Technology and efficiency, its role and mechanism for improving carbon intensity, and the implications for IMO policy and the Nordics

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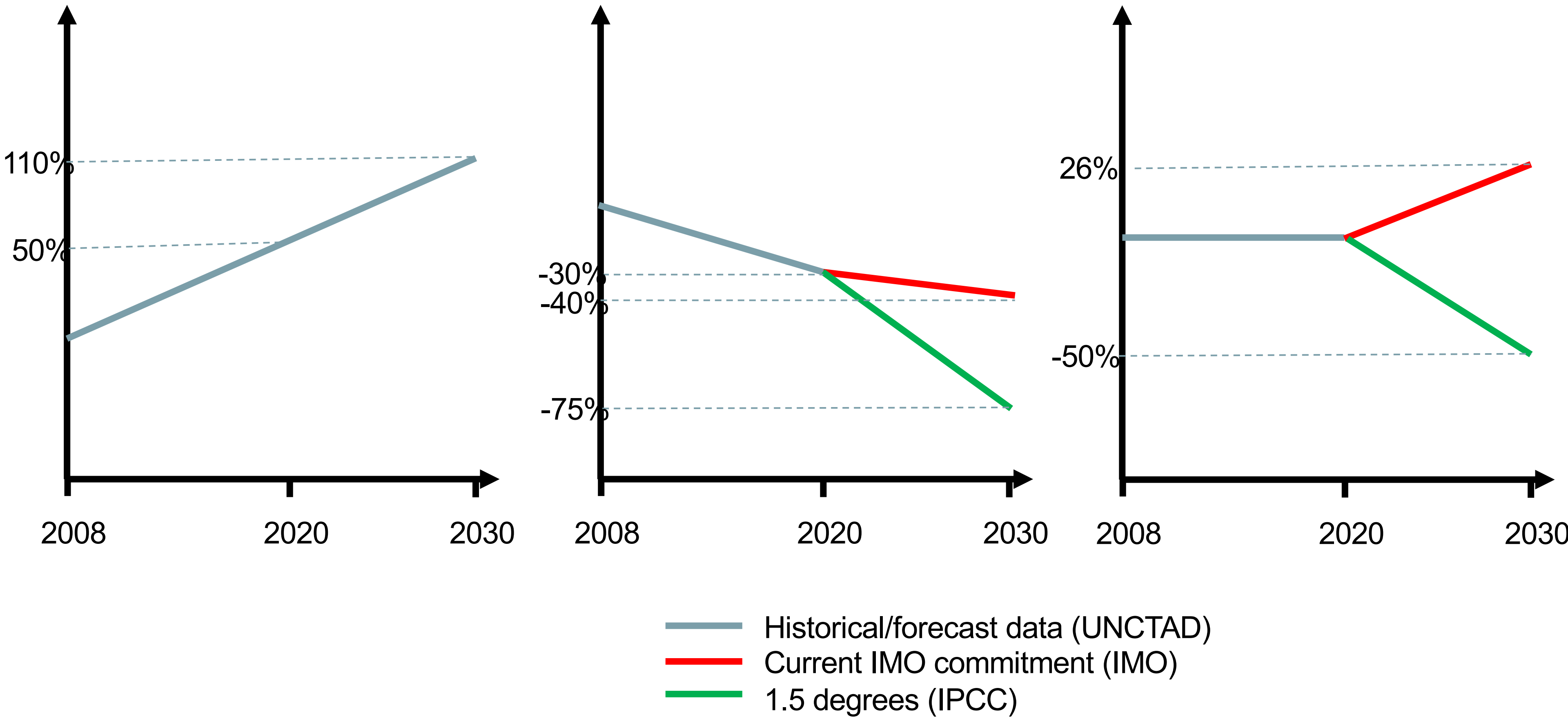
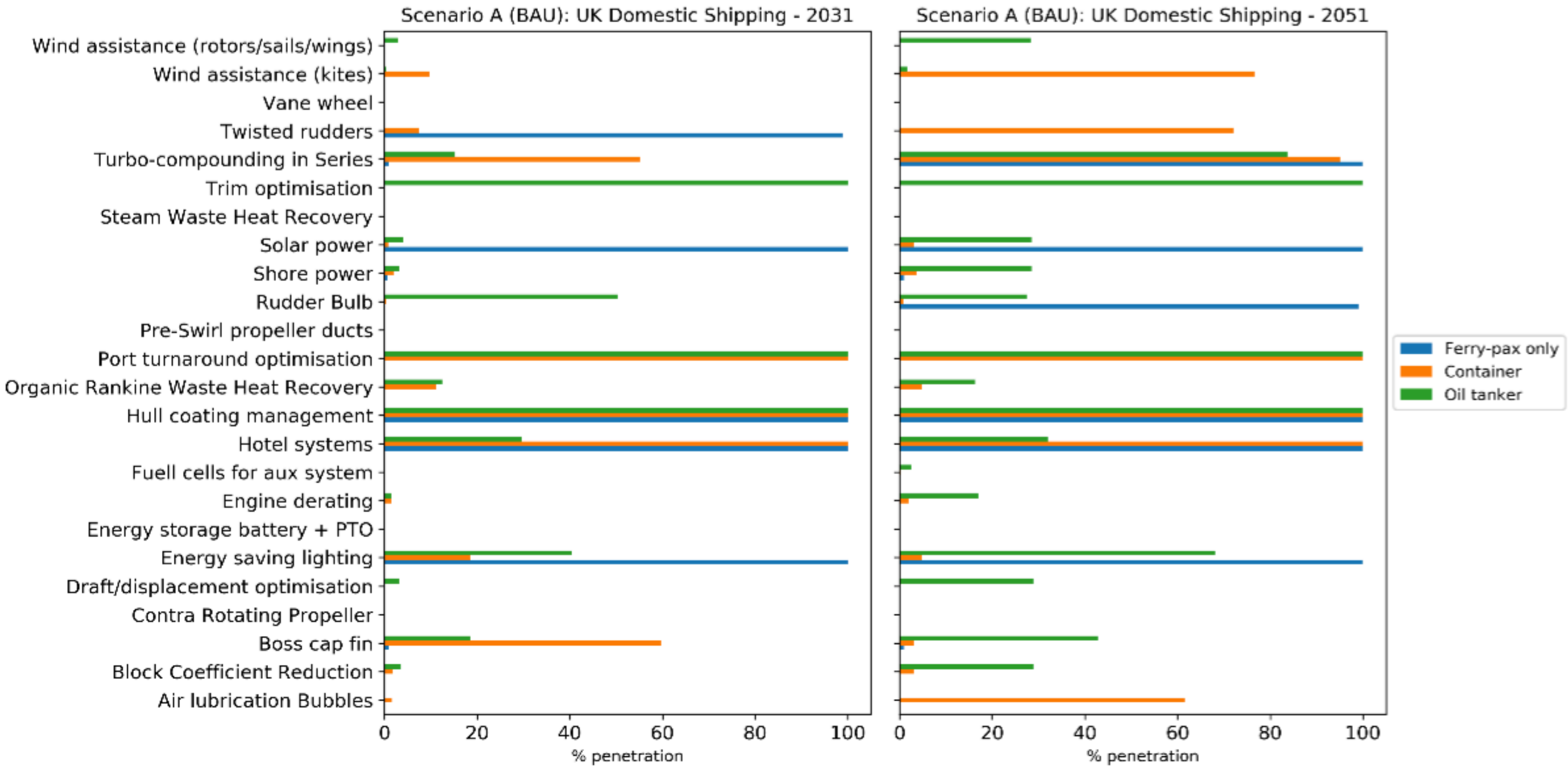
Transport work x Carbon intensity = CO_2



