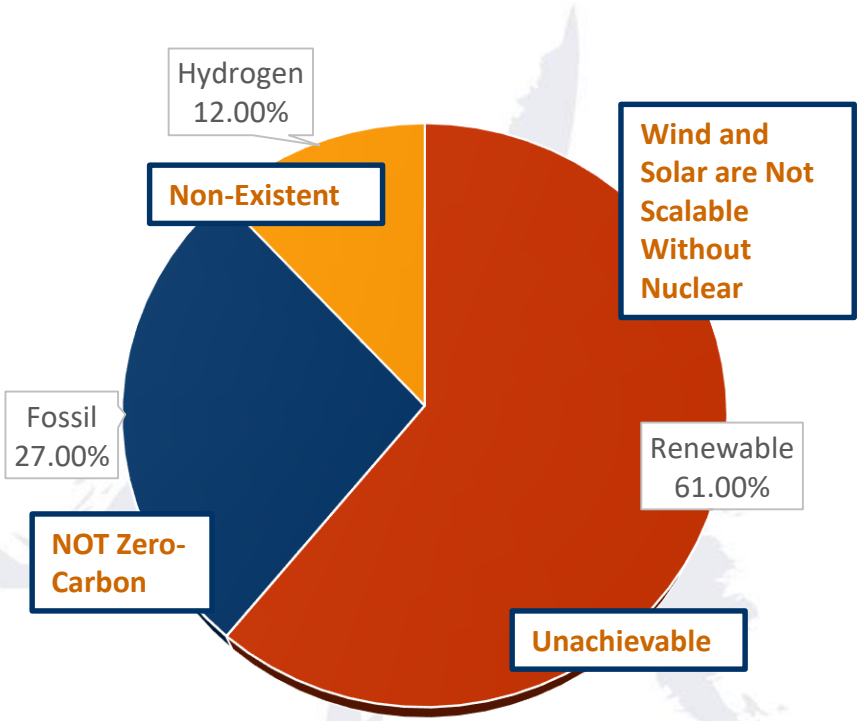
The Best the Taiwan Government Can Do is Achieve 20% Renewable Energy by 2027

Taiwan's "Carbon Neutral" Roadmap IS NOT carbon neutral

- The current Taiwan government has engaged in a greenwash campaign to pretend they are decarbonizing
- They are incredibly behind the UN goals
- 27% of fossil fuels (LNG and Coal) in the energy mix IS NOT carbon neutral
- Hydrogen technology (12%) is non-existent in Taiwan
- The Taiwan Government claims it can achieve 61% renewable energy but it is undeliverable and hallucinogenic
- Sources of renewable energy, especially new solar and offshore wind capacity, are negligible. How can there be a 1300% increase in renewable energy from the current 5%?

Electricity Generation in 2050 According to Taiwan Government's "Carbon Neutral" Roadmap



Source: Energy security must be improved
https://www.taipeitimes.com/News/editorials/archives/2022/05/04/2003777671

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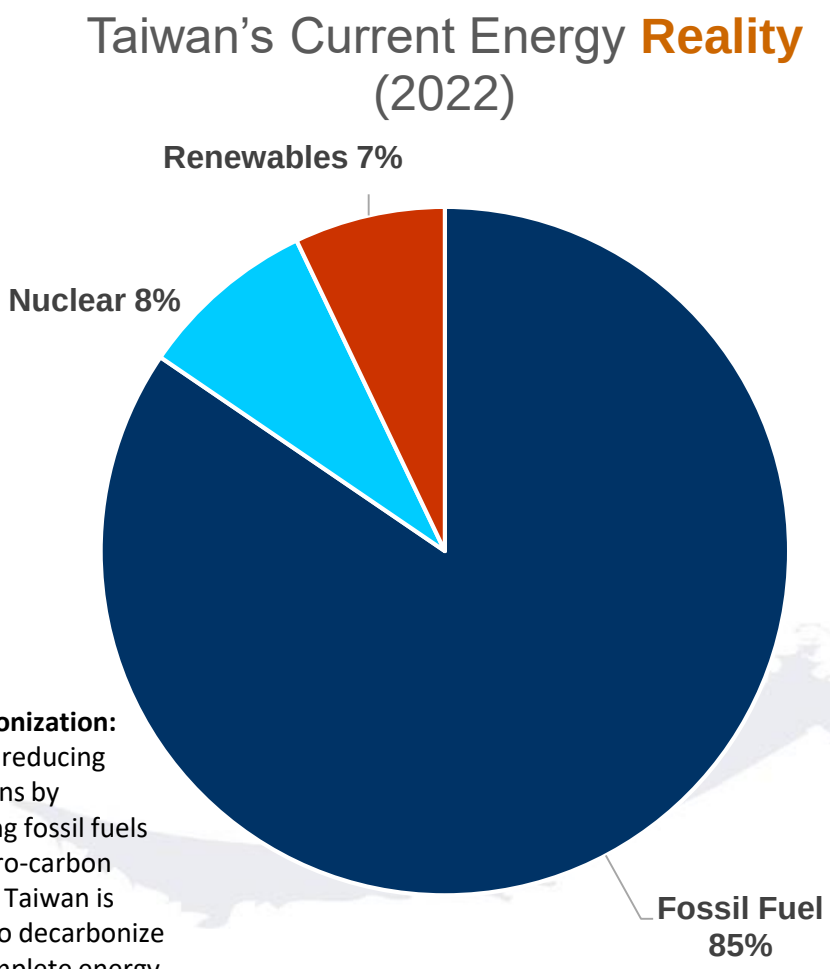
The Best the Taiwan Government Can Do is Achieve 20% Renewable Energy by 2027



Decarbonization: means: reducing emissions by replacing fossil fuels with zero-carbon energy. Taiwan is failing to decarbonize and complete energy transition

The Taiwan Government's claim that it will be "Carbon Neutral" **is a lie**

- Removing nuclear from the energy mix makes Taiwan dependent on fossil fuel imports
- Taiwan companies (and their supply chains) will lose their access to market share and global supply chains as governments and MNCs in developed markets demand reduced carbon footprints (see slide 17)
- Lack of zero-carbon energy will lead to a mass exodus of Taiwan's supply chains and a complete hollowing out of the economy
- This will result in mass unemployment, stock market collapse, loss of all international competitiveness and missed global leadership opportunity
- Not only will Taiwan suffer but this will cause a global supply chain disruption leading to a huge rise in the cost of all electronics, national security concerns and global economic slowdown

Source: Our World in Data Taiwan Energy Profile
https://ourworldindata.org/energy/country/taiwan

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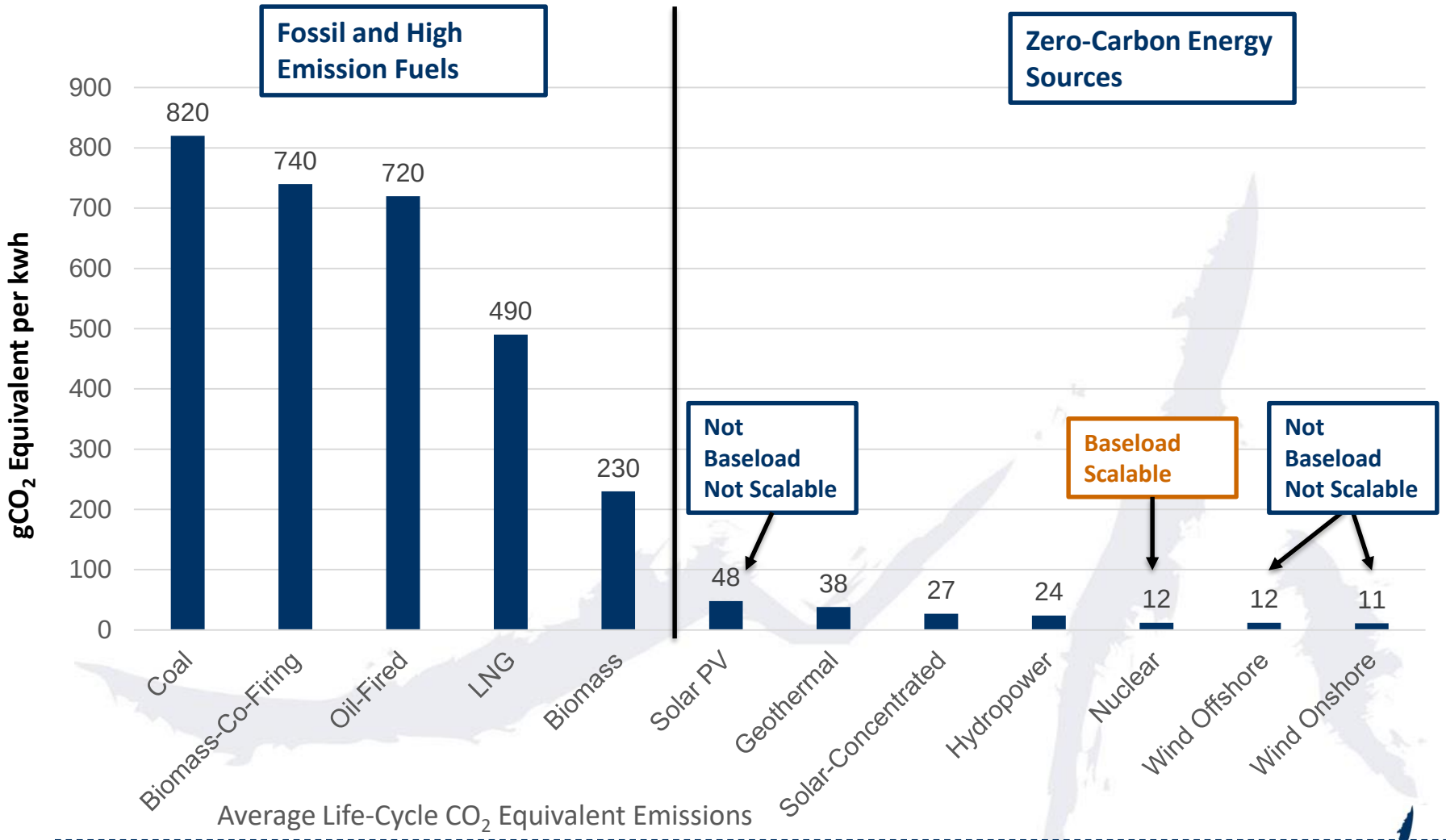
The Best the Taiwan Government Can Do is Achieve 20% Renewable Energy by 2027

Taiwan's new roadmap calls for a 60%-70% renewable energy goal by 2050

Year	Renewable Energy Generation %	% Increase from 2022
2023	5-7%	N/A
2050	70%	1300%

- If Taiwan's government cannot deliver a 200% increase to 15% and 300% increase to 20% renewable energy then:
- How can Taiwan achieve a 1300% increase in renewable energy from today's levels to meet the 2050 goal of 70%?
- How can the Taiwan government be trusted to achieve large and long-term goals when the short term goals for renewable energy have failed?
- Taiwan Government's "Carbon Neutral" Roadmap Is a Greenwashing Placebo Failure

High Emission Fossil Fuels vs Zero-Carbon Energy Sources



Source: Carbon Dioxide Emissions From Electricity https://www.world-nuclear.org/information-library/energy-and-the-environment/carbon-dioxide-emissions-from-electricity.aspx

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All of Taiwan's Companies are Part of Global Supply Chains with Increasing Sustainability Requirements

- **All of Taiwan's enterprises are in the global supply chains and are racing to comply with a wave of new sustainability regulations and requirements. These include:**
  - New 2023-year end US Securities & Exchange Commission ESG Rules to Enhance and Standardize Climate-Related Disclosures,
  - EU Carbon Border Adjustment Mechanism (border carbon taxes coming into force by January 1, 2026),
  - China's new Emissions Trading Scheme ("ETS") which will expand coverage to different industrial sectors in the next 5 years,
  - Multiple global supply chains' net-zero emissions requirements by 2030-2040 (e.g. Apple, Amazon, Meta and Google)
  - RE100 commitments by various MNC supply chains by 2050

- **Individually and collectively, these sustainability requirements pose an existential challenge to Taiwan's enterprises, as they struggle due to the government's failure to provide zero-carbon energy to replace 80% fossil fuels**
- **Taiwan companies will mass migrate to relocate their cutting-edge global manufacturing supply chains away from Taiwan to zero-carbon jurisdictions to preserve their ability to sustainably compete and to export to the world's largest (zero-carbon energy requiring) consumer markets.**
- **Taiwan saw a 170% rise in outbound investment flows from 2023-2024 as supply chains continue to leave**

Source: Approved H1 outbound investments outpace entire 2023, led by TSMC
https://focustaiwan.tw/business/202407160005

The World is Rapidly Transitioning to Nuclear Energy to Decarbonize. Taiwan is the Only Territory Shutting Down Nuclear Energy

- **52+ countries currently expanding nuclear capacity, considering, planning or starting nuclear power programs include:**

- USA
- China
- South Korea
- Japan
- Germany
- India
- Turkey
- UK
- UAE
- Bangladesh
- Romania
- Ukraine
- Slovakia
- France
- Russia
- Brazil
- Belarus
- Iran
- Argentina
- Albania
- Croatia
- Estonia
- Israel
- Jordan
- Egypt
- Kuwait
- Morocco
- Tunisia
- Sri Lanka
- Kazakhstan
- Pakistan
- Belgium
- Latvia
- Armenia
- Bulgaria
- Canada
- Czech Republic
- Finland
- France
- Hungary
- Mexico
- Netherlands
- Slovenia
- South Africa
- Spain
- Sweden
- Switzerland
- Italy
- Mongolia
- Moldova
- Ghana
- Bulgaria

