BSR InnoShip

Baltic Sea cooperation for reducing ship and port emissions through knowledge- & innovation-based competitiveness

Baltic Sea Region Programme 2007–2013
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Best practices for Clean Shipping and Port operations

Tapani Stipa

Project leader

Baltic Sea Region Programme 2007–2013

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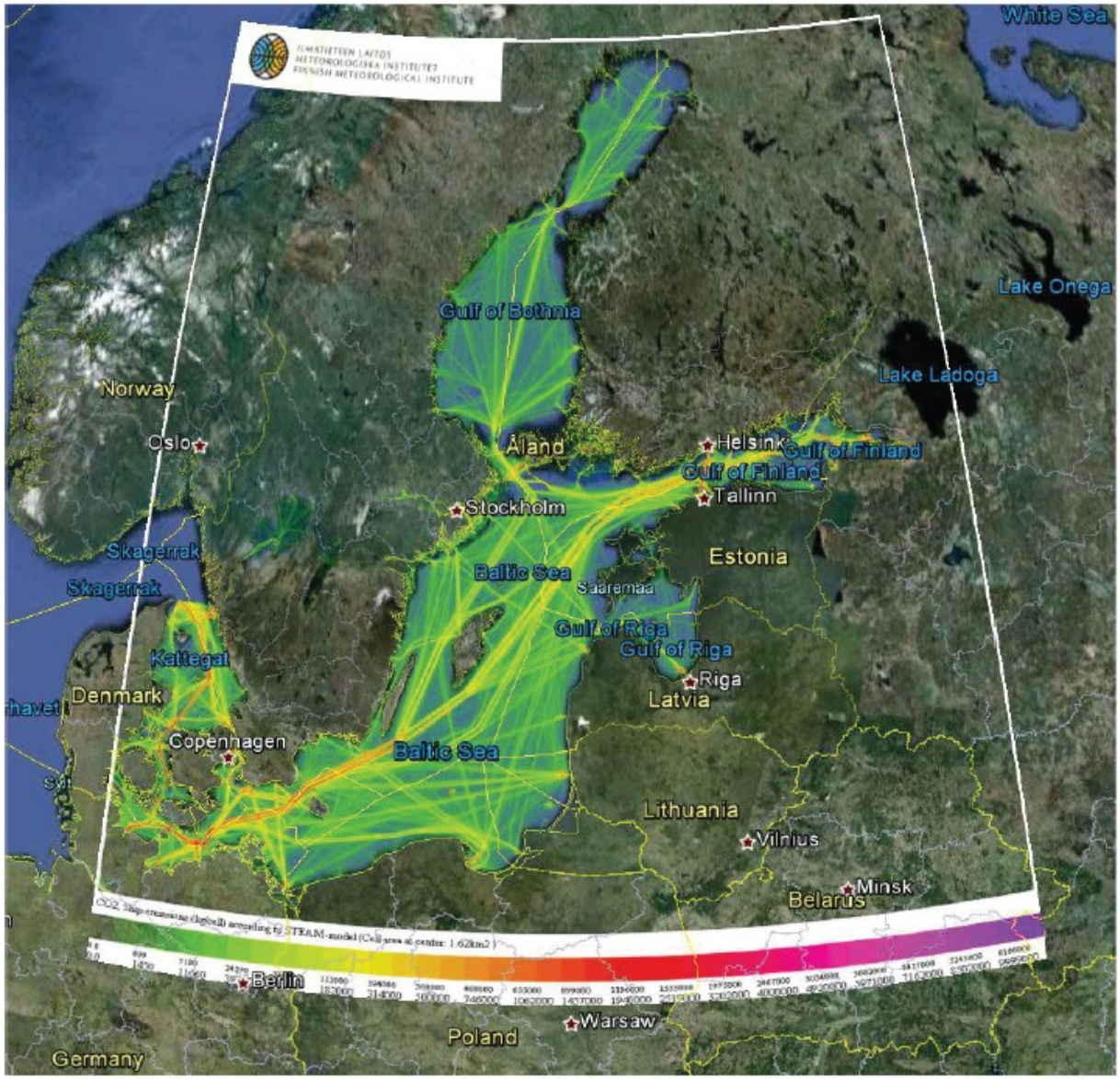

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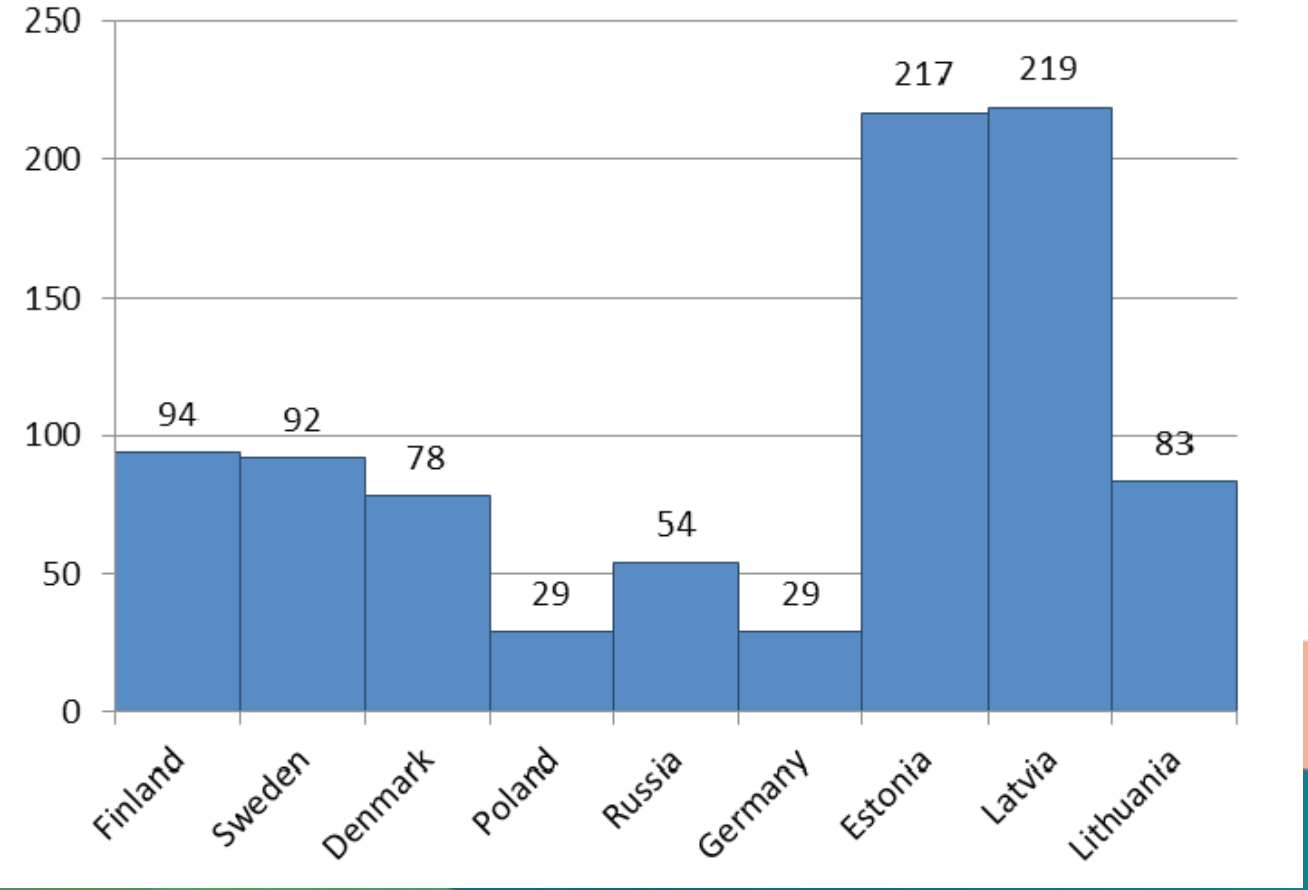
Sea transport as % of foreign trade



