국회출장보고서

IMO 제4차 온실가스(GHG) Study 운영위원회(Steering Committee)

◈ '19.7.23(화) 영국 IMO에서 개최된 제4차 IMO 온실가스(GHG) 연구, 제1차 운영위 참석결과를 보고 드림

* 참가자 : 한국해양수산개발원(KMI) 박한선 실장

2019. 7.

한국해양수산개발원
[해사안전연구실]

Ⅰ. 회의 개요

□ **회의날짜/장소 :** ’19.7.23(화)/런던 IMO 본부

□ **운영위원회 참석자**(약 20명, 13개국)

○ 운영위원(13명) : 중국(1), 일본(1), 터키(1), 파나마(1), 캐나다(1), 라이베리아(1)*, 한국(1)**, 덴마크(1), 싱가폴(1), 노르웨이(1), 브라질(2), 미국(1), 벨기에(불참)

* 운영위원회 의장(헤리 콘웨이 라이베리아, MEPC 현 부의장)

** 한국해양수산개발원(KMI) 박한선 실장 참석

○ 사무국(6명) : IMO 해양환경국장(1), 과장(1), 직원(4)

Ⅱ. 주요 회의결과

□ **회의결과**

○ 참석자 소개, 의제 채택, 작업일정 소개

○ 제안서 발표(3개 기관)

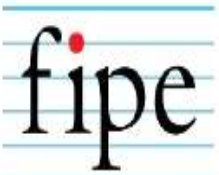
1) ClassNK, ICCT 등 컨소시엄
- 일본, 영국, 브라질, 중국, 네덜란드. 미국
- (인벤토리) 배출량의 불확실성 제거(AIS & 선박활동도_AIS가 없는 선박의 실제 연료사용량을 조사하여 추정), 카본밀도
- (시나리오) BAU 기반, GDP를 고려한 시나리오 추정 예정
- 프로젝트 관리(연구책임자, 15년), 공동 연구자(하나야마, 25년)
- 제3차 IMO GHG Study 수행기관임

Offer for the Fourth IMO GHG Study

RFP 2019-17, Part A: outline of the Study

Krannert School of Management

THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION



Fundação Instituto de Pesquisas Econômicas

2) DNV-GL, NUS, 싱가폴 난영공대, 국립대, 중국 칭화대학 등 7개

- 노르웨이, 미국, 핀란드, 독일, 싱가폴, 중국
- (인벤토리) 배출량 조사 (2008, 2012-18), Bottom-up 방식+Top-down 방식, 6개의 GHG 조사, 미세먼지(PM) 등 TOR 준수,
- 불확실성 제거(활동도), 날씨, 엔진부하 추정, 보조엔진, 엔진 팩터 (부하, 연료형식, 황함유량), 제2차 IMO GHG Study 수행기관임
- (시나리오) 배출량 시나리오 (2018-2050)

THE FOURTH IMO GHG STUDY

PROPOSAL, PART A

Submitted by:

DNV GL	Norway
Energy and Environmental Research Associates	USA
Finnish Meteorological Institute	Finland
Kühne Logistics University	Germany
Nanyang Technical University	Singapore
National University of Singapore	Singapore
Tsinghua University	China

3) SINTEF, ABS, DTU, NTNU, BV, 로이드, KR(한국선급)

- 노르웨이, 미국, 덴마크, 프랑스, 한국
- (배출량 조사) 선박 데이터, AIS 데이터, 해양사고 데이터, 선박 소유자 데이터, 항만 데이터 등을 활용
- (시나리오) 2050년 목표를 고려한 16개 시나리오 제시, BAU,

SINTEF

Proposal for

FOURTH IMO GREENHOUSE GAS STUDY

PART A: OUTLINE OF THE STUDY

Submitted to

IMO International Maritime Organization
Tender reference: RFP 2019-17

Submitted by

SINTEF Ocean AS, Norway

Consortium in alphabetic order

ABS, USA
Bureau Veritas, France
DTU, Denmark
Korean Register of Shipping, Korea
Lloyd's List, Maritime intelligence, Sweden
NTNU, Norway
SINTEF Ocean, Norway
Shanghai Maritime University, China
University of Strathclyde, UK

Ⅲ. 향후 일정

□ 향후 일정

○ 평가 및 선정에 관련하여 해당양식을 IMO 사무국에서 개별적으로 메일로 송부하면 평가를 수행하여 스켄후 사무국으로 전송요함

- 2019년 9월 중순까지 평가결과 송부, 2019년 9월말까지(비용 산정 조치), 차기 대면회의는 2020년 1월에 개최예정
- 프로젝트 총비용은 약427만불(약 50억)로 예정
- 선정된 연구용역기관의 연구계획서를 고려하여 IMO에서 프로젝트 금액 산정예정

붙임 1. 잠정의제 1부.
2. 평가 양식표 1부.
3. 기밀유지 서약서 1부.
4. IMO GHG Study 전체일정 1부. 끝.