Source: https://world-nuclear.org/information-library/country-profiles/others/emerging-nuclear-energy-countries.aspx

The World is Rapidly Transitioning to Nuclear Energy to Decarbonize. Taiwan is the Only Territory Shutting Down Nuclear Energy

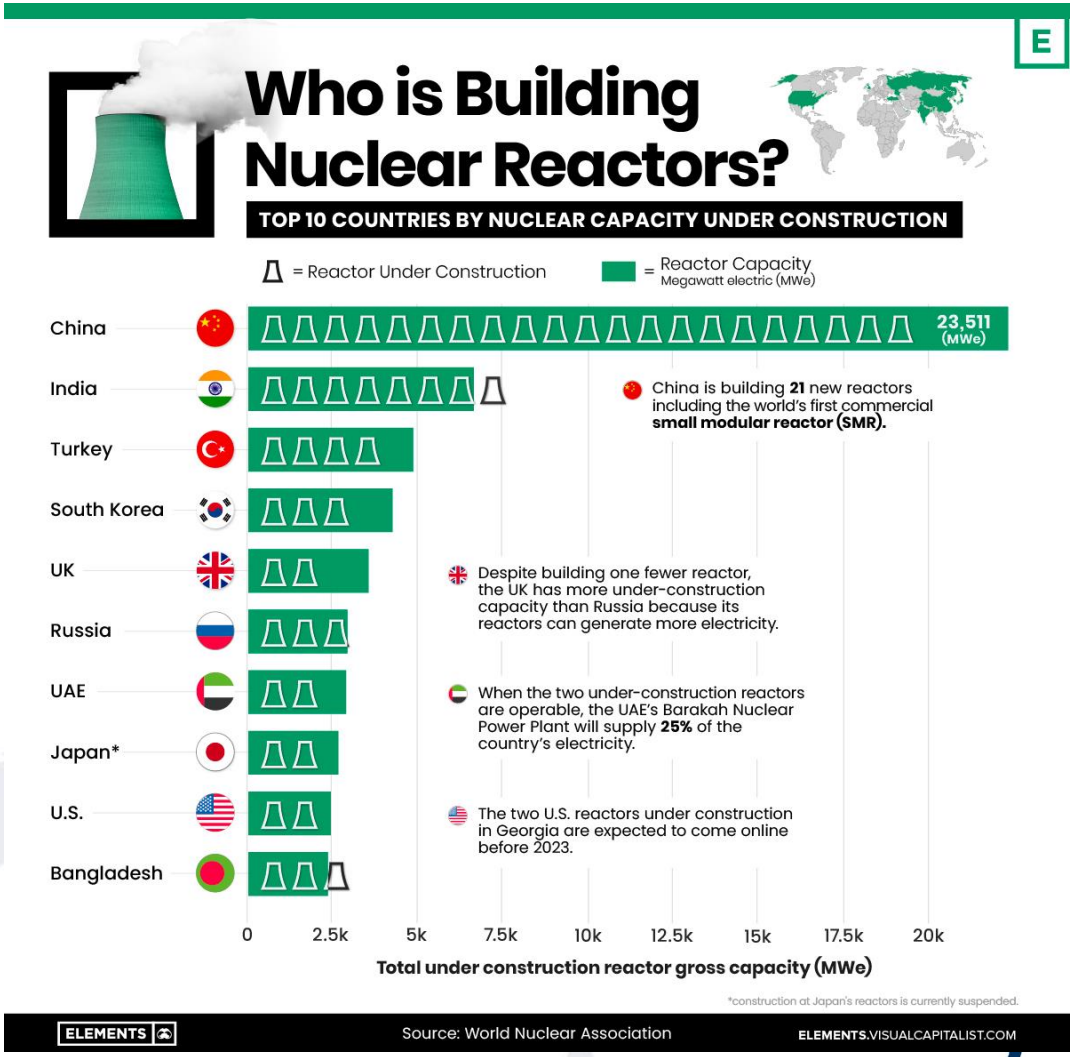
- There are roughly 440 nuclear reactors operating worldwide, generating around 10% of the world's electricity annually
- 59 reactors under construction worldwide with a combined capacity of over 65,000MWe
- China has 23 nuclear reactors under construction but has already planned and budgeted to build a total of 150 nuclear power plants and will achieve 86% zero-carbon by 2035 making it the green factory floor of the world
- Many countries including Japan and South Korea have reversed their nuclear energy policies and are expanding nuclear energy generation
- Why is Taiwan the only jurisdiction that plans to phase out nuclear energy?
- In order to meet UN decarbonization and energy transition goals, Taiwan must replace 50GW of fossil fuels annually with zero-carbon energy using nuclear power (2022 levels assuming no growth) (see slide 69 for next 40 years need)

Source: Nuclear Reactors Under Construction Globally https://elements.visualcapitalist.com/nuclear-reactors-under-construction/

Source: China Continues Rapid Growth of Nuclear Power Capacity https://www.eia.gov/todayinenergy/detail.php?id=61927

The World is Rapidly Transitioning to Nuclear Energy to Decarbonize. Taiwan is the Only Territory Shutting Down Nuclear Energy

- Why is Taiwan going against the rest of the world and phasing out nuclear energy that is zero-carbon baseload power? 52+ countries have chosen nuclear power unlike Taiwan.
- Nuclear energy is the global solution for decarbonization.
- Nuclear energy is Taiwan's only option to successfully deliver zero-carbon energy to all industries and end-users.
- During COP28 in December 2023, 22 countries* pledged to triple nuclear energy capacity by 2050.



Source: Visual Capitalist Reactors Under Construction https://elements.visualcapitalist.com/nuclear-reactors-under-construction/
Source: 20-plus countries pledge to triple the world's nuclear energy by 2050 https://www.canarymedia.com/articles/nuclear/20-plus-countries-pledge-to-triple-the-worlds-nuclear-energy-by-2050#:~:text=COP28%20might%20be%20remembered,the%20world's%20annual%20climate%20summit.

*USA, Bulgaria, Canada, Czech Republic, Finland, France, Ghana, Hungary, Japan, South Korea, Moldova, Mongolia, Morocco, Netherlands, Poland, Romania, Slovakia, Slovenia, Sweden, Ukraine, UAE.

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59% of Citizens Voted in Favor of Keeping Nuclear Power Plants Open Beyond 2025

- **DPP's policy to oppose nuclear energy is anti-democratic, unscientific, anti-progress and anti-business. It is economic and environmental suicide for Taiwan and its supply chains**
- **Despite the results of the November 2018 referendum, showing 59% of citizens voted against the government's policy to phase out the use of nuclear energy by 2025**
  - **The ruling party has been engaged in a anti-nuclear campaign, trying to phase it out in Taiwan.**
- **Solving the SNF crisis in Taiwan is good for the economy, for society , for public safety and for the environment**
- **Why is the DPP, the "champion of the referendum", going against the will of the people?**
  - Against science?
  - Against the environment?
  - Against the economy?
  - Against Business?
  - Against public safety?
- **Is the Taiwan Government perpetrating a "fraud" by unilaterally claiming Taiwan is a "nuclear free homeland" when 59% of Taiwanese voted to keep NPPs open beyond 2025? How can Taiwan be nuclear free when the NPPs are not decommissioned which takes around 30 more years?**

59% of Citizens Voted in Favor of Keeping Nuclear Power Plants Open Beyond 2025

- **The Taiwan government has the obligation to safeguard the public safety of over 23 million Taiwanese**

- **The Taiwan government has an obligation to properly manage SNF and to provide zero-carbon energy to enterprises and the population at large so they don't have to mass migrate and hollow out Taiwan's economy**

- **Shutting down the nuclear power plants Does Not solve the SNF storage issue and risks caused by 40 years of apparent departure from global best practices SNF management SOP (See slides 31 and 39)**

59% of Citizens Voted in Favor of Keeping Nuclear Power Plants Open Beyond 2025

- **The Taiwan Government must take responsibility to plan, budget and implement a real plan to solve the SNF constipation by:**
  - Buying dry casks to place SNF inside them currently stored in the reactor cores and pools
  - Placing new fuel in the reactor cores to continue operation to continue to supply zero-carbon energy for 40 more years (see benefits on slide 58-62)
  - Taiwan needs to retain a professional nuclear engineering company who have a proven track records of racking spent fuel pools, un-racking them and loading SNF into dry casks as well as global experience, not local amateurs who have never done it before and might have conflicts of interest with Taipower and the local regulators and that don't modify existing, proven and licensed technology
- **Failure to remove the SNF from cores and pools prevents Taiwan from continuing to operate its baseload, zero-carbon energy nuclear power plants for 40 more years**

Introduction to Taiwan's NPPs

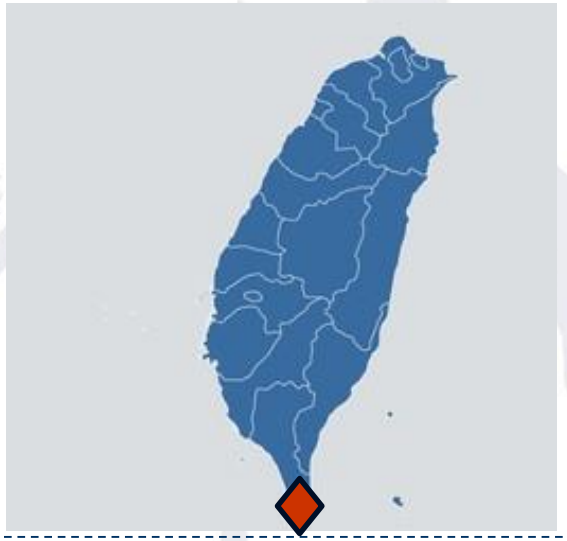
- **Chinshan ("NPP1") (Shutdown)**
  - Date of Commercial Operation: 1977 and 1978 (reactor 1 and reactor 2)
  - Generation Capacity: 1,272 MW
  - Shutdown in December 2018 and July 2019
  - Other Specifications:
    - 28 Km from Taipei
    - Two General Electric ("GE") (USA) Boiling Water Reactor -4
- **Not Decommissioned which requires:**
  - (i) Shut Down
  - (ii) Removal of Fuel
  - (iii) Restore Site to Original Condition
  - Decommissioning Takes on Average Around 30 Years

Introduction to Taiwan's NPPs

- **Kuosheng ("NPP2") (Shutdown)**
  - Date of Commercial Operation: 1981 and 1982 (reactor 1 and reactor 2)
  - Generation Capacity: 1,970 MW
  - Shutdown in December 2021 and March 2023
  - Other Specifications:
    - 22 Km from Taipei
    - Two GE (USA) Boiling Water Reactor-6
- **Not Decommissioned which requires:**
  - (i) Shut Down
  - (ii) Removal of Fuel
  - (iii) Restore Site to Original Condition
  - Decommissioning Takes on Average Around 30 Years

Introduction to Taiwan's NPPs

- **Maanshan ("NPP3") (Only one left in operation)**
  - Date of Commercial Operation: 1984 and 1985 (reactor 1 and reactor 2)
  - Generation Capacity: 1,902 MW
  - Projected Shutdown Date: July 2024 and May 2025
  - Other Specifications:
    - Located at the southern tip of Taiwan
    - Two Westinghouse (USA) 3-Loop Pressurized Water Reactors
- **Not Decommissioned which requires:**
  - (i) Shut Down
  - (ii) Removal of Fuel
  - (iii) Restore Site to Original Condition
  - Decommissioning Takes on Average Around 30 Years



Introduction to Taiwan's NPPs

- **Lungmen ("NPP4") (Never went into operation)**
  - Deferred
  - Generation Capacity: 2,700 MW
  - Other Specifications:
    - 40 Km from Taipei
    - Two GE Advanced Water Boiling Reactors
- **Contracted Companies**
  - **GE**: Reactors and Steam Generators
  - **Mitsubishi Heavy Industries**: Steam Generators
  - **SA Belgatom and Ebasco**: Engineering and Evaluation Services
  - **Stone and Webster**: Architect Engineer
- **USD16.3 billion dollars in expenses with zero revenue**

Only One Out of 4 Nuclear Power Plants in Taiwan is Currently Operational

- Chinshan (NPP1)'s first and second reactors were shutdown in December 2018 and July 2019, respectively (Not Decommissioned)
- Kuosheng (NPP2)'s first and second reactors were shutdown in June 2021 and March 2023, respectively (Not Decommissioned)
- Maanshan (NPP3) is the only plant still running at full capacity
- During the past 40 years, Taiwan's government has failed to properly manage all the spent fuel produced by the 3 NPPs in accordance with worldwide established SOP
- Instead of buying dry casks to store the SNF currently stored in the reactor cores and spent fuel pools, the government is saying it will decommission the NPPs to cover up 40 years of departure from global SOP in handling and storing SNF
- By failing to manage SNF in accordance with global SOP they are depriving Taiwan of 40 more years of zero-carbon energy and preventing Taiwan from achieving energy transition and decarbonization (see slide 59-63 for benefits)

Definitions

Nuclear Power Plants ("NPPs"): a type of power plant that uses nuclear fission in order to generate electricity.

Nuclear Fuel: a substance that will sustain a fission chain reaction so that it can be used as a source of nuclear energy.

Spent Nuclear Fuel ("SNF"): nuclear fuel that is withdrawn from a nuclear reactor following irradiation and is no longer useful in generating energy. Normally SNF is transferred to a spent fuel pool where it remains for 7-10 years and then transferred to dry casks for above ground storage removal and finally it is placed in a permanent storage facility

Spent Fuel Pool ("SFP"): are water-filled storage pools for spent fuel from nuclear reactors. They are typically 40 or more feet deep and equipped with storage racks designed to hold fuel assemblies removed from reactors. Spent fuel is placed in the pools to cool for 7-10 years.

