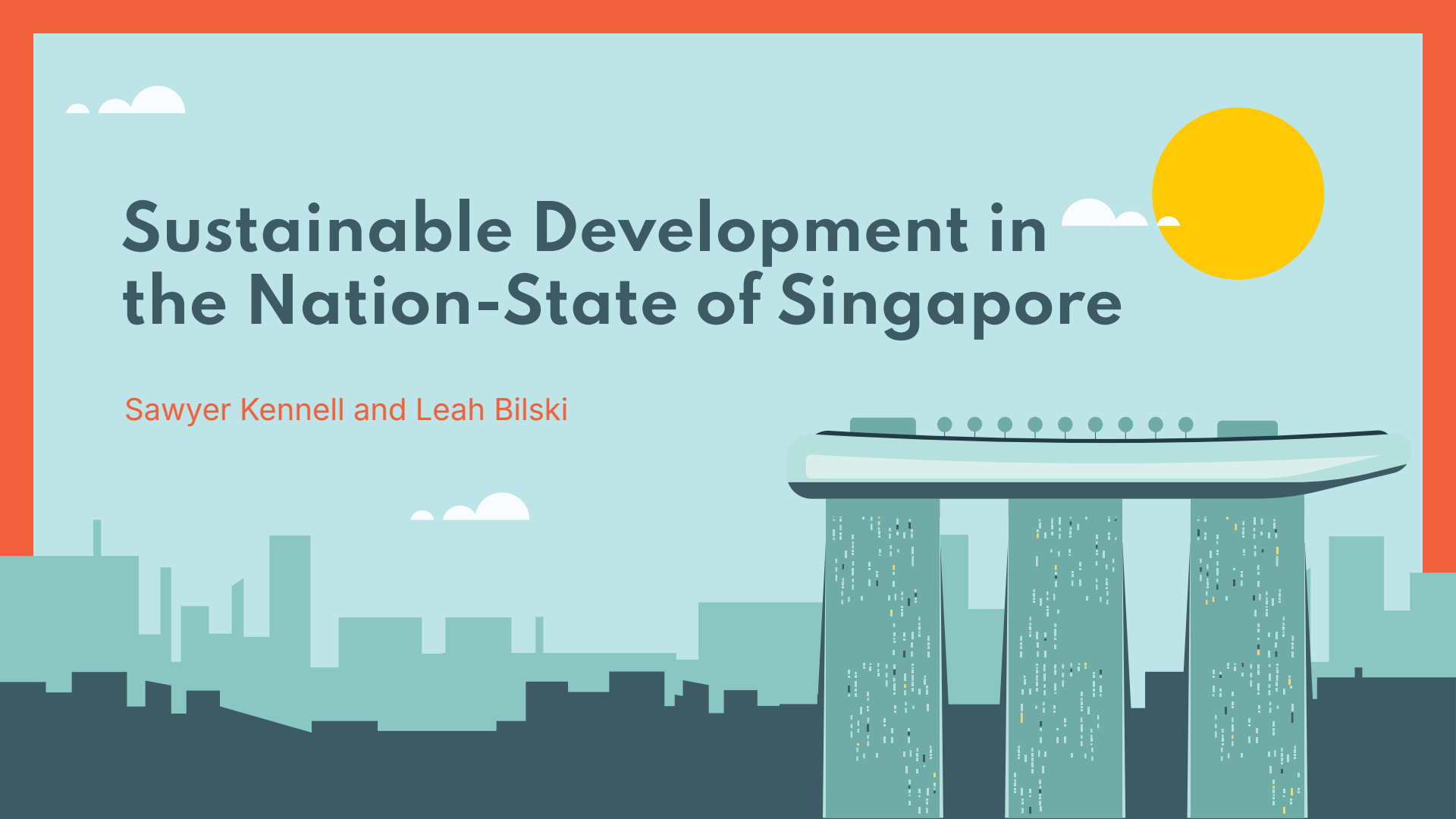


The background of the slide is a stylized illustration. It features a light blue sky with a large, bright yellow sun in the upper right corner. Several white, fluffy clouds are scattered across the sky. In the foreground, there is a dark teal silhouette of a city skyline. On the right side, a prominent feature is a large, teal-colored structure that resembles a modern bridge or a high-rise building with a flat top. This structure has several small, dark teal circles along its top edge. The overall aesthetic is clean and modern, with a focus on geometric shapes and a limited color palette of teal, yellow, and light blue.

Sustainable Development in the Nation-State of Singapore

Sawyer Kennell and Leah Bilski



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Article Discussion



UNDP Article

- What is a alternative-energy disadvantaged country?
- Carbon credits and Renewable energy imports? What are these?
- (1) catalysing business transformation, (2) investing in low-carbon technologies, (3) pursuing effective international cooperation
(4) adopting low-carbon practices
- What does their commitments say about their attitude towards sustainability?
- What is the overall tone of this article?
- What feelings did you come away with?

