# Port Decarbonization: Focusing on South Korean Five Major Ports

Industry Trends Brief 2023 No.3

Issue Brief

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- International Maritime Organization (IMO) recently adopted the 2023 Strategy on Reduction of GHG Emissions from Ships, which aims to reach net-zero GHG emissions of international shipping by 2050 with "indicative checkpoints" striving for 30% reduction by 2030 and 80% by 2040.
- Most (62.5%) of South Korea's industrial complexes are situated adjacent to ports; thus, the ports play a key role in Scope 3 GHG reduction of the South Korean corporates. South Korean Ministry of Oceans and Fisheries (MOF)'s two key policies (*Strategy for International Shipping Decarbonization* and *The 4th National Port Master Plan*) should be more closely aligned and implemented to realize greater GHG reduction in South Korean ports.
- Policy Recommendation #1: The government should require ports to publicly disclose scope 1, 2, and 3 GHG emissions, which must include GHG emissions of the ships entering and leaving the port;
- Policy Recommendation #2: The government should encourage the utilization of Alternative Maritime Power (AMP) in ports; and
- Policy Recommendation #3: Ports should strive for 100% use of renewable energy for port electrification to be Paris Agreement aligned.

## ° The Role of South Korean Ports in Decarbonization of the Shipping Industry

Global shipping emissions profile and international developments

- GHG emissions from international shipping comprise 2% of total global emissions as of 2022; and the global shipping industry's share of the global GHG emissions is expected to increase. [1]
- Decarbonization of the South Korean ports can lead to reduction in shipping industry's Scope 3[1] GHG emissions, which can significantly contribute to each company's GHG reduction.

[1] We follow the Scope 3 standard of the GHG Protocol(Greenhouse gas protocol). Scope 1 emissions are direct emissions from owned or controlled sources, meaning including all sources operated by the port. Scope 2 emissions are indirect emissions from the generation of purchased energy, including power generation of port-owned buildings. Scope 3 emissions are all indirect emissions that occur in the value chain of the reporting company, including emissions from the port hinterland and during both upstream and downstream emissions.

- In 2018, IMO initially proposed a 50% reduction target by 2050. But at the Marine Environment Protection Committee (MEPC 80) in July 2023, IMO revised its target to up to 30% by 2030, up to 80% by 2040, and to reach net zero by 2050.
    - At each port level, this creates the need for renewable powered Alternative Maritime Power (AMP) to be installed along with low or zero-emission bunkering facilities.
    - Implementation of the maritime GHG emissions pricing mechanism in the near future was discussed.
- In February 2023, South Korea's MOF announced the *Strategy for International Shipping Decarbonization*, including its intention to achieve a 60% reduction by 2030, an 80% reduction by 2040, and carbon neutrality in international shipping by 2050.
- In comparison, the EU's GHG reduction targets are at least 55% by 2030 (from 1990 levels); and the US's targets are 37% reduction by 2030 and 96% reduction by 2040.
    - The US recognizes the role of ports as a key player in commitment to the creation and operation of Green Shipping Corridors[2].
    - The US is also taking global leadership through initiating the 2021 Clydebank declaration[3] and the 2022 Green Shipping Challenge[4].

Necessity of zero-emission ports

- South Korea, as a peninsula, has 20 out of 32 Industrial Complexes (62.5%) situated near ports. [2] In 2022, around 44,000 foreign ships traveling international routes docked at South Korea's major ports such as Port of Busan, Incheon, Ulsan, and Yeosu-Gwangyang, representing a significant opportunity for GHG reduction, if shipping transformed into a zero or near-zero emission industry. [3]
- South Korean MOF's *Strategy for International Shipping Decarbonization* classifies LNG (liquefied natural gas) as an eco-friendly fuel and includes LNG-capable vessels in its eco-friendly fleet transition plan.
    - LNG-capable vessel (based on the most common type, a low-pressure dual-fuel engine, medium speed, and 4 stroke) emits 70% more GHG emissions than conventional fuels on a life cycle basis. [4]

[2] SFOC defines "green corridor" as follows: A shipping route between at least two ports where zero-emission ships are deployed, ports use 100% renewable energy with 100% electrified infrastructure, and the use of AMPs is mandatory

[3] Set of intentions to promote the creation of 6 green shipping corridors through cooperation between countries by 2025 launched at COP26

