

Maritime Transport and Ports

Provides thematic methodology for compiling ocean accounts relating to maritime transport and port activities.

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DRAFT

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RECOMMENDED CITATION

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- Compile physical and monetary accounts for shipping emissions, including greenhouse gases and air pollutants, following the SEEA Central Framework air emissions accounting approach detailed in [TG-3.4 Flows from Economy to Environment](#)
- Measure the economic contribution of maritime transport through value added, employment, and trade flows using SNA 2025 production account methods, integrating these measures with the ocean economy structural indicators in [TG-2.5 Structure and Function of the Ocean Economy](#)
- Account for port infrastructure, including land use, dredging, and capital formation, within the asset accounting framework established in [TG-3.1 Asset Accounts](#) and extended in [TG-6.11 Coastal Infrastructure Accounting](#)
- Record environmental interactions including ballast water, hull biofouling, anchoring impacts, and underwater noise as residual flows and ecosystem condition impacts, linking to the emissions methodology in [TG-2.8 Climate Indicators](#)

This Circular connects maritime transport accounts to broader ocean economy measurement ([TG-2.5](#)), climate policy ([TG-2.8](#)), infrastructure investment ([TG-6.11](#)), and labour accounts ([TG-3.5 Social Accounts](#); see Section 3.4.2 for the operational employment-to-social-accounts linkage).

① Framework Position

This Circular specialises the ocean-economy identification method of [TG-3.3 Economic Activity Relevant to the Ocean](#) for one sector: maritime transport and ports, ISIC Revision 4 Division 50 and Class 5222. TG-3.3 owns the general method for identifying ocean-related industries and the ISIC concordance; this Circular adds the sector-specific apportionment, the port asset treatment, and the vessel-activity basis for emissions.

It cross-refers for the residual-flow and air-emissions framework ([TG-3.4](#)), produced asset accounting ([TG-3.1](#)), employment and social accounts ([TG-3.5](#)) and indicator derivation ([TG-2.5](#), [TG-2.8](#)).

Port infrastructure as a produced coastal asset is [TG-6.11](#); this Circular records it as sector capital formation. Vessel-sourced litter is [TG-6.12](#).

1. Outcome

¶1 This Circular provides thematic methodology for compiling ocean accounts relating to maritime transport and port activities. Maritime transport carries more than 80 per cent of global merchandise trade by volume.¹ The compilation of maritime transport accounts supports port investment planning, shipping decarbonisation tracking, and trade facilitation assessment.

¶2 Upon completion, users will be able to:

- ¶3 Identify and classify maritime transport and port activities according to ISIC Revision 4 Division 50 (Water Transport) and Class 5222 (Service Activities Incidental to Water Transportation), applying the ocean economy thematic and extended account framework described in **TG-3.3 Economic Activity Relevant to the Ocean**²
- ¶4 Compile physical and monetary accounts for shipping emissions, including greenhouse gases and air pollutants, following the SEEA Central Framework air emissions accounting approach detailed in **TG-3.4 Flows from Economy to Environment**³
- ¶5 Measure the economic contribution of maritime transport through value added, employment, and trade flows using SNA 2025 production account methods, integrating these measures with the ocean economy structural indicators in **TG-2.5 Structure and Function of the Ocean Economy**⁴
- ¶6 Account for port infrastructure, including land use, dredging, and capital formation, within the asset accounting framework established in **TG-3.1 Asset Accounts** and extended in **TG-6.11 Coastal Infrastructure Accounting**⁵
- ¶7 Record environmental interactions including ballast water, hull biofouling, anchoring impacts, and underwater noise as residual flows and ecosystem condition impacts, linking to the emissions methodology in **TG-2.8 Climate Indicators**⁶

¶8 This Circular connects maritime transport accounts to broader ocean economy measurement (**TG-2.5**), climate policy (**TG-2.8**), infrastructure investment (**TG-6.11**), and labour accounts (**TG-3.5 Social Accounts**; see Section 3.4.2 for the operational employment-to-social-accounts linkage).

¶9 ⓘ Framework Position

¶10 This Circular specialises the ocean-economy identification method of **TG-3.3 Economic Activity Relevant to the Ocean** for one sector: maritime transport and ports, ISIC Revision 4 Division 50 and Class 5222. TG-3.3 owns the general method for identifying ocean-related industries and the ISIC concordance; this Circular adds the sector-specific apportionment, the port asset treatment, and the vessel-activity basis for emissions.

¶11 It cross-refers for the residual-flow and air-emissions framework (**TG-3.4**), produced asset accounting (**TG-3.1**), employment and social accounts (**TG-3.5**) and indicator derivation (**TG-2.5**, **TG-2.8**).

¶12 Port infrastructure as a produced coastal asset is **TG-6.11**; this Circular records it as sector capital formation. Vessel-sourced litter is **TG-6.12**.

2. Requirements

¶1 This Circular builds upon the following prerequisites:

- ¶2 **TG-0.1 General Introduction to Ocean Accounts** – foundational framework for GOAP Technical Guidance, including core concepts, terminology, and accounting principles.
- ¶3 **TG-3.3 Economic Activity Relevant to the Ocean** – general approach to compiling accounts for ocean-related economic activity, including industry classifications, supply and use tables, and the ocean economy thematic and extended account framework. The maritime transport accounts compiled under this Circular are a sector-specific application of the methods in TG-3.3.

¶4 Related Circulars (optional but recommended):

- ¶5 **TG-2.5 Structure and Function of the Ocean Economy** – indicator derivation methodology for transport GVA shares, employment intensity, and export contribution.
- ¶6 **TG-2.8 Climate Indicators** – GHG emission indicators and integration into climate monitoring frameworks.
- ¶7 **TG-3.1 Asset Accounts** – produced asset accounting framework underlying valuation of port infrastructure and vessel capital stock.
- ¶8 **TG-3.4 Flows from Economy to Environment** – detailed emissions accounting methodology, including classification of residual flows underpinning the shipping emissions accounts in Section 3.3.
- ¶9 **TG-4.1 Remote Sensing** – port area spatial delineation using satellite imagery and GIS, supporting land use mapping in Section 3.2.1.
- ¶10 **TG-6.9 Offshore Energy** – accounting treatment of offshore support vessels and maritime logistics of offshore energy installations.
- ¶11 **TG-6.11 Coastal Infrastructure Accounting** – broader infrastructure accounting framework within which port capital formation is situated.