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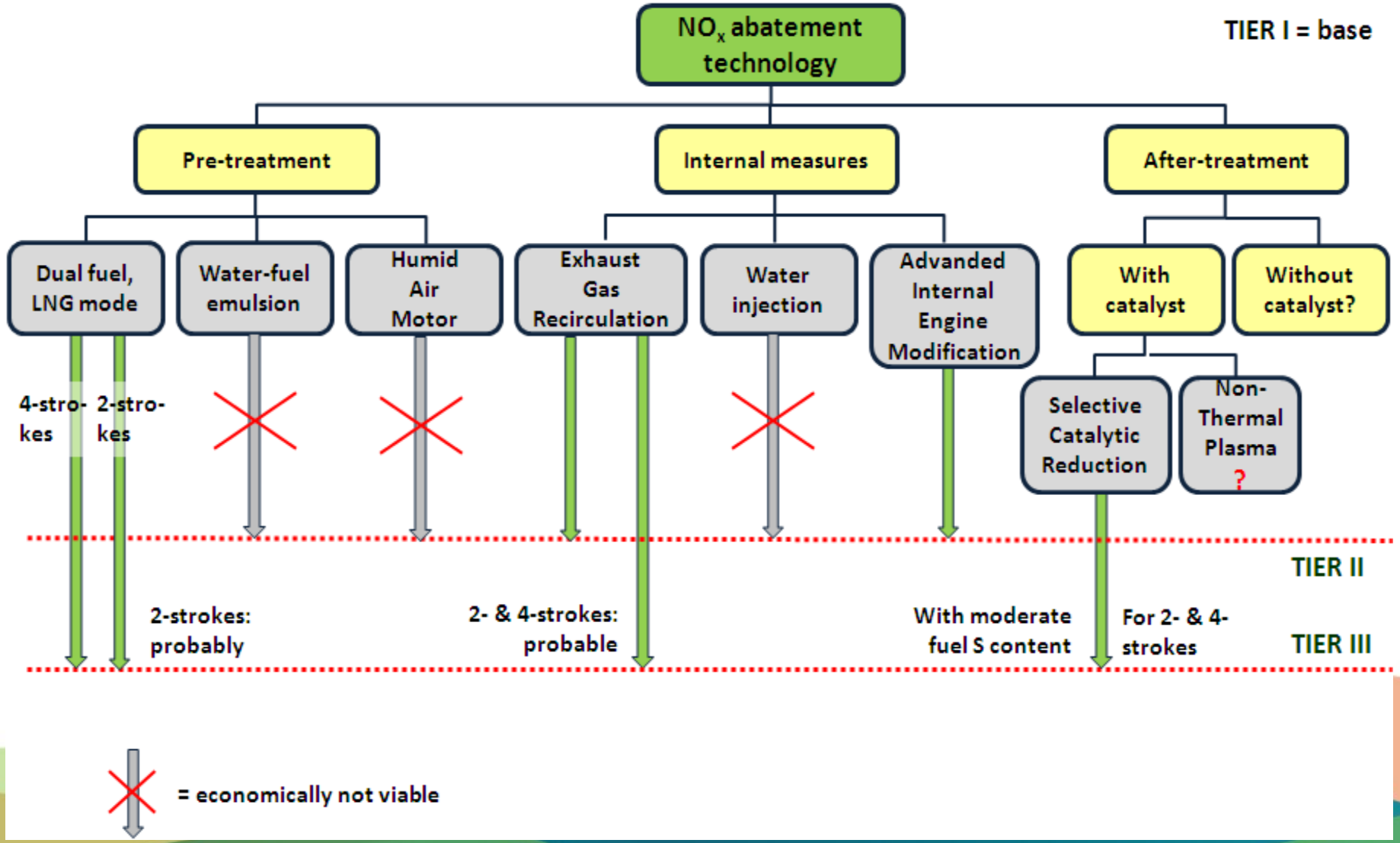
State-of-the-art of NO_x reduction options



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The IGPS system includes an AIS reciever and software to plot the locations of the ships and airplane/helicopter. Here is shown ship measurements within BSR-Innoship from a MI-8 helicopter in Neva bay outside Sankt Petersburg.

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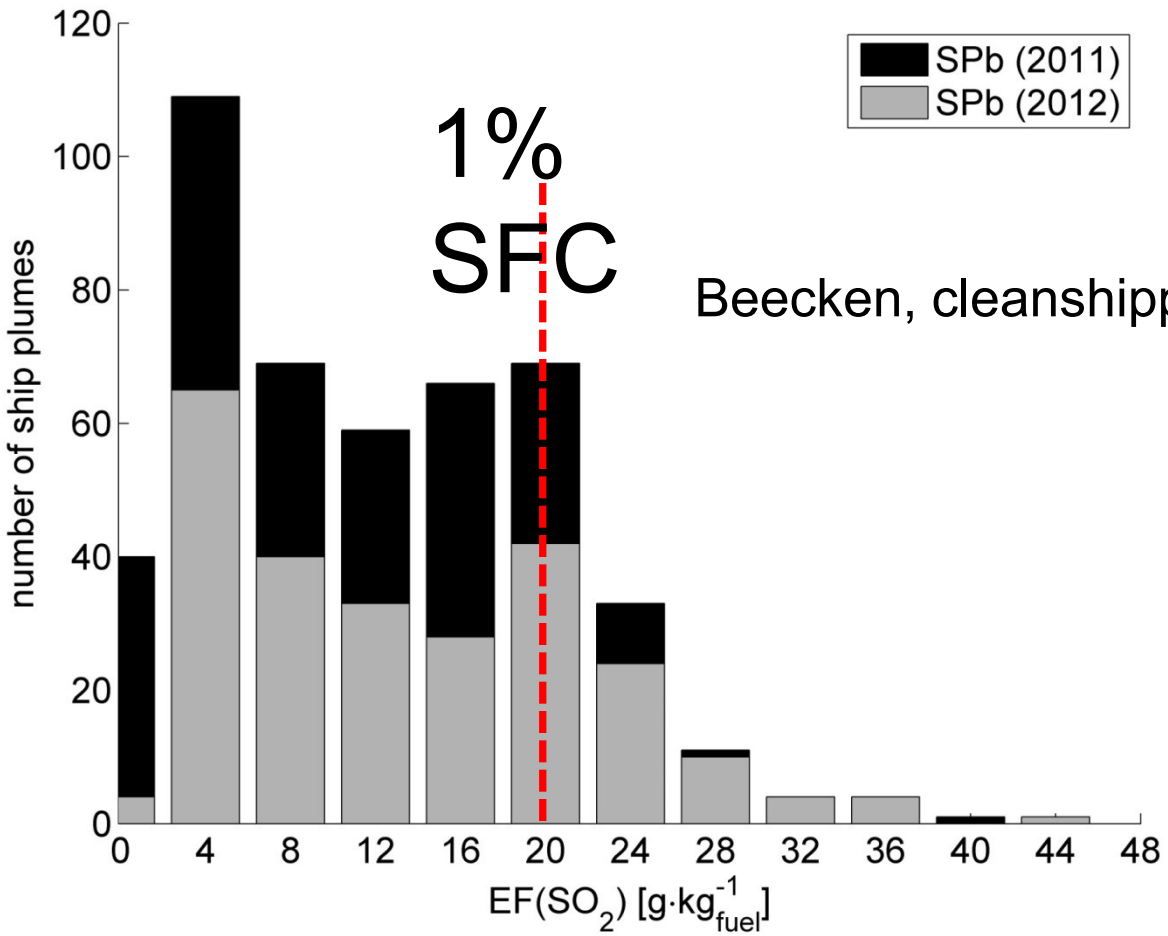
Emission factors of SO2 from Sankt Petersburg