[붙임 1]

PROVISIONAL AGENDA

First meeting of the Steering Committee for the Fourth IMO GHG Study
IMO Headquarters,
4 Albert Embankment, London SE1 7SR
(Conference Room 14 on the second floor)

Tuesday, 23 July 2019, start time 11.00 am

Opening of the Meeting

1 Adoption of the agenda

2 Consideration of the Steering Committee working arrangements, taking into account the timetable for delivery of the Fourth IMO GHG Study

3 Overview of the terms of reference of the Fourth IMO GHG Study approved by MEPC 74, including the list of criteria for technical evaluation of tenders

4 Presentation of bids received

5 Date of next meeting

6 Any other business

Closing of the meeting

[붙임 2]

APPENDIX

LIST OF CRITERIA FOR TECHNICAL EVALUATION OF TENDERS FOR THE FOURTH IMO GHG STUDY

MANDATORY CRITERIA	
A)The tenderer must demonstrate, by including a description of the aggregate expertise of the group and the specific expertise for each scientist, research institute, and/or consultant in the group that the main scientist(s), research institute(s), and/or consultant(s) involved in the work have adequate experience (i.e. a minimum of five years' experience) and knowledge covering the scope of the Study, including relevant research and analytical work such as: • estimation of fuel consumption and emissions of GHG and other relevant substances for the international maritime sector; • development of ship emissions inventories; and • modelling of future scenarios related to the above. "Adequate experience" in section A) above means a minimum of five years' experience for the main scientist(s) involved in the work	Yes / No
and	
B)The tenderer must include relevant research work undertaken by the involved scientist(s) and/or consultants(s) over the last two years.	Yes / No
and	
C)The project leader should have significant experience (i.e. a minimum of 10 years' experience and a postgraduate degree in a relevant discipline) covering the scope of the Study, including relevant research and analytical work, such as: • estimation of fuel consumption and emissions of GHG and other relevant substances for the international maritime sector; • development of ship emissions inventories; and • modelling of future scenarios related to the above. "Significant experience" in section C) above means: • a minimum of 10 years' experience; • a postgraduate degree in a relevant discipline	Yes / No

RATED CRITERIA	Weight %	Score
1. Approach and methodology	**Total weight: 40%**	
1.1 Tenderer should provide a clear and logical explanation of methodologies for the analysis		
Section 1: Inventory of GHG emissions from international shipping 2012-2018: Does the tenderer clearly explain the methodology (or methodologies, as appropriate) and data and data sources that will be used to achieve the tasks related to Section 1 of the terms of reference of the Fourth IMO GHG Study	8	/10
Section 2: Scenarios for future international shipping emissions 2018-2050: Does the tenderer clearly explain the methodology (or methodologies, as appropriate) and data and data sources that will be used to achieve the tasks related to Section 2 of the terms of reference of the Fourth IMO GHG Study	8	/10
1.2 Tenderer should demonstrate an understanding of the methodological challenges associated with this project and how they will be addressed.		
Section 1: Inventory of GHG emissions from international shipping 2012-2018: Does the tenderer indicate an understanding of uncertainties and include a methodology for analysing them in emissions estimates?	6	/10
Section 1: Inventory of GHG emissions from international shipping 2012-2018: Does the tenderer include a description of proposed methods to compare their inventories with those of the *Third IMO GHG Study 2014*?	6	/10
Section 2: Scenarios for future international shipping emissions 2018-2050: Does the tenderer explain how challenges in the design and development of possible trends for GHG emissions and carbon intensity from international shipping and for shipping as a whole between 2018 and 2050 will be considered?	12	/10

2. Assigned individuals Tenderer should provide the information and documents listed below:	**Total weight: 20%**	
2.1 Names and CVs for the main staff involved in the Study, including relevant research work undertaken by the involved scientist(s) and/or consultant(s) over the last two years, and including any sub-contractors *Note: incompleteness of this information may limit ability to rate individual experience.*	10	/10
2.2 Description of team composition, including a statement of the roles and the level of participation for each assigned individual. Individuals may fill more than one role. Criteria: • Appropriateness of team composition to meet requirements (as set out in section 1. Approach and methodology); and • Completeness of information provided	10	/10