¶12 **Readiness and sequencing.** Whether a country is positioned to compile this account at all – mandate, data architecture, capacity and the order in which to build – is assessed under **TG-0.8 Implementation Readiness Assessment**, and is not restated here.

3. Guidance Material

3.1 Maritime Transport Activities

3.1.1 Industry Classification Framework

¶1 Maritime transport activities are classified according to ISIC Revision 4.⁷

¶2 Division 50 – Water Transport

¶3 This division encompasses the transport of passengers or freight over water, whether scheduled or not, distinguishing between sea-going vessels and inland waterway vessels based on vessel type.⁸

ISIC Code	Description	Scope
501	Sea and coastal water transport	Transport on sea-going vessels
5011	Sea and coastal passenger water transport	Ferries, cruises, water taxis on sea-going vessels
5012	Sea and coastal freight water transport	Container ships, tankers, bulk carriers, general cargo
502	Inland water transport	Transport on vessels not suitable for sea transport
5021	Inland passenger water transport	Rivers, canals, lakes, harbours
5022	Inland freight water transport	Inland freight on waterways and ports

¶4 These codes have been verified against the official ISIC Rev.4 publication.⁹ Compilers should also note the correspondence with the Central Product Classification (CPC) Ver.2.1 for product-level analysis of transport services, which aligns with the supply and use table approach described in **TG-3.3 Economic Activity Relevant to the Ocean**.

¶5 **Inland waterway transport (ISIC 502).** For inland navigation emissions, compilers should refer to the IPCC 2006 Guidelines, Volume 2, Chapter 3, which provides default emission factors for wa-

ter-borne navigation including inland vessels.¹⁰ Vessels operating in both inland and coastal environments should be classified by predominant area of operation. Compilers should document the classification rule in metadata and apply it consistently across the time series.

¶6 Supporting Activities (Division 52)

ISIC Code	Description	Scope	Coverage
5222	Service activities incidental to water transportation	Harbour operations, pilotage, lighterage, vessel salvage, navigation services, berthing	Mandatory
5224	Cargo handling	Loading and unloading of vessels (port portion)	Mandatory (apportioned by maritime ratio)
5229	Other transportation support activities	Freight forwarding, customs agencies	Supplementary

¶7 The “Coverage” column distinguishes ISIC classes that are mandatory components of maritime transport accounts (ISIC 5222 and the maritime-attributable share of ISIC 5224) from those that are supplementary. ISIC 5224 (Cargo Handling) covers both maritime and non-maritime cargo handling. Compilers should apply a maritime ratio to apportion the maritime share, as illustrated in the worked example in Section 3.7 using an illustrative 0.70 ratio.¹¹

¶8 (Note: ISIC Division 30, ship building [3011] and pleasure boats [3012], is excluded from TG-6.10 scope. Record these under general industry accounts.)

3.1.2 Vessel Categories

¶1 For accounting purposes, the commercial fleet may be disaggregated by vessel type. Table 3.1.1 below summarises the principal categories¹².

Vessel category	Description
Container vessels	Carry standardised cargo containers.
Bulk carriers	Dry bulk cargo (grains, ores, coal).
Tankers	Liquid bulk cargo (oil, chemicals, liquefied gas).
General cargo vessels	Non-containerised cargo.
Roll-on/roll-off (Ro-Ro) vessels	Wheeled cargo.
Passenger vessels	Ferries and cruise ships.
Fishing vessels	Commercial fishing (cross-reference TG-6.7 Fisheries Accounting: Integrating Stock Assessment).
Service vessels	Tugs, dredgers, offshore support vessels (cross-reference TG-6.9 Offshore Energy for vessels supporting offshore installations).

¶2 This disaggregation is important for emissions accounting because emission factors vary by vessel type, size, and engine configuration. The vessel classification should be used consistently across physical activity accounts, economic accounts, and emissions accounts. The Fourth IMO GHG Study (2020) provides emission factor data by vessel type and operating mode that can serve as a starting point where country-specific factors are not available.¹³

3.1.3 Trade Flow Measurement

¶1 Maritime trade flows are measured through:

- ¶2 **Volume (physical):** Tonnes loaded and unloaded at ports
- ¶3 **Value (monetary):** Value of goods transported (CIF/FOB basis)¹⁴

- ¶4 **Activity (operational):** Vessel movements, port calls, cargo handling operations

¶5 Data sources include port authority records, customs declarations, automatic identification system (AIS) tracking, and shipping company reports. Satellite AIS covers most commercial vessels over 300 gross tonnes in major shipping lanes, though coverage in remote ocean areas, smaller vessel classes, and terrestrial AIS-predominant regions remains incomplete.¹⁵ Compilers should cross-check AIS-derived activity data against vessel registry sources such as UNCTAD's *Review of Maritime Transport* and document coverage limitations in metadata.

3.2 Port Infrastructure

3.2.1 Port Areas and Land Use

¶1 Port infrastructure accounting requires spatial delineation of port areas. Table 3.2.1 below summarises the main land-use components of a port¹⁶.

Component	Description
Quays and berths	Vessel mooring facilities.
Storage areas	Container yards, warehouses, tank farms.
Intermodal connections	Rail terminals, road connections.
Administrative areas	Offices, customs facilities.
Ancillary facilities	Ship repair, bunkering stations.

¶2 Port areas should be mapped using consistent spatial references (see **TG-4.1 Remote Sensing**) and linked to the SEEA land cover and land use classifications.¹⁷ The port boundary should encompass the full operational area including anchorages, fairways, and approach channels.

3.2.2 Dredging and Land Reclamation

¶1 Dredging activities modify the seabed to maintain or create navigational channels and berthing areas. The distinction between capital and maintenance dredging determines SNA treatment:¹⁸

Type	Definition	SNA treatment
Capital dredging	Creates new channel/berth capacity or enlarges existing capacity beyond previous design depth or width	Gross fixed capital formation (GFCF)
Maintenance dredging	Restores a channel or berth to its original design depth and width following sedimentation	Intermediate consumption

¶2 Compilers should apply this rule to dredging expenditure records from port authorities and contractor invoices. Where invoices do not clearly distinguish the two, compilers should document the criterion used. For the fuller treatment of capital versus maintenance distinctions for coastal works, cross-reference **TG-6.11 Coastal Infrastructure Accounting** Section 3.2.4.