Beecken, cleanshippingcurrents, 2013

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We are not there yet

- Very little operational experiences with any of the clean shipping solutions
- Virtually no LNG infrastructure in place, nor in pipeline; none built without state aid
- Costs high, reduction potential remains potential
- No assurance of a level playing field

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Policy instruments in the Baltic

- EU SBSR, Finnish CBSS presidency
- TEN-T
  - Only 15% of 2012 Motorways of the Sea funding contribute to clean shipping in the Baltic
  - This is around 1% of total TEN-T funds in 2012 call
- BSRP and other regional instruments

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More can be done

- LNG infrastructure development
- Financing arrangements for investments
  - loans, guarantees, state aid
- Compliance monitoring, level playing field
- Continued guidance and advice
  - Including technology selection and slow steaming operations

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Acknowledgements

- The best practice manual is available in print
- Editors:
  - Ms. Mia Hytti (UBC)
  - Prof. Karl-Heinz Breitzmann (BIR)

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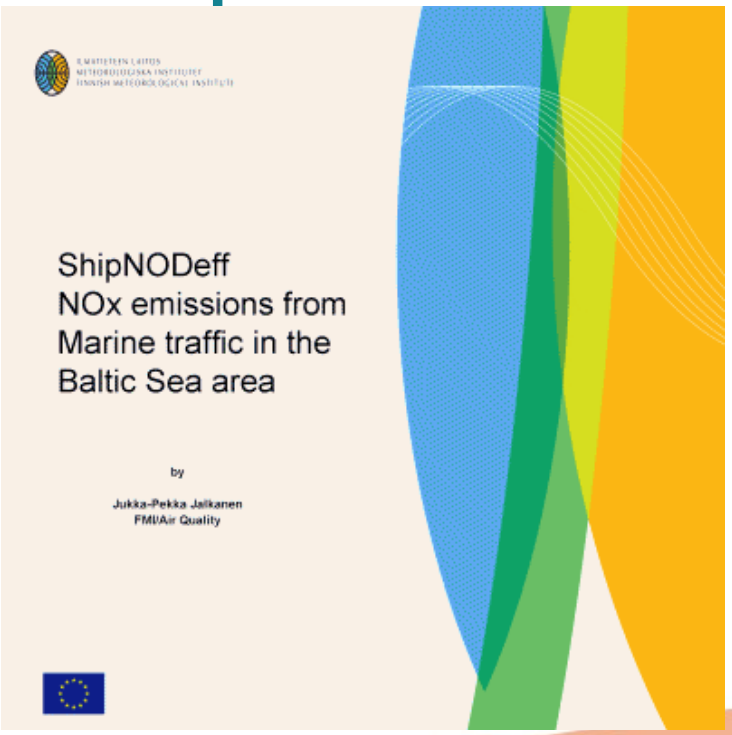
Scale of problem: 3000-5000 ships each month



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Type of cargo	Year	Total		Baltic external transport		Baltic internal transport	
		(mill. tons)	share (%)	(mill. tons)	share (%)	(mill. tons)	share (%)
Liquids	2008	251	43,0	184	[illegible]	67	26,7
	2009	251	47,0	188	[illegible]	63	25,1
	2010	257	44,0	191	[illegible]	66	25,7
Dry bulk	2008	144	24,7	105	[illegible]	39	27,1
	2009	130	24,3	98	[illegible]	32	24,6
	2010	144	24,7	106	[illegible]	38	26,4
Ro-Ro	2008	71	12,2	13	18,3	58	[illegible]
	2009	59	11,1	10	16,9	49	[illegible]
	2010	65	11,1	10	15,4	55	[illegible]
Container	2008	59	10,1	54	[illegible]	5	8,5
	2009	48	9,0	43	[illegible]	5	10,4
	2010	58	9,9	52	[illegible]	6	10,3
Break bulk/ other general cargo	2008	59	10,1	44	[illegible]	15	25,4
	2009	46	8,6	35	[illegible]	11	23,9
	2010	60	10,3	46	[illegible]	14	23,3
Total	2008	584	100	400	68,5	184	31,5
	2009	534	100	374	70,0	160	30,0
	2010	584	100	405	69,3	179	30,7

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Cargo group	period	CAGR* (%)	period	CAGR* (%)
Liquids	2004-2007	7,0	2004-2010	3,9
Dry bulk	2004-2007	1,7	2004-2010	1,7
Ro/ro	2000-2007	7,4	2000-2010	4,6
Break bulk / other general cargo	2004-2007	-3,1	2004-2010	-1,1
Container	2000-2007		2000-2010	
Total	2000-2007	4,7	2000-2010	2,8

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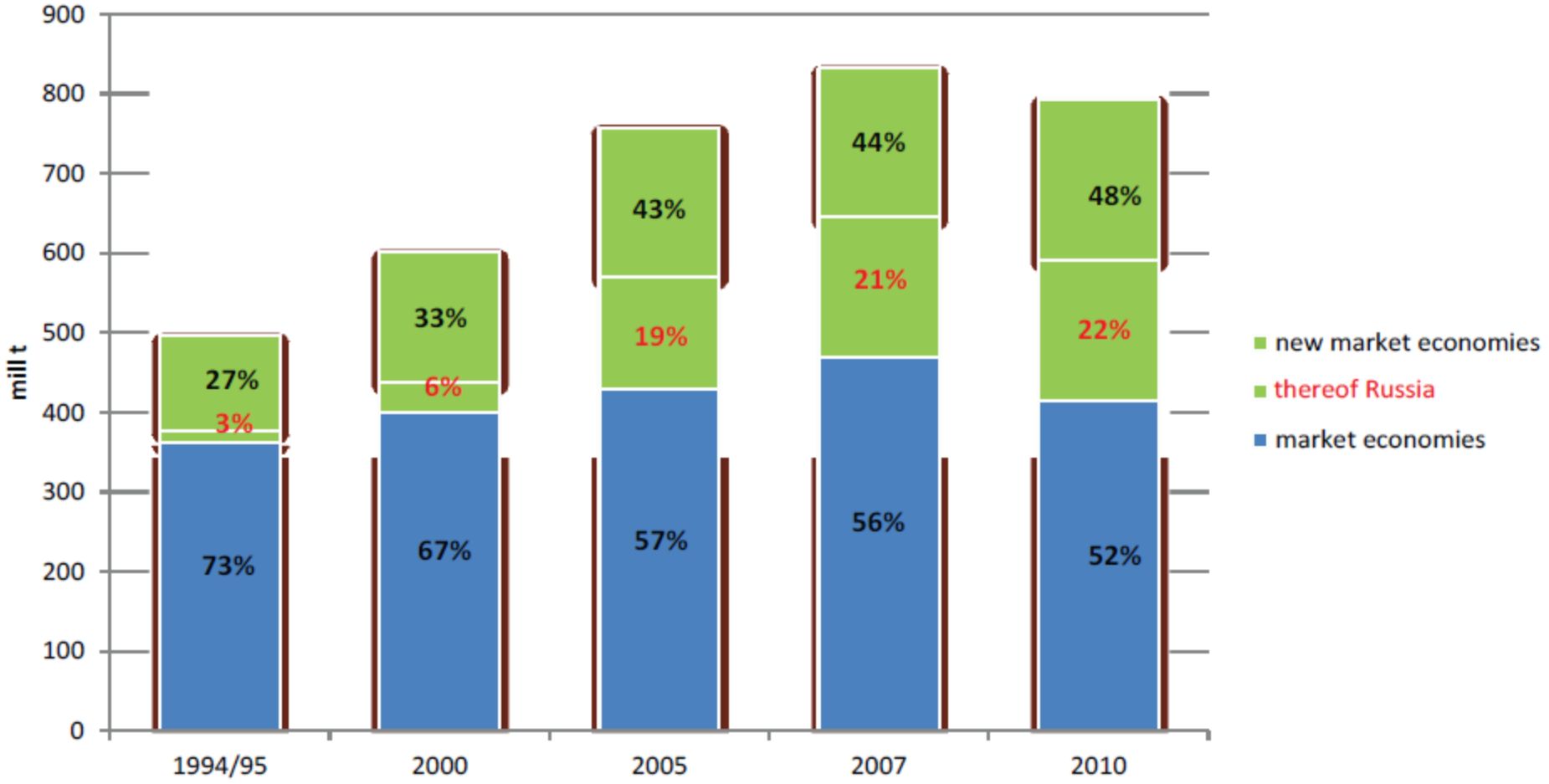