There are a few technologies, as yet to be fully adopted, they are limited in their ability to produce any significant further reductions in efficiency

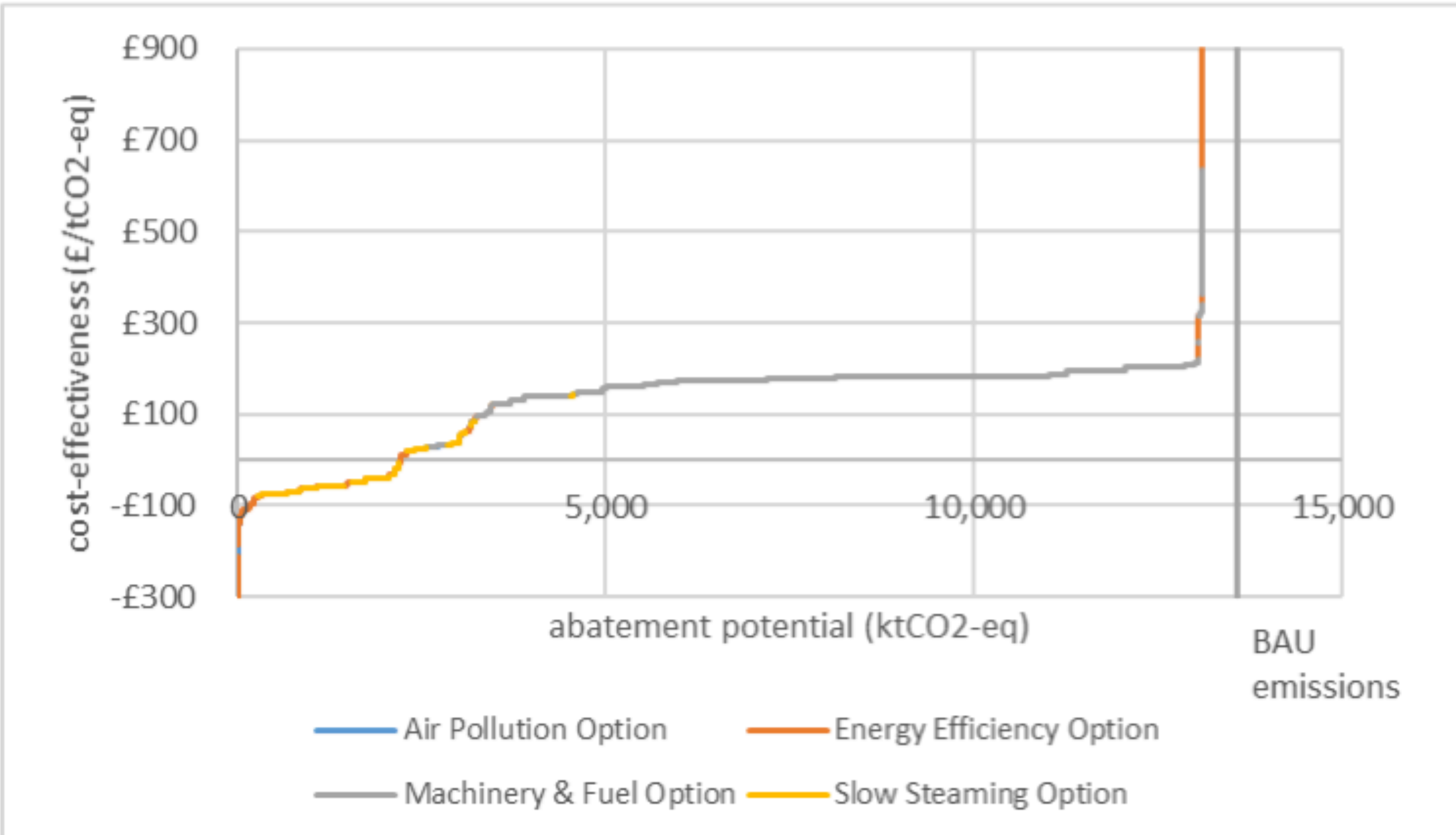
There are long lists of options that can improve efficiency. Many interact/interfere, some will be taken up under BAU conditions



The design and technology options can be broadly summarized as:

- Hullform and the right propeller
- Wind assistance
- Air lubrication
- Rudder/prop hydrodynamics
- Right engine size, heat/waste recovery
- Main/aux integration
- Coatings

MACC for UK international shipping, 2030 (2018 prices)



We must look at carbon intensity holistically, some of the cheapest and bigger improvements are not to do with technology but incentivizing the market to overcome barriers/failures that currently prevent efficient operation