¶3 Physical measures:

- ¶4 Volume of sediment removed (cubic metres)
- ¶5 Disposal location (ocean dumping, beneficial reuse, confined disposal)
- ¶6 Channel depth and width specifications

¶7 **Dredge spoil as a material flow.** Dredged sediment should be recorded as a material flow in the SEEA Central Framework physical flow accounts. SEEA CF paragraph 3.267 treats dredging material flows under physical flow accounting, with contaminated spoil recorded as a residual flow within waste accounts and unpolluted spoil excluded from the waste-flow boundary.¹⁹ Compilers should record dredge spoil volumes by disposal pathway and sediment quality classification.

¶8 Environmental considerations:

- ¶9 Sediment quality (contaminant levels)
- ¶10 Impacts on benthic habitats
- ¶11 Turbidity and sedimentation effects

¶12 Land reclamation for port expansion should be recorded as a transformation of marine extent to land (cross-reference **TG-3.1 Assets**).²⁰ Port expansion through reclamation may also trigger requirements under coastal infrastructure accounting (see **TG-6.11 Coastal Infrastructure Accounting**).

3.2.3 Port Capital Formation

¶1 Gross fixed capital formation in ports includes investment in:²¹

- ¶2 Breakwaters and seawalls
- ¶3 Quay structures and berths
- ¶4 Container handling equipment (cranes, straddle carriers)
- ¶5 Warehouses and storage facilities
- ¶6 Navigational aids and vessel traffic systems
- ¶7 Environmental protection infrastructure (oil spill response, waste reception)

¶8 Capital formation should be recorded following SNA 2025 principles, distinguishing new construction and major improvements (gross fixed capital formation) from routine maintenance (intermediate consumption). Depreciation schedules vary by asset type: quay structures may have useful lives of 50 years or more, whilst handling equipment typically depreciates over 15–25 years. The perpetual inventory method (PIM) is the standard approach for compiling port capital stock.²²

3.2.4 Vessel Capital Stock

¶1 Vessels are produced assets that should appear in national balance sheets as transport equipment under SNA 2025 asset classification AN1131.²³ Vessel capital stock is required for: (i) calculating consumption of fixed capital used to derive net value added in Table 3.71, and (ii) supporting complete asset accounting for the maritime transport industry.

¶2 **Data sources for vessel capital stock:**

- ¶3 National vessel registries and maritime administration records (acquisition costs, vessel age, type)
- ¶4 Lloyd's Register / IHS Markit (now LSEG/Clarksons) maritime fleet databases (vessel characteristics, valuation benchmarks)
- ¶5 Customs records on vessel imports and exports
- ¶6 Shipping company financial statements (book values, depreciation schedules)

¶7 **PIM application.** Compilers should apply the perpetual inventory method to vessel acquisition costs using vessel-type-specific service lives and depreciation profiles (container vessels typically 20–30 years, bulk carriers and tankers 25–30 years, and passenger ferries 30–40 years). For the general PIM framework, see **TG-3.1 Asset Accounts**. The depreciation entry for ISIC 501 in Table 3.71 represents vessel depreciation derived through this PIM approach.

3.3 Emissions Accounting

3.3.1 Greenhouse Gas Emissions

¶1 Following the SEEA Central Framework, air emissions accounts record the generation of emissions by resident economic units by type of substance.²⁴

¶2 **GHG emissions from shipping include:**

Substance	Chemical Symbol	Primary Source	GWP100 (AR6)
Carbon dioxide	CO ₂	Fuel combustion	1
Methane (fossil)	CH ₄	Fuel combustion, LNG slip	29.8
Methane (biogenic)	CH ₄	Biofuel combustion	27.0
Nitrous oxide	N ₂ O	Fuel combustion	273

¶3 GWP100 values are taken from IPCC AR6 WGI Chapter 7 Supplementary Material Table 7.SM.7.²⁵ Compilers should align the GWP cycle (AR5 vs. AR6) used in maritime transport accounts with the cycle adopted in their country's national GHG inventory under UNFCCC reporting. AR5 GWP100 values may be retained for historical comparability in time series where the national inventory has not yet transitioned.

¶4 Estimation methodology:

¶5 Shipping emissions are typically estimated using activity-based methods:²⁶

¶6

$$E = \sum_v \sum_m (A_{v,m} \times EF_{v,m})$$

¶7 Where:

- ¶8 E = Total emissions
- ¶9 A = Activity (fuel consumption or distance travelled)
- ¶10 EF = Emission factor
- ¶11 v = Vessel type
- ¶12 m = Operating mode (cruising, manoeuvring, at berth)

¶13 Data sources:

- ¶14 Ship fuel consumption records
- ¶15 AIS-derived activity data
- ¶16 Port call statistics
- ¶17 National fuel sales data with maritime allocation

¶18 The Fourth IMO GHG Study (2020) provides emission factor data by vessel type and operating mode. Compilers may also draw on the IPCC 2006 Guidelines, Volume 2, Chapter 3.²⁷

¶19 *Table 3.3.1: Shipping emission calculation methods*

Emission Source	Calculation Basis	Data Source	Account Entry
Main engines	Fuel consumption x EF	Fuel sales, voyage reports	Residual flow (air)
Auxiliary engines	Activity hours x load factor x EF	Port records	Residual flow (air)
Underwater noise	Vessel type x speed	AIS data	Condition impact
Oil discharge	Incident reports	Coast guard	Residual flow (water)

¶20 Ballast water discharge is not an air emission or a SEEA residual air flow. It is a biological pressure with ecosystem condition implications. The accounting treatment for ballast water is set out in Section 3.5.1.

¶21 Residence principle application:

¶22 Following the SEEA CF residence principle, emissions should be attributed to the country where the operating enterprise is resident, not the flag state of the vessel.²⁸ In practice, emissions from a vessel flagged in one country but operated by an enterprise resident in another should be attributed to the country of the operator.

¶23 **Reconciliation with IPCC national inventories.** The SEEA-based residence attribution will differ from IPCC national inventory treatment, which excludes international marine bunker fuels from national totals and reports them as a memo item.²⁹ Compilers should prepare a bridging table in metadata distinguishing SEEA-attributed shipping emissions from IPCC memo-item international marine bunker fuel quantities. For broader reconciliation between thematic emissions accounts and national climate reporting, see **TG-2.8 Climate Indicators**.