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Modal split, W-E trade in the Baltic

YEAR		SEA	ROAD	RAIL	PIPELINE	OTHERS/ UNKNOWN
1999	export	48	42	7	0	2
	import	39	12	0	55	5
2010	export			3	0	0
	import			0	26	9

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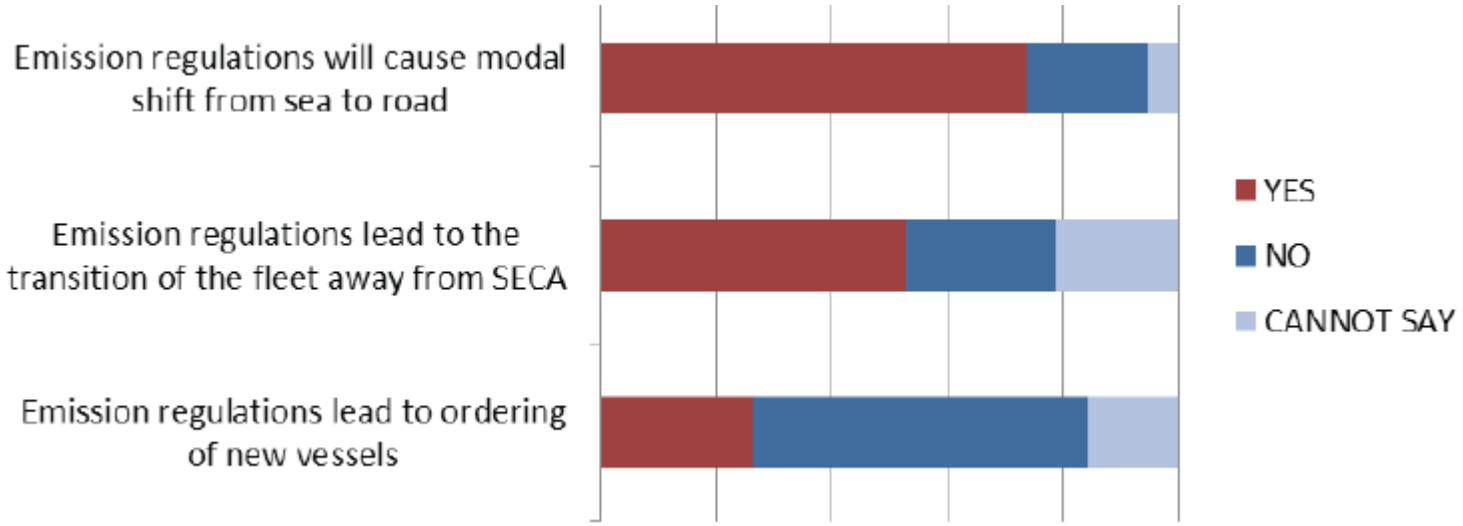
Query to shipowners



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Emission and transports 2011

		NOx [t]	Sox [t]	PM2.5 [t]	CO [t]	CO2 [t]	Payload [10^6 kg*ton]	Ships	Messages	KM
All		356 311	75 498	21 794	36 274	18 698 232	638 452	27 684	426 641 793	137 241 490
	IMO	302 866	69 418	19 232	28 569	15 470 887	638 452	13 762	281 260 756	120 991 950
	S/U	53 445	6 080	2 562	7 705	3 227 345	0	13 922	145 381 037	16 249 541
Top flags	Sweden	53 114	11 748	3 527	6 138	3 219 926	23 344	2 569	63 996 456	17 372 005
	Denmark	29 614	5 277	1 738	4 262	1 745 903	22 442	1 654	84 881 550	11 461 364
	Finland	30 237	6 612	1 929	3 422	1 704 642	21 660	682	27 140 701	11 576 243
	Germany	23 457	4 976	1 445	2 765	1 260 947	20 899	2 613	39 466 478	9 145 888
	Netherlands	19 969	4 500	1 281	2 025	1 080 264	30 191	3 464	23 142 958	12 374 889
	Cyprus	16 213	3 520	985	1 490	804 045	38 805	423	10 291 011	6 729 587
	Malta	15 637	3 290	924	1 415	756 049	36 150	717	12 215 772	6 767 693
	Antigua_and_Barbuda	13 875	3 017	870	1 408	740 971	24 218	721	15 423 336	9 143 116
	United_Kingdom	14 550	3 284	888	1 285	686 668	37 861	1 811	9 484 776	4 657 193
	Liberia	16 694	3 523	928	1 215	672 740	82 397	809	5 168 522	3 332 692
	Bahamas	14 279	3 366	896	1 168	664 219	32 525	568	8 067 817	4 285 301
	Russia	9 831	1 367	504	1 095	542 965	10 664	784	16 465 951	5 065 321
	Norway	10 696	2 446	665	958	531 510	19 050	3 426	38 800 316	4 667 380
	Gibraltar	9 453	1 915	546	840	451 815	15 123	234	7 542 031	5 008 230
	Marshall_Islands	6 313	1 359	362	487	268 167	26 626	464	2 508 410	1 388 753
	Greece	7 553	1 639	410	492	267 575	56 145	170	1 548 915	1 118 054
	Italy	5 448	1 459	370	458	263 464	10 957	162	1 661 198	1 245 423
	Hong_Kong	4 226	905	240	295	175 299	21 412	297	1 289 945	853 109
	Saint_Vincent_and_the_Gre	2 067	346	114	193	112 914	3 060	157	5 235 898	2 221 157
	Panama	1 969	391	110	143	88 346	7 360	243	1 259 553	486 318
Ship types	Passenger	69 255	19 644	5 244	7 580	4 070 428	28 552	1 253	47 312 681	18 521 527
	Cargo	92 536	20 605	5 742	8 165	4 710 025	230 062	5 287	98 604 500	54 088 870
	Container	45 836	9 560	2 716	4 554	2 191 240	86 519	1 313	18 090 052	12 560 737
	Tanker	65 988	14 355	3 832	5 583	2 851 259	293 319	2 375	38 324 169	19 587 621
	Misc	29 251	5 256	1 698	2 687	1 647 935	0	3 534	78 929 354	16 233 194