3. Proposed schedule and ability to meet timelines	Total weight: 10%	
A detailed work plan outlining the major activities and estimated completion date should be included in the proposal. Criteria: • For each task, the tenderer has provided a detailed draft working plan, including identification of: (a) milestones; and (b) progress reporting; and • The tenderer has provided a draft timetable.	10	/10

4. Overall quality of the proposal	Total weight: 30%	
Is the proposal clear and concise in how the tenderer will fulfil the terms and requirements of the tender as described in the terms of reference of the Fourth IMO GHG Study (as appropriate)?	4.5	/10
Description of interdisciplinary coordination procedures and in-house quality control/management.	4.5	/10
Logic of approach, i.e. does the approach seem to be a logical way of approaching the tasks related to sections 1 and 2 of the terms of reference (as appropriate)?	6	/10
Clear proposed organization chart and lines of responsibility amongst key personnel.	3	/10
Description of a logical sequence of steps involved from project inception to completion and associated resource schedule and understanding of the timescales to realize the objectives of the project.	4.5	/10
Completeness of approach, i.e. does the tenderer fully reflects all aspects as described in the terms of reference of the Fourth IMO GHG Study (as appropriate) with clear, easy to read and well structured and presented proposal documents with appropriate sub-headings, charts, figures, and illustrations.	7.5	/10

Total score overall for rated criteria	Total weight: 100%	/1000

The following point system should be used as a guide: 10 = excellent; 8 = very good; 6 = good; 5 = average; 4 = just acceptable; 2 = substandard; 0 = wrong or not addressed.

Scoring should be substantiated with comments.

[붙임 3]

DECLARATION OF IMPARTIALITY, CONFIDENTIALITY AND NO CONFLICT OF INTEREST

I, the undersigned, acknowledge that I am bound by the provisions of the IMO Code of Ethics, the IMO Procurement Manual and any other relevant IMO policies or regulations.

I further declare that, as an evaluator of the proposals which were received in response to the tender for the Fourth Greenhouse Gas Study RFP2019-17:

1. I will discharge my functions in the interest of the IMO only, and neither seek nor accept instructions from any external authority.

2. I will not use my position as evaluator to any private material or immaterial advantage, or accept from present or potential suppliers, directly or indirectly, gifts, gratuities, favors or services that might influence or appear to influence any purchasing decision.

3. I will hold in trust and confidence any confidential information or documents to which I gain access as a result of my involvement in the procurement process.

4. Neither I nor my family has any past or present relationship, direct or indirect, whether of a financial, professional or other nature, which may cause a conflict of interest with any of the suppliers.

5. I am independent from all parties which stand to gain from the outcome of the procurement process and confirm that, should I discover during the course of the procurement process that such a relationship, link or actual or potential conflict of interest exists, I will declare such conflict of interest immediately and withdraw from any involvement in the procurement case.

Name: _____

Signature: _____

Date: _____

[붙임 4]

제4차 IMO GHG Study 전체일정(잠정)