¶24 **Flag-of-convenience and complex vessel ownership.** Compilers should apply the following decision tree for residence attribution:

Case	Situation	Attribution rule
1	Vessel flagged and operating enterprise resident in same country	Attribute emissions and output to that country
2	Flag state differs from operating enterprise's country of residence	Attribute to the operator's country of residence
3	Complex multinational ownership through shell companies and multiple flag states	Apply the ultimate beneficial ownership chain consistent with SNA 2025 guidance; document the chain in metadata

¶25 Practical sources include the IMO Global Integrated Shipping Information System (GISIS) and Lloyd's Register / IHS Markit (LSEG/Clarksons) maritime databases. Open or international registries account for the majority of global gross tonnage, so most compiling countries will encounter Case 2 or Case 3 in practice.

3.3.2 Air Pollutants

¶1 Beyond GHGs, maritime transport releases air pollutants with local and regional health impacts:³⁰

Pollutant	Symbol	Impact	Mitigation
Sulphur oxides	SOx	Acid rain, respiratory health	Low-sulphur fuel, scrubbers
Nitrogen oxides	NOx	Smog, respiratory health	Emission control areas (ECAs)
Particulate matter	PM	Cardiovascular, respiratory	Engine efficiency, fuel quality
Black carbon	BC	Arctic warming, health	Operational measures

¶2 IMO MARPOL Annex VI regulates these emissions and has established Emission Control Areas. The 2020 global sulphur cap of 0.50 per cent m/m has had a material effect on fuel composition and emissions profiles that should be reflected in time series accounts.³¹

¶3 For linkage to health impacts, see **TG-2.7 Pollution and Other Flows**. For integration of shipping GHG emissions into national climate indicator frameworks, see **TG-2.8 Climate Indicators**.

3.3.3 Underwater Noise

¶1 Shipping is a major source of chronic underwater noise pollution, particularly at low frequencies (10–1000 Hz) that overlap with marine mammal communication bands.³²

¶2 Noise emissions can be characterised by:

- ¶3 **Source level** (dB re 1 microPa at 1 m)
- ¶4 **Frequency spectrum**
- ¶5 **Temporal patterns** (continuous vs. intermittent)

¶6 Accounting for underwater noise requires:

- ¶7 Vessel traffic density data (AIS)
- ¶8 Source level models by vessel type and speed
- ¶9 Propagation modelling for spatial distribution
- ¶10 Overlay with sensitive habitats and species distributions

¶11 Underwater noise accounting is an emerging area where data availability and standardised methods remain under development. The IMO Guidelines for the Reduction of Underwater Noise from Commercial Shipping (MEPC.1/Circ.833) provide a voluntary framework, whilst regional initiatives such as JOMOPANS are developing monitoring methodologies.³³ Compilers should record noise indicators where feasible and note limitations in metadata. For linkage to ecosystem condition assessment, see **TG-2.1 Biophysical Indicators**.

3.4 Economic Measurement

3.4.1 Value Added

¶1 Maritime transport value added is calculated according to SNA 2025 principles:³⁴

¶2 **Gross Value Added (GVA)** = Output – Intermediate Consumption

¶3 For maritime transport industries (ISIC 50, 5222):

- ¶4 **Output** = Freight revenue + passenger revenue + charter income + ancillary services
- ¶5 **Intermediate consumption** = Fuel, port fees, insurance, maintenance, provisions

¶6 **Net Value Added** = GVA – Depreciation

¶7 **Illustrative calculation structure:**

Component	ISIC 501	ISIC 502	ISIC 5222	Total Maritime
Output (P.1)	[value]	[value]	[value]	[sum]
Intermediate consumption (P.2)	[value]	[value]	[value]	[sum]
GVA (B.1g)	[value]	[value]	[value]	[sum]
Depreciation (P.51c)	[value]	[value]	[value]	[sum]
NVA (B.1n)	[value]	[value]	[value]	[sum]

¶8 For countries with material transshipment activity, care should be taken to correctly attribute output to resident enterprises, consistent with the balance of payments treatment of freight transport described in BPM6.

3.4.2 Employment

¶1 Employment in maritime transport includes:³⁵

¶2 **Seafarers:**

- ¶3 Officers and ratings on commercial vessels
- ¶4 Measured by nationality (flag state vs. residence state considerations)

¶5 **Shore-based employment:**

- ¶6 Port workers (stevedores, crane operators)
- ¶7 Port authority and maritime agency staff
- ¶8 Ship agents, freight forwarders
- ¶9 Ship repair and maintenance workers

¶10 Employment data should distinguish:

- ¶11 Number of persons employed

- ¶12 Full-time equivalents (FTEs)
- ¶13 Hours worked
- ¶14 Compensation of employees

¶15 **Residence-basis measurement and seafarer reconciliation.** Employment should be measured on a residence basis consistent with SNA 2025 Chapter 19, adjusting flag-state data from MLC 2006 sources to reflect the number of seafarers resident in the compiling country regardless of vessel flag.³⁶ The BIMCO/ICS *Seafarer Workforce Report* (2021 edition) provides national seafarer supply estimates by country of residence that may be used as a reference benchmark.³⁷ Compilers should document the reconciliation approach in metadata and reflect the adjustment in the employment row of the worked example (see the note attached to Table 3.7.2).

¶16 **Linkage to social accounts.** For integration of maritime transport employment data with social accounts, including labour income distribution, working conditions, occupational safety, and gender disaggregation, see **TG-3.5 Social Accounts**.

3.4.3 Supply Chain Linkages

¶1 Maritime transport has extensive backward and forward linkages:³⁸

¶2 **Backward linkages (inputs):**

- ¶3 Shipbuilding and repair (ISIC 3011)
- ¶4 Fuel suppliers
- ¶5 Port services
- ¶6 Classification societies
- ¶7 Marine insurance

¶8 **Forward linkages (outputs):**

- ¶9 Wholesale and retail trade
- ¶10 Manufacturing (imported inputs)
- ¶11 Agriculture (commodity exports)
- ¶12 Tourism (cruise industry)

¶13 These linkages can be quantified using supply and use tables and input-output analysis (see **TG-3.3 Economic Activity Relevant to the Ocean**).³⁹

3.5 Environmental Interactions

¶1 Table 3.5.1 summarises the main environmental interactions of maritime transport and their corresponding SEEA account entries.