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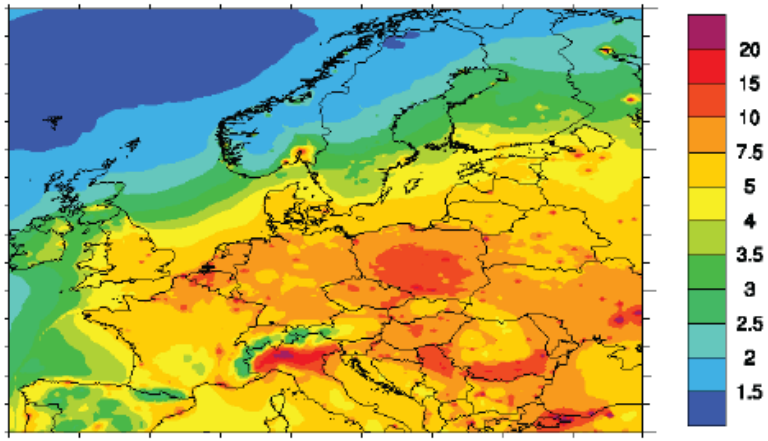
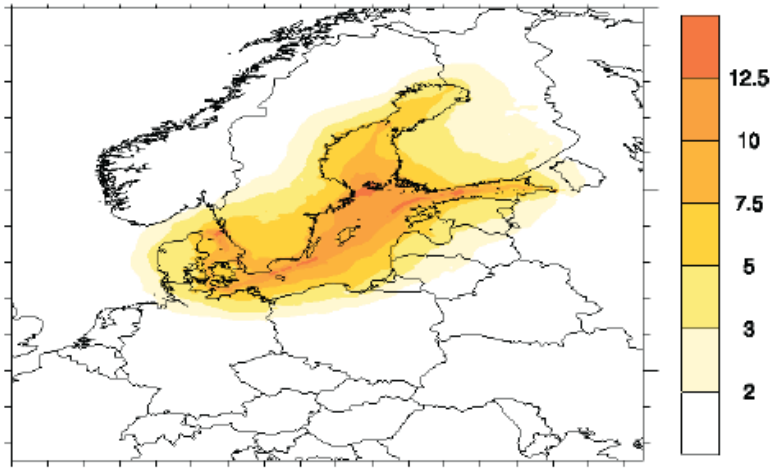
Years of life lost

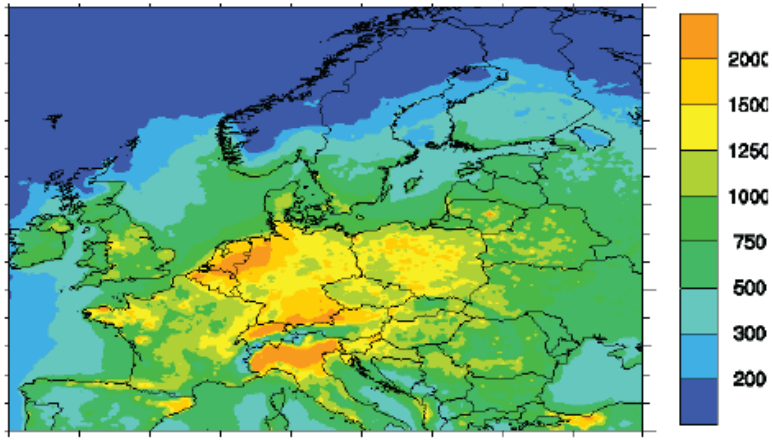
	DK	SE	FI	EE	LV	LT	PL	DE
2009	664401	934556	630737	168858	562939	986758	18100364	26190780
FROM BALT	33162	60041	26871	7122	13990	19786	159288	231564
2009 - 2011	15905	22022	6204	1292	2493	2493	34680	101038



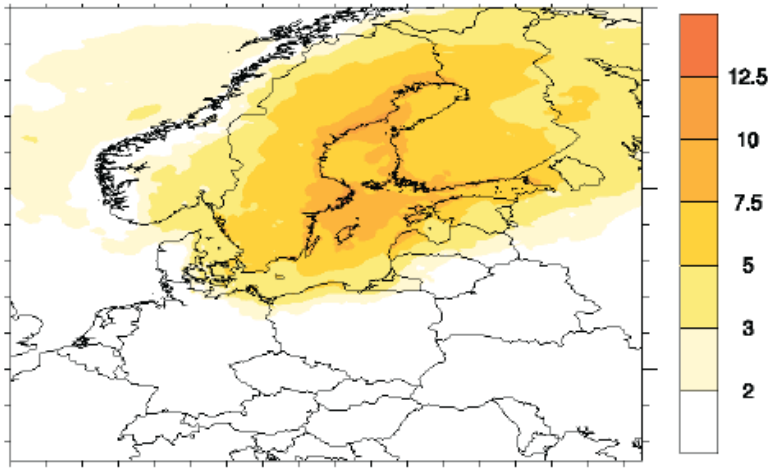
a) PM2.5 in μgm^{-3}



b) PM2.5 percentage difference



c) Dep. Nitrogen in $mg(N)m^{-2}$



d) Percentage difference N dep.

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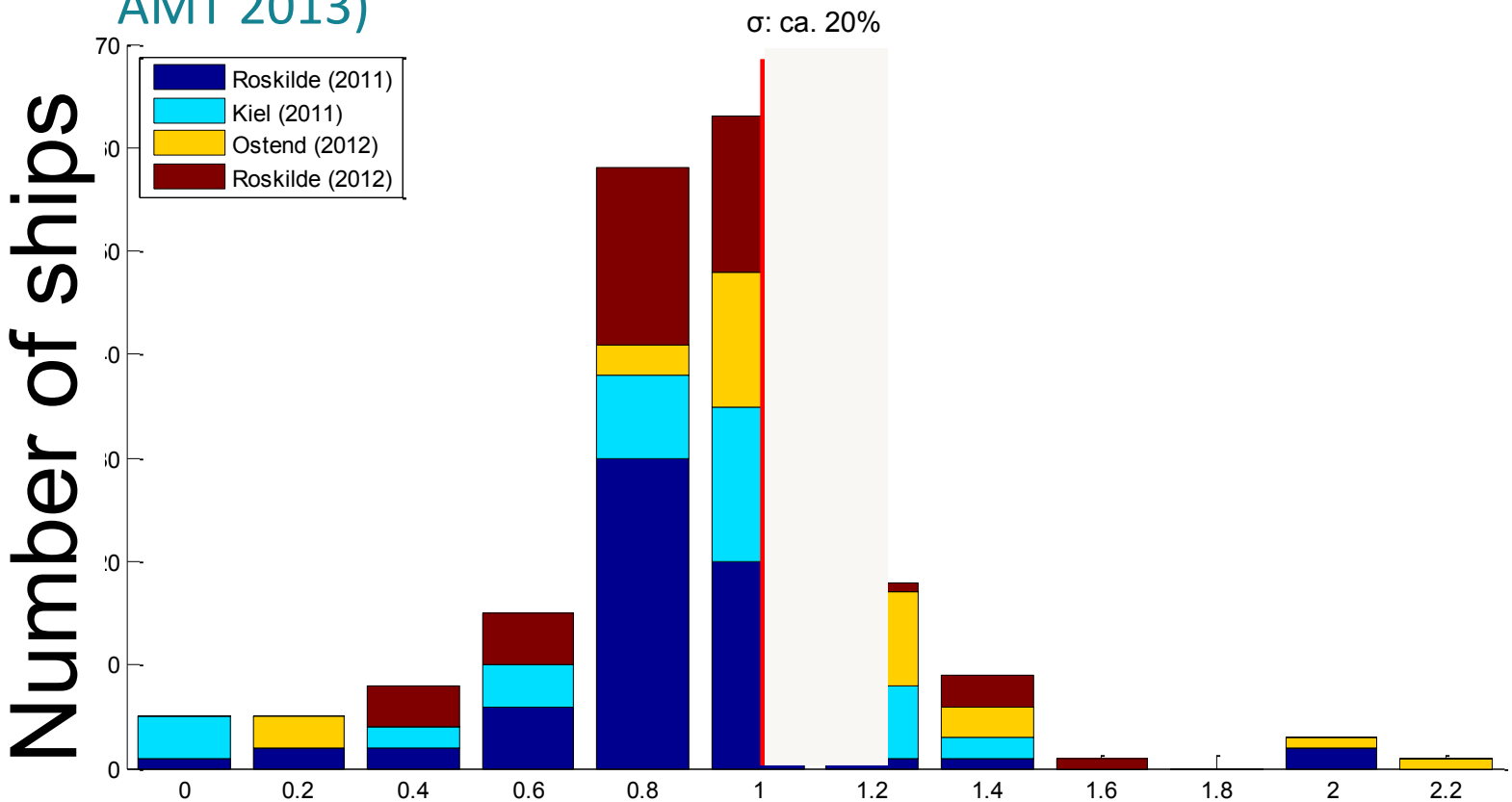
Sulfur content histogram obtained by airborne measurement of 162 ships in the Baltic and North sea 2011/2012 (Beecken AMT 2013)