Definitions

Dry Cask Storage: are steel cylinders surrounded by concrete that are either welded or bolted closed. The fuel rods inside are surrounded by inert gas. These are used post SFP stage to store spent fuel safely above ground or used to transport spent fuel to permanent storage facilities outside Taiwan. These are specialized and licensed and cannot be arbitrarily modified by amateurs or those who are not globally experienced on dry cask manufacturing, un-racking, loading and storage.

Permanent Storage: is a secure and specially designed facility located beneath the Earth's surface. It utilizes geological barriers and engineered containment systems to prevent the release of harmful radiation and protect the environment and public health for an extended period of time. These specialized facilities exist or are currently being built in France, Germany, Finland, Sweden, Switzerland, China, South Korea and the US. Taiwan cannot be the permanent storage site because it is fully faulted and lacks the right geological (bentonite clay) conditions. Claims that Taiwan can be a permanent storage site are a scientific falsehood and irresponsible, if not negligent.

Full Core Offload ("FCO"): the act of removing all nuclear fuel from the reactor core and placing it in the SFP.

Re-Racking: the practice of replacing original storage racks in existing spent fuel pools with higher-density storage racks to store more spent fuel. Un-racking and removing fuel from pools is best performed by the company that originally did the re-racking. Taiwan needs to retain a professional nuclear engineering company who have a proven track record of re-racking, un-racking them and loading SNF into dry casks as well as global experience, not local amateurs who have never done it before and might have conflicts of interest

Definitions

Decommissioning: the process by which nuclear power plants are retired from service and terminate their operating licenses, there are 3 phases to decommissioning: (i) shutdown, (ii) removal of fuel, and (iii) restoration of site to original condition.

- Media and politicians erroneously say that 2 of Taiwan's NPPs have been decommissioned. This is incorrect. The plants have shut down (Phase 1 only) and are not producing energy.
- SNF remains in the reactor cores because the spent fuel pools are full (Phase 2 is not complete) as dry casks were not purchased and systematically loaded for 40 years in accordance with international SOPs and best practices.
- The sites of the NPPs have not been restored to their original condition (Phase 3 is not complete).
- The decommissioning process takes on average 30 years. Thus claiming that Taiwan is a "nuclear free homeland" is completely misleading and false.
- NPP1 and NPP2 have not been decommissioned.

Taiwan is not a "nuclear free homeland" because it has not completed decommissioning of any of the nuclear power plants and SNF is still inside the power plants

Any statements claiming that Taiwan is a "nuclear free homeland" are false and irresponsible

Definitions

Taiwan's SNF Management (Constipation): The Taiwan Government appears to have failed to plan, budget and carry out normal, systematic removal of SNF from Taiwan's nuclear power plants and appears to have failed to follow the established worldwide SOP for 40 years. The Taiwan Government has still not taken any responsibility for the timely and proper disposal of it's spent fuel.

1. The Taiwan Government has not purchased dry casks to (i) store the 40 years of accumulated SNF currently fully constipating the reactor and the spent fuel pools (the pools are at capacity). Un-racking of spent fuel pools and loading SNF into dry casks has not been systematically carried out by qualified professionals
2. Because the spent fuel pools are full, fuel in the reactor cores cannot be transferred to the spent fuel pools
3. Because the cores are full, new fuel cannot be placed in to continue operation and fuel cannot be removed to begin decommissioning because there are no dry casks

Taiwan needs to retain a professional nuclear engineering company who has a proven track records of racking spent fuel pools, un-racking them and loading SNF into dry casks as well as global experience, not local amateurs who have never done it before and might have conflicts of interest with Taipower and the local regulators and that don't modify existing, proven and licensed technology

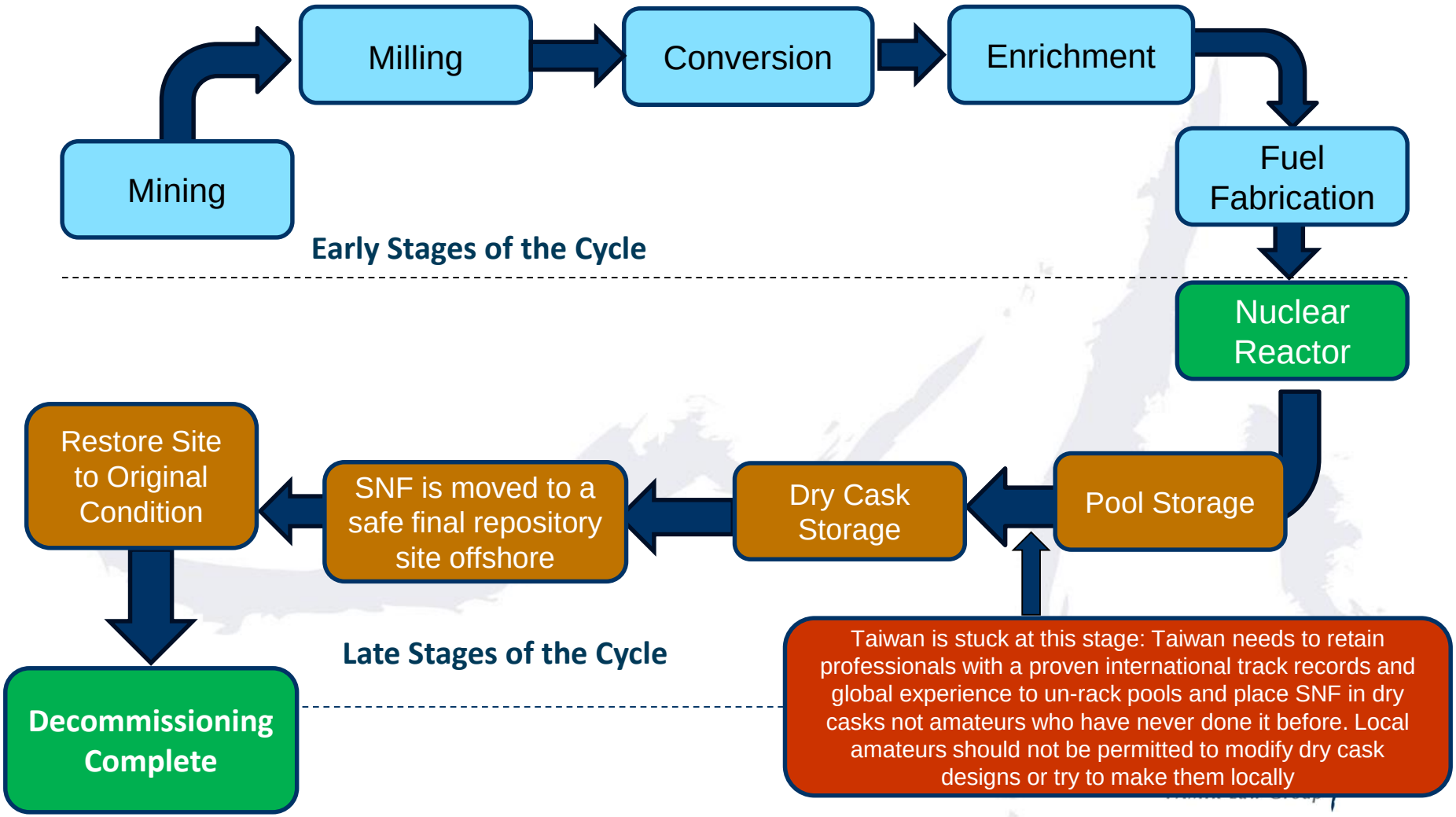
The current Taiwan Government is wasting 40 years of zero-carbon energy because the NPPs have been constipated after only reaching half of their lifespan

Any statements claiming that any of Taiwan's nuclear power plants have been decommissioned and that Taiwan is a "nuclear free homeland" are a lie and irresponsible and misleading

The Taiwan Government has apparently poorly managed the timely and safe removal of SNF from pools to dry casks as per the global SOP. The current Taiwan Government's misguided policy to shut down nuclear energy is to conceal the fact that apparent SNF management has left the plants constipated and inoperable.

Nuclear Fuel Cycle Explained

Nuclear Fuel Cycle:



Spent Nuclear Fuel has Remained in Taiwan for 40 Years

- **Nuclear energy in Taiwan was first developed in 1956, under Chiang Kai-Shek with the Institute for Nuclear Energy Research (INER)**
  - An ambitious program was initiated for the procurement and operation of nuclear power facilities
- **With China having its first nuclear test in 1964, Taiwan launched the Hsinchu Project to try to create weapons disguised as nuclear energy program**
  - The CIA became concerned about the weaponization developments in Taiwan and stopped the project in the late 1980's
- **After Taiwan began commercially operating NPPs, the US proposed a deal to transfer the SNF back to the US, but the ROC to date has not negotiated to send SNF back to the US.**

Normal Practice is to Have a Spent Fuel Offtake Agreement

- **Steps the Taiwan Government must follow for managing SNF:**
  - Retain a professional, international nuclear engineering company with proven track record and experience with SNF management not local amateurs with possible conflicts of interests and no global experience un-racking or loading dry casks with SNF
  - Un-rack the spent fuel pools
  - Place SNF inside dry casks and store them above ground medium term
  - Final underground storage in Taiwan is not possible because Taiwan is fully faulted and lacks bentonite clay to construct a final depository site (see slide 53)
  - Saying Taiwan can construct a final depository site to store SNF permanently is completely irresponsible, if not willfully negligent. This conduct could be viewed as unprofessional
  - Taiwan must eventually move its SNF to a final depository site offshore

Normal Practice is to Have a Spent Fuel Offtake Agreement

Taiwan can send the SNF back to the US (or to a third party only with written permission from the US)

Move the SNF offshore through existing agreements:

- **The** *Agreement for Cooperation Between US and ROC (present day: TECRO-AIT) Concerning Peaceful Uses of Nuclear Energy* (1974) **outlines both nations' obligations and cooperation on nuclear safety, security, safeguards, nonproliferation, and civil applications**

  - Article 5.3 of the Agreement states: "In order to facilitate the management of spent fuel…pursuant to this Agreement may be transferred to a **third party as agreed by the Parties**, or, if AIT agrees and designates a storage or disposition option, to the territory of the authorities represented by AIT. In the event of transfer to the territory of the authorities represented by AIT, the Parties shall make appropriate implementing arrangements".

A diplomatic cable sent from the US to the ROC in 1977 stated: "*All spent [irradiated] fuel from existing and future reactors located in the ROC would be disposed of under conditions mutually acceptable to our two governments*."

- This agreement prevents the ROC from reprocessing and/or weaponizing SNF and US Government expects SNF to be sent back to the US for safe disposal
- Despite this 40 year old agreement, the Taiwan Government has still not taken any responsibility for the timely and proper disposal of it's spent fuel.
- The **SNF cannot be stored in Taiwan permanently** or reprocessed
- This is a ticking time bomb

Agreement for Cooperation Between TECRO-AIT Concerning Peaceful Uses of Nuclear Energy: *https://www.aec.gov.tw/english/Administration-Regulations/Taiwan-U.S.-79.html*

Normal Practice is to Have a Spent Fuel Offtake Agreement

US Nuclear Cooperation Agreement Criteria with Other Jurisdictions:

- **Section 123a of the Atomic Energy Act lists criteria that a nuclear cooperation agreement with a non-nuclear weapon state must meet unless the President determines an exemption is necessary. These include:**
  - "nothing transferred is used for any nuclear explosive device or for any other military purpose**; the United States has the right to demand the return of transferred nuclear materials and equipment**, as well as any special nuclear material produced through their use, if the cooperating state detonates a nuclear explosive device or terminates or abrogates an IAEA safeguards agreement;"
  - "there is no retransfer of material or classified data without U.S. consent;"
  - "physical security of nuclear material is maintained;"
  - "there is no enrichment or reprocessing by the recipient state of transferred nuclear material or nuclear material produced with materials or facilities transferred pursuant to the agreement without prior approval;"
  - "storage for transferred plutonium and highly enriched uranium is approved in advance by the United States; and any material or facility produced or constructed through use of special nuclear technology transferred under the cooperation agreement is subject to all of the above requirements."

Source: Nuclear Energy Cooperation with Foreign Countries: https://crsreports.congress.gov/product/pdf/R/R41910

Taiwan Has Over 4000 Metric Tons of Spent Nuclear Fuel Sitting Inside Reactors or in SFPs

- **Reactor cores and spent fuel pools are stuffed (constipated)**
- **This is because of the Taiwan Government's 40 years of management not in accordance with global SOPs**

Unit		Year of Commercial Operation	Capacity in Pool (Assemblies)	Storage Inventory in Pool (Assemblies)	Assemblies in Reactor Cores
Chinshan (NPP1)	#1	1978	3,083	**3,074**	408
	#2	1979	3,083	**3,076**	408
Kuosheng (NPP2)	#1	1981	4,838	**4,808**	624
	#2	1983	4,838	**4,812**	624
Manshaan (NPP3)	#1	1984	2,160	**1,653**	157
	#2	1985	2,160	**1,657**	157
Total (August 2022)			20,162	**19,080**	2,379

This Equates to Around 4950 Metric Tons of Spent Nuclear Fuel

Source: https://www.aec.gov.tw/english/Radioactive-Waste-Management/Spent-Fuel-Management-148.html
Source: Proceedings of the 15th International Symposium on the Packaging and Transportation of Radioactive Materials PATRAM 2007 October 21-26, 2007, Miami, Florida, USA

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Does 40 Years of Taiwan Government Management Raise Risks to the Public Safety of the People of Taiwan?