¶2 *Table 3.5.1: Maritime transport environmental interactions and SEEA flow types*

Interaction	SEEA Flow Type	Section	Related Circular
Ballast water discharge	Biological pressure (ecosystem condition)	3.5.1	TG-2.1 Biophysical Indicators
Hull biofouling	Residual flow (biological)	3.5.2	TG-3.4 Flows from Economy to Environment
Anchoring damage	Ecosystem condition change	3.5.3	TG-6.1 Coral Reef, TG-6.3 Seagrass
Oil and chemical spills	Residual flow (water)	3.5.4	TG-3.4 Flows from Economy to Environment

3.5.1 Ballast Water

¶1 Ships take on ballast water for stability, potentially transporting organisms across biogeographic boundaries.⁴⁰ Ballast water discharge is treated as a biological pressure indicator rather than a SEEA residual air or water flow. Compilers should record ballast water indicators alongside ecosystem condition variables and link them to invasive species monitoring programmes.

¶2 **Accounting elements:**

- ¶3 Volume of ballast water discharged (by port, by vessel origin)
- ¶4 Species detection monitoring
- ¶5 Compliance with Ballast Water Management Convention
- ¶6 Expenditure on ballast water treatment systems (recorded as environmental protection expenditure)

¶7 **Cross-reference:** See [TG-2.1 Biophysical Indicators](#).

3.5.2 Hull Biofouling

¶1 Hull biofouling is a pathway for invasive species introduction.⁴¹

¶2 **Accounting elements:**

- ¶3 Antifouling system application and maintenance
- ¶4 Hull cleaning activities and waste disposal
- ¶5 Biofouling inspections at ports
- ¶6 Linkage to invasive species monitoring

3.5.3 Anchoring Impacts

¶1 Anchoring causes physical damage to seabed habitats, particularly seagrass meadows and coral reefs.⁴²

¶2 **Accounting elements:**

- ¶3 Anchorage locations and frequency of use
- ¶4 Duration of anchor events
- ¶5 Overlap with sensitive habitat areas
- ¶6 Mooring buoy installation as mitigation

¶7 **Cross-reference:** See [TG-6.1 Coral Reef](#) and [TG-6.3 Seagrass](#).

3.5.4 Oil and Chemical Spills

¶1 Despite improved safety, shipping remains a source of marine pollution from accidental and operational discharges.⁴³

¶2 **Accounting elements:**

- ¶3 Spill volume and substance type
- ¶4 Location and environmental sensitivity
- ¶5 Response costs
- ¶6 Natural resource damage assessments
- ¶7 Linkage to SEEA pollution flow accounts ([TG-3.4 Flows from Economy to Environment](#))

¶8 Operational discharges (bilge water, cargo residues) remain a persistent source of chronic pollution that should be captured in flow accounts alongside acute events.

3.6 Compilation Procedure: Maritime Transport Supply-Use Table

¶1 Compiling maritime transport accounts follows a systematic procedure for extracting maritime transport sub-matrices from national supply and use tables, adapted from SNA 2025 Chapter 15

and the ocean economy thematic account compilation approach in **TG-3.3 Economic Activity Relevant to the Ocean** Section 3.4.⁴⁴

Step-by-step compilation

¶1 **Step 1: Identify maritime transport industries by ISIC code.** Using Table 3.1.1, identify all ISIC classes constituting maritime transport: Division 50, Class 5222, Class 5224 (port portion), and related industries. For each class, determine whether it is wholly maritime-related (ocean ratio = 1.0) or partially maritime-related (ocean ratio < 1.0).

¶2 **Step 2: Extract maritime transport sub-matrices from national SUTs.** From the balanced national supply and use tables, extract columns corresponding to maritime transport industries to create a maritime transport supply table and use table.

¶3 *Excluding non-resident enterprise output.* For countries that are major port hubs or transshipment centres, maritime transport columns may include services provided by non-resident enterprises. The residence principle requires excluding non-resident maritime output before deriving GVA. Practical data sources include balance of payments supplementary data on transportation services and port authority records of vessel nationality and operator residence. Cross-reference BPM6 paragraphs 10.73–10.88 on transportation services.⁴⁵

¶4 **Step 3: Determine the maritime share for mixed industries.** For partially maritime-related industries, estimate the share of output attributable to maritime activity. For Class 5224 (Cargo Handling), the 0.70 ratio used in Section 3.7 is illustrative, and compilers must derive their own country-specific ratio from primary data. At least one of the following methods must be documented in metadata: (a) *Revenue-based split*: share of cargo handling revenue attributable to seaport establishments from structural business surveys or port authority financial accounts. (b) *Physical-unit split*: seaport cargo handling tonnes as a share of total cargo handling tonnes from port authority and customs statistics. Where neither method is feasible, apply a sensitivity analysis around the assumed ratio and report the range of resulting GVA estimates in metadata.

¶5 **Step 4: Calculate Maritime Transport Direct GVA.** For each maritime industry, multiply the industry's gross value added from the Use Table by its maritime ratio:

¶6

$$\text{Maritime Transport Direct GVA} = \sum_i (\text{GVA}_i \times \text{Maritime ratio}_i)$$

¶7 **Step 5: Compile employment accounts.** Using labour input rows from the Use Table, calculate maritime transport employment by applying the same maritime ratios to employment data by industry.

¶8 **Step 6: Derive trade flow indicators.** From the Exports column in the Use Table, sum across maritime transport service products to calculate maritime transport service exports. From customs data, compile merchandise trade volumes and values passing through ports.

¶9 **Step 7: Integrate emissions accounts.** Using the emissions calculation methods in Section 3.3, compile air emissions by maritime transport industries from national air emissions accounts, ensuring consistency with GVA and activity data in the maritime transport SUTs.

Data sources

¶1 Key data sources for maritime transport account compilation:⁴⁶

- ¶2 National supply and use tables (primary source for GVA and output)
- ¶3 Port authority statistical reports (cargo volumes, vessel calls, employment)
- ¶4 Maritime administration records (vessel registries, seafarer certification)

- ¶5 Structural business surveys (port and shipping company financial data)
- ¶6 Customs declarations (trade values and volumes)
- ¶7 AIS tracking data (vessel activity, voyage data)
- ¶8 Fuel sales records (maritime fuel consumption for emissions)
- ¶9 Balance of payments transport services supplementary data (for resident/non-resident enterprise attribution)

3.7 Worked Example: Synthetic Port/Shipping Account

¶1 This section presents a worked example for a synthetic medium-income coastal state ("Country B") with a total GDP of approximately USD 80 billion, total employment of 15 million persons, and two major ports handling combined cargo volumes of 45 million tonnes per year. The example illustrates the mixed-industry apportionment for ISIC 5224. It applies an illustrative maritime ratio of 0.70.