Sulfur fuel content %

Compliance: ca. 90%

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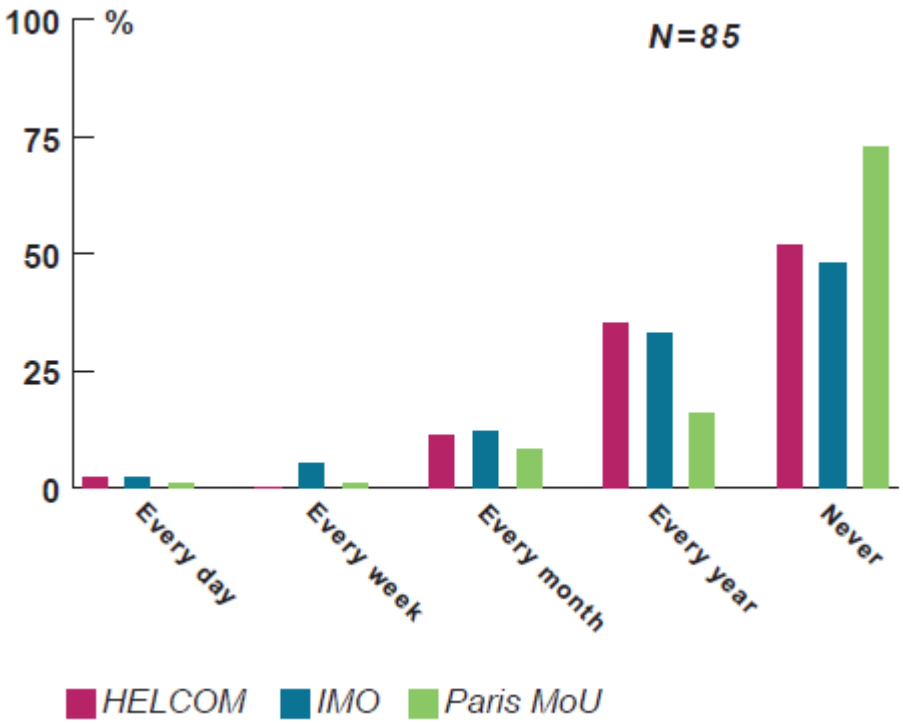
Intensity of interactions



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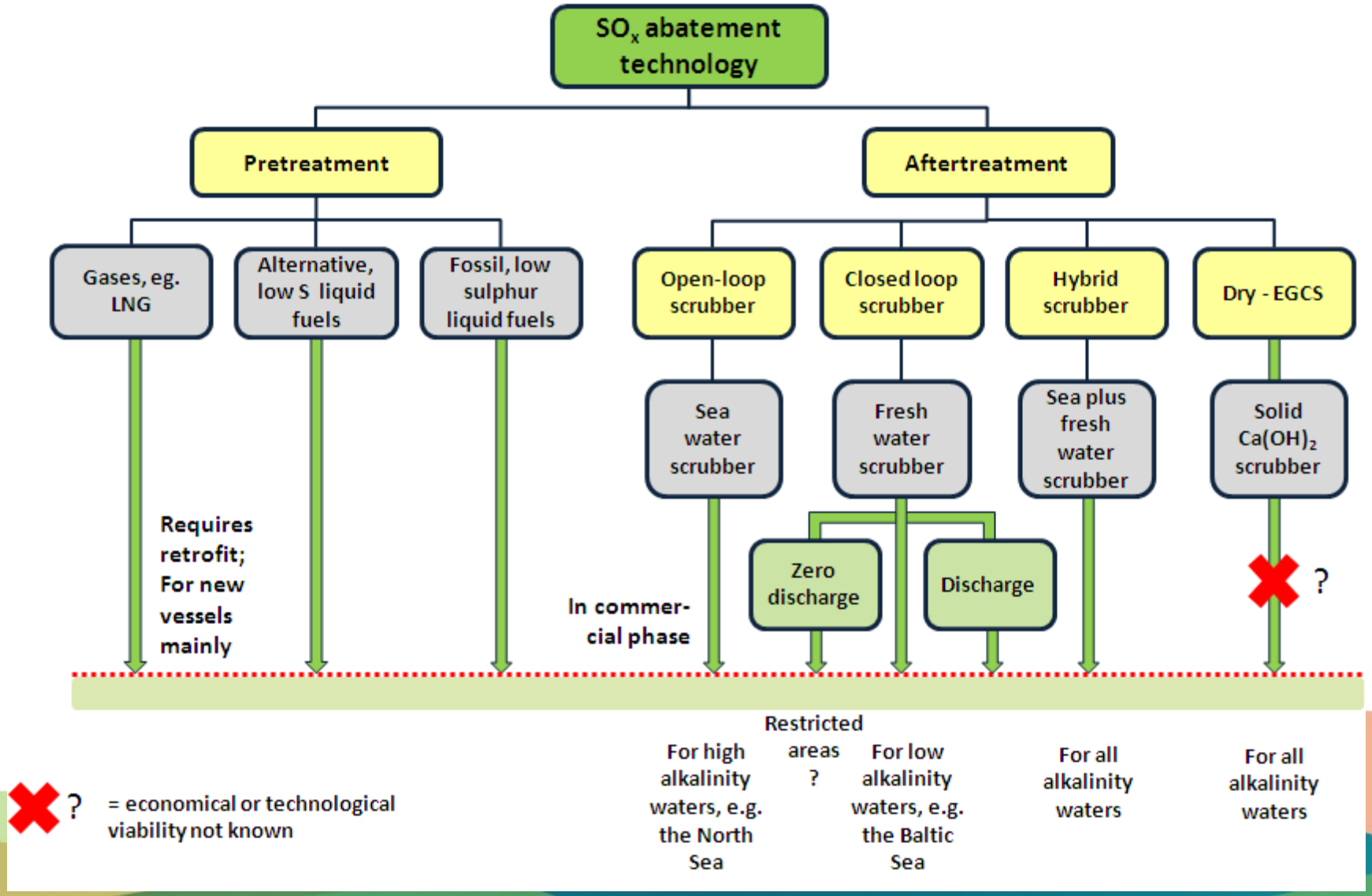
State-of-the-art of SO_x reduction options