- **Taiwan's extreme high density storage of spent nuclear fuel is due to the Taiwan Government apparently not following the global SOP for SNF management is high risk and can lead to serious accidents:**
  - Public Safety Risks Related to Re-Racking
  - Public Safety Risks Related to Earthquakes
  - Public Safety Risks Related to Tsunamis
  - Public Safety Risks Related to Volcanic Eruptions
  - Public Safety Risks Related to Radiation Spread in Case of a Serious Accident
  - Public Safety Risks and Threats to the Asia Pacific Region and the World
- **40 years of Taiwan Government apparently not following the global SOP for SNF management risks public safety of the people of Taiwan**

Public Safety Risks Related to Re-Racking

- **Risks Related to Re-Racking**

  - The Union of Concerned Scientists (UCSUSA) states a malfunction, natural disaster, or terrorist attack can lead to a loss of water in the re-racked pools can lead to a higher release of radioactivity

  - Boiling water reactor pools like the ones at NPP 1 and 2 lie outside the primary containment dome

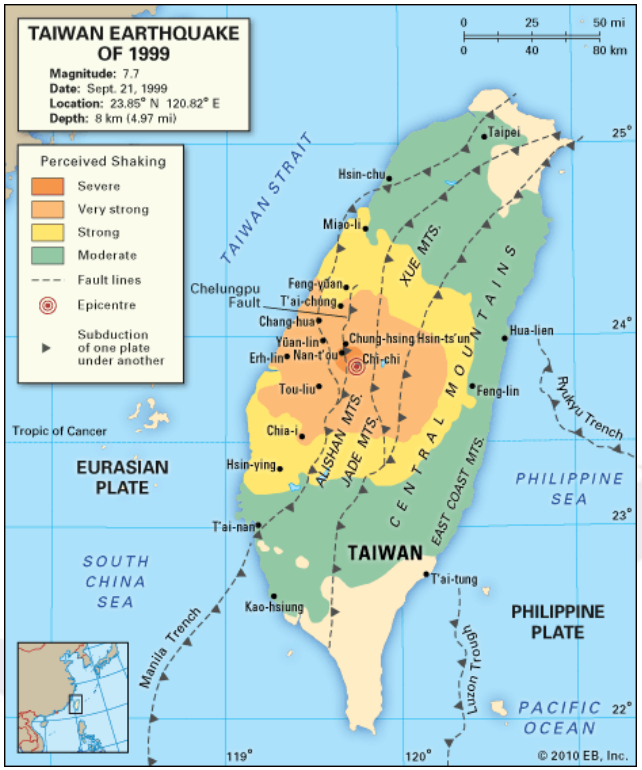
  - Radioactive releases to the environment are more dangerous due to a lack of extra shielding and a higher storage density means larger amounts of radioactivity release in the case of an accident

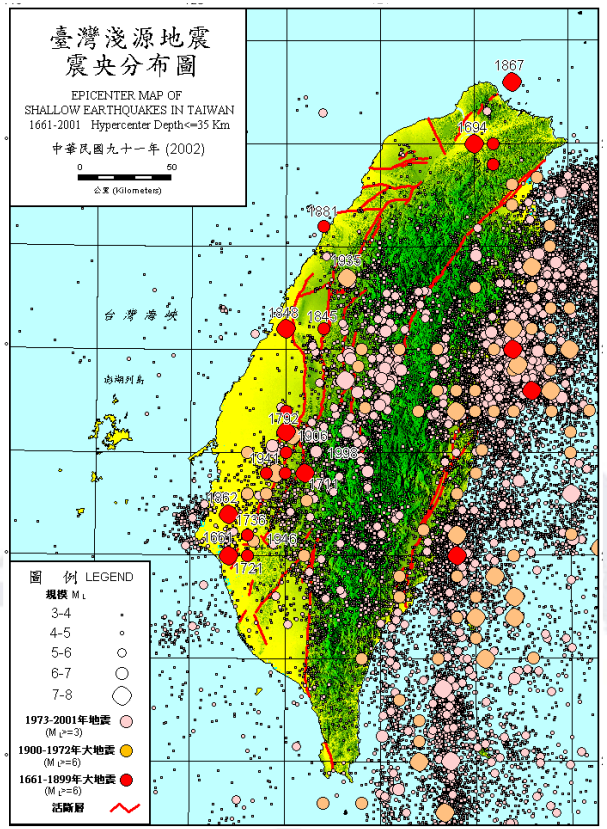
  - Taiwan needs professional, international nuclear energy experts to un-rack the pools and load SNF into dry casks not local amateurs with possible conflicts of interests deciding they are qualified to middy dry cask designs

[5] https://www.ucsusa.org/resources/safer-storage-spent-nuclear-fuel

Taiwan is Prone to Earthquakes and Makes the Overstuffed Pools More Vulnerable

- Taiwan sits on the Ring of Fire and is incredibly prone to strong earthquakes that can cause damage similar to Fukushima
- The map shows the location of shallow earthquakes in and around Taiwan in past





Earthquake Hazard Map of Taiwan

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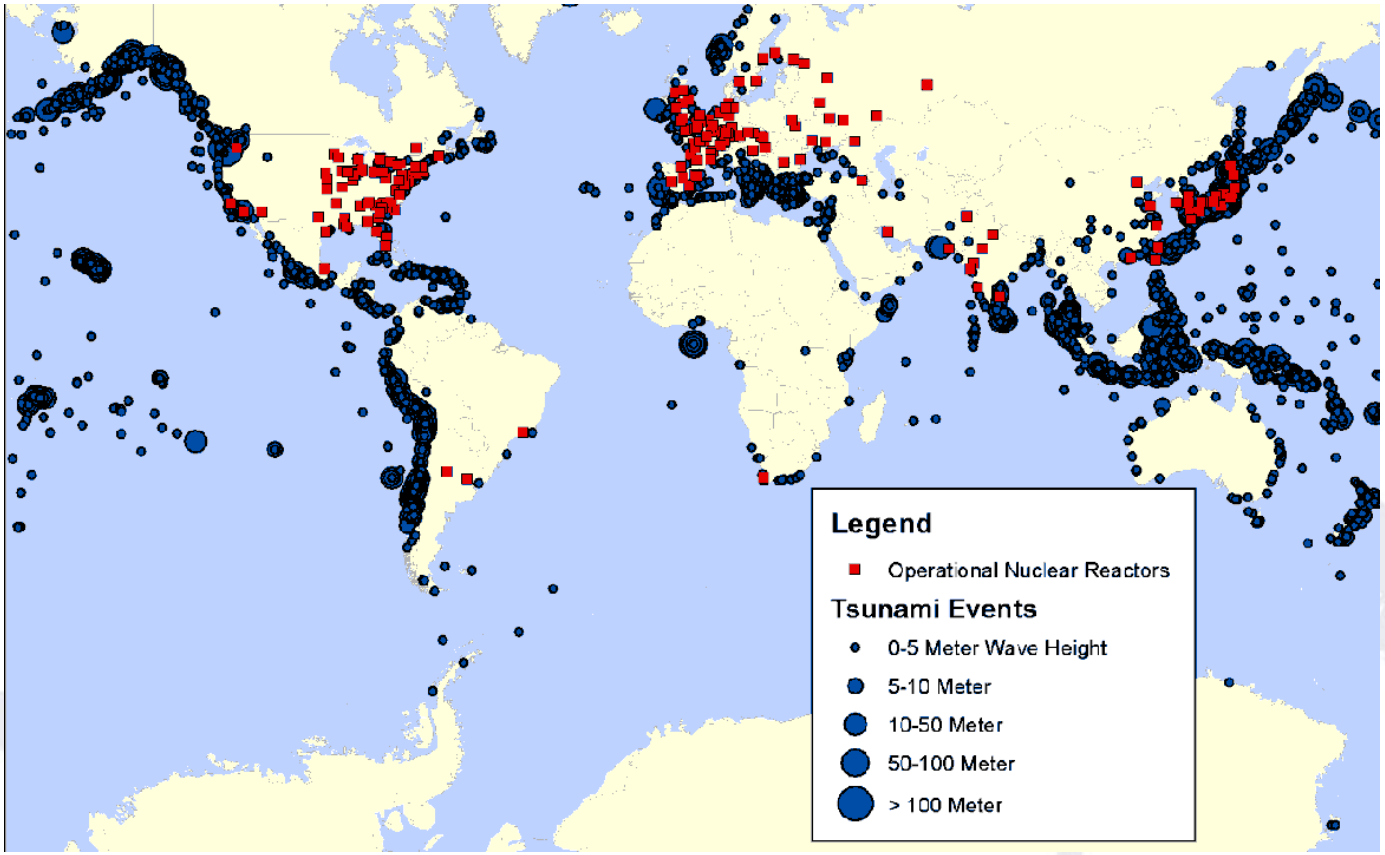
Tsunami Risks Around Taiwan are a Great Danger for Overstuffed Pools

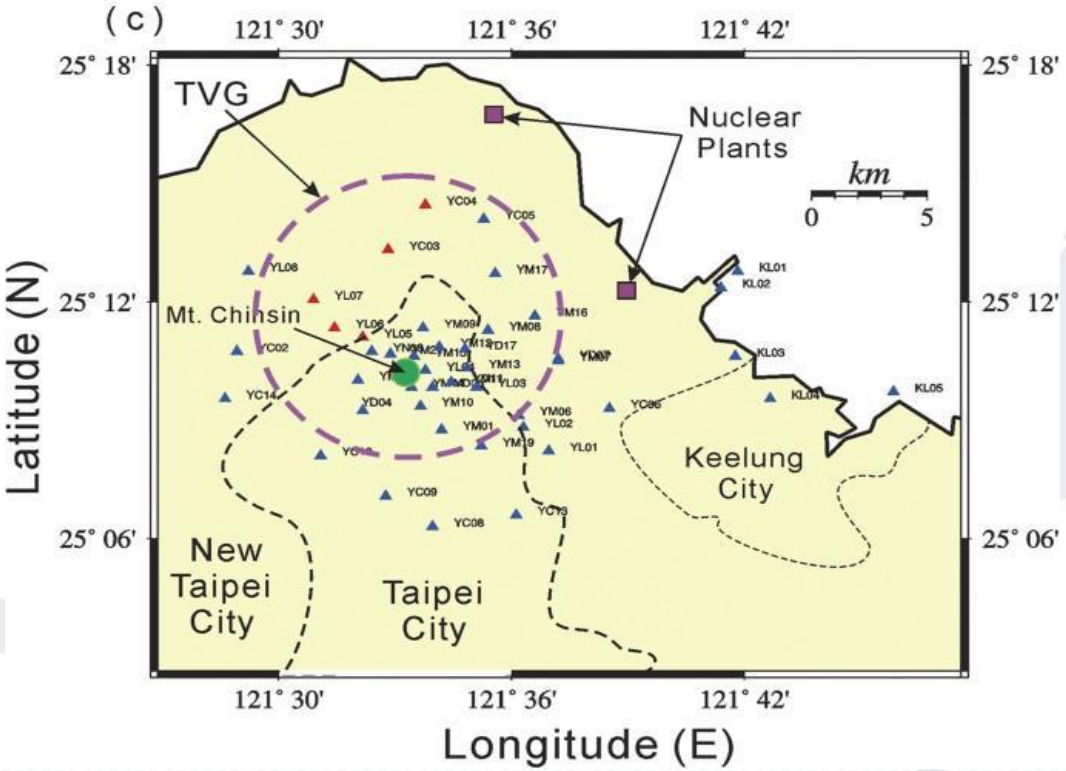
- Taiwan is in a historical area prone to tsunamis that can lead to a situation similar to Fukushima



The NOAA map showing historical tsunami event locations and operational nuclear reactors

Volcanic Activity Dangers in Northern Taiwan

- The Tatun Volcano Group in Northern Taiwan is located next to two nuclear power plants
- The Tatun Volcano Group was found to be active in 2020
- The Volcano Group is around 15km away from NNP1 and NPP2



Source: https://www.bbc.com/future/article/20220427-how-taiwan-discovered-an-active-volcano-on-its-doorstep