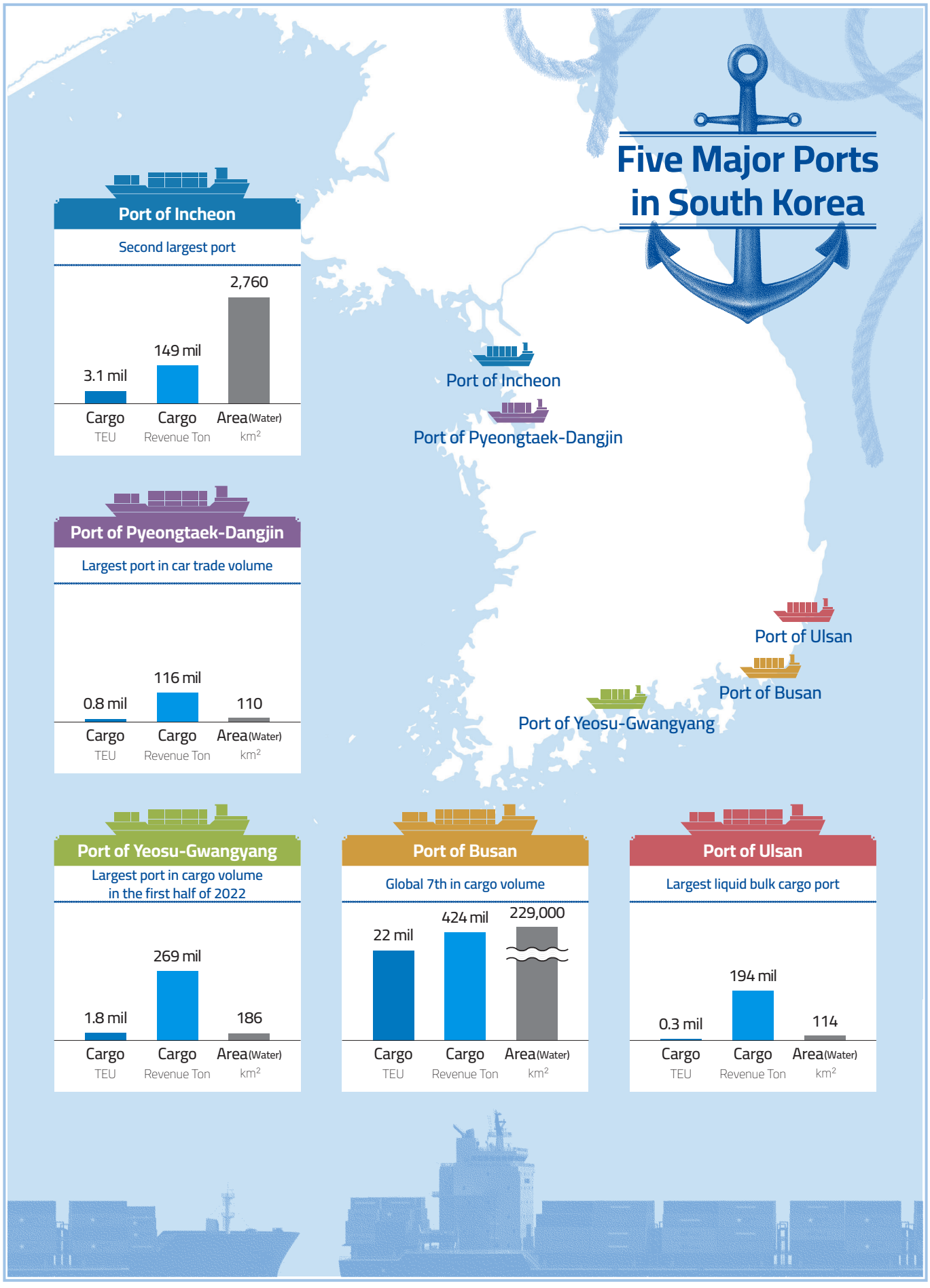
[4] Launched at COP 27 by the US and Norway to align the shipping sector to limit global temperature rise to 1.5 degrees

- Demand for zero-emission ships (such as green hydrogen or green ammonia-capable vessels) will increase with IMO's implementation of maritime GHG emissions pricing mechanism. Shipping companies without zero-emission fuels and industrial ports without zero-emission bunkering facilities will likely lose their competitive edge.