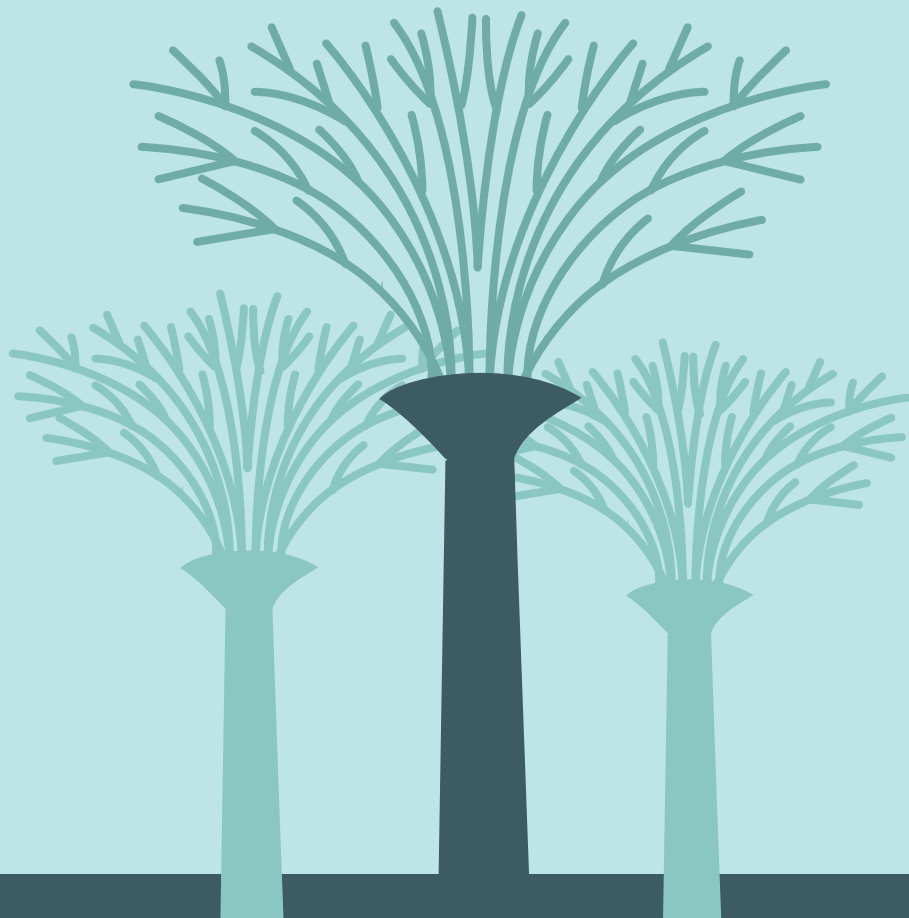
SEAS Article and Video

- What specific reasons did respondents claim was responsible for the lack of progress?
- How do the responses stack up to the progress stated in the UNDP article?
- Is there a rift in what is being shared from officials versus professionals?
- What is the overall tone of the article?
- What feelings did come away with?

01

Introduction

What's going on in
Singapore?





Contradiction in Singapore

What Singapore is Celebrated for:

- ★ 'City in a Garden'
- ★ World-class transit
- ★ NEWater
- ★ 80% of population in public housing

What the Numbers Show:

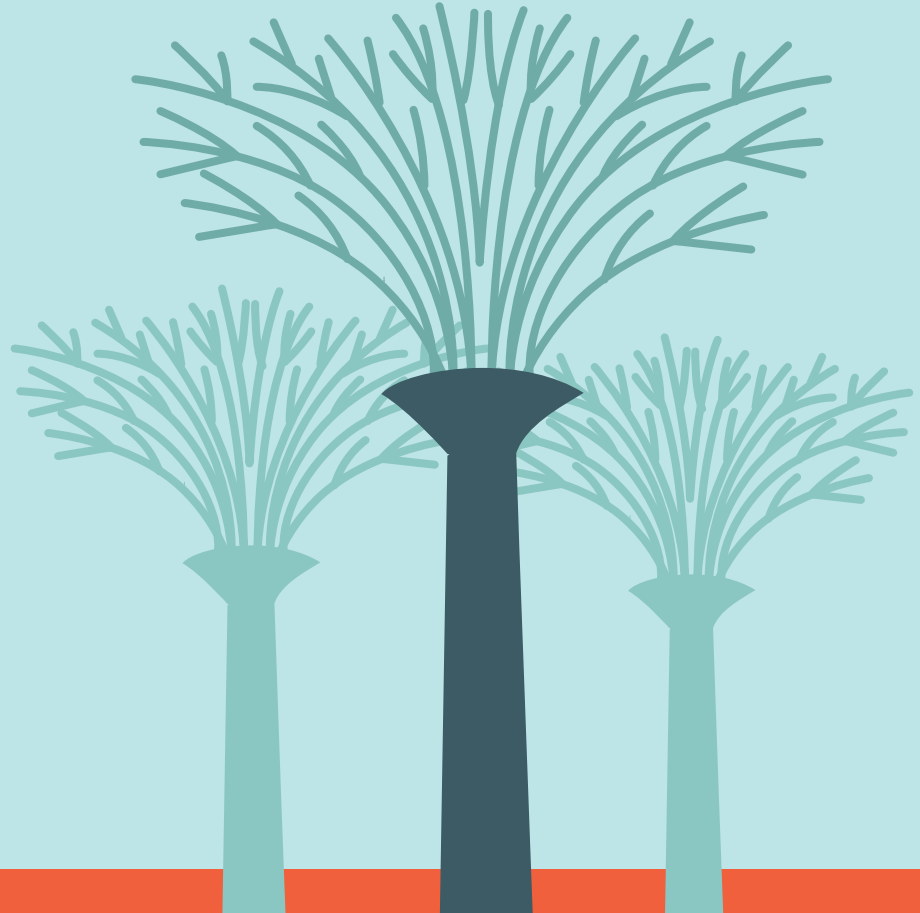
- ★ CAT overall rating - "Highly Insufficient"
 - ★ NDC pathway implies 3°C+ warming if globally replicated
 - ★ 3rd-largest oil refining center in the world
- 

How does one of the world's most efficient,
best-planned city remain so far from a 1.5°
C-compatible climate pathway and what does
that tell us about sustainable urban development
globally?



02

Background & Context



The background of the slide is a light blue sky with a few white clouds. At the bottom, there is a stylized illustration of a city skyline in shades of teal and dark blue. A train with a white body and green and orange accents is traveling from left to right on a dark grey bridge. The bridge is supported by several dark blue pillars.

"We are a small country with no natural resources, so our people must be our greatest asset."