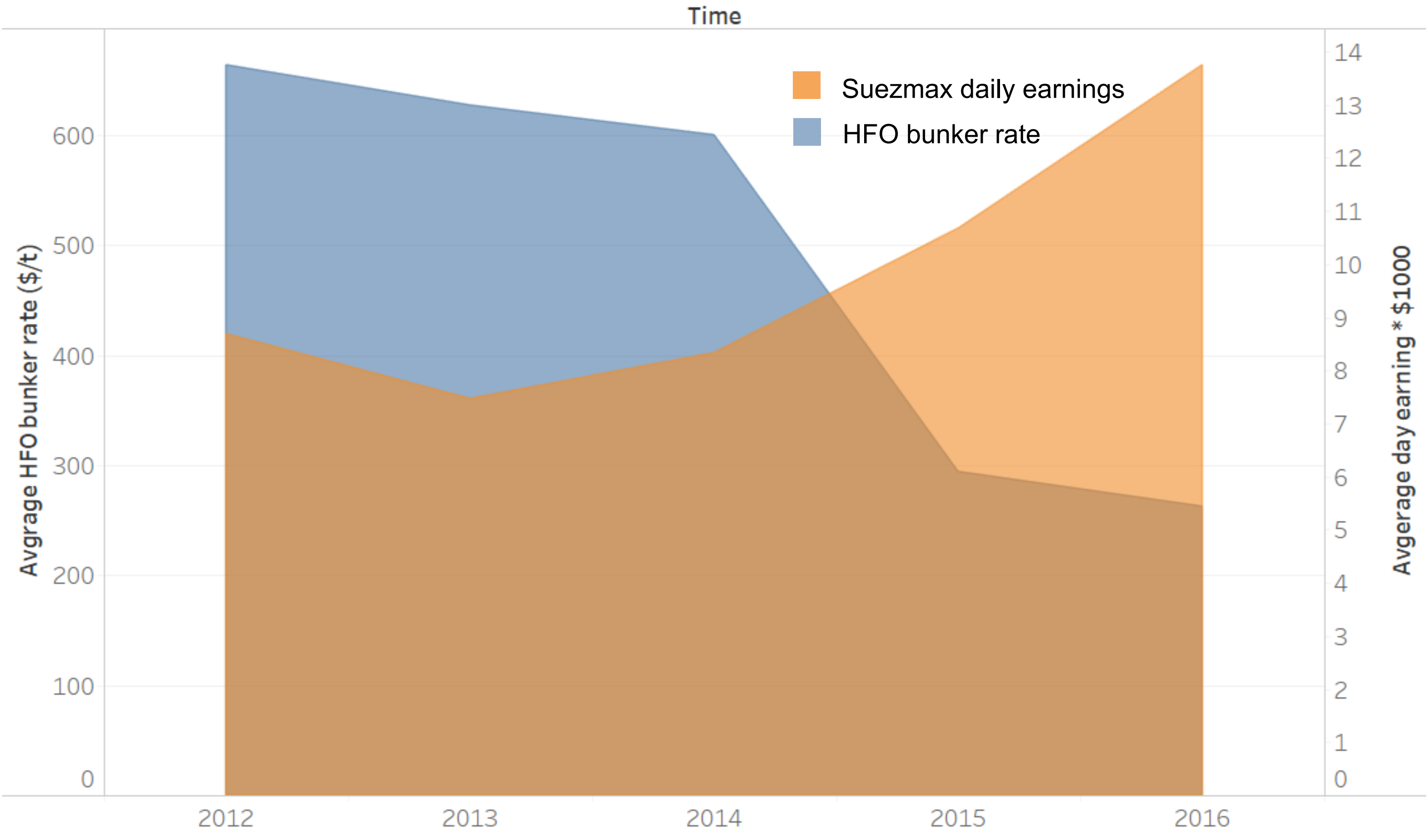
Suezmax Tankers

- Suezmax - largest vessel size capable of transiting the Suez Canal in laden condition
- 514 in service Suezmaxs in global fleet