## ° Selection of Five Major Ports in South Korea

- In 2022, the highest volumes of twenty-foot equivalent units (TEU)[5] were handled by the following five South Korean ports: [5]
  - **Port of Busan** ranked the seventh largest port in cargo volume and second largest transshipment port in the world
  - **Port of Incheon** ranked 60th largest port in the world in cargo volume and 2nd largest port in South Korea
  - **Port of Ulsan** ranked the largest liquid cargo port in South Korea
  - **Port of Yeosu-Gwangyang** ranked 85th largest port in the world in cargo volume and was ranked the largest port in South Korea in cargo volume in the first half of 2022 [6]
  - **Port of Pyeongtaek-Dangjin** ranked as the largest port in South Korea in car trade volume
- In 2022, four ports – Port of Busan, Incheon, Ulsan, and Yeosu-Gwangyang – signed a *MOU between the four major Port Authorities to Enhance Cooperation* to enhance port competitiveness. These ports have committed to active collaboration efforts in decarbonization such as sharing insights on sustainable port transition, overseas port networking, and ESG management. [7]
  - To accelerate the decarbonization of the Port of Pyeongtaek-Dangjin, entering into above mentioned MOU or a similar arrangement is recommended.
- In this brief, we propose key policy recommendations to accelerate the decarbonization efforts of the above five major ports.

[5] In 2022, a total of 1.54 billion tons of TEU was handled by Korean ports


Five Major Ports in South Korea
Port of Incheon
Second largest port
3.1 mil
149 mil
2,760
Cargo TEU
Cargo Revenue Ton
Area(Water) km²
Port of Pyeongtaek-Dangjin
Largest port in car trade volume
0.8 mil
116 mil
110
Cargo TEU
Cargo Revenue Ton
Area(Water) km²
Port of Yeosu-Gwangyang
Largest port in cargo volume in the first half of 2022
1.8 mil
269 mil
186
Cargo TEU
Cargo Revenue Ton
Area(Water) km²
Port of Busan
Global 7th in cargo volume
22 mil
424 mil
229,000
Cargo TEU
Cargo Revenue Ton
Area(Water) km²
Port of Ulsan
Largest liquid bulk cargo port
0.3 mil
194 mil
114
Cargo TEU
Cargo Revenue Ton
Area(Water) km²
Port of Incheon
Port of Pyeongtaek-Dangjin
Port of Ulsan
Port of Busan
Port of Yeosu-Gwangyang

## 1. Lack of Full Disclosure of the Ports' GHG Emissions

- South Korea's *Harbor Act (2005)* does not categorize GHG emissions from ports by the Scope 3 standard of the GHG Protocol. GHG emissions reported by South Korean ports vary due to the lack of specific and comprehensive regulations.

> Article 30 (Reduction of Greenhouse Gases)
>
> ① To maintain and manage low-carbon harbors, anyone who runs a licensed, permitted, or registered business in a harbor zone (harbor business entity) under this Act, the *Marine Transportation Act*, the *Harbor Transport Business Act*, or any other relevant statutes or regulations shall endeavor to reduce the emissions of greenhouse gases and pollutants when using harbor facilities.
>
> ② The Government may recommend harbor business entities to install facilities necessary for preventing or reducing the emissions of greenhouse gases, etc., or take other relevant measures.

- Most major ports report on GHG emissions of office buildings and vehicles for Scope 1 and 2. Reported data are also arbitrarily calculated by entering the usage of energy sources into the National GHG Inventory Management System.
    - 2021 GHG emissions of the port authorities [8]

| Busan Port Authority | Incheon Port Authority | Ulsan Port Authority | Yeosu-Gwangyang Port Authority | Gyeonggi Pyeongtaek Port Corporation |
|---|---|---|---|---|
| **2.2 mil** $tCO_2eq$[6] | **161** $tCO_2eq$ | **535** $tCO_2eq$ | **543** $tCO_2eq$ | 40% of GHG emission reduction in 3 years [9] |

The importance of Life Cycle Assessment (LCA) in port decarbonization

- LCA of South Korean ports, including the disclosure of the emissions accounting, can provide the evidence basis to prioritize GHG reduction strategy for the shipping industry.