—Lee Kuan Yew,
Singapore's Founding Father

Population, Wealth, Poverty Levels



- Separated from Malaysia in August 1965, ~60 years ago
- ~287 square miles of land area, Rhode Island is ~1,545
- Population of just over 6 million
- Wealth equality: 1%:14%, 5%:33%, US - 1%:30%, 10%:67%
- Heavily Urbanized and compact, Gini Coefficient ~.36
- Strong Services and trade sectors 70-75% of output
- Extreme poverty is lower than other earning dense countries
- 3rd Highest cost of living in the world
- Virtually no agriculture sector, heavily reliant on imports

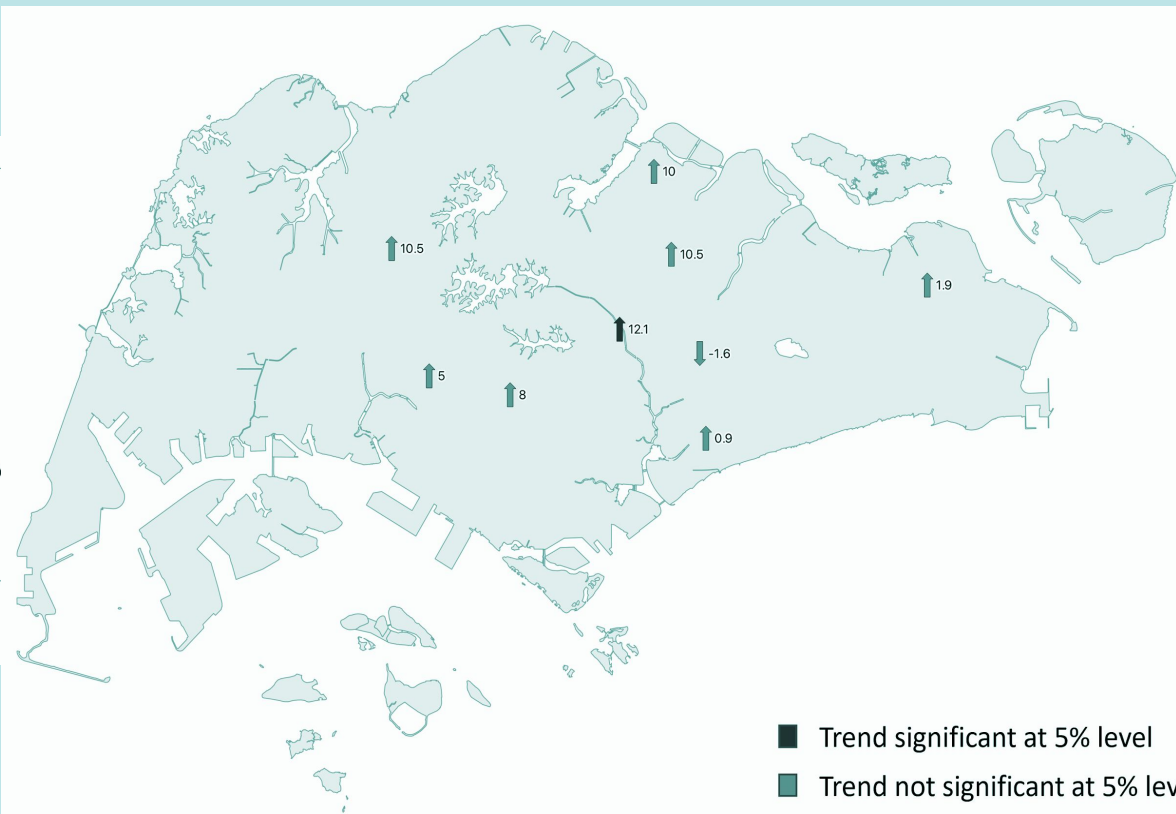
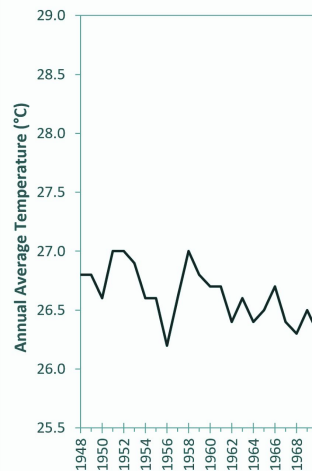
Climate, Weather, Urban Heat Islands



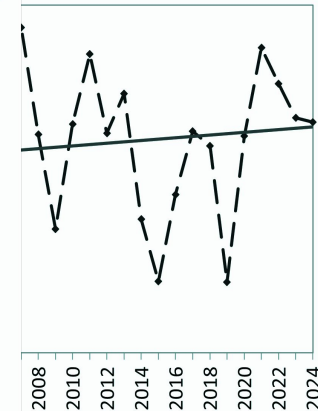
- Classified as Tropical Rainforest, temps ranging from 77 to 91 averages throughout the year
- Seeing Heat Island impacts in the last decade or so due to urban expansion
 - Temperatures rising overall in Changi (semi-urban) over Tengah (rural)
- Overall hotter and wetter conditions than in previous decades



Mapping Trends



1980-2024)