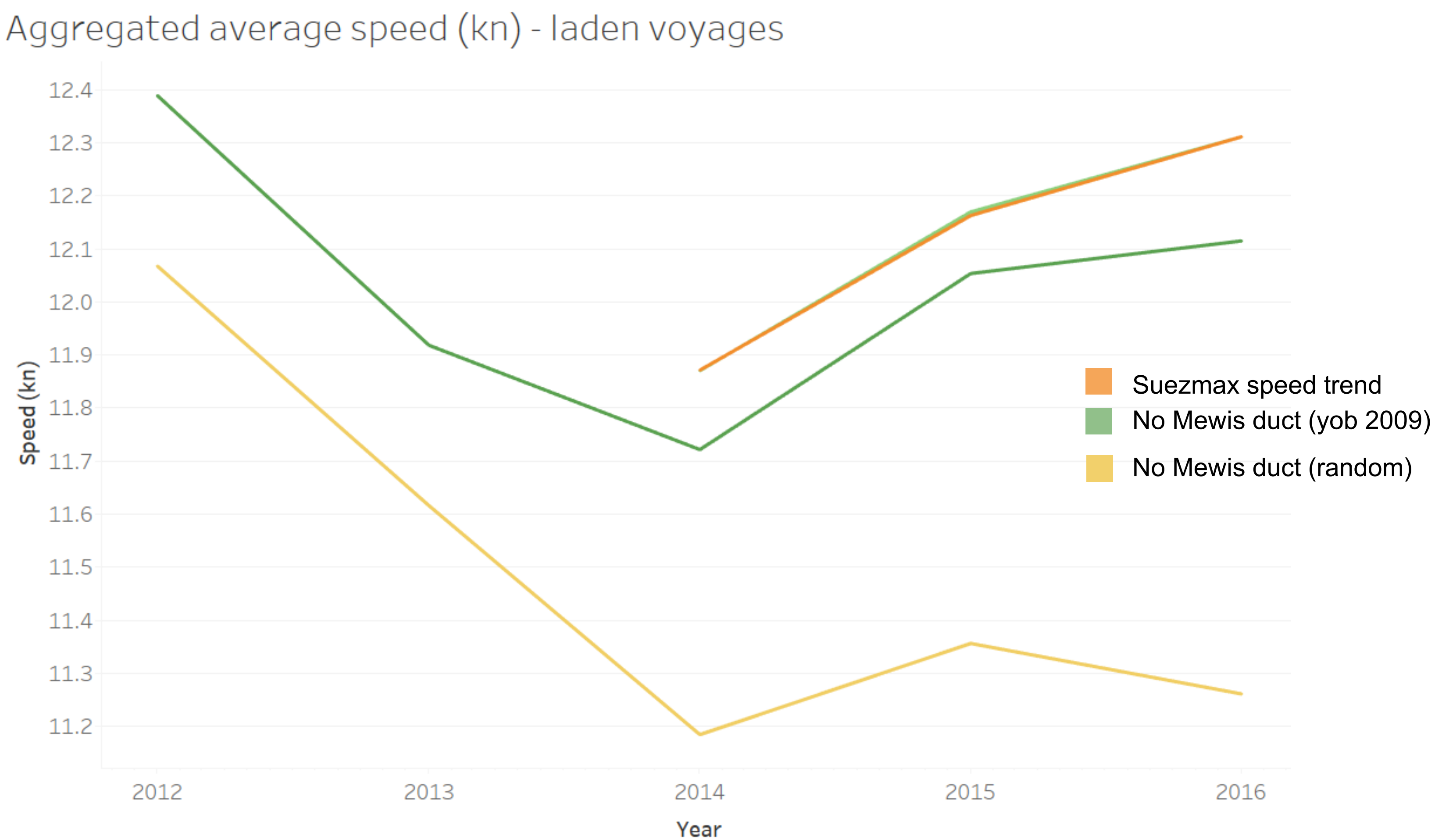
Maximum Dimensions
- Draft 20.1m
- Beam: 77.5m
- Height: 68m