[6] According to the Port of Busan Authority, the GHG emission provided to SFOC includes direct and indirect emissions from the port and nearby industrial area for Scope 1 and 2, and also covers Scope 3 by calculating emissions from vessels operating in the harbor and at berth

Emission disclosure and Scope 3 categorization of international ports

- Port of Rotterdam, the leading European port, is associated with about **13.7 mil** $tCO_2eq$ per year. [10]
    - GHG emissions of ships entering and departing from the Port of Rotterdam across the supply chain, such as loading and unloading, bunkering, and other in-port activities are included in the above emissions.

**If Scope 1, 2, and 3 GHG emissions of the ports are defined and disclosure of every aspect of ports' emissions becomes mandatory, the GHG emission reduction strategy in South Korea's *Harbor Act (2005)* can be more comprehensive and effective.**

## 2. Underutilization of Alternative Marine Power (AMP)

AMP installation in South Korean Ports

- AMP is a unique air quality measure that reduces severe emissions from diesel auxiliary generators by using on-shore electric power as a substitute. Through AMP, ports can even achieve zero or near-zero emissions if AMP is renewable energy powered.
- In 2019, South Korea's MOF announced the *Mid-term Strategy for AMP Installation to Reduce Fine Dust at ports* which included an ambitious plan to deploy 248 AMPs in South Korean ports by 2030. [11]
- South Korea's MOF also announced *The 4th National Port Master Plan* which will increase the installation of AMPs to improve the quality of life of local residents around the ports by preventing the spread of Particulate Matters.
    - Under the plan, a total of 932.2 billion KRW (approx. 707 million USD) will be invested by 2030, consisting of a government subsidy of 699.1 billion KRW (approx. 530 million USD) and Port Authories' contribution of 233.1 billion KRW (approx. 176 million USD).
- AMPs installed at South Korea's five major ports (2021)

| Port of Busan | Port of Incheon | Port of Ulsan | Port of Yeosu-Gwangyang | Port of Pyeongtaek-Dangjin |
|---|---|---|---|---|
| 20 High voltage, 78 Low voltage | 3 High voltage, 2 Low voltage | 28 Low voltage | 26 Low voltage | 3 Low voltage [12] |

- South Korea's *Harbor Act (2005)* does not mandate the use of AMP, resulting in low usage by the at-berth vessels. [13]

AMP regulations in EU, US, and China

- In the EU, the *FuelEU Maritime* initiative was presented in 2021 to reduce maritime sector emissions. The *Alternative Fuels Infrastructure Regulation (AFIR)*, requiring vessels docking at EU ports to plug into AMPs, will take effect in 2030. [14]
- In the US, the California Air Resources Board (CARB) adopted the *Ocean-Going Vessel Regulation* in 2007 to reduce emissions from diesel auxiliary generators of the at-berth vessels by connecting to AMP. Since 2014, an 80% reduction in pollution from at-berth vessels was achieved. [15]
- In China, according to the *Measures for the Administration of Port and Ship Shore Power* amended in 2021, vessels with AMP capability (excluding tankers) must use AMP at inland ports[7] if vessels are in dock for at least two hours. [16]

**Legislative regulation for the mandatory use of AMP is essential to achieve further emissions reductions from at-berth vessels.**

## 3. South Korean Ports Need to Strive for 100% Renewable Energy Use

Electrification of South Korean ports' transfer cranes

- Most transfer cranes in South Korean ports were installed with Diesel Particulate Filter (DPF)[8], but due to climate impact concerns, they are gradually being replaced with electrified facilities.
    - DPF-installed transfer cranes reduce 80% of Particulate Matter, which is responsible for worsening air pollution. [17] Electrification of all transfer cranes and other types of equipment at ports must be promptly pursued to further reduce air pollution.
    - Number of Electrified Transfer Cranes (T/C) in South Korea's major ports

| Port of Busan | Port of Incheon | Port of Ulsan | Port of Yeosu-Gwangyang |
|---|---|---|---|
| 366 of 400 T/C | 72 of 77 T/C | 15 of 17 T/C | 23 of 36 T/C |