일정	주요내용	비고
2019.5	- 위임사항(TORs)의 승인, 입찰참여자의 기술평가 목록 승인 - 사무국에 운영위원회 설치요청, 입찰 제안서 발행 요청	MEPC 74
2019년 5월말	- 6월말까지 입찰 제안마감시한이 기재된 입찰제안서 발행 - 6월 중순까지 운영위원으로 참여할 회원국들을 위해 참여 회람문서 발행, 약 20개 회원국으로 구성된 운영위원회 설치	사무국 사무총장
2019년 6월말	- 입찰 제안서류 제출 후, MEPC 74에서 승인된 평가기준에 따라 개별적으로 점수를 평가하도록 운영 위원에게 요청	사무국
2019년 7월	- IMO 본부에서 제1차 운영위원회 개최 - 코디네이터 및 부코디네이터 선출, 일정이 포함된 작업계획 심의(화상회의 참여 검토), 추가 재원상태 확인	**사무국 운영위원회**
2019년 9월초	- 제2차 운영위원회 개최 (입찰 참여자의 인터뷰 개최)	**사무국 (운영위원회)**
2019년 9월 중순	- 합의된 날짜까지 각 입찰참여자에 대한 점수평가 및 제출	운영위원
2019년 9월말	- 제안된 입찰가격 및 운영위원회의 기술평가를 고려한 입찰가격 산정 (기술평가 결과와 가격평가를 동시에 고려) - 사무국은 가격평가에 대한 사항을 운영 위원에게 전자적 방법으로 전달 - 운영위원은 가격평가 결과에 대한 사항을 검토, 코디네이터는 계약체결을 위한 운영위원회의 최종결과를 사무국에 전달	사무국 운영위원 코디네이터
2019년 10월	- 운영위원회 최종 권고사항을 반영하여 조달 담당자에게 권고 - IMO 조달담당자는 계약위원회에 권고, 계약위원회는 행정국장에게 전달, 행정 국장은 가격협상을 위하여 계약위원회의 권고사항을 고려하여 결정	사무국
2020년 1월	- 제3차 운영위원회 개최 (계약자 참석 및 발표_ 중간보고회_질의·응답, 최종보고서에 포함될 코멘트 및 제안사항 권고, 연구 최종보고일정 협의, 최종보고서에 대한 품질보증/관리(QA/QC) 방안 확정	**운영위원회** 용역수행자
2020년 봄	- 코디네이터는 MEPC 75차에 제4차 IMO GHG Study 중간결과 보고	코디네이터
2020년 4월말	- 운영위원회 심의를 위한 최종 요약보고서 및 최종보고서 초안 제출	계약자
2020년 5월말	- 제4차 운영위원회 개최(계약자 참석, 최종요약보고서 및 최종보고서 초안 심의, Q&A, 과업지시서 최종이행 점검, QA/QC 검토	**운영위원회**
2020년 6월말	- 사무국에 최종보고서 제출	계약자
2020년 가을	- MEPC 76차에 위원회 심의를 위한 완성보고서 제출	사무국 (계약자)

[붙임1] 제4차 IMO GHG Study 2019, Steering Committee Member

Dr. Park Han-Seon is director and research fellow of Maritime Safety Department in Maritime Industry & Safety Division in Korea Maritime Institute (KMI) from Sep 2015. He was a former General Manager and the Head of Green Growth Office in KST (Korea Ship Safety Technology Authority) of Republic of Korea (ROK) where he has engaged as a principal ship surveyor for about 17years after working for Hanjin Shipping Co. Ltd for 3years and 4months as second engineer on board.

He graduated from the World Maritime University (Maritime Safety Environment Administration, M.Sc.) in Sweden 2009 after the graduation of Korea Maritime and Oceans University (Marine Engineering) in 1995 and Graduate School of Korea Maritime and Oceans University (Marine Engineering) in 2001. He graduated the Graduate School of Korea Maritime and Oceans University (Ph.D., Maritime Law & Policy) in 2014.

He has been a member of Korean delegation to many international meetings such as IMO MEPC 46th~53th& 60th~70th, BLG 8th~9th&14th, DSC8th, IBWWG1st~4th, Diplomatic Conference of BWM, ISWG-GHG 3rd~5th, MSC 98th~101st, ASS 24th, 29th~30th, Council 28th~29th, LEG 104th~106th, EEDI-WG, MBM-WG, Update-EW, since 2001. Recently he has been jointed at the COP 16th~20th of UNFCCC since 2010. Since the second IMO GHG study, he has been on the member of steering committee of the 3rd IMO GHG study.

Dr. Park has many times engaged as a consultant and advisor of IMO capacity-building project against climate change and Climate Change Partnerships for East Asian Countries. He also carried out international cooperation projects related to capacity-building for enhancing ship safety in Algeria from 2006 to 2007, building capacities in East Asian Countries to address GHG emissions from ships by IMO-KOICA from 2012 to 2013 and capacity building for ship safety and marine environment in Indonesia from 2013 to 2015 funded by KOICA.

Dr. Park is author or co-author of some books, dissertations & articles on themes with regard to climate change, Autonomous & Digitalized Ship and has been a lecture at Korea Maritime and Ocean University and SungKyunKwan University in Seoul when it comes to climate change and green & smart ship technology as well as maritime safety and marine pollution prevention technology.