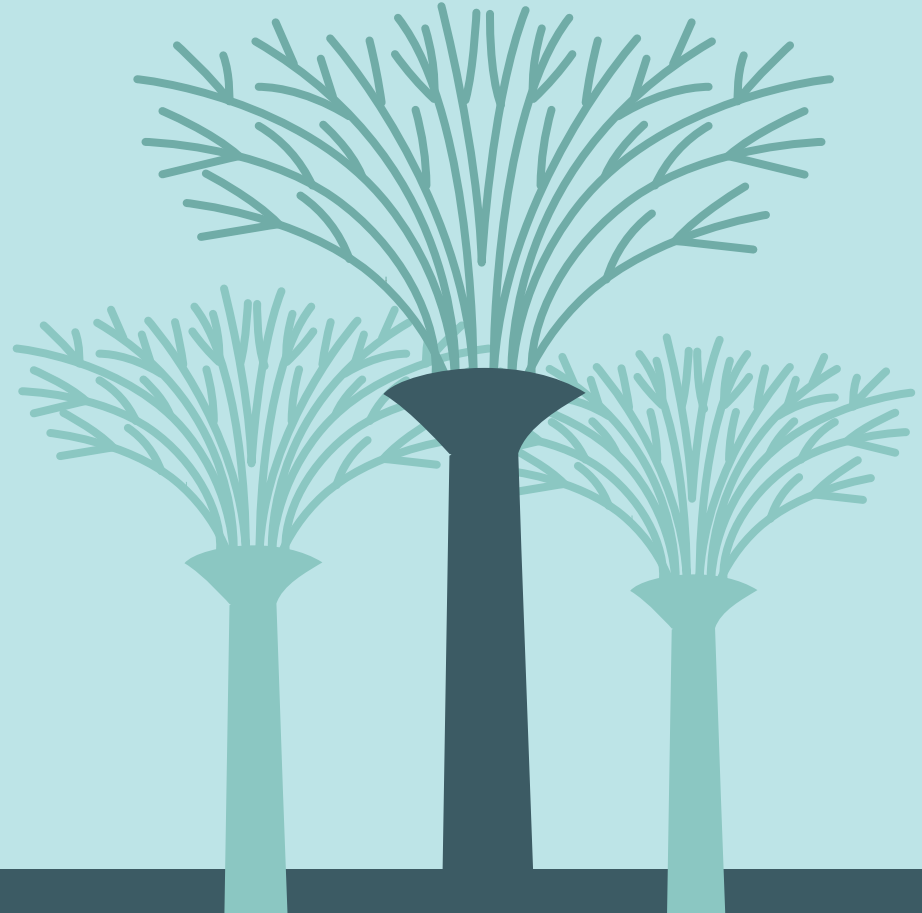
Trade Relations

- Location: southern tip of the Malay Peninsula in Southeast Asia, at the crossroads of global shipping lanes connecting the Indian Ocean to the South China Sea
- 3rd-largest oil refining center in the world; 2nd-largest LNG (liquid natural gas) trading hub in Asia
- Within ASEAN (Association of Southeast Asia Nations), Singapore functions as the dominant financial and professional services center, the region's capital market, and green finance hub
- Why regional context matters for sustainability:
 - 100% of Singapore's natural gas is imported
 - As a fossil fuel trading hub, Singapore has a direct economic interest in the longevity of the fossil fuel system
 - Singapore's green finance role means its climate decisions have outsized regional influence
 - Potential low-carbon electricity imports from Vietnam, Laos, and Indonesia make regional relationships central to Singapore's own decarbonization



03

State of Sustainability





Sustainability Marks



- **High Emitter** putting emphasis on building efficiency (20%)
- Sustainability measures are **waste recovery and disposal**
- **Green Building Standards**, vertical greenery, high density living
- Resource pricing and availability (housing, transport, water, etc)
 - Extremely high cost of living
- **Very little natural resources** - Water strategy "**four national taps**"
 - Rain water, Waste water, Desal water, Imported water
- Workforce
 - **Large service economy**, reliance non-domestic workforce
- **Green economy** transition for **buildings**, travel, and energy production
- **Mass Rapid Transit system** - cheap travel to almost anywhere in singapore