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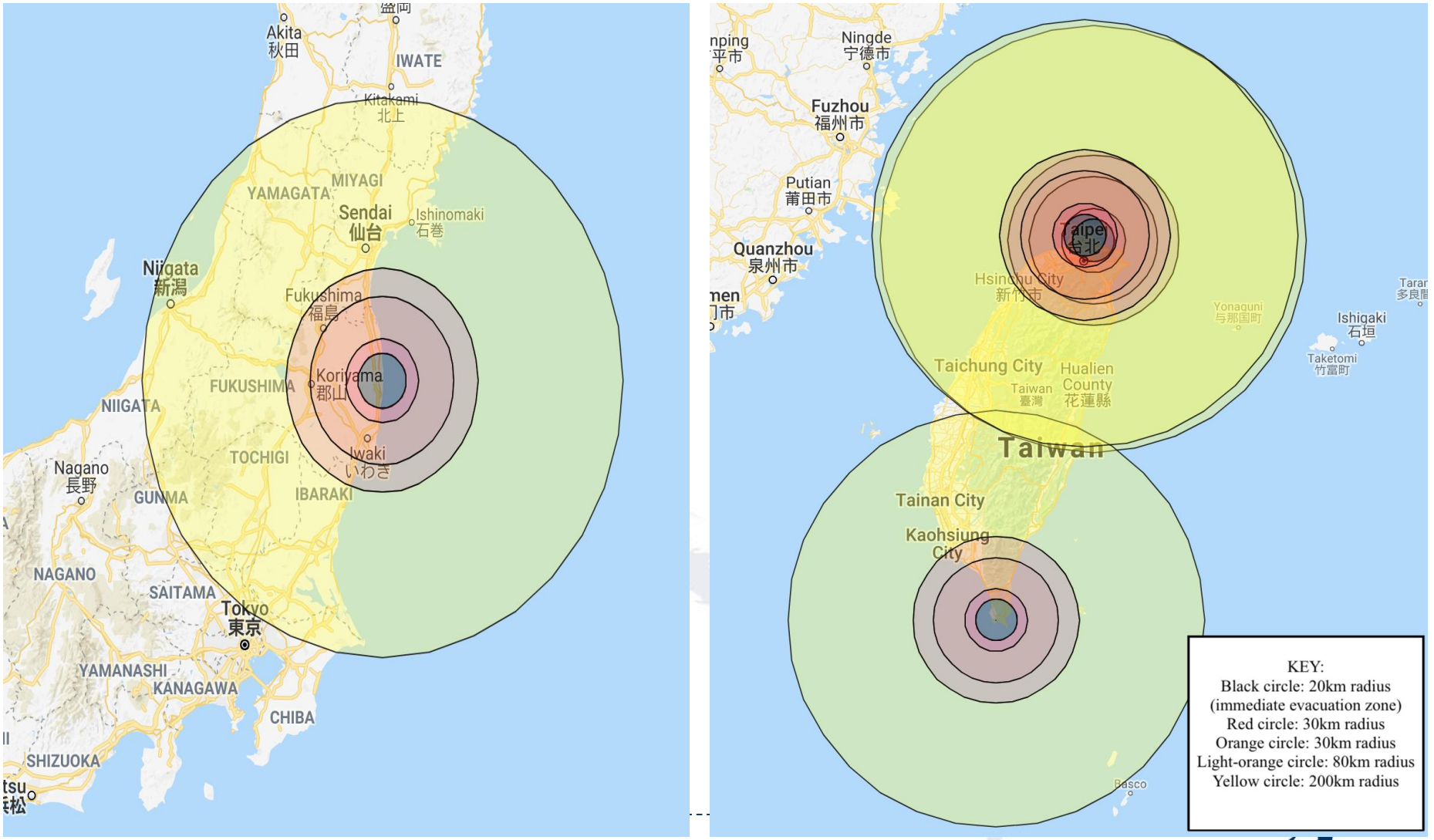
Risks of Radiation Spread Over Taiwan

- **Radiation Spread Over Taiwan**
  - "Global Implications of the Fukushima Disaster for Nuclear Power" calculated the radiation spread over Taiwan in the event of a severe accident via a model created by the US Department of Defense
  - Radiation from NPP1 and NPP2 would travel south over areas of high-density population including the cities of Taipei and New Taipei
  - Radiation from NPP3 would fall on the South China Sea and impact nations in the region and normal international transport

Source: https://www.nrdc.org/sites/default/files/nuc_11102801a.pdf

Risks of Radiation Spread Over Taiwan



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Risks of Radiation Spread Over Taiwan

Evacuation would be impossible in Taiwan in case of a nuclear disaster

- Taiwan's nuclear power plants are located incredibly close to large population centers compared to most nuclear power plants worldwide
- Population in 30km radius of NNP1 and NPP2 is 50x greater than Fukushima's 30km radius
- Evacuating 23 million people from a small island is impossible

Country	Site Name	Reactors	MWe	Population within 30 km	…within 75 km	Location
PAKISTAN	KANUPP	1	125	8,346,926	14,470,519	Seacoast
TAIWAN, CHINA	KUOSHENG	2	1,933	5,454,287	9,882,167	Seacoast
TAIWAN, CHINA	CHIN SHAN	2	1,208	4,687,065	9,833,555	Seacoast
KOREA, REPUBLIC OF	KORI	8	3,227	3,410,020	7,052,596	Seacoast
CHINA	GUANGDONG	2	1,888	3,247,486	27,821,860	Seacoast
CHINA	LINGAO	4	3,876	3,106,385	27,537,030	Seacoast
INDIA	NARORA	2	404	2,243,522	15,929,296	Inland near a river
CANADA	PICKERING	8	3,094	2,197,681	5,832,548	Inland near a lake
GERMANY	PHILIPPSBURG	2	2,292	1,743,695	6,373,483	Inland near a river
GERMANY	NECKARWESTHEIM	2	2,095	1,619,944	7,073,310	Inland near a river
BELGIUM	DOEL	4	2,910	1,511,575	9,034,387	Seacoast
GERMANY	BIBLIS	2	2,407	1,510,809	7,253,269	Inland near a river
TAIWAN, CHINA	LUNGMEN	2	2,600	1,498,212	9,144,323	Seacoast
KOREA, REPUBLIC OF	WOLSONG	4	2,722	1,300,745	5,378,972	Seacoast

Source: https://www.sciencedirect.com/science/article/pii/S0265931X16300224

Potential Risks to Taiwan's People and the Asia Pacific Region

Threat to the entire Asia Pacific Region and the World

- Economic collapse of Taiwan and interruption to global supply chains
  - Taiwan's exports were valued at US$477.8 billion during 2022
  - Taiwan manufactures 60% of all semiconductor chips and 95% of high end semiconductor chips globally

- Food exports are likely to plummet
- Food imports would be impossible in an irradiated island
- A refugee crisis of Taiwanese fleeing radioactive contamination
  - No countries would accept the refugees due to fear of radiation
- No possibility of evacuating 23 million people

https://www.moea.gov.tw/MNS/english/news/News.aspx?kind=6&menu_id=176&news_id=104334

Taiwan's NPPs Have Almost 3 Times More Spent Nuclear Fuel than Fukushima

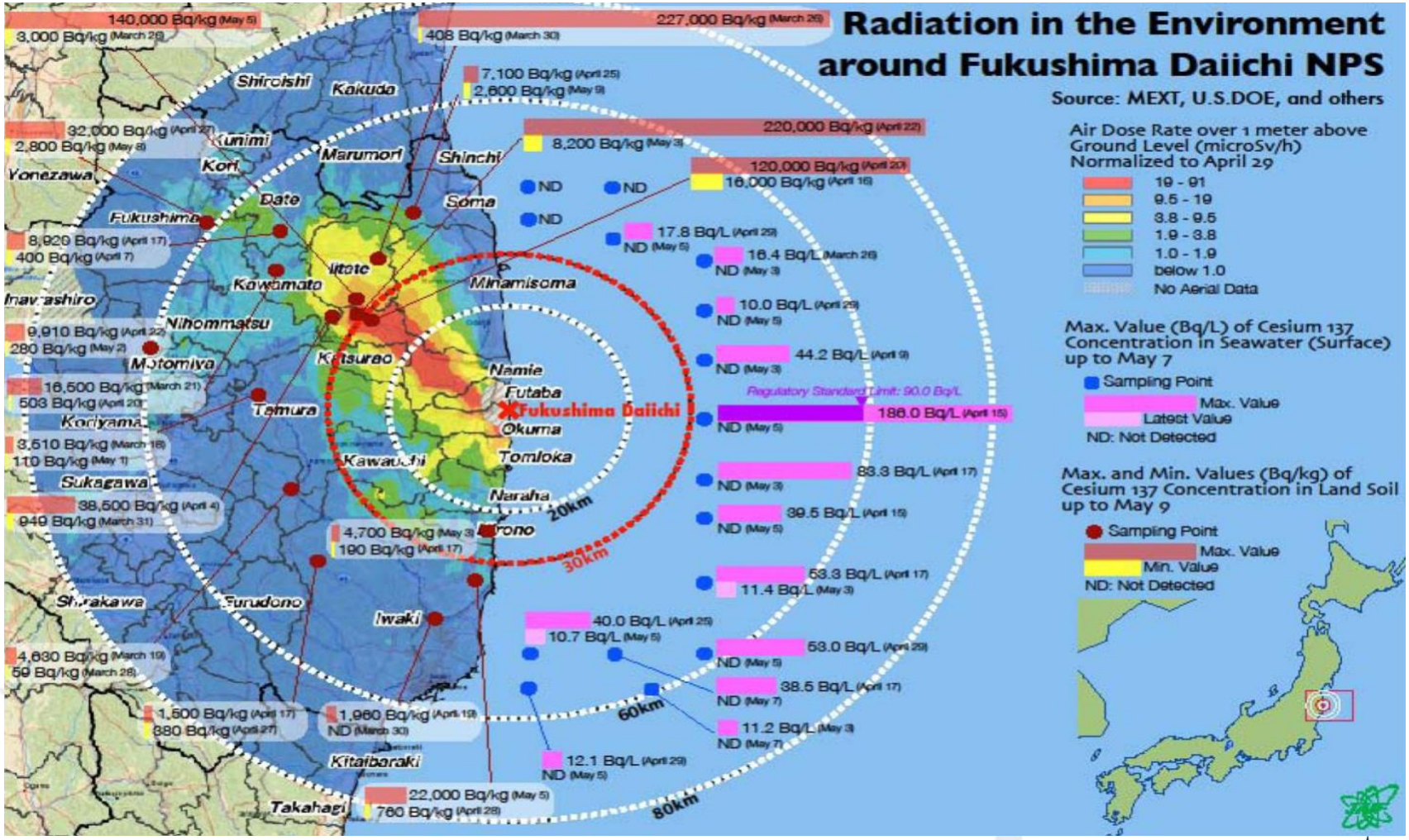
- **SNF Comparisons Between Taiwan and Fukushima**

	Taiwan	Fukushima (At the time of the accident)
Amount of Spent Nuclear Fuel	4,950 Metric Tons	1,800 Metric Tons

  - Taiwan = 2.75x of the Amount of Uranium in Fukushima
  - Taiwan = 10x Smaller than Japan

Source: https://www.scientificamerican.com/article/nuclear-fuel-fukushima/

The Japanese Government Issued a 30km Evacuation Order However, Radiation was Detected up to 200km Away from Fukushima



Source: https://iopscience.iop.org/article/10.1088/0952-4746/34/3/675

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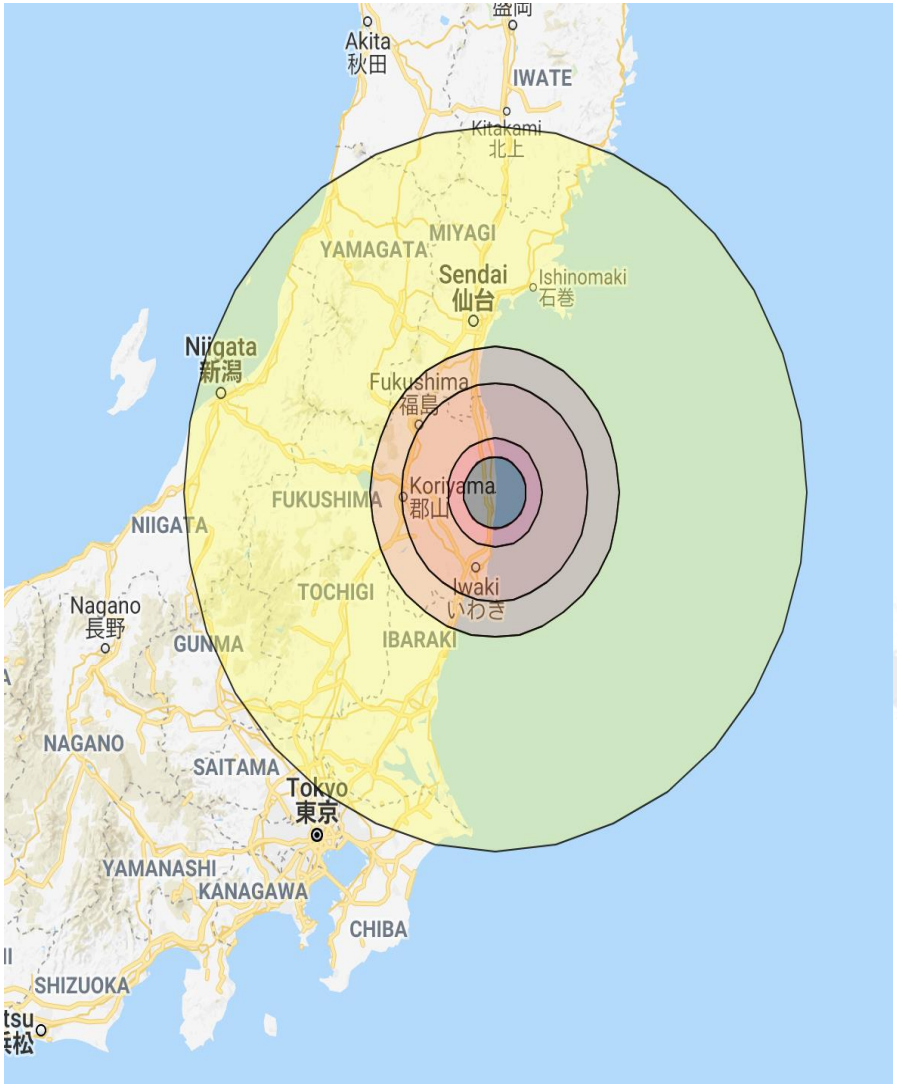
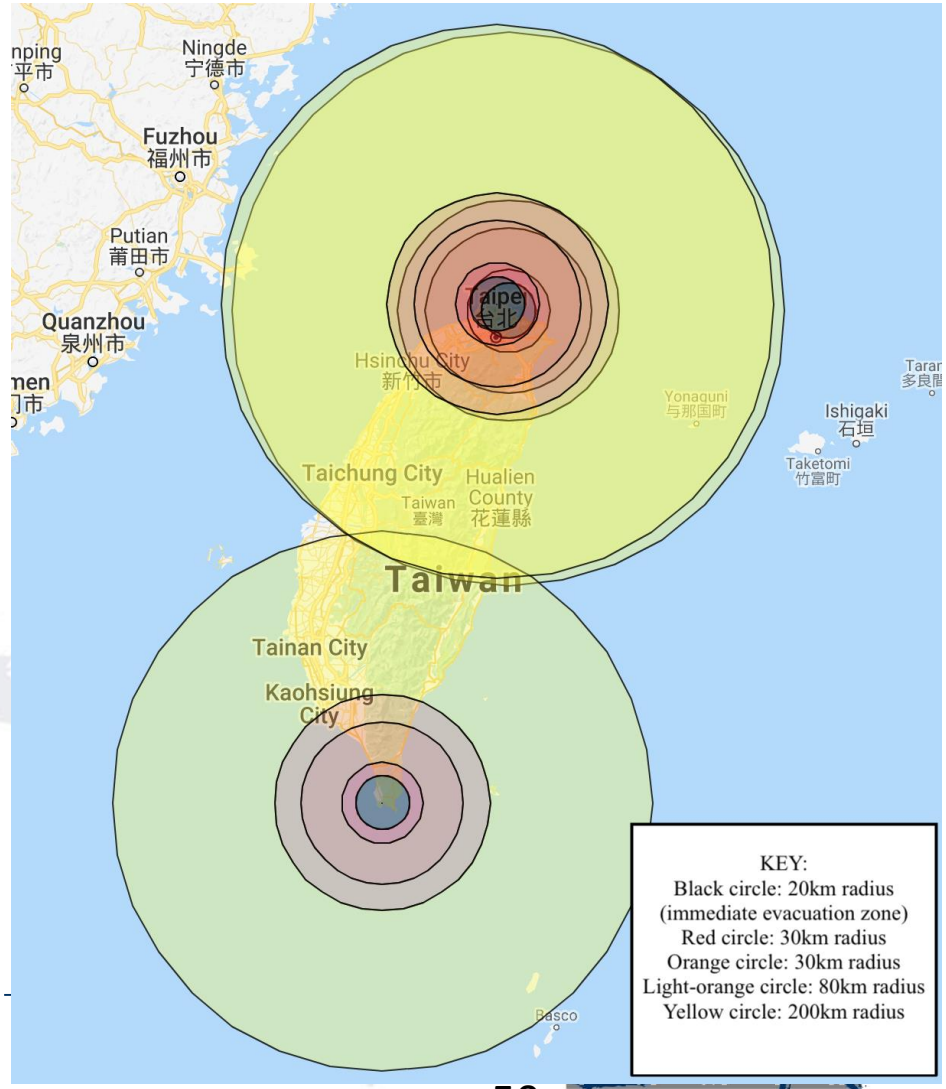
200km Radius Comparison Over Fukushima and Taiwan's NPPs