AIS density plots of Suezmax tankers in study
Denser traffic shown in yellow

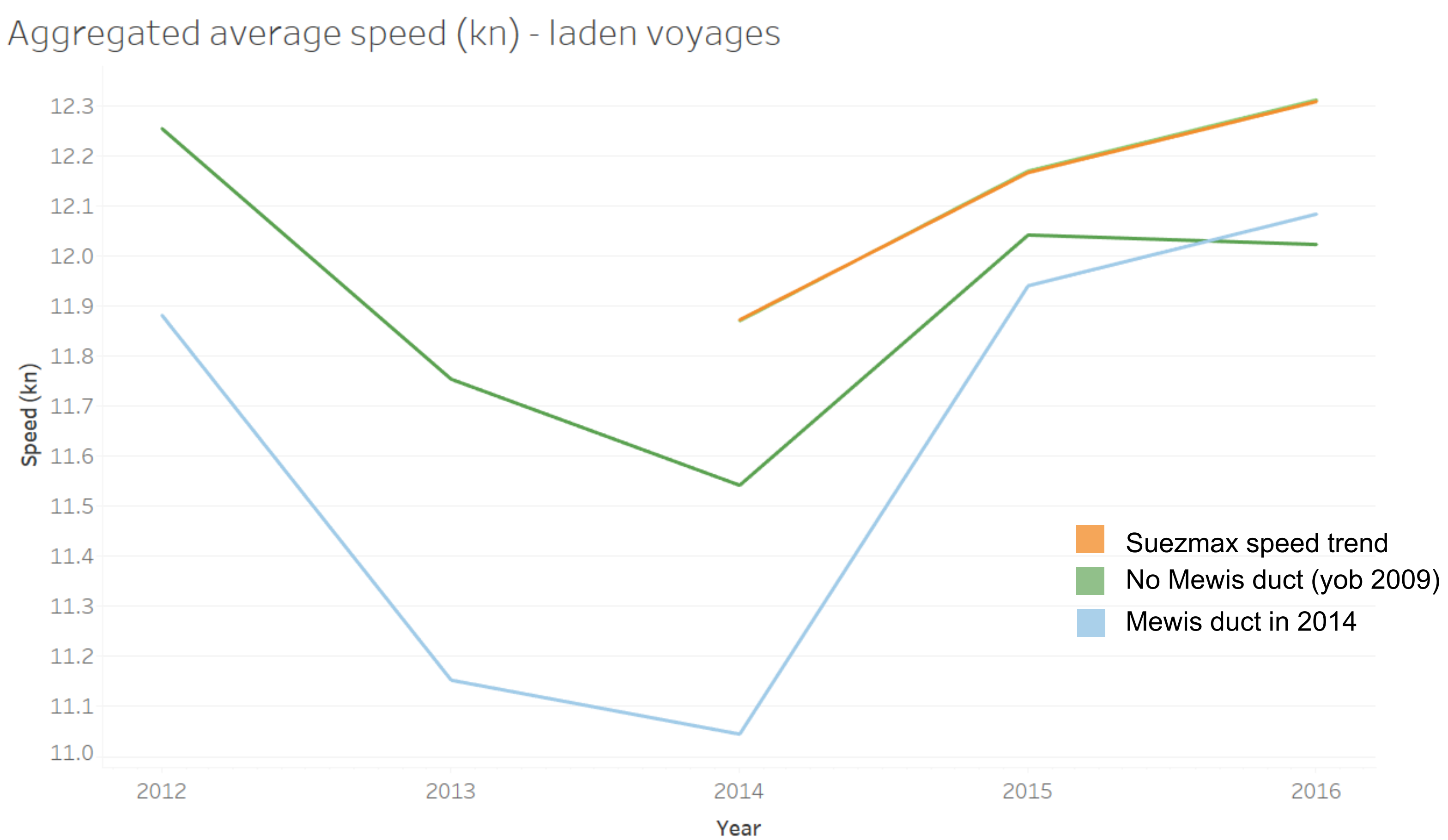
HFO Bunker prices and Suezmax day earning rates



Big Picture


Aggregated average speed (kn) - laden voyages
12.4
12.3
12.2
12.1
12.0
11.9
11.8
11.7
11.6
11.5
11.4
11.3
11.2
Speed (kn)
2012
2013
2014
2015
2016
Year
Suezmax speed trend
No Mewis duct (yob 2009)
No Mewis duct (random)