Cost of Living

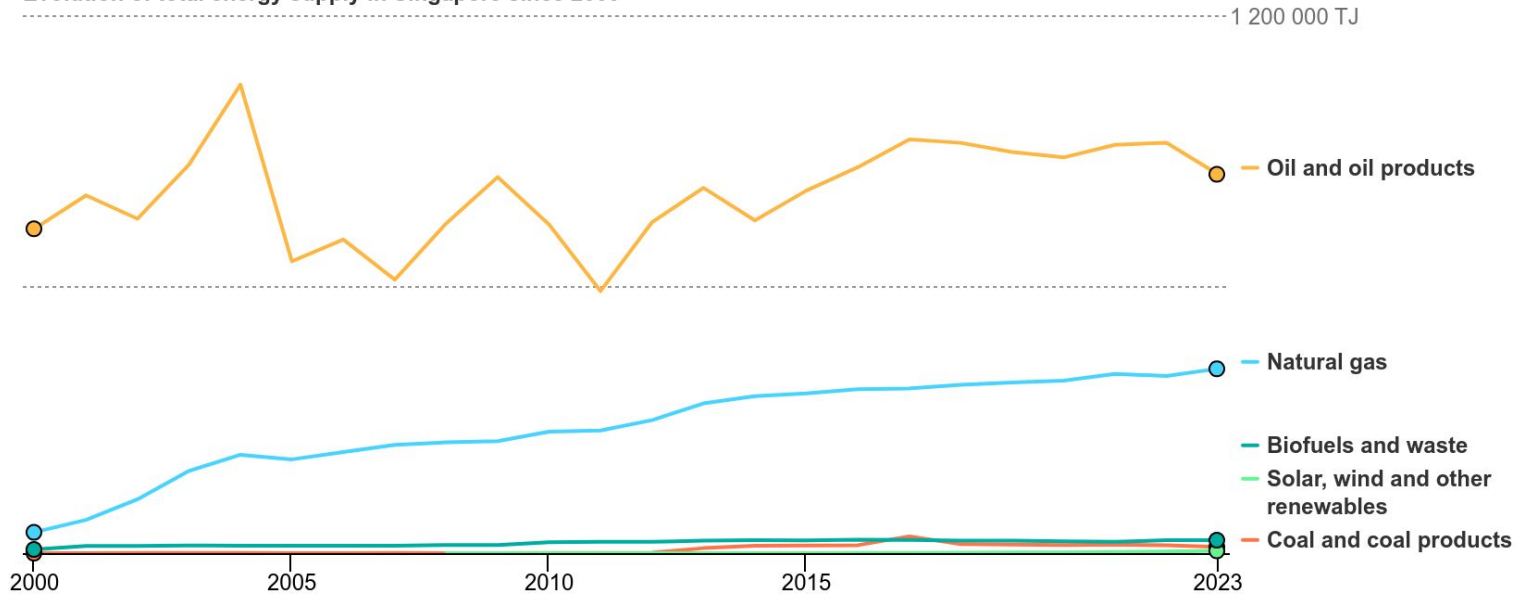


- Cost of Living in United States is **22.2% lower** than in Singapore (excluding rent)
- Cost of Living Including Rent in United States is **30.8% lower** than in Singapore
- Rent Prices in United States are **44.4% lower** than in Singapore
- Restaurant Prices in United States are **34.2% higher** than in Singapore
- Groceries Prices in United States are **7.2% lower** than in Singapore
- Local Purchasing Power in United States is **46.7% higher** than in Singapore

<https://www.singstat.gov.sg/find-data/search-by-theme/households/household-expenditure/visualising-data/household-expenditure-survey-dashboard>

Energy Mix

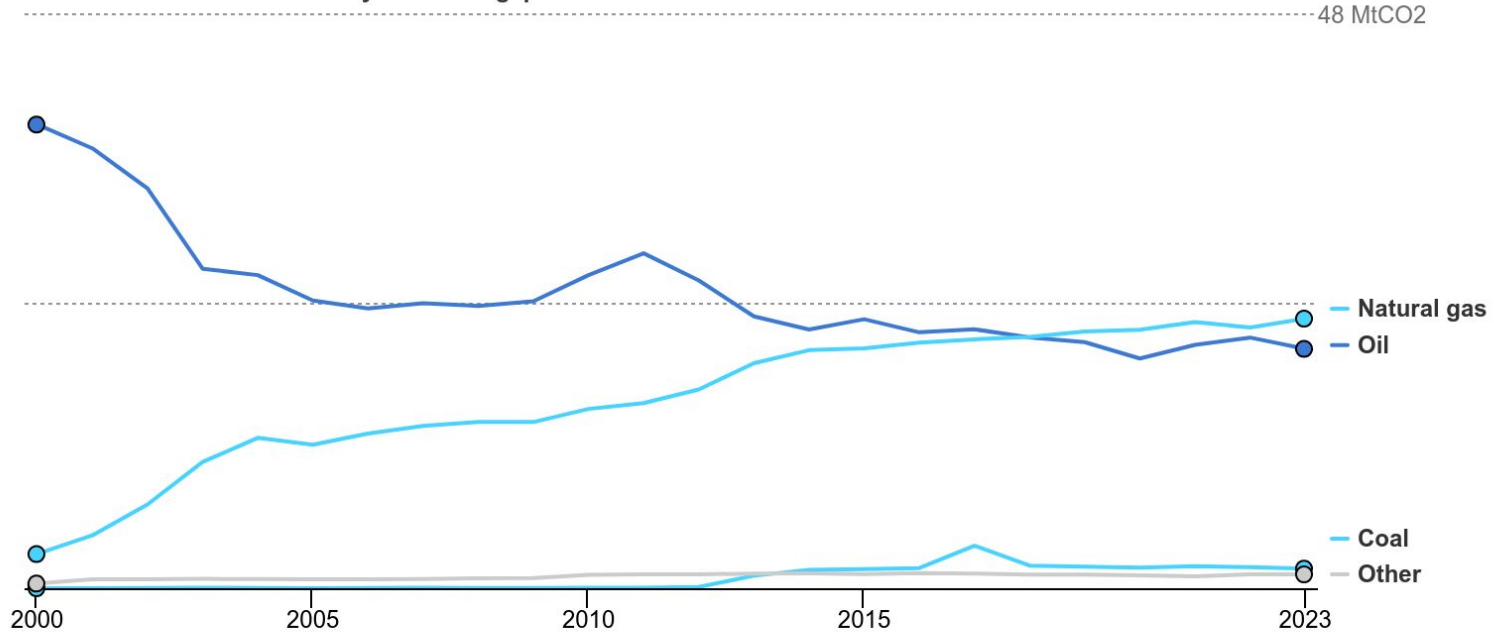
Evolution of total energy supply in Singapore since 2000