Worldwide SOP for SNF Management

Remove Fuel From Reactor Core and Place in Spent Fuel Pools

- After fuel is used up in the core it is removed from the reactor core and placed in spent fuel pools
- SNF can remain in temporary storage in the spent fuel pools for 7-10 years
- Then fresh fuel assemblies can placed in the reactor core to continue producing zero-carbon energy

Store SNF in Spent Fuel Pools ("SFP") for 7-10 Years

- Discharged spent fuel from the reactor core is still highly radioactive ("hot")
- SNF is placed in a SFP to cool down for usually 7-10 years before being removed from the pools and placed in dry casks
- Spent fuel pools are located inside or outside of the NPPs
- Normal worldwide SOP calls for SNF to be systematically removed from the pool and placed in dry casks (re-racking to increase pool storage is not the accepted worldwide SOP)

Worldwide SOP for SNF Management

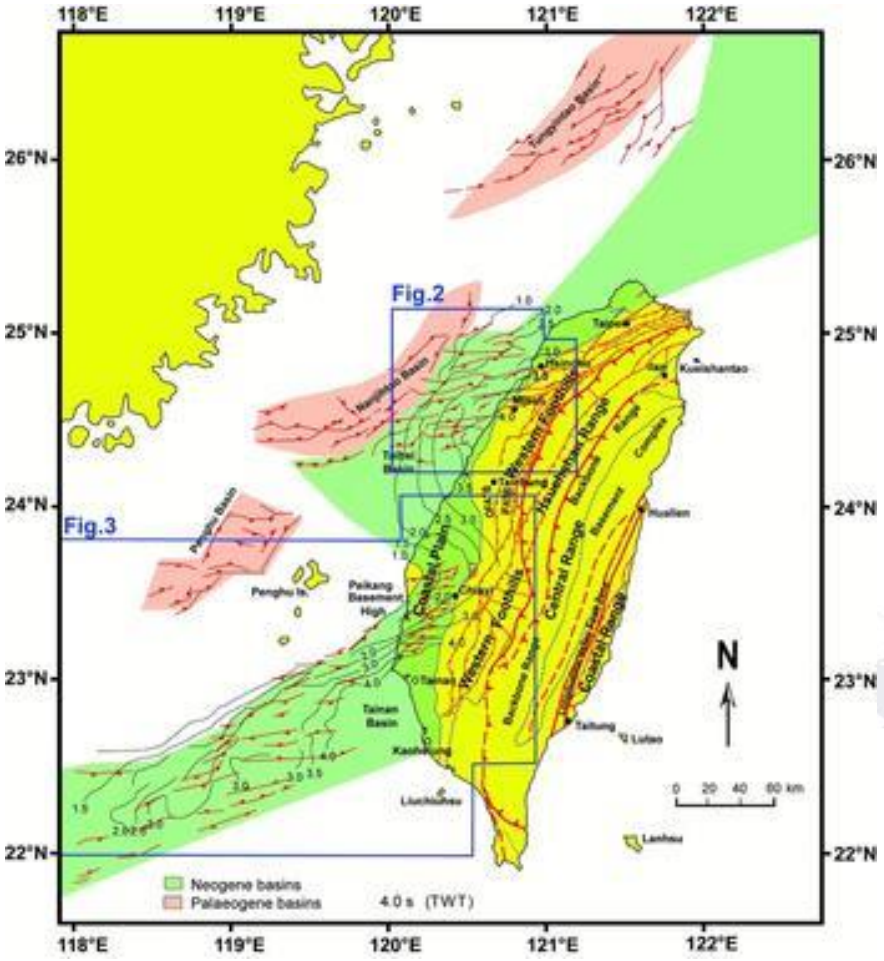
Remove SNF from Pools and Place in Dry Cask Storage

- After cooling in the pool, the SNF is removed and placed in large cylindrical steel and concrete lined structures called dry casks
- SNF can remain in dry casks indefinitely
- Dry casks can be placed inside or near the nuclear power plant, outside and above ground
- Dry casks are also used to transport SNF to its final storage site

Transport Dry Casks to a Permanent Storage Site

- The dry casks are transported to a permanent storage site, an underground facility, where they will remain for hundreds of years
- Many countries with the right geological conditions have already built or are in the process of building permanent storage site including: France, Germany, Finland, Sweden, Switzerland, China, South Korea and the US
- Taiwan is fully faulted (see next slide) and does not have the right soil conditions (bentonite clay) to build an underground permanent storage facility

Active Faults in Taiwan



- Taiwan is fully faulted and there are no conditions (lack bentonite) for a permanent deep storage site
- It is completely irresponsible for the Taiwan Government to pretend that deep storage of SNF in Taiwan is possible. It endangers the public safety of 23 million people
- Who benefits by keeping SNF in Taiwan, preventing 40 more years of zero-carbon energy supply and continue fossil fuel use? (see slide 70)

Source: https://www.cambridge.org/core/journals/geological-magazine/article/role-of-basementinvolved-normal-faults-in-the-recent-tectonics-of-western-taiwan/9AE62EB8EB44C320B1A3197F5ABC884E

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The Taiwan Government has Apparently Not Followed the Worldwide SOP for SNF for 40 Years

- **By failing to properly manage SNF according to established worldwide SOPs, the Taiwan government is now unable to operate its only zero-carbon, scalable energy source**
- **The Taiwan Government's management has caused:**
  1. **The reactor cores to become constipated because the spent fuel pools are full**
  2. **The spent fuel pools to become constipated because it has not purchased and loaded SNF into dry casks on an ongoing systematic basis**
  3. **Fact: NPPs to become inoperable because the Taiwan Government has not followed worldwide SOPs**
- **Why is the government claiming Taiwan is a "nuclear free homeland"?**
- **The government's 40 years of management have led to the DPP's misguided policy to prematurely shut down NPPs to hide the SNF management incompetence that will eventually leave Taiwan's 3 nuclear power plants inoperable (2 already are) if dry casks are not purchased and properly loaded with SNF by professionals with international experience and proven track records soon**
  - **Properly loaded means: that SNF is properly, placed, confined, shielded and passively cooled inside the dry cask**
- **According to the US Department of Energy, NPPs have an 80 year lifespan**

Source: https://www.energy.gov/ne/articles/whats-lifespan-nuclear-reactor-much-longer-you-might-think

The Taiwan Government has Apparently Not Managed SNF According to the Global SOP for 40 Years

- **The Taiwan Government's Departure from Global SOP has Caused:**
  - Stuffed spent fuel pools
  - Stuffed reactor cores
  - Lack of planning to properly manage SNF
  - No dry casks to store SNF on a regular, systematic schedule
  - Endangering the public safety and the lives 23 million Taiwanese
- **The Taiwan Government MUST:**
  - Adopt the worldwide SOP for managing SNF by retaining a professional nuclear engineering company with proven track records to un-rack the spent fuel pools and load dry casks with SNF
  - Buy enough proper (not arbitrarily modified by local amateurs with possible conflicts of interest and no experience) dry casks
  - Un-rack and move SNF from spent fuel pools to dry casks
  - Move fuel from the cores to the spent fuel pools
  - Place new fuel in the cores to continue operation
  - Budget and plan for SNF management in accordance with the global SOP in the future to avoid the problems of the past 40 years

Source: https://www.energy.gov/ne/articles/whats-lifespan-nuclear-reactor-much-longer-you-might-think

The Taiwan Government has Apparently Not Managed SNF According to the Global SOP for 40 Years

Offload Fuel from Reactor Core

- Offloading of cores at NPP1 and NPP2 is impossible because the SFPs at each NPP are at full capacity because the government has not bought enough dry casks to place SNF that currently in the congested pools
- NPP1 and NPP2 have become inoperable because of government departure from global SOP. New fuel cannot be placed in the constipated reactors containing SNF
- To solve the constipation the Taiwan government must buy enough dry casks to place in SNF currently in pools and reactor cores, only by doing this can the NPPs continue operations or be decommissioned
- The Taiwan Government must retain professionals with a proven track record to un load fuel from the reactor, un-rack pools and properly load SNF into dry casks
- The government claims that they can safely remove fuel from cores and un-rack pools and load dry casks but this should not be done by local amateurs with no experience and possible conflicts of interest

Spent Fuel Pool Storage

- Currently most of Taiwan's SNF is stored inside the cores and pools at the 3 nuclear power plants
- The pools are at capacity because the Taiwan government's departure from global SOP and delay in buying dry casks to decongest the spent fuel pools and manage SNF on a systematic, regular schedule
- The Taiwan Government is responsible for lacking an adequate SNF management plan to solve the constipation. The Taiwan government must buy enough dry casks to be able to remove SNF from the pools and reactor cores and place SNF in dry casks and finally transfer the SNF to a permanent storage site

The Taiwan Government has Apparently Not Managed SNF According to the Global SOP for 40 Years

Dry Cask Storage

- Taiwan only has constructed dry casks for 16% of the total spent fuel
- The remaining 84% is still in pools because of government management and finger pointing between the KMT and DPP
- The New Taipei City Government has not issued a Soil and Water Conservation permit to place the remaining dry casks, claiming that the construction deviated from the official plan without approval
- Government management has prevented the purchase of dry casks and SNF remains in the pools
- To solve the decongestion the Taiwan government must buy dry casks to follow the worldwide SOP and transfer SNF to a permanent storage site offshore
- Only by doing this can the NPPs continue operations or be decommissioned
- Both the DPP and KMT share joint responsibility and cannot be excused by finger blaming the other, they each have a duty to perform and protect the public safety

Permanent Storage

- Taipower plans to build an underground permanent storage site in Taiwan by 2055. This is another example of apparent energy mismanagement, waste of taxpayer money, irresponsible and possible corruption
- Taiwan is fully faulted and does not have the proper soil conditions (bentonite clay) for a permanent storage site*. It is scientifically impossible. Why is this lie being promoted?
- To solve the constipation the Taiwan government must buy dry casks to (i) remove SNF from the cores and place in pools, (ii) remove SNF from pools and place in casks, and (iii) transfer dry casks to a permanent storage offshore
- All of this must be done by an experienced professionals with proven track records not by local amateurs that has not done it before. Conflicts of interests are suspicious