[붙임2] 발표자료

Fourth IMO GHG Study Interim Report

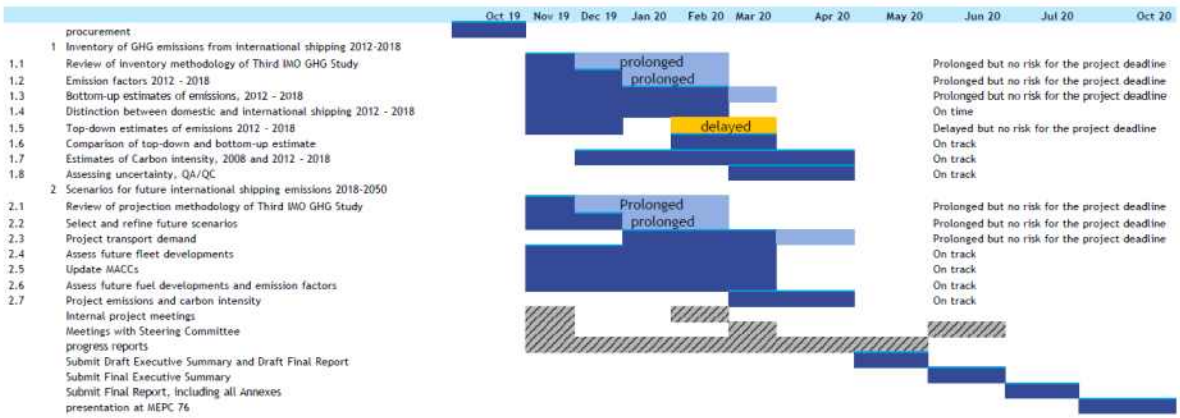
Steering Committee meeting

Outline of the presentation

- Overview of progress
- Task 1.1: review of the inventory methodology
- Task 1.2: emission factors
- Task 1.4: distinction between domestic and international shipping
- Task 2.1: review of projection methodology
- Task 2.2: choice of socio-economic long-term scenarios
- Internal QA/QC procedures

Overview of progress

- Although some tasks are prolonged or delayed, we do not currently foresee a risk to the project deadline



Review of the inventory methodology

- Reviewed recent literature on inventories
- Identified differences between methodology in the Third IMO GHG Study 2014 and the recent literature
- Developed recommendations on:
  - missing technical specifications for ships: *use the multiple regression approach currently using by UMAS*.
  - treatment of shipping activity in the case of sparse satellite AIS data: *linearly interpolate ship positions between missing AIS signals and infill with a representative SOG and draught for interpolated positions*.

Review of the inventory methodology

- reflection of environmental conditions (weather), hull fouling, draught, interpolated speeds, and procedure for main engine load factors > 1:
  - ***weather:*** Use the same weather adjustment factors as the Third IMO GHG Study and describe the potential effects of different assumptions in the uncertainty analysis.
  - ***hull fouling:*** Use the hull fouling factor from the Third IMO GHG Study 2014.
  - ***draught:*** Apply a voyage-specific draught adjustment factor.
  - ***procedure for main engine load factors > 1:*** Replace instances where SOG > max speed with interpolated SOG based on the mean SOG for that phase (cruise or manoeuvring; interpolated SOG not needed for anchor or berth phases); (2) apply the weather, hull fouling, and draught adjustment factors; (3) if load factor > 1, replace with 0.98.
- auxiliary and boiler power requirements: *use the auxiliary engine and boiler power demand assumptions in the tables in the appendix*.

Review of the inventory methodology

- accounting for the energy use effects of innovative energy saving technologies and exhaust gas cleaning systems:
  - innovative energy saving technologies:
    - We recommend that the effects of innovative energy saving technologies not be modeled because few ships have applied them during the period 2012-2018.
  - exhaust gas cleaning systems:
- do not model the effects of EGCS on fuel consumption and emissions because few ships have applied them during the period 2012-2018.

Review of the inventory methodology

- Update ship size categories (capacity bins): *use the updated ship size category (capacity bins) found in the tables in the appendix.*
  - Split chemical tanker 20,000+ dwt in two (20,000 – 39,999 and 40,000+)
  - Split container ships 14,5000+ TEU in two (14,500 – 19,999 and 20,000+)
  - Split general cargo 10,000+ dwt in two (10,000 – 19,999 and 20,000+)
  - Split liquefied gas tanker 50,000 – 199,999 cbm in two (50,000 – 99,999 and 100,000 - 199,999)
  - Split other liquids tankers in two (0 – 999 dwt and 1000+)
  - Split Ferry-pax only 0 – 1999 GT in three (0 – 299, 300 – 999 and 1000 - 1999)
  - Split cruise 100,000+ GT in two (100,000 – 149,999 and 150,000+)
  - Split Ferry-RoPax 2000+ GT in four (2000 – 4999, 5000 – 9999, 10,000 – 19,999 and 20,000+)