Source: International Energy Agency. Licence: CC BY 4.0

Carbon Footprint

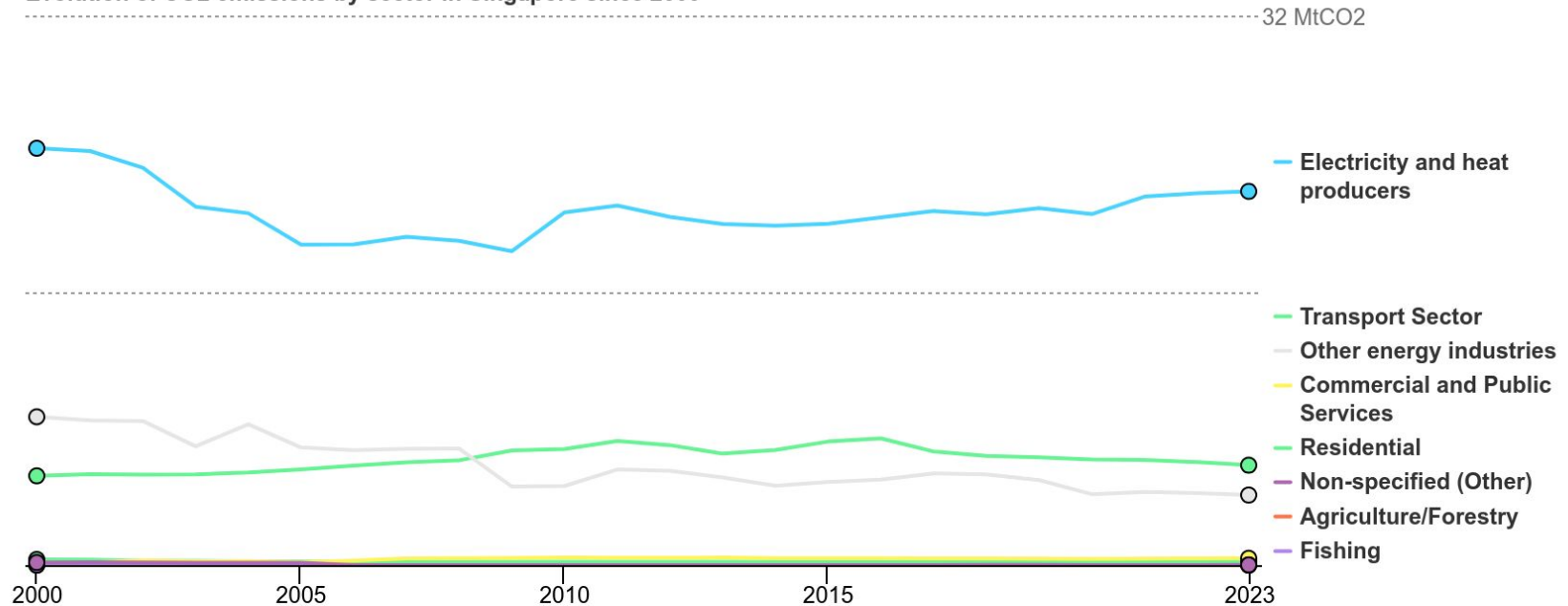
Evolution of CO2 emissions by fuel in Singapore since 2000



Source: International Energy Agency. Licence: CC BY 4.0

Emissions by Sector

Evolution of CO2 emissions by sector in Singapore since 2000



Source: International Energy Agency. Licence: CC BY 4.0

Built Environment & Green Buildings



- ~80% of residents live in **HDB public housing**
 - Compact, transit-integrated, relatively energy-efficient by design
- BCA Green Mark Scheme
- Buildings account for **20% of total national emissions**
- Since 2021: all new and existing public sector buildings must achieve **"Green Mark Platinum Super Low Energy" (SLE) standard**
- "Living Buildings" and vertical greenery are often required to **replace square footage** of plant life lost after the construction of a new building



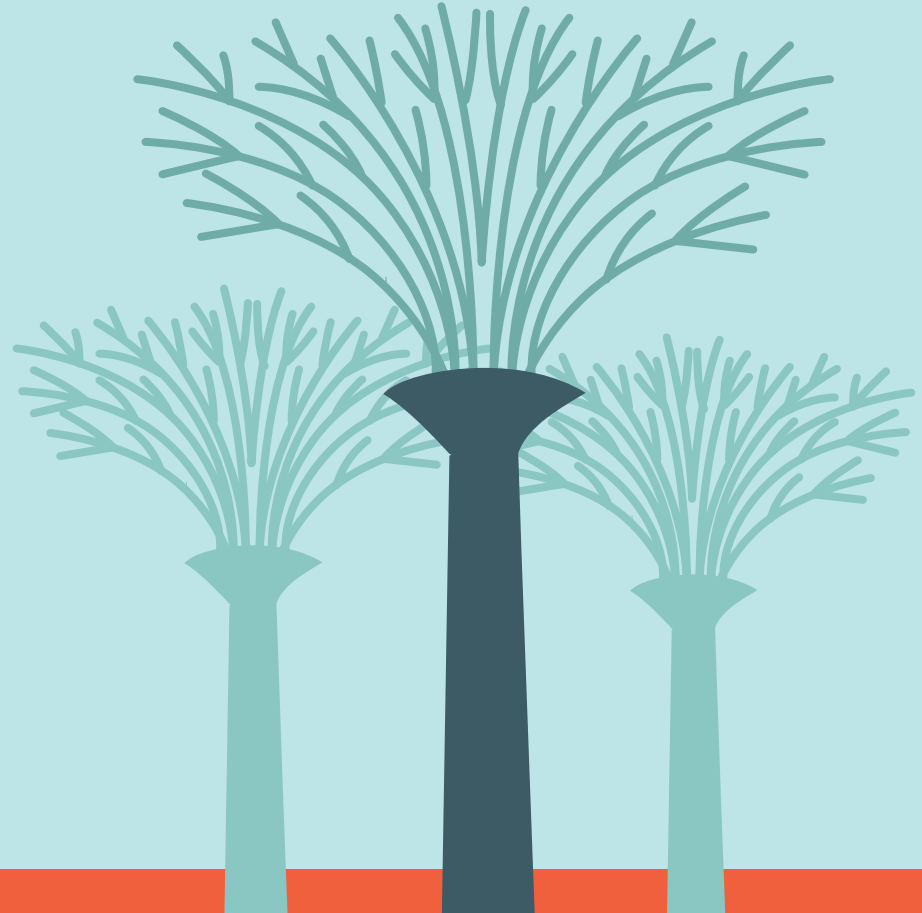
Waste & Recycling

- Over the last 40 years, the amount of solid waste disposed in Singapore has **increased seven-fold** (2020).
 - At current rates, the city-state's only landfill at Semakau Island, covering an area of 350 hectares (~1.3 sq miles), will run out of space by 2035.
- Most non-recyclable trash in Singapore is transported to Semaku and **incinerated**. Incineration smoke is filtered and remaining ash is kept in a localized fly ash pond.
 - **Four existing waste-to-energy (WtE) incineration plants** process large majority of non-recyclable waste with energy recovery
 - **NEWSand Initiative** (pilot) converts incinerated bottom ash into construction-grade material for roads
- **Zero Waste Master Plan** and **Singapore Green Plan** aim for a **70% overall recycling rate** and a **30% overall reduction rate** in per capita daily landfill waste by 2035.
- Overall recycling rate in **2023 was 55%**, falling from previous years and highlighting a challenge to meet 2035 recycling goals.