¶2 **Table 3.7.1: Country B Maritime Transport Account – Production Account**

Component	ISIC 501 (Sea Transport)	ISIC 5222 (Port Services)	ISIC 5224 (Cargo Handling, 0.70 maritime ratio)	Total Maritime
Output (P.1)	1,850	680	245	2,775
Intermediate consumption (P.2)	1,200	380	140	1,720
GVA (B.1g)	650	300	105	1,055
Depreciation (P.51c)	120	85	18	223
NVA (B.1n)	530	215	87	832

¶3 All monetary values in millions of USD at current prices. The ISIC 5224 column reports the maritime-attributable share after applying the 0.70 maritime ratio (total ISIC 5224 output of 350 x 0.70 = 245). The depreciation entry for ISIC 501 (USD 120 million) reflects vessel capital consumption derived through the perpetual inventory method described in Section 3.2.4.

¶4 **Table 3.7.2: Country B Maritime Transport Employment**

Indicator	Sea Transport	Port Services	Cargo Handling (0.70)	Total Maritime
Persons employed	22,000	18,000	5,600	45,600
FTE employment	21,500	17,000	5,400	43,900
Average compensation (USD/year)	18,500	16,200	14,800	17,138
Labour productivity (USD GVA per person)	29,545	16,667	18,750	23,136

¶5 Sea transport employment is measured on a residence basis as set out in Section 3.4.2. For Country B, seafarer employment from MLC flag-state data has been adjusted to a residence basis using the BIMCO/ICS *Seafarer Workforce Report* (2021) national supply estimates.

¶6 **Table 3.7.3: Country B Maritime Transport Emissions**

¶7 *Panel A: Greenhouse gases (tonnes CO₂e, AR6 GWP100)*

Emission	Sea Transport	Port Services	Cargo Handling (0.70)	Total
CO ₂ from fuel combustion	1,250,000	85,000	22,000	1,357,000
CH ₄ (fossil, GWP 29.8)	191	16	4	211

Emission	Sea Transport	Port Services	Cargo Handling (0.70)	Total
N ₂ O (GWP 273)	227	19	5	251
Total GHG (CO ₂ e)	1,250,418	85,035	22,009	1,357,462
Emission intensity (kg CO ₂ e per USD 1,000 GVA)	1,924	283	210	1,287

¶8 *Note (biogenic CH₄):* The CH₄ row applies the AR6 GWP100 of 29.8 for fossil-sourced methane. As biofuel blends and bio-LNG become material under IMO's 2023 GHG Strategy fuel-mix scenarios, biogenic CH₄ should be reported separately at GWP100 = 27.0 (AR6 non-fossil value). Compilers should document the fuel-type split and apply the corresponding GWP factor for each CH₄ emission stream once biofuel uptake is material.

¶9 *Panel B: Air pollutants (tonnes; illustrative, derived from the same fuel-consumption activity data using EMEP/EEA emission factors)*

Pollutant	Sea Transport	Port Services	Cargo Handling (0.70)	Total
SO _x	4,200	95	25	4,320
NO _x	25,500	1,400	360	27,260
PM _{2.5}	1,150	75	20	1,245
Black carbon (BC)	165	9	2	176

¶10 The figures in Panel B are derived from the same fuel-consumption activity data used for Panel A, applying air pollutant emission factors from the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Chapter 1.A.3.d. Emission factors applied at the IMO 2020 global 0.50% sulphur cap (non-ECA). Compilers applying this method to pre-2020 data or ECA-regulated routes should substitute factors consistent with the applicable sulphur limit. For linkage to health impact assessment, see **TG-2.7 Pollution and Other Flows**.

¶11 **Table 3.7.4: Country B Port Infrastructure Capital Stock (PIM approach)**

Asset Type	Gross Capital Stock	Accumulated Depreciation	Net Capital Stock	Annual Depreciation
Quay walls and berths	1,200	480	720	20
Container handling equipment	350	210	140	23
Port buildings and facilities	280	140	140	8
Breakwaters and navigation aids	450	180	270	9
Total port infrastructure	2,280	1,010	1,270	60

¶12 All monetary values in millions of USD at current replacement cost. The net capital stock of USD 1,270 million represents approximately 4.2 times the annual GVA from port services (USD 300 million). Vessel capital stock for ISIC 501 (not shown: see Section 3.2.4) is compiled separately under SNA asset class AN1131. The compilation applies vessel-type-specific PIM parameters. The USD 60 million annual depreciation on port infrastructure is lower than port-services depreciation in Table 3.7.1 (USD 85 million) because ISIC 5222 depreciation also covers fixed assets outside this table; compilers should reconcile the two and document the USD 25 million difference by asset type.

¶13 The maritime transport sector contributes 1.3 per cent of Country B's GDP (USD 1,055 million / USD 80 billion) whilst employing 0.30 per cent of the workforce (45,600 / 15 million). The GHG emission intensity of 1,287 kg CO₂e per USD 1,000 of GVA provides a baseline for tracking decarbonisation progress under IMO targets.