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Baltic Sea cooperation for
through knowledge- & in

Cost of Nox abatement

€/ABATED TON OF NOX	2020	2025	2030
RO-RO	1 191	1 239	956
ROPAX	1 087	1 077	963
PRODUCT TANKER	2 694	3 010	3 464
CONTAINER	2 051	1 719	1 466
CHEMICAL TANKER	1 935	2 569	2 473
GENERAL CARGO	2 396	2 329	2 063
VEHICLE CARRIER	2 596	2 473	2 328
CRUDE OIL TANKER	2 886	3 151	3 087
BULK SHIP	4 445	4 446	4 111
LPG TANKER	2 299	2 176	2 200
CRUISE SHIP	2 626	1 904	1 187
REEFER	3 059	3 134	1 855

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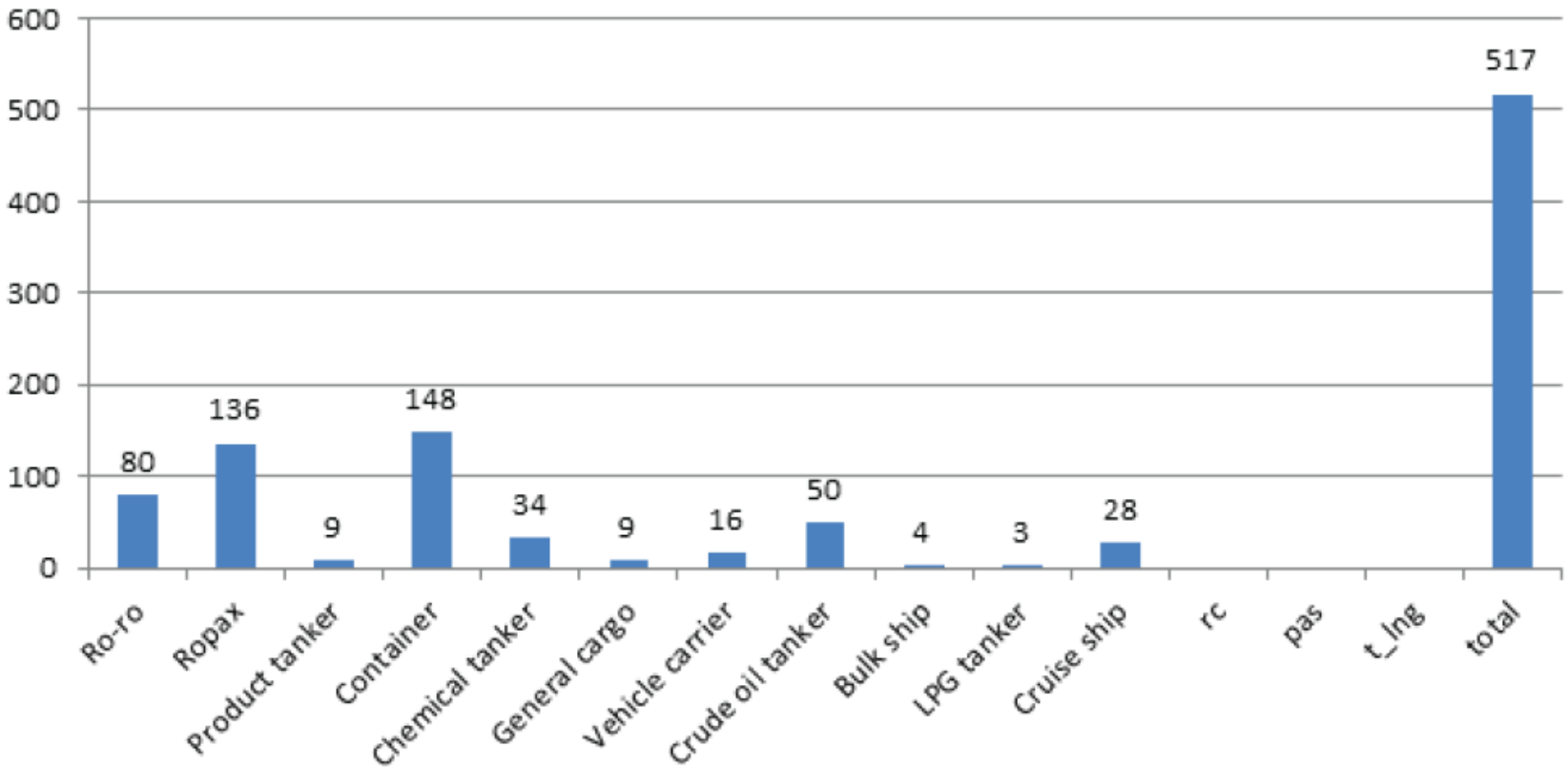
Model 1, vessels fulfilling the criteria for scrubbers in 2014



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Slow Steaming

SLOW-STEAMING (30%)									
	SHARE OF TOTAL	ΔMAIN FUEL	ΔOPERATIONAL	ΔFUEL COST	ΔCO2	ΔNOX	ΔSOX	ΔPM2.5	ΔCO
SHIP CATEGORY	FC 2011 [%]	cons. [%]	time [%]	[%]	[%]	[%]	[%]	[%]	[%]
CONTAINER SHIP	19.4	-34.5	12.2	-13	-14.4	-22.6	-23.8	-13.9	5.5
ROPAX	10.1	-34	9.7	-25	-26.3	-29.9	-32	-29.2	13.6
CHEMICAL TANKER	8.3	-31.4	8.9	-15.5	-17.1	-24.4	-27.2	-22.9	19.6
BULK CARGO	6.7	-31.1	9	-16.2	-17.7	-24.8	-26.7	-23.1	26.8
CRUDE TANKER	4.6	-31.7	8.1	-20.6	-21.8	-28.8	-28.2	-25.8	26.4
RORO	4.5	-42	15.8	-31.2	-32.9	-36.7	-40	-34.4	6.9
VEHICLE CARRIER	2.1	-41.5	12.9	-22.5	-24.3	-33.9	-34.6	-24.2	14.2
REFRIGERATED CARGO SHIP	1.7	-39.7	9.6	-14.9	-16.9	-26.6	-31	-20	13.2
PASSENGER CRUISER	1.4	-30.8	9.2	-18.2	-19.7	-22.6	-26.5	-21.8	7.3
LPG TANKER	1.1	-34.4	9.2	-15	-16.8	-25.2	-28.8	-22.7	19.1