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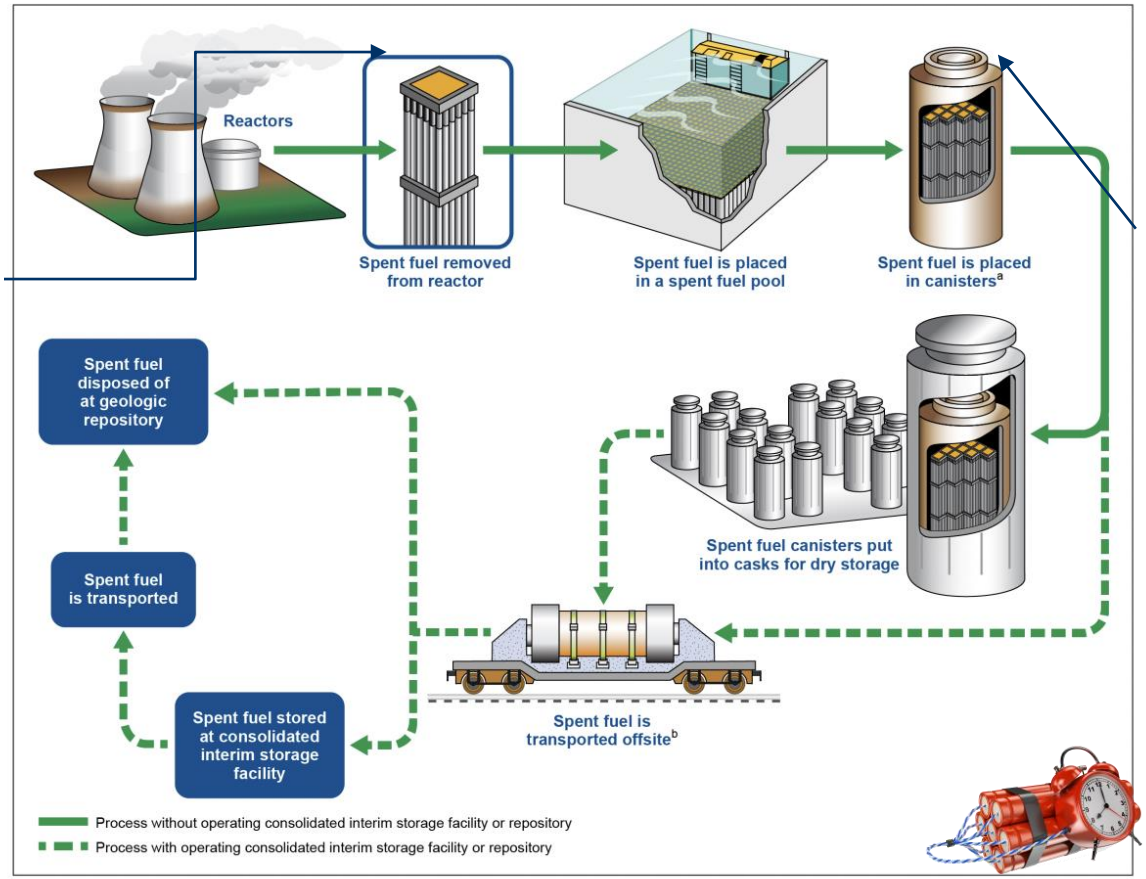
*USGS: A Review of Recently Active Faults in Taiwan https://pubs.usgs.gov/of/1975/of75-41/

The Taiwan Government has Apparently Not Managed SNF According to the Global SOP for 40 Years

Taiwan Government's Apparent Mismanagement: Unable to remove fuel from the reactor core because pools are full because they have not bought dry casks on a regular and systematic basis and have not send SNF to permanent storage site offshore

Figure 2: Process for Managing Commercial Spent Nuclear Fuel, from Removal and Storage at a Reactor Site to Transportation to a Consolidated Interim Storage Facility or Permanent Repository



Source: GAO. | GAO-21-603

Taiwan Government's Apparent Mismanagement: Unable to remove fuel from the pools because it has not bought dry casks on a regular and systematic basis and has not sent SNF to permanent storage site offshore

Taiwan Government's Apparent Mismanagement: Unable to transfer SNF to a permanent storage site offshore because they have not bought dry casks on a regular and systematic basis

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Benefits of Operating NPPs for 40 More Years

How can the government justify failure to avoid 1.7 billion tons of CO2 (332 million cars) and USD446 billion dollars in revenue for 40 more years?

CO2 Emissions Avoidance

	Tons of CO2 Avoided	Cars Eliminated Equivalent
1 Year of Operation (5.1GW)	44,000,000	~8.3 million
40 Years of Operation	1,760,000,000	~332 million

Increased Government Revenue with Zero-Carbon Energy Generation

	Electricity Generated	Possible Revenue with Current IPP PPA Price for Zero-Carbon Energy USD230	Possible Revenue Assuming CO2 Avoidance Monetization USA: USD4 per ton	Possible Revenue Assuming CO2 Avoidance Monetization Japan: USD20 per ton
1 Year of Operation (5.1GW)	44,676,000MWh	**USD10.2 billion**	(USD10.2 billion + USD176 million) = **USD10.37 billion**	USD10.2 billion + USD880 million) = **USD11 billion**
40 Years of Operation	1,787,040,000MWh	**USD411 billion**	(USD411 billion + USD7billion) = **USD418 billion**	(USD411 billion + USD35.2 billion) = **USD446 billion**

Spend USD0.5 billion to earn up to USD446 billion = 892x multiple

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Benefits of Operating NPPs for 40 More Years

Why would anyone shut down the NPPs and miss out on all the benefits?

	By shutting down the nuclear power plants Taiwan suffers:	By purchasing dry casks and keeping NPPs operational Taiwan benefits:

Why Close NPPs? Costs vs Benefits	• 40 years of Government mismanagement will cause all NPPs in Taiwan to be shut down prematurely due to the SNF constipation
	  • Delaying to buy dry casks
	  • Refusal to buy dry casks to place inside them SNF currently in the pools and cores
	  • Inability to place new fuel into cores and provide 40 more years of zero-carbon energy due to constipation
	• The DDP is using its anti-nuclear policy as a cover up for 40 years of constipation mismanagement and how it has created a ticking time bomb
		• Shutting down the NPPs does not solve the growing problem to public safety posed by the large quantities of SNF (see slide 39)
		• Buying dry casks, transporting SNF back to the US and continued operation of the NPPs guarantees Taiwan 40 more years of 5.1GW zero-carbon energy
		• Even if Taiwan continues to operate its nuclear power plants Taiwan still needs to replace at least 45GW of fossil fuels annually to meet the UN decarbonization goals (see slide 69)

Permanent Storage	• Proposing to build a permanent storage site in Taiwan is completely irresponsible and threatens the public safety of all Taiwanese • It is much more expensive for Taiwan to learn about permanent storage when there is already an off the shelf solution in the form of dry casks (cost to learn vs off the shelf solution) • Taiwan is fully faulted and lacks the proper geological conditions like bentonite clay to construct a permanent storage site for SNF. It is impossible (see slide 53)	• Buying dry casks and transferring SNF offshore will decongest the NPPs and allow their production of zero-carbon energy to continue for 40 more years • By buying dry casks and transporting all SNF offshore, Taiwan reduces all of the public safety risks associated with SNF • Taiwan complies with international agreements and worldwide SOP

Benefits of Operating NPPs for 40 More Years

Why would anyone shut down the NPPs and miss out on all the benefits?

	By shutting down the nuclear power plants Taiwan suffers:	By purchasing dry casks and keeping NPPs operational Taiwan benefits:

Green Dollar Revenues on Continuing 5.1GW of Existing NPPs	• Taiwan makes USD0 revenue from nuclear energy and green CO2 monetization dollars	• By only spending USD0.5 billion to decongest the NPPs and continue to run them for 40 years Taiwan can generate a revenue of USD411 billion at the current IPP price of USD230 per MW
		  • With CO2 monetization at a US price of 4USD per ton Taiwan can generate a revenue of USD418 billion over 40 years
		  • With a CO2 Monetization of at a Japan price of 20 USD per ton Taiwan can generate a revenue of USD446 billion over 40 years
		• **If Taiwan continues to operate its nuclear power plants it can achieve 892x multiple**

Baseload Zero-Carbon Energy on 45GW Required to Reach Net-Zero	• Taiwan loses 5.1GW of annual zero-carbon energy
	• Taiwan still needs to replace 50GW of fossil energy annually over 40 years
	• Taiwan increases reliance on imported fossil fuels
	• Decreased energy security
	• Taiwan government continues to greenwash (techniques aimed at creating an illusion of environmental responsibility and compliance, misleading the general public) without actually decarbonizing
	• If the DPP Government can't continue operating the existing 5.1GW of nuclear energy and refuses to add more the damage to Taiwan will be massive (see slide 63)
		• Even if Taiwan generates 5.1GW zero-carbon energy for 40 more years it still needs to replace the remaining fossil fuels (45GW as of 2022 at 0% growth)
		  • Assuming 0% growth in demand Taiwan must replace 45GW of fossil energy over 40 years
		  • Assuming a yearly 3% growth in demand Taiwan must replace 147GW of fossil energy over 40 years
		  • Assuming a yearly 5% growth in demand Taiwan must replace 316GW of fossil energy over 40 years
		• Taiwan partially meets UN global decarbonization goals
		• Greater energy independence and resiliency
		• International leadership in zero-carbon energy

Benefits of Operating NPPs for 40 More Years

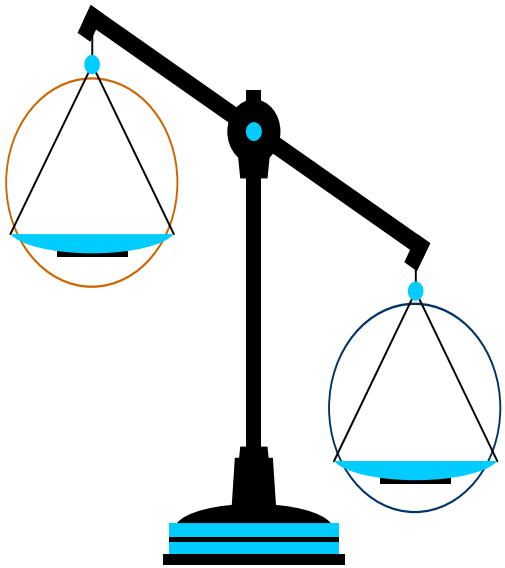
Why would anyone shut down the NPPs and miss out on all the benefits?

	By shutting down the nuclear power plants Taiwan suffers:	By purchasing dry casks and keeping NPPs operational Taiwan benefits:

Emissions	• Taiwan will emit an extra 1.7 billion tons of CO2 emissions (~332 million cars) over 40 years
	• Higher pollution levels
	• Taiwan continues to be an environmental pariah
	• Taiwan forces foreign investment away and emissions rise (i.e. offshore wind energy players)
	• Taiwan is a climate laggard and recidivist and is excluded from the UN and multiple NGOs
		• Taiwan replaces 1.7 billion tons of CO2 emissions equivalent of ~332 million cars over 40 years
		  • Assuming no growth Taiwan still needs to replace 45GW worth of fossil fuel emissions over 40 years (15.8 billion tons)
		  • Assuming a 3% yearly demand Taiwan needs to replace 147GW worth of fossil emissions over 40 years (51 billion tons)
		  • Assuming a 5% yearly demand Taiwan needs to replace 316GW worth of fossil emissions over 40 years (110 billion tons)
		  • Improved air quality
		• Positive global reputation
		• Taiwan becomes a first mover jurisdiction and a global model to drive the re-deployment of capital to cause decarbonization and energy transition
		• Taiwan attracts foreign and domestic investment that drives more technologies that reduce emissions
		• Taiwan becomes the hero jurisdiction and a global model for other to follow to decarbonize and complete energy transition

Economic, Social and Environmental	• Taiwan loses the ability to export to developed markets due to inability to comply with zero-carbon energy requirements of multiple jurisdictions such as:
	  •EU CBAM
	  •US SEC rules on climate related disclosures
	  •China's emissions trading scheme
	  •Multiple global supply chains net-zero requirements by 2030-2040
	  •RE100 commitments by various MNC supply chains by 2050
	• 52% of export dependent GDP will suffer
	• Industries and supply chains migrate away from Taiwan to zero-carbon energy jurisdictions (i.e. China)
	• Job loss and massive unemployment
	• Loss of international competitiveness
	• No foreign investment
	• Loss of tax revenue
		• Taiwan government comes closer to meeting UN energy transition and decarbonization goals
		• Taiwan becomes a model for other jurisdictions to follow
		• Companies stay in Taiwan and benefit from zero-carbon energy
		• Taiwan becomes a jurisdiction that attracts foreign investment
		• Taiwan successfully competes for international and domestic institutional investor dollars
		• Taiwan successfully competes for international institutional ESG investment dollars
		• Taiwan meets the challenges of climate change to make enterprises and supply chains more resilient and ensure that they are increasingly "green" over a period of time to keep the funding and investment flowing
		• Taiwan drives investment, development, job creation, innovation and more tax revenues
		• Taiwan creates energy security, tech innovation and more jobs
		• All of Taiwan's enterprises become more sustainable and resilient

Benefits of Operating NPPs for 40 More Years



Shutting Down NPPs

- Taiwan makes USD0 revenue from nuclear energy over the next 40 years
- Taiwan loses 5.1GW of zero-carbon energy generation over 40 years
- Taiwan will emit an extra 1.7 billion tons of CO2 emissions (~332 million cars) over 40 years
- Taiwan increases reliance on imported fossil fuels
- Taiwan does not decarbonize and fails to meet the UN goals
- Taiwan loses the ability to export to developed markets due to inability to comply with zero-carbon energy requirements of multiple jurisdictions
- 52% of export dependent GDP will suffer
- Industries and supply chains migrate away from Taiwan to zero-carbon energy jurisdictions (i.e. China)
- Job loss and massive unemployment
- Loss of international competitiveness