04

Policy & Regulatory



Political Agreements

- Signed and ratified the **Kyoto Protocol** and **Paris Agreement**
- Submitted Long-Term Low-Emissions Development Strategy (LDES) in 2022, committing to **net-zero emissions by 2050**.
- Updated Nationally Determined Contribution (NDC) targets a peak of **60 MtCO₂e by 2030**, which is a **reduction from the previous target of 65 MtCO₂e**. Still substantially above 1.5 C compatible pathways..
- Singapore's commitments are not consistent with limiting global warming to 1.5 C, and if replicated globally, would **likely result in a warming of 3 C or above**.



Governance



- **One-party rule since 1965** - The People's Action Party (PAP) has governed continuously since independence, operating as a parliamentary republic with a strong executive and limited political opposition
- **Technocratic, long-term planning** - Major infrastructure and policy decisions are made by professional agencies with strong mandates, large budgets, and planning horizons measured in decades, not election cycles
- **Authoritarian efficiency** - The PAP model enables rapid, large-scale project execution and can impose politically unpopular policies (vehicle quotas, carbon taxes, high water prices) without electoral consequences
- **State-linked economy** - Sovereign wealth funds and state-linked firms dominate key infrastructure sectors, blurring the line between public interest and private profit
- **Democratic accountability is limited** - Civil society, environmental NGOs, and independent media operate in a constrained space; trade-offs in sustainability policy are decided top-down with little public deliberation

International Commitments & CAT Report Card



- Nationally Determined Contribution (NDC)
 - Peak emissions at **60 metric tons CO2e by 2030**
 - An improvement on the previous 65 metric ton CO2e target, but still substantial above 1.5°C-compatible pathways
- Long-Term Low-Emissions Development Strategy (LDES): **commits Singapore to net-zero emissions by 2050**
- Climate Action Tracker assessment (updated August 2024):
 - Overall rating: "Highly Insufficient"
 - Fair share target "Critically Insufficient"
 - Singapore argues that its constrained renewable options justify a higher-than-average emissions trajectory. CAT does not accept this as fully excusable



Singapore Green Plan 2030 - Five Pillars



The **Singapore Green Plan 2030** is the government's overarching domestic sustainability framework, organized around **five pillars**:

1. City in Nature
2. Sustainable Living
3. Energy Reset
4. Green Economy
5. Resilient Future

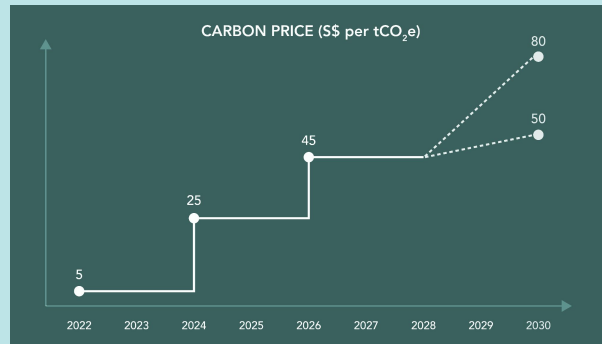
Legislation & Regulatory Architecture

Key enabling legislation:

- Electricity Act & Energy Market Authority Act
- Carbon Pricing Act
- Electricity (Amendment) Bill 2024
- Resource Sustainability Act

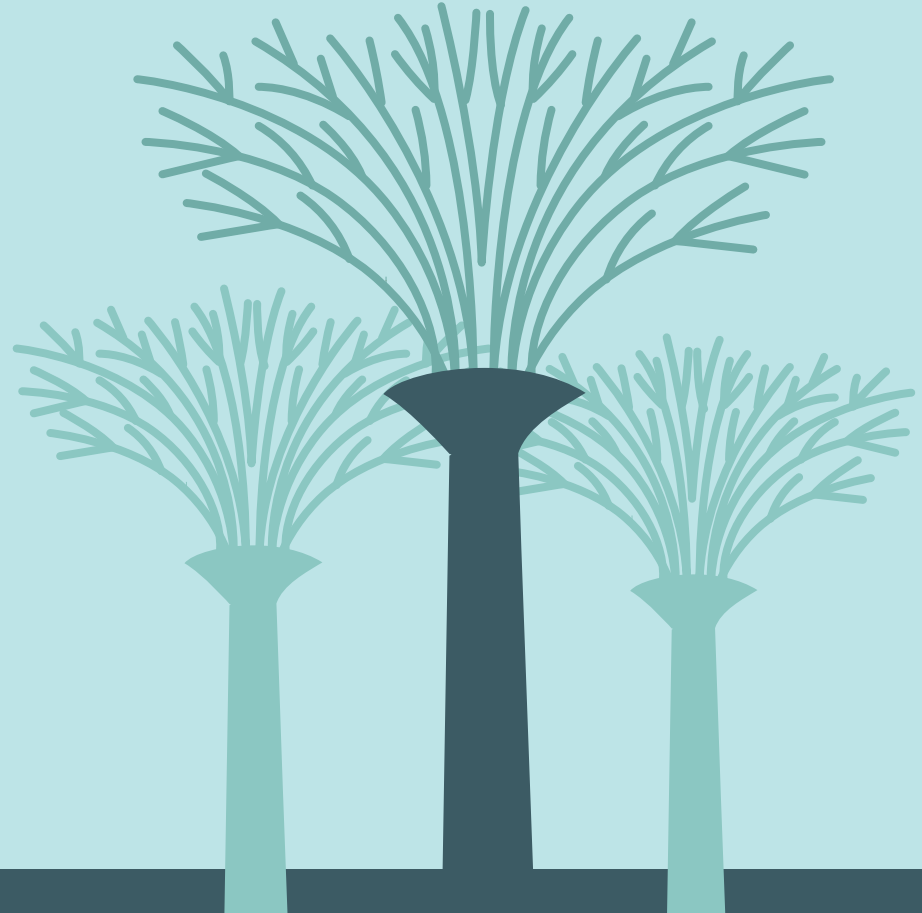
Structural Constraints:

- Land scarcity limits solar scale
- No viable hydro, geothermal, or wind resources
- Political economy of oil refining
- Carbon tax level is too low



05

Climate Initiatives



The \$10 Billion Future Energy Fund



Photo credit: Yazmin Padrilla

Budget 2024: S\$5 billion Future Energy Fund announced

- Singapore's most significant direct public financial commitment to energy transition to date

Budget 2025 adds another S\$5 billion - total committed investment S\$10 billion

Fund designed to support low carbon infrastructure investment:

- Submarine electric cable systems, hydrogen power, power grid updates, feasibility study for SMRs



Low-Carbon Electricity Imports: A Regional Strategy

- Singapore's grid is **too small to decarbonize from domestic renewables alone** - regional imports are necessary
- 2023: Singapore awarded Conditional Approvals to seven projects to import low-carbon electricity from Cambodia, Indonesia, and Vietnam
- Target: **approx. 30% of electricity from regional imports by 2035**
- Requires new submarine cable infrastructure
- **Key risks and uncertainties:**
 - Supply security: dependency on foreign power grids and international political relationships
 - Greenness verification: ensuring imported electricity is genuinely low-carbon
 - Timeline uncertainty: submarine cable projects are multi-year and expensive



New Energy Strategies



Hydrogen

- National Hydrogen Strategy launched 2022
- Ammonia-to-hydrogen pilot underway
- Singapore is positioning itself as a regional hydrogen trading hub
- Some caveats
 - H is still pre-commercial, not a near-term solution

Nuclear

- Nuclear power formally ruled out in 2010
- Budget 2025: government announced a formal feasibility study on SMRs
- Nuclear development signals a meaningful shift in Singapore's risk calculus
 - Not a near-term solution



Realizing Climate Projects



- Winners of the **SolarNova Award Program** (led by EDB and HDB):
 - 2024: EDP Renewables - up to 200MWp equating to 302,000 panels
 - 2022: SembCorp - up to 75MWp dispersed on public infrastructure
 - Ongoing since 2014, and offers annual awards to solar developers
- **Sustainability Funds** for encouraging climate organizations eco-projects:
 - **3R Fund** - Up to 70% of project costs towards recycling and disposal projects
 - **Call for Ideas Fund** - Up to 400,000 towards building energy efficiency
 - **Our Singapore Fund** - 50 million fund towards community building
- **Maritime Singapore Green Initiative** - Reduce impact of shipping and logistics with 100 million going towards near-zero emission fuels, technologies, and practices
- **Singapore's First Polder**: Pulau Tekong adds 800 hectares of land, provides coastal protection, and water remediation
- **REG(E) - Resource Efficiency Grant for (Emissions)** - Grants provided for up to 50% of qualifying costs for emitters for Data Centers and Manufacturers

Testing Climate Projects

BCA SkyLab allows researchers to test building facades

PUB Floating Solar testbed allows for new SOTA panel testing

Singapore Agri-Food Innovation Lab (SAIL) and other university partnerships boost agrifood programs

Singapore: A living laboratory for climate solutions

Open Innovation Lab



BCA SkyLab

- Established under the leadership of Singapore's Building and Construction Authority (BCA) in collaboration with the Lawrence Berkeley National Laboratory in California, USA
- This open innovation lab is a sophisticated platform for researchers and industry professionals to refine and test their technologies
- Allows for the pushing the boundaries of energy efficiency beyond the standards of Green Mark platinum-rated technologies

Floating Solar PV Test-Bed



World's largest 1 MWp floating solar photovoltaic (PV) test-bed

- Launched by the Public Utilities Board (PUB) and Singapore Economic Development Board (EDB); managed by the Solar Energy Research Institute of Singapore (SERIS)
- Involved 10 types of floating structures and PV modules constructed by 9 different companies
- Test-bed revealed that the floating solar PV systems outperform typical rooftop systems in Singapore, with minimal ecological impact when well-designed
- Led to the development of a 60 MWp floating solar PV system

Collaborating with Academia



Environmental & Water Technology Centre of Innovation (EWT COI)

- Collaboration between Enterprise Singapore (EnterpriseSG) and Ngee Ann Polytechnic (NP)
- Serves as a bridge for Small and Medium Enterprises (SMEs) seeking market-driven technology solutions in areas like water and membrane technology, sustainable materials and energy efficiency for built environment

The Singapore Agri-Food Innovation Lab (SAIL)

- A partnership established between Nanyang Technological University (NTU) and EnterpriseSG, to foster innovation in the agri-food sector, facilitating collaborations that drive advancements in agri-food technologies



Final Thoughts



- Efficiency vs. Emissions
- Climate Leader vs. Fossil Fuel Hub
- Top-Down Planning - Asset or Liability
- Just Transition and Who Pays

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Final Thoughts



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- Climate Leader vs. Fossil Fuel Hub
- Top-Down Planning - Asset or Liability
- Just Transition and Who Pays