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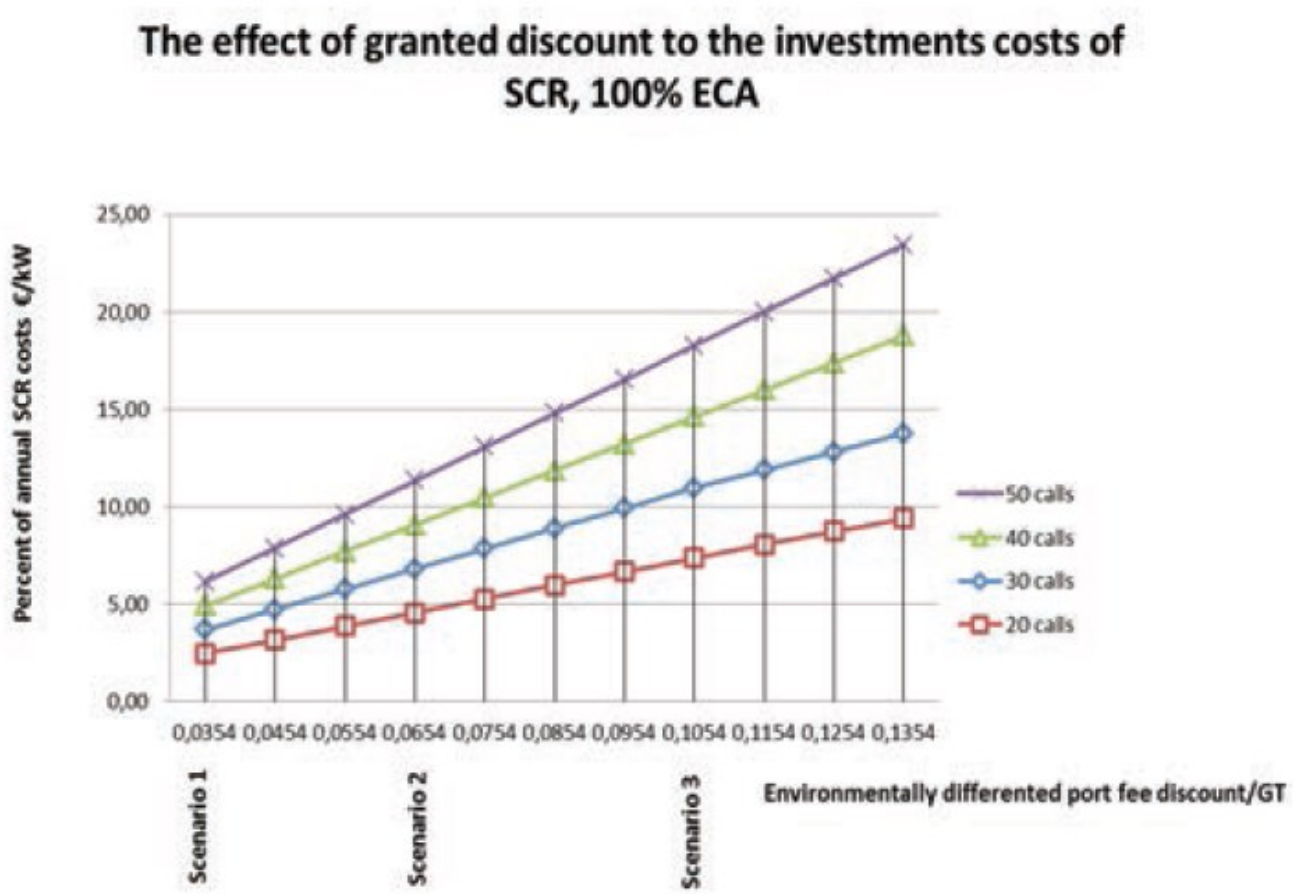
Effect of differentiated port dues



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Emissions from Baltic shipping, tn

	NOx	PM	CO	CO_2
2006	336	29	52	15600
2007	369	28	58	15900
2008	377	26	64	16600
2009	360	23	64	15900
2010	345	23	63	17300
2011	356	22	36*	18700

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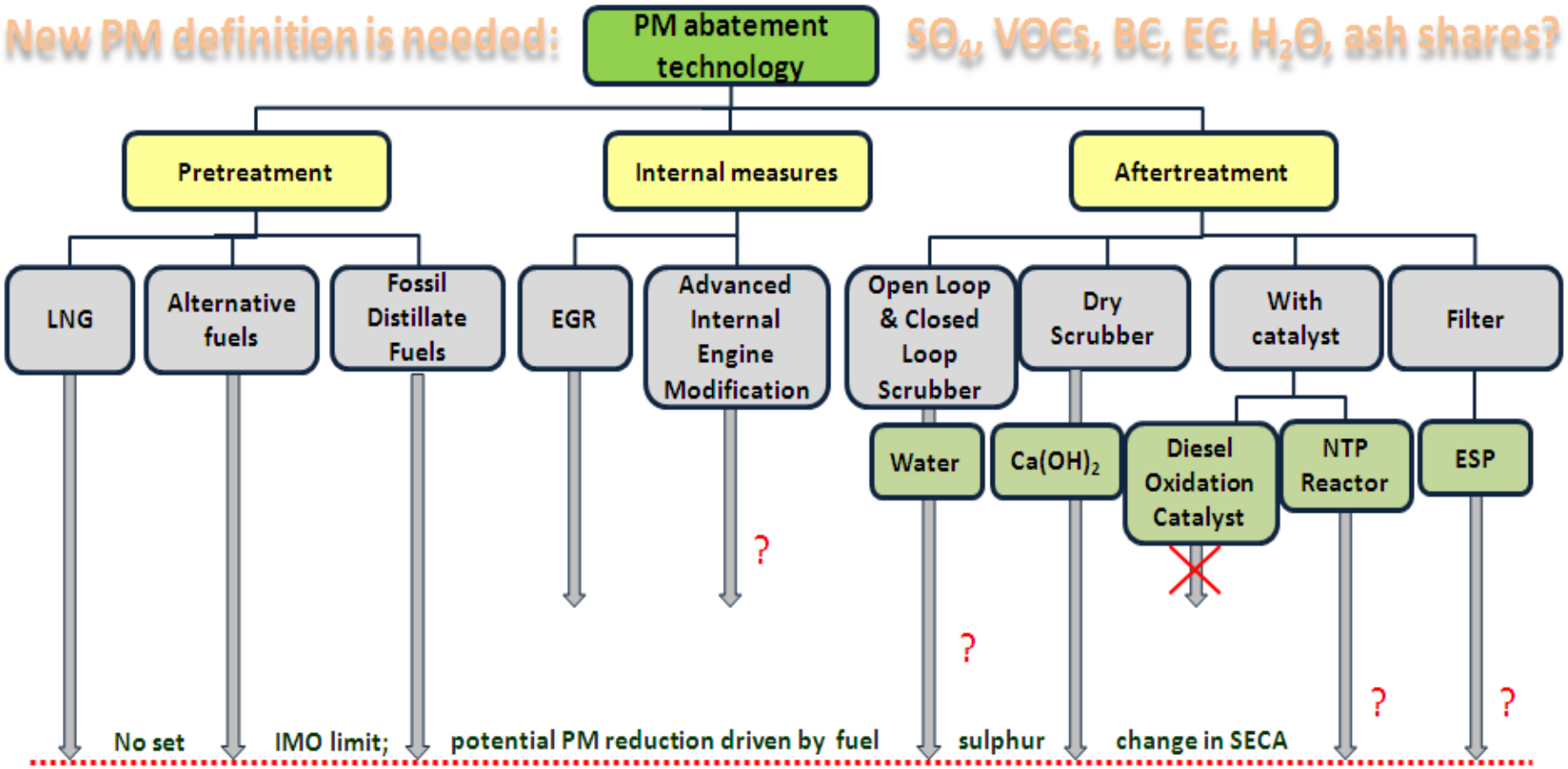
State-of-the art of (not-limited) PM reduction options



= clean fuels only

? = not certain, or technical viability not known