Buying Dry Casks and Keeping NPPs Operational

- By only spending USD0.5 billion Taiwan can earn up to USD411 billion of possible revenue over 40 years
- With CO2 monetization at a US price of 4USD per ton Taiwan can generate a revenue of USD418 billion over 40 years
- With a CO2 Monetization of at a Japan price of 20 USD per ton Taiwan can generate a revenue of USD446 billion over 40 years
- Increase revenue of 892x
- Taiwan generates 5.1GW zero-carbon energy for 40 more years
- Taiwan replaces 1.7 billion tons of CO2 emissions equivalent of ~332 million cars over 40 years
- Taiwan becomes a first mover jurisdiction and a global model to drive the re-deployment of capital to cause decarbonization and energy transition
- Taiwan attracts foreign and domestic investment that drives more technologies that reduce emissions
- Taiwan becomes the hero jurisdiction and a global model for other to follow to decarbonize and complete energy transition
- Taiwan government comes closer to meeting UN energy transition and decarbonization goals
- Taiwan successfully competes for international institutional ESG investment dollars

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The Next Taiwan Government Must End the SNF Crisis

- **Why would the Taiwan Government not spend USD0.5 billion to buy dry casks and forgo the opportunity to operate NPPs for 40 more years and generate USD446 billion (including CO2 monetization) in revenue for Taipower and the government?**
- **That is a 892x difference**
- **Who would not spend USD0.5 billion to achieve:**
  - Increased revenues by 892x difference
  - 5.1GW of baseload zero-carbon energy for 40 more years
  - Emissions avoidance equivalent to 332 million cars over 40 years
  - Decarbonization and energy transition to partially meet the UN goals
  - Economic, social and environmental benefits for Taiwan
- **Why would the current or the next government not make the rational choice instead of endangering public safety?**
- **Cua Bono?**
- **Who benefits from the continued use of fossil fuels at such a huge public expense and increased public safety risk?**

Solutions for the Next Government to Solve Taiwan's Spent Nuclear Fuel Safety Crisis

1. The Taiwan Government Must Purchase Dry Casks

- The next Taiwan Government must purchase all the dry casks necessary to decongest the cores and spent fuel pools at all of Taiwan's nuclear power plants
- The Taiwan Government must plan, budget and implement a plan to remove all the spent fuel currently in the cores and pools
- The Taiwan Government must make a concrete plan for disposal of Taiwan's future SNF
- Taiwan must retain a professional nuclear engineering company, with proven track records to un-rack the spent fuel pools and load SNF into dry casks

2. SNF Must be Removed from the Pools and Placed in Dry Casks

- SNF must be removed from the cores and re-racked pools and placed in dry casks
- This will decongest the re-racked pools and make room for the SNF currently inside the constipated reactor cores
- The Taiwan government must retain professionals with a proven track record to do this, not local amateurs with no experience and possible conflicts on interest

Solutions for the Next Government to Solve Taiwan's Spent Nuclear Fuel Safety Crisis

3. SNF Must be Removed from the Reactor Cores and Placed in the Pools

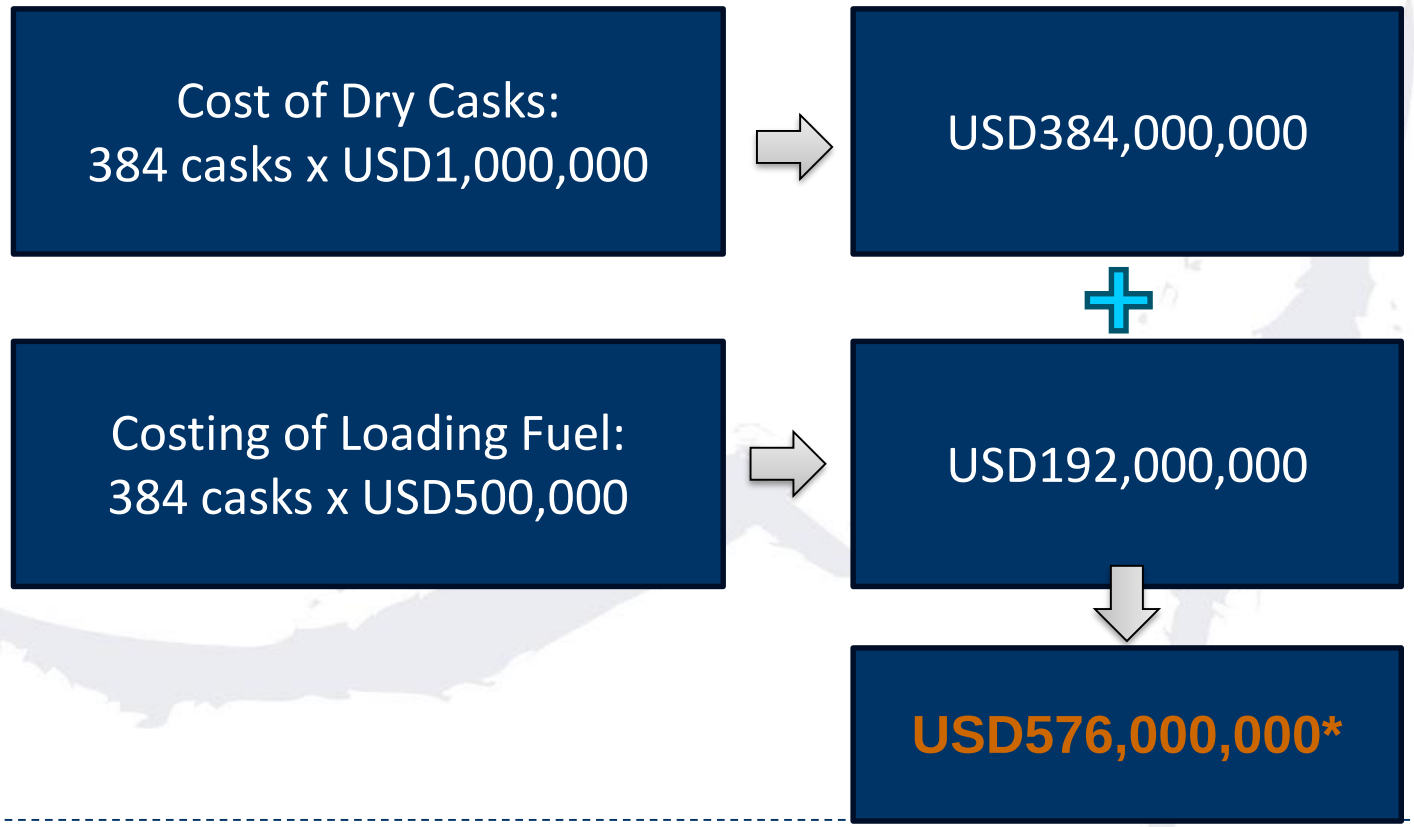
- Once all the SNF has been removed from the pools, SNF currently in the cores can be placed in the pools
- The SNF currently constipated in the reactor core can finally be placed in the pool to make room in the reactor core for fresh fuel assemblies
- After 7-10 years in the pools new dry casks will be available to proceed with normal SNF SOPs and avoid constipation due to government mismanagement then the casks can be transferred to a permanent storage site

4. New Fuel Can be Placed in the Reactor Cores and the Power Plants and Continue Providing Zero-Carbon Power

- New fuel assemblies can be placed in the reactor cores
- Taiwan can keep benefiting from 5.1GW of installed zero-carbon energy capacity for the next 40 years (see slide 59-63)
- Over 40 years Taiwan can gain **USD446 billion** (including CO2 monetization) of revenue if it spends USD0.5 billion to buy dry casks and decongest the NPPs that is a **892x positive gain**
- If the Taiwan government can decarbonize and complete energy transition, companies will not have to mass migrate due to lack of zero-carbon energy
- No mass migration of an economy worth USD800 billion

Dry Casks Cost Estimate for NPP1, NPP2, and NPP3

- **Estimated average cost of a dry cask: USD1,000,000**
- **Estimated average cost of loading spent fuel to dry cask: USD500,000**
- **Estimated total number of dry casks needed: 384**



*Other costs not included as well as well as costs for 40 more years of operation

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Conclusion: Purchasing Dry Casks and Services from Experts with Global Experience and Proven Track record is the Only Way to Solve the SNF Crisis

- **The Taiwan government has 2 options:**
  - 1. Shut down the nuclear power plants after 2025 and suffer all the consequences of lacking zero-carbon energy (see slides 59-63)
  - 2. Purchase dry casks to decongest the nuclear power plants and operate them for 40 more years (see slides 59-63)
    - Purchasing dry casks at a price of around USD**0.5 billion** will enable the Taiwan government to achieve a revenue of about USD**446 billion** over 40 years and all the added benefits of supplying more zero-carbon energy (see slides 59-63)
    - **= 892x multiple**
    - **Reduce emissions equivalent to 332 million cars**
    - **Why would any government not want to this?**
    - **How can this wrong decision be justified?**
    - **Who benefits at such a large societal cost?**
    - **How is this applying best business judgement?**

Conclusion: The Next Taiwan Government Needs Nuclear Energy to Replace at least 45GW of Fossil Fuels over the Next 40 Years to Decarbonize and Complete Energy Transition

- **Assuming no growth from the year 2022, Taiwan needs to replace 50GW or 80% of fossil fuel annually with zero-carbon energy generation to be UN goals compliant**
- **Taiwan's 3 nuclear power plants can only supply 5.1GW of the 50GW that needs to be replaced annually**
- **45GW of fossil (assuming 2022 levels and no growth) still need to be replaced each year for 40 years**

Assumed % Increase Per Year in Energy Demand Over 40 years	Energy Demand in 40 years (Fossil needed to be replaced)	Increase in Nuclear Energy Generation Needed from Current 5.1GW	Tons of Nuclear Fuel Needed for 40 Years (4,950 tons to run 5.1GW for 40 years)
0%	45GW	9x Increase	44,550 Tons
3%	147GW	29x Increase	145,000 Tons
5%	316GW	63x Increase	312,840 Tons

- **Even if Taiwan continues to operate its 3 NPPs and assuming no growth in energy demand Taiwan needs to increase its zero-carbon energy generation 9x to replace fossil fuels.**
- **This is a huge gap that the next Taiwan Government must fill to supply enough zero-carbon energy to companies and supply chains to prevent them from mass migrating to China or other jurisdictions.**

*Assuming Cost of Uranium is USD100,000 Per Ton
Source: International Atomic Energy Agency: Nuclear Power Costs: https://www.iaea.org/sites/default/files/publications/magazines/bulletin/bull5-4/05404700305.pdf

Conclusion: Who Benefits from the Continued Use of Fossil Fuels?

- **Decarbonization and energy transition can only be completed with massive foreign investment in nuclear independent power producers ("IPPs")**
- **Taipower has no money, therefore the next Taiwan Government needs to change the laws to attract enough foreign investment to replace at least 45GW of fossil fuels yearly over 40 years**

1. **Global energy companies have all made record breaking profits in the past two years***
2. **In stark contrast, TPC and CPC are among the few energy companies that have been losing money. The Taiwanese people must ask themselves why this is happening. Is this mismanagement? Who is benefitting from stopping the energy transition? Is an independent audit warranted by the next government?**

- **Taiwan needs to allow 100% privately owned IPPs to decarbonize and complete the energy transition as stated by the UN goals (current law requires 50% JV with Taipower)**
  - Taipower incurred a loss of USD8.9 billion in 2022**
  - CPC incurred a loss of almost USD2 billion in 2022***
- **Who would want to joint venture 50% with Taipower when Taipower has no money and Taipower mismanaged the construction of NPP4?**
- **Why are international fossil companies making record-breaking profits but Taiwan's Taipower and CPC are on the brink of economic collapse?**
  - Is this also mismanagement?
  - Fossil fuel subsidies or leakage?
- **Who benefits from continued fossil fuel use?**
- **Who benefits from closing down Taiwan's NPPs?**
- **Taipower has to fill in the zero-carbon energy gap to prevent the hollowing out of Taiwan as companies mass migrate to zero-carbon energy jurisdictions like China**
- **How can Taiwan fill the zero-carbon energy gap without nuclear energy?**

*Source: https://www.theguardian.com/environment/2023/feb/09/profits-energy-fossil-fuel-resurgence-climate-crisis-shell-exxon-bp-chevron-totalenergies
**Source: https://focustaiwan.tw/business/202205170010
***Source: https://www.reuters.com/business/energy/taiwans-cpc-says-has-lost-almost-2-bln-this-year-due-high-energy-prices-2022-07-05/

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The Two Major Political Parties Share Responsibility for the 40 Year SNF management and for Taiwan's Huge Zero-Carbon Energy Gap
The Taiwan Government Must Solve the SNF Constipation and Address Taiwan's Lack of Zero-carbon Energy that Will Cause the Hollowing out of its Economy

Years	New Taipei City Mayor	President
1980-1984	Lin Fong-Cheng	Chiang Ching-Kuo
1984-1988	Lin Fong-Cheng	Chiang Ching-Kuo
1988-1992	You Ching	Lee Teng-Hui
1992-1996	You Ching	Lee Teng-Hui
1996-2000	Su Tseng-Chang	Lee Teng-Hui
2000-2004	Su Tseng-Chang	Chen Shui-Bian
2004-2008	Lin Hsi-Yao/Chou Hsi-Wei	Chen Shui-Bian
2008-2012	Eric Chu	Ma Ying-Jeou
2012-2016	Eric Chu	Ma Ying-Jeou
2016-2020	Eric Chu/Hou Yu-Ih	Tsai Ing-Wen
2020-2024	Hou Yu-Ih	Tsai Ing-Wen

For More Information

Contact: info@pamirlaw.com