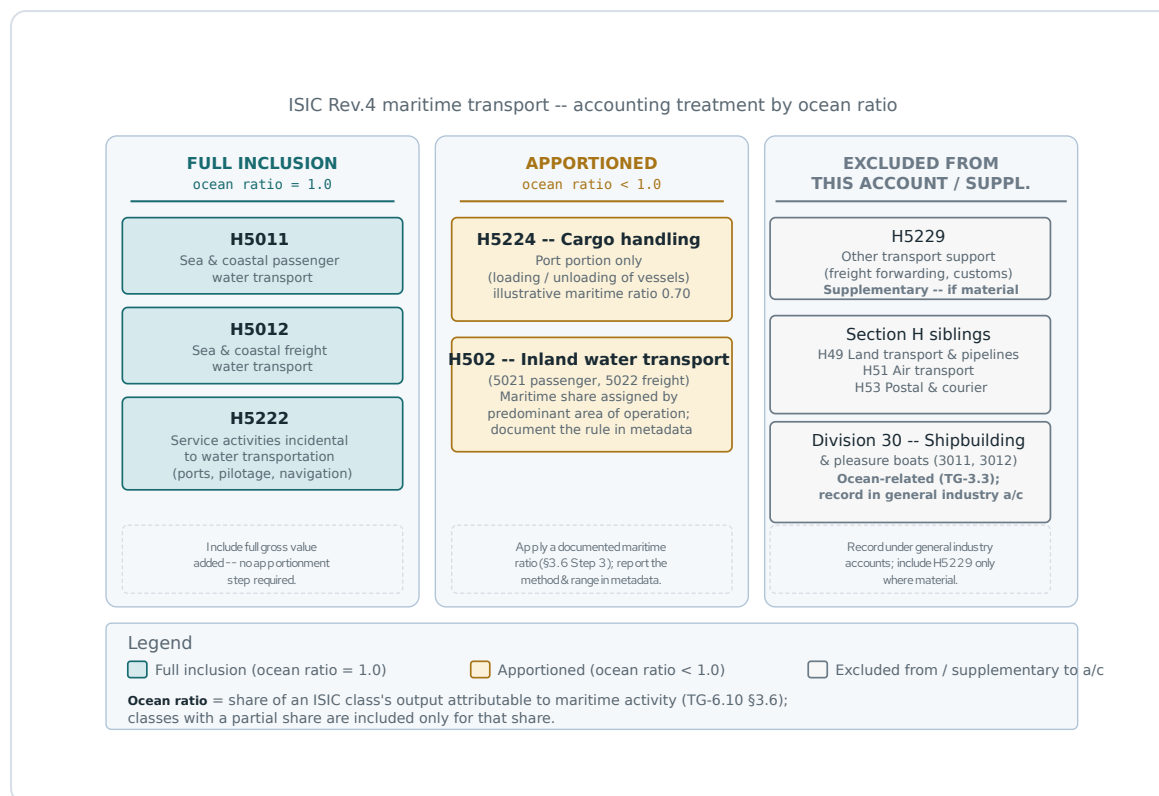


Figure 6.10.1 Maritime-transport ISIC classes placed by ocean-ratio treatment: wholly maritime, partly apportioned, or excluded to general industry accounts. H502 predominant-area rule and 0.70 cargo-handling ratio are illustrative; document country ratios in metadata.

Source: TG-6.10 §3.1.1, §3.6 (ocean-ratio apportionment) and §3.7 (worked 0.70 cargo-handling example); ISIC Rev.4 Section H, Division 50, and Classes 5222/5224/5229. Shipbuilding scope per TG-3.3 (ISIC 3011, ocean-related/direct).

4. Acknowledgements

¶1 **Authors:** [To be confirmed]

¶2 **Reviewers:** [To be confirmed]

¶3 **Contributing frameworks and sources:**

¶4 This Circular draws upon:

- ¶5 *SEEA Central Framework* (UN et al., 2012)
- ¶6 *ISIC Revision 4* (UN, 2008)
- ¶7 *SNA 2025* (UN et al., 2025)
- ¶8 *MARPOL Convention* (IMO)
- ¶9 *Ballast Water Management Convention* (IMO)
- ¶10 *Fourth IMO GHG Study* (IMO, 2020)
- ¶11 *UNCTAD Review of Maritime Transport*
- ¶12 *IPCC Guidelines for National Greenhouse Gas Inventories*
- ¶13 *IPCC AR6 WGI Chapter 7 Supplementary Material* (GWP100 values)
- ¶14 *BIMCO/ICS Seafarer Workforce Report* (2021)
- ¶15 *EMEP/EEA Air Pollutant Emission Inventory Guidebook* (2019)
- ¶16 *OECD Measuring Capital: OECD Manual* (2009)