Big picture



Aggregated average speed (kn) - laden voyages
Speed (kn)
12.3
12.2
12.1
12.0
11.9
11.8
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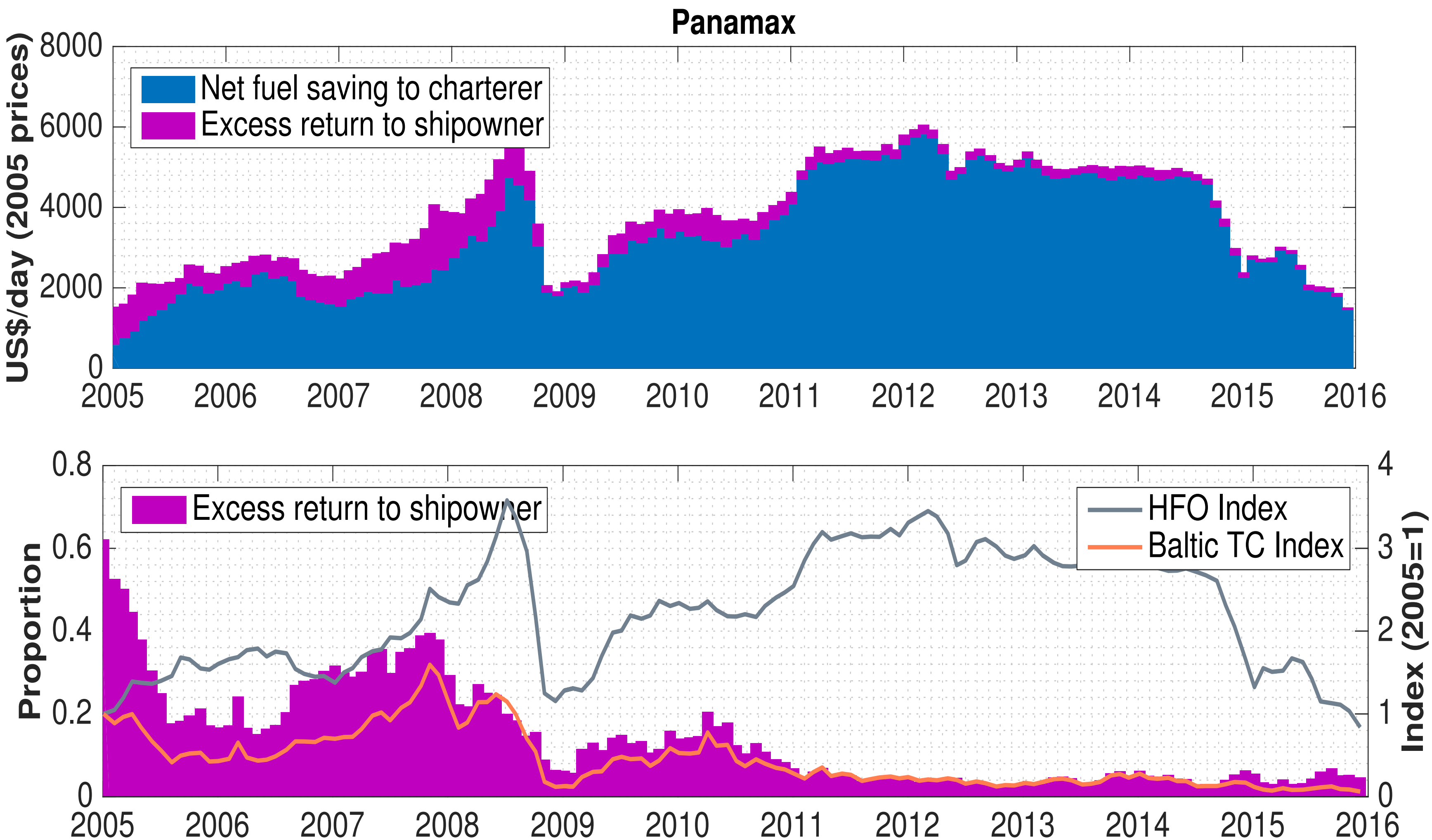
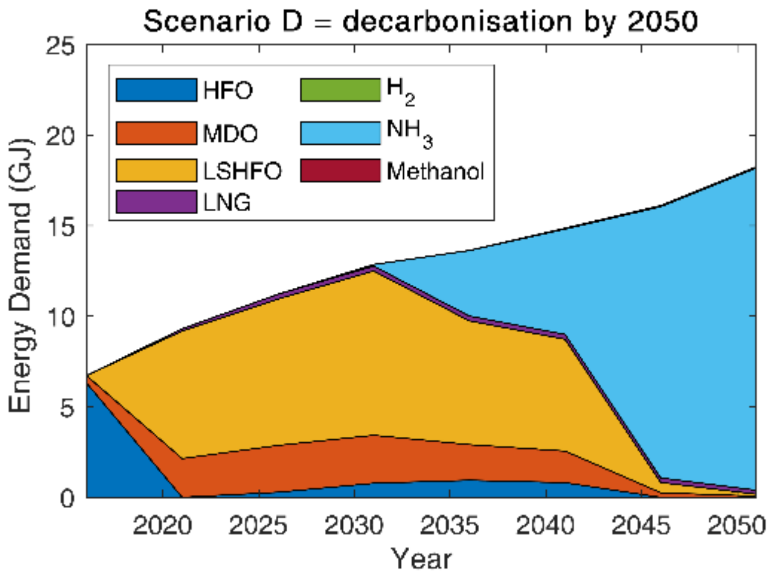
11.6
11.5
11.4
11.3
11.2
11.1
11.0
2012
2013
2014
2015
2016
Year
Suezmax speed trend
No Mewis duct (yob 2009)
Mewis duct in 2014