Review of the inventory methodology

- Update ship size categories (capacity bins): *use the updated ship size category (capacity bins) found in the tables in the appendix.*
  - Split reefer into four (0 – 1999 dwt, 2000 – 5999, 6000 – 9999 and 10,000+)
  - Split RoRo 5000+ dwt in three (5000 – 9999, 10,000 – 14,999 and 150,000+)
  - Rearrange Vehicle in three bins (0 – 29,999 GT, 30,000 – 19,999 and 50,000+)

Emission factors

- Reviewed literature
- Developed recommendations on:
  - SFOC;
  - emission factors of CO_2, CH_4, N_2O, NOx, SO_x, CO, PM, BC, and NMVOC on the basis of fuel use; and
  - emission factors of HFCs, PFC, SF_6 and NMVOC

Emission factors

- SFOC assumptions:
  - use the equation for SFOC as a function of engine load from the Third IMO GHG Study.
- baseline SFOC assumptions by engine type and age (g/kWh):

* Change from Third IMO GHG Study

Engine Type	Fuel Type	Before 1983	1984-2000	2001+
SSD	HFO	205	185	175
	MDO	190*	175*	165*
	MeOH	N/A	N/A	350*
MSD	HFO	215	195	185
	MDO	200*	185*	175*
	MeOH	N/A	N/A	370*
HSD	HFO	225	205	195
	MDO	210*	190*	185*
LNG-Otto (dual fuel, medium speed)*	LNG	N/A	173*	156*
LNG-Otto (dual fuel, slow speed)*	LNG	N/A	N/A	148 LNG + 0.8 MDO (pilot)*
LNG-Diesel (dual fuel)*	LNG	N/A	N/A	135 LNG + 6 MDO (pilot)*
LBSI*	LNG	N/A	156*	156*
Gas Turbines	HFO	305	305	305
	MDO	300	300	300
	LNG	N/A	N/A	203*
Steam Turbines (and boilers)	HFO	340*	340*	340*
	MDO	320*	320*	320*
	LNG	285*	285*	285*
Auxiliary Engines	HFO	225	205*	195*
	MDO	210*	190*	185*
	LNG	N/A	173*	156*

Emission factors

- methodologies for estimating CO2 and SOx:
  - carbon conversion factors: *use the same carbon conversion factors for marine fuels as the Third IMO GHG Study 2014.*
  - equation to convert from fuel S content to SOx emissions: *use the same approach as the Third IMO GHG Study 2014 and Olmer et al. (2017a, 2017b).*
- emission factors for other pollutants emitted from combustion (NOx, PM, CH4, CO, N2O, NMVOCs):
  - use mostly the same emission factors and approach as the Third IMO GHG Study 2014 and Olmer et al. (2017a, 2017),
  - but use the updated CH4 emission factors for LNG engines and differentiate between PM10 and PM2.5.

Engine type	fuel type	CH_4 (g/kWh)
LNG-Otto (dual fuel, medium speed)*	LNG	5.5*
LNG-Otto (dual fuel, slow speed)*	LNG	2.5*
LNG-Diesel (dual fuel)*	LNG	0.2*
LBSI*	LNG	4.1*

Emission factors

- black carbon emission factors: *use BC emission factor equations consistent with Comer et al. (2017) and Olmer et al. (2017b) and explain the complexity of providing accurate estimates of BC in the report*.
- emission factors for fugitive emissions (HFCs, PFCs, SF6, NF3, and NMVOCs): *Estimate fugitive HFC and NMVOC emissions, as far as possible. Do not estimate fugitive PFC, SF6, or NF3 emissions*.
- Future emission factors: don't include the projection of emissions of other relevant substances because future emission factors are too uncertain.

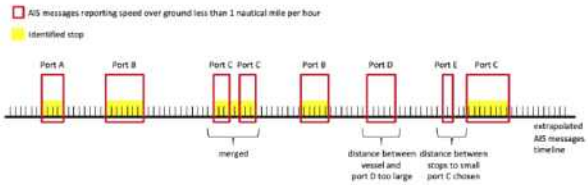
Distinction between domestic and international shipping

- Develop clear and unambiguous definitions and methods for differentiation between domestic and international voyages, with the aim to exclude domestic voyages from the inventory for "international shipping" and mitigate the risk of double counting of emissions from ships
- Consistent with IPCC (2006) inventory guidelines
  - International shipping: shipping between ports of different countries, as opposed to domestic shipping. International shipping excludes military and fishing vessels.
  - Domestic shipping: shipping between ports of the same country, as opposed to international shipping. Domestic shipping excludes military and fishing vessels.
  - By this definition, the same ship may frequently be engaged in both international and domestic shipping operations.
- Based on AIS data