[7] A port on an inland waterway, such as a river, lake, or canal

[8] A device designed to capture and remove diesel Particulate Matter

Renewable Energy Usage by South Korea's major ports

- South Korean government has not announced a specific plan for how much renewable energy is needed for South Korean ports. [18]
- Ports' renewable energy usage compared to the total energy consumption is not publicly available. Port authorities use the umbrella term "new and renewable energy"[9] to set targets as eco-friendly energy, and the actual share of the renewable energy is unavailable.
    - For example, the Ulsan Port Authority's 2022 "new and renewable energy" share of directly operated facilities was 17.1%. [19] But its renewable energy usage compared to the total energy consumption was not disclosed.
    - "New and renewable energy" usage by South Korea's five major ports

| Port of Busan | Port of Incheon | Port of Ulsan | Port of Yeosu-Gwangyang | Port of Pyeongtaek-Dangjin |
|---|---|---|---|---|
| 31.3GWh (2022) | 3.2GWh (2021) | 337kW (2021) | 42.5GWh (2021) | Marine Center solar panels (2020) |

- South Korean government plans to expand the infrastructure of offshore wind and solar energy to electrify ports to increase the use of "new and renewable energy" as stated in *The 4th National Port Master Plan*. [20]

[9] "New and renewable energy" under the Act On The Promotion Of The Development, Use And Diffusion Of New And Renewable Energy (2021) includes energy from liquefied or gasified coal, and energy from gasified heavy residual oil, in addition to renewable energies.

- South Korean Port Authorities' "New and Renewable Energy" Plans

| | Port of Busan | Port of Incheon | Port of Ulsan | Port of Yeosu-Gwangyang |
|---|---|---|---|---|
| Roadmap | 2022 Sustainability Report of Busan Port Authority | 2021 Sustainability Report of Incheon Port Authority | 2022 Sustainability Report of Ulsan Port Authority | 2021 Sustainabilty Report of Yeosu-Gwangyang Port Authority |
| Specific Targets for "New and Renewable Energy" | Increase to 6.3% of energy mix by 2026<br>Increase to 63.9% by 2030<br>Achieve 100% by 2050 | Not publicly disclosed | Increase to 50.6% of energy mix by 2026 | Achieved 49% of energy sufficiency as of 2021<br>Achieve 100% by 2030 |
| Investment Plans in Renewable Energy | Plans to deploy offshore solar farms, fuel cells, and small-scale wind farms | Plans to deploy offshore solar farms | Plans to expand solar panels and offshore wind farms | Plans to expand solar panels, small-scale wind farms, fuel cells, and geothermal plant |

- An example for Korean ports to consider is the Port of Newcastle in NSW Australia, which announced a transition to 100% renewable power to achieve net zero by 2040 (via a Power Purchase Agreement). [21] The Port of Newcastle plan is expected to reduce 5,000 cubic tons[10] of GHG emissions in total.

**The government should take further steps to make ports strive for 100% renewable energy powered.**

[10] Equivalent to taking 1,000 cars off the road or planting 80,000 trees per year

## ° Policy Recommendations

- More than ever, IMO's revised strategy and international regulations for vessels and ports are focusing on the reduction of GHG emissions. For South Korea to actively adapt to such changes and to maintain competitiveness, the South Korean government has a role in accelerating ports' transition to zero or near-zero emission ports. To achieve this, the following policies are recommended:

    1. If Scope 1, 2, and 3 GHG emissions of the ports are defined and disclosure of every aspect of ports' emissions becomes mandatory, the GHG emission reduction strategy in South Korea's *Harbor Act (2005)* can be more comprehensive and effective.

        - South Korean government must provide a standard for disclosure of Scope 1, 2, and 3 of ports' GHG emissions based on Life Cycle Assessment.

    2. Legislative regulation for the mandatory use of AMP is essential to achieve further emissions reductions from at-berth vessels.

        - South Korean government must not only continue to install AMPs but also require the use of AMPs by the at-berth vessels to further reduce GMG emissions of the ports.

    3. The government should take further steps to make ports strive for 100% renewable energy powered.

        - South Korean government should incentivize ports to disclose their energy mix (share of renewable from the total energy consumption).

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Issue date September 2023

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Special thanks to Anna Song (SFOC) and Allyson Browne (Pacific Environment)

Solutions for Our Climate (SFOC) is an independent nonprofit organization that works to accelerate global greenhouse gas emissions reduction and energy transition. SFOC leverages research, litigation, community organizing, and strategic communications to deliver practical climate solutions and build movements for change.