Panamax
US$/day (2005 prices)
Net fuel saving to charterer
Excess return to shipowner
8000
6000
4000
2000
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Proportion
0.8
0.6
0.4
0.2
0
Excess return to shipowner
HFO Index
Baltic TC Index
Index (2005=1)
4
3
2
1
0

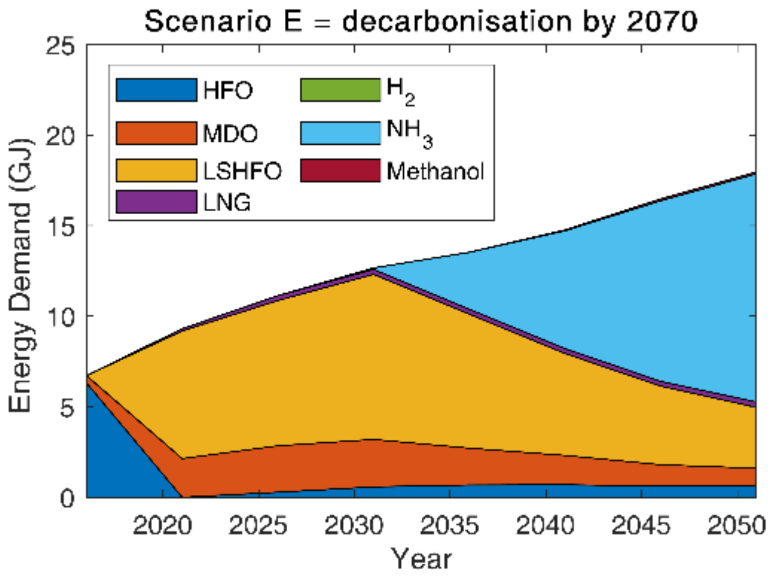
Because technology and operational improvements cannot keep up with the pace of decarbonization needed, the debate has moved onto how to exit from the use of fossil fuel. Any technology decisions must be considered in light of that.

A hydrogen carrier (e.g. ammonia) will have a 75-99% market share by 2050

2050 decarbonization (1.5ºC aligned)
GJ



2070 decarbonization (IMO aligned)
GJ



Source: UMAS GloTraM (2019), UK Clean Maritime Plan

Concluding remarks - 1

- Further efficiency improvement is important
  - Its our main means to control emissions this decade, which is critical
  - It reduces the cost of the move from fossil fuel
  - It reduces the demand for zero emission fuels, reducing risks from any constraints on shipping's decarb by energy system decarb
- But thinking about efficiency as something we solve using technology misses the point, we must
  - Factor in real operating conditions
  - Factor in commercial forces
- The decarbonization debate is now about moving fast away from fossil fuels:
  - Efficiency improvements that are machinery/fuel agnostic (e.g. wind)
  - Look for systems engineering synergies from new machinery/fuel

Concluding remarks - 2

- To maximise emission reduction potential 2020-2030, short term measures will either need to mandate minimum operational efficiency for the existing fleet.
- Or mandate a proxy to operational efficiency
  - Technical efficiency (e.g. EEXI)
  - Speed
- Choices for proxies (speed and technical efficiency) are inferior including because of interactions with commercial behavior (rebound):
  - Mandating reduced speed reduces the incentive to invest in technology and lower carbon intensity reduction cost-effectiveness
  - Mandating investment in technology can incentivize increased speeds and lower carbon intensity reduction cost-effectiveness
- Besides the interaction inferiority, EEXI will:
  - Only incentivize a subset of the options that can improve efficiency, missing some of the key cheaper options
  - Create perverse incentives to optimize for design speed, flat water, deep loading
- In the absence of the strong IMO policy we need, transparency is key. It enables the commercial markets to drive change by managing their risk and taking opportunity.
  - Banks
  - Charterers
  - Others…

Thank you very much

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https://www.gov.uk/government/publications/clean-maritime-plan-maritime-2050-environment-route-map

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