Distinction between domestic and international shipping

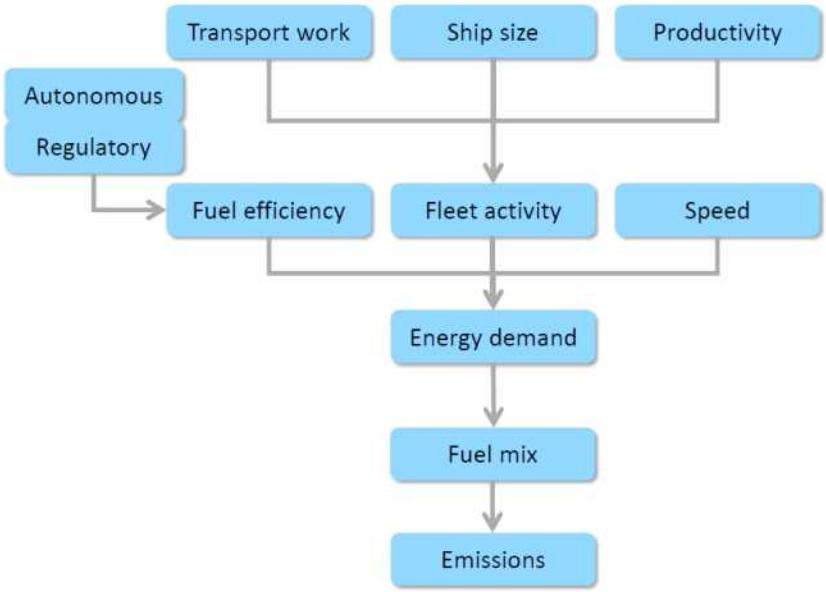
- Emissions will be modelled for each voyage and aggregated on the basis of the nature of the voyage (domestic or international). In detail, we propose applying the geospatial approach to distinguish domestic from international voyages.

- To finalise the GHG emission at 2008 for calculating Carbon Intensity, we recommend to apply the average share of domestic and international emissions from 2012 – 2018 to the 2008 emissions in each ship type/size bins, as reported in the Third IMO Greenhouse Gas Study.



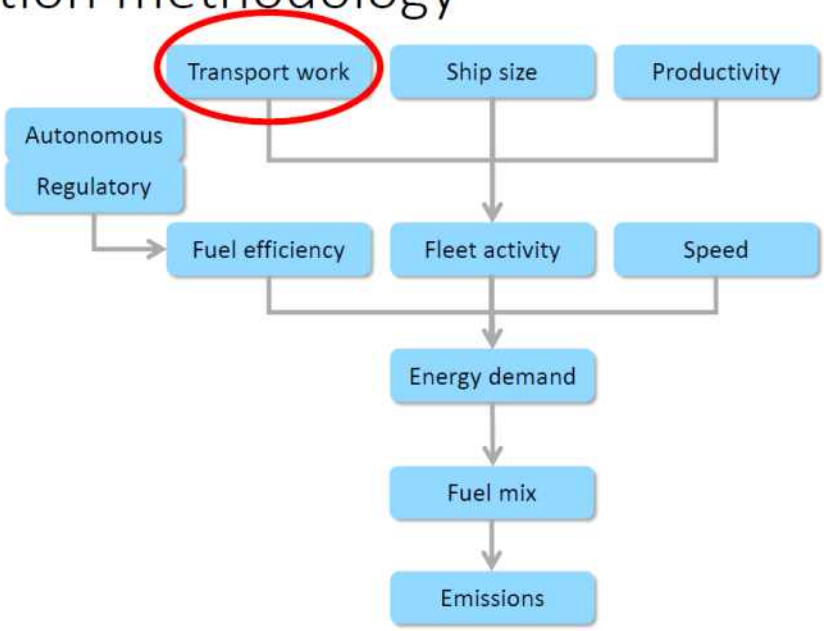
Review of projection methodology

- Reviewed recent literature on inventories
- Identified differences between methodology in the Third IMO GHG Study 2014 and the recent literature