5. References

1. ¶1 UNCTAD. (2023). *Review of Maritime Transport 2023*. United Nations Conference on Trade and Development. Geneva: United Nations. Estimates maritime transport at over 80% of global merchandise trade by volume. unctad.org/publication/review-maritime-transport-2023 (<https://unctad.org/publication/review-maritime-transport-2023>)
2. ¶2 ISIC Rev.4, Division 50 “Water transport” and Class 5222 “Service activities incidental to water transportation.”
3. ¶3 SEEA Central Framework (2012), Chapter 3, Section 3.6 on emission accounts (air emissions covered under sub-section 3.6 of Chapter 3 physical flow accounts; verify exact sub-paragraph range against the SEEA CF PDF).
4. ¶4 SNA 2025, Chapter 6 on production accounts and value added measurement.
5. ¶5 SEEA Central Framework, Chapter 4 on produced assets including infrastructure.
6. ¶6 IMO guidelines on biofouling and ballast water management; UNCLOS Part XII on marine environment protection.
7. ¶7 ISIC Rev.4, International Standard Industrial Classification of All Economic Activities, United Nations, 2008.
8. ¶8 ISIC Rev.4, Division 50 scope note: “This division includes the transport of passengers or freight over water, whether scheduled or not. Also included are the operation of towing or pushing boats, excursion, cruise or sightseeing boats, ferries, water taxis etc.”
9. ¶9 ISIC Rev.4, Part Three, Section H (Transportation and Storage), Division 50 (Water Transport), pages 194–196.
0. ¶10 IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Volume 2 (Energy), Chapter 3 (Mobile Combustion), Section 3.4.3 on water-borne navigation (inland navigation emission factors); see also the NGGIP background paper on water-borne navigation emissions. National Greenhouse Gas Inventories Programme, IGES.
1. ¶11 ISIC Rev.4, Class 5222 scope note: “activities related to water transport of passengers, animals or freight: operation of terminal facilities such as harbours and piers, operation of waterway locks etc., navigation, pilotage and berthing activities, lighterage, salvage activities, lighthouse activities.”
2. ¶12 IMO vessel type classifications align with SOLAS and MARPOL conventions.
3. ¶13 IMO. (2020). *Fourth IMO GHG Study*. International Maritime Organization. Provides emission factors by vessel type, size category, and operating mode.
4. ¶14 CIF (Cost, Insurance, Freight) and FOB (Free on Board) are standard international trade valuation bases per BPM6.
5. ¶15 AIS (Automatic Identification System) coverage is most complete for commercial vessels over 300 GT operating on major shipping lanes; coverage is materially lower for vessels in remote ocean areas (parts of the Pacific, Indian Ocean and Arctic), for smaller vessel classes, and where terrestrial AIS predominates over satellite AIS. UNCTAD (2023) *Review of Maritime Transport* and IMO GISIS provide vessel registry data for cross-checking AIS completeness. See also: Comer, B., Olmer, N., Mao, X., Roy, B. and Rutherford, D. (2017). *Black carbon emissions and fuel use in global ship-borne trade*. International Council on Clean Transportation.
6. ¶16 PIANC (World Association for Waterborne Transport Infrastructure) guidelines on port facility classification.
7. ¶17 SEEA Central Framework, Chapter 5 on land and ecosystems accounting.
8. ¶18 ISIC Rev.4, Class 4290 includes “dredging of waterways” as part of civil engineering activities. For the capital/maintenance distinction in coastal works generally, see TG-6.11 Section 3.2.4.
9. ¶19 SEEA Central Framework (2012), paragraph 3.267 on dredging material flows within physical flow accounts. Contaminated (polluted) dredging spoil is recorded as a residual flow within waste accounts; unpolluted spoil is excluded from the waste-flow boundary. Verify paragraph reference against the SEEA CF PDF before final publication.
0. ¶20 SEEA EA, Chapter 4 on ecosystem extent accounts and land cover change.
1. ¶21 SNA 2025 treatment of gross fixed capital formation in infrastructure.
2. ¶22 OECD (2009). *Measuring Capital: OECD Manual*, 2nd edition. Chapter 6 provides detailed guidance on applying the perpetual inventory method to infrastructure assets.
3. ¶23 SNA 2025, asset classification ANI131 (Transport equipment) covers vessels as produced assets in national balance sheets. Vessel registries and the Lloyd’s Register / IHS Markit (LSEG/Clarksons) maritime fleet databases provide standard data sources for vessel acquisition costs and characteristics used in PIM-based vessel capital stock estimation. See OECD (2009), Chapter 6 for PIM application.
4. ¶24 SEEA CF (2012), Chapter 3 (Physical Flow Accounts). Air emissions accounts record the generation of gaseous and particulate substances released to the atmosphere by establishments and households as a result of production, consumption and accumulation processes. The specific paragraph supporting this definition is in Chapter 3, Section 3.6 on air emissions accounts; the paragraph number (previously cited as 3.91) has not been confirmed against the SEEA CF 2012 print edition and has been replaced with this section-level citation to ensure robustness.
5. ¶25 IPCC. (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Chapter 7 (The Earth’s Energy Budget, Climate Feedbacks and Climate Sensitivity), Supplementary Material Table 7.SM.7 (GWPI00 values, including climate-carbon-feedback effects for fossil CH₄). Cambridge University Press. See also UNFCCC Decision 18/CMA.1 on the common reporting framework for national GHG inventories.
6. ¶26 IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Volume 2, Chapter 3 on mobile combustion.
7. ¶27 Fourth IMO GHG Study (2020) and IPCC 2006 Guidelines provide complementary emission factor sources for maritime transport.
8. ¶28 SEEA CF, paragraph 2.110 on the residence principle, aligned with SNA. See also SNA 2025, Chapter 4 on globalisation and institutional units.

9. ¶29 IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Volume 2 (Energy), Chapter 3 (Mobile Combustion), Section 3.4 on international bunkers (treated as a memo item excluded from national totals). For broader reconciliation between SEEA-attributed shipping emissions and IPCC memo-item bunker fuel quantities, see [TG-2.8 Climate Indicators](#).
0. ¶30 WHO. (2021). *Air Quality Guidelines*. World Health Organization. European Environment Agency guidance on shipping emissions. See also EMEP/EEA (2019), *Air Pollutant Emission Inventory Guidebook*, Chapter 1.A.3.d on shipping.
1. ¶31 IMO MARPOL Annex VI establishes global sulphur limits and designates Emission Control Areas (ECAs). The 2020 sulphur cap reduced the global limit from 3.50% to 0.50% m/m.
2. ¶32 NOAA. (2023). *Ocean Noise Strategy Roadmap*. National Oceanic and Atmospheric Administration. Identifies shipping as dominant source of low-frequency noise.
3. ¶33 JOMOPANS (Joint Monitoring Programme for Ambient Noise in the North Sea) project methodology for mapping shipping noise in European waters. IMO MEPC.1/Circ.833 provides voluntary guidelines.
4. ¶34 SNA 2025, Chapter 6 on the production account and derivation of value added.
5. ¶35 ILO. (2006). *Maritime Labour Convention (MLC 2006)*. International Labour Organization. Definitions for seafarer employment.
6. ¶36 ILO Maritime Labour Convention, 2006 (MLC 2006), Title I, Regulation 1.4; SNA 2025, Chapter 19 on labour accounts and residence.
7. ¶37 BIMCO and International Chamber of Shipping (ICS). (2021). *Seafarer Workforce Report: 2021 edition*. BIMCO/ICS. [ICS Publications](https://www.ics-shipping.org/publications/) (<https://www.ics-shipping.org/publications/>). Provides national seafarer supply estimates by country of residence; used as a reference benchmark when reconciling MLC flag-state data to a residence basis.
8. ¶38 Leontief input-output framework for measuring inter-industry linkages.
9. ¶39 Supply and use tables methodology per SNA 2025 Chapter 15.
0. ¶40 IMO. (2017). *Ballast Water Management Convention (BWM Convention)*. International Maritime Organization. Entered into force 2017.
1. ¶41 IMO. (2011). *Biofouling Guidelines (MEPC.207(62))*. International Maritime Organization. Voluntary measures for hull biofouling management.
2. ¶42 UNEP/MAP guidelines on anchoring impacts in Mediterranean Marine Protected Areas.
3. ¶43 ITOPF statistics on oil spill trends and response operations.
4. ¶44 SNA 2025, Chapter 15, paras 15.9, 15.130–15.139 on supply and use table compilation. See also TG-3.3 Section 3.4 on ocean economy SUT compilation.
5. ¶45 BPM6 (Balance of Payments and International Investment Position Manual, 6th edition), paragraphs 10.73–10.88 on transportation services in the balance of payments (chapter number and paragraph range to be verified against the BPM6 PDF – IMF editions vary between Chapter 10 and Chapter 12 for the services treatment). Provides the framework for identifying maritime services provided by non-resident enterprises (foreign shipping lines at domestic ports).
6. ¶46 Data source guidance aligns with [TG-4.2 Survey Methods](#), [TG-4.3 Administrative Data](#), and [TG-4.6 Data Harmonisation](#).