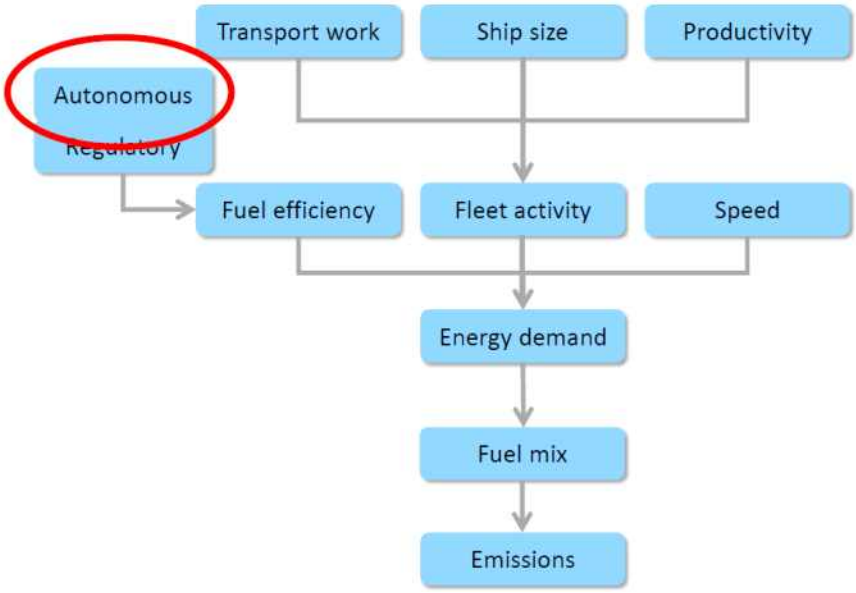
Review of projection methodology

- Propose to supplement the method to project transport work with a gravity-model approach



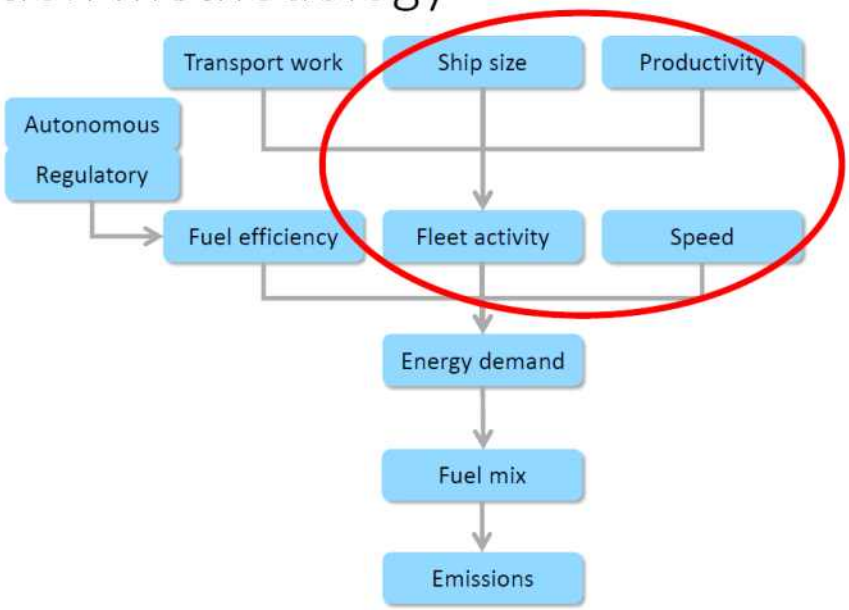
Review of projection methodology

- Update MACC



Review of projection methodology

- Update other factors



Choice of socio-economic long-term scenarios

- The aim is to 'develop business-as-usual emission scenarios on the basis of all possible combinations of representative concentration pathways (RCPs) and shared socioeconomic pathways (SSPs), and *discuss their plausibility* in the light of recent peer reviewed scientific literature and GDP growth projections made by international economic organizations. In addition, the Study should develop business-as-usual emission scenarios on the basis of *one or more recent GDP growth projections* made by international economic organizations, e.g. OECD'

Choice of socio-economic long-term scenarios

- Economic scenarios that result in large temperature increases are considered to be implausible now that the Paris Agreement is in force. These are:
  - RCP 6.0 ($\Delta T \sim 3\text{-}5\ ^\circ C$)
  - RCP 8,5 ($\Delta T \sim 4\text{-}6\ ^\circ C$)
- Other RCPs are combined with all possible SSPs.
- In addition, they are combined with OECD projections

Choice of socio-economic long-term scenarios

- Proposal to use:
  - RCP 1.9 combined with SSP1 and OECD;
  - RCP 2.6 combined with SSP1, SSP2, SSP4, and OECD;
  - RCP 3.4 combined with SSP1, SSP2, SSP3 (modified by OECD 2019), SSP4 and SSP5;
  - RCP 4.5 combined with SSP1, SSP2, SSP3 (modified by OECD 2019), SSP4 and SSP5.