Improving Vessel and Supply Chain Fuel Efficiency

CAAAC – 2/27/2013
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Director, Environment & Sustainability
Transportation is a significant source of CO$_2$ and other air emissions.

- Human activity generates GHG emissions of about 50,000 mega-tonnes CO$_2$e.
- An estimated 5.5% of the total is contributed by the logistics and transportation sector.

Ocean shipping is the most energy-efficient way to move cargo long distances... 

*But is impacting the planet*

90% of all goods transported globally are carried by ship.

Ocean shipping generates 4% of all man-made CO$_2$.

http://climate.nasa.gov/news/860
Air quality in many US ports exceeds national standards, requiring reductions in emissions.
The A.P. Møller–Maersk Group

• Headquarters: Copenhagen, Dk
• 2011 Revenue: $60 B
• Shipping, Energy, Banking and Supermarkets

Est. 1904 by Arnold Peter Møller with his father, Captain Peter Mærsk Møller.

1965 -- Mærsk Mc-Kinney Moller assumed leadership

1993 MMM withdrew from day-to-day management

The Group is currently headed by Nils S. Andersen, the fourth Group CEO.
Today, a single ship can deliver thousands of tons of cargo for many customers to dozens of ports. But it was not always this way ...
Diesel engines have replaced wind power
Containers have replaced “break bulk” cargo handling
Containers are standard sizes: 20’, 40’ or 45’

- A 40-foot container is the size of a city bus
  - Can hold:
    - 1,500 DVD players
    - 18,000 T-shirts
    - 90,000 lamb chops

- 45-foot container can hold 28,000 Barbie Dolls
“Liner shipping” means vessels have strict routes and schedules. Routes require several weeks, so multiple vessels are scheduled on each route to provide regular service (weekly).
A 14 week round trip requires 14 vessels.

**Sample Vessel Schedule: Georg Maersk on TP-6 in 2010**

<table>
<thead>
<tr>
<th>Port Name</th>
<th>Arrival Date</th>
<th>Departure Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>18 Apr 2010</td>
<td>19 Apr 2010</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>30 Apr 2010</td>
<td>03 May 2010</td>
</tr>
<tr>
<td>Yokohama</td>
<td>20 May 2010</td>
<td>20 May 2010</td>
</tr>
<tr>
<td>Nagoya</td>
<td>21 May 2010</td>
<td>21 May 2010</td>
</tr>
<tr>
<td>Shanghai</td>
<td>23 May 2010</td>
<td>24 May 2010</td>
</tr>
<tr>
<td>Ningbo</td>
<td>24 May 2010</td>
<td>25 May 2010</td>
</tr>
<tr>
<td>Xiamen</td>
<td>26 May 2010</td>
<td>27 May 2010</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>27 May 2010</td>
<td>28 May 2010</td>
</tr>
<tr>
<td>Yantian</td>
<td>28 May 2010</td>
<td>29 May 2010</td>
</tr>
<tr>
<td>Tanjung Pelepas</td>
<td>01 Jun 2010</td>
<td>02 Jun 2010</td>
</tr>
<tr>
<td>Jeddah</td>
<td>11 Jun 2010</td>
<td>12 Jun 2010</td>
</tr>
<tr>
<td>Suez Canal</td>
<td>15 Jun 2010</td>
<td>15 Jun 2010</td>
</tr>
<tr>
<td>Barcelona</td>
<td>19 Jun 2010</td>
<td>20 Jun 2010</td>
</tr>
<tr>
<td>Valencia</td>
<td>21 Jun 2010</td>
<td>22 Jun 2010</td>
</tr>
<tr>
<td>Algeciras</td>
<td>23 Jun 2010</td>
<td>24 Jun 2010</td>
</tr>
<tr>
<td>Port Tangier Mediterranee</td>
<td>25 Jun 2010</td>
<td>26 Jun 2010</td>
</tr>
<tr>
<td>Suez Canal</td>
<td>01 Jul 2010</td>
<td>02 Jul 2010</td>
</tr>
<tr>
<td>Tanjung Pelepas</td>
<td>17 Jul 2010</td>
<td>18 Jul 2010</td>
</tr>
<tr>
<td>Vung Tau</td>
<td>20 Jul 2010</td>
<td>21 Jul 2010</td>
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<tr>
<td>Yantian</td>
<td>23 Jul 2010</td>
<td>24 Jul 2010</td>
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<tr>
<td>Hong Kong</td>
<td>25 Jul 2010</td>
<td>26 Jul 2010</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>08 Aug 2010</td>
<td>12 Aug 2010</td>
</tr>
</tbody>
</table>
Ocean shipping has the lowest environmental impact for long distance transportation.

90% of all goods transported globally are carried by ship.
Things used to be simpler for the shipping industry...

- Fuel costs were **low and predictable**
- Environmental regulations were **limited and manageable**
- **CO₂ emissions** were not an issue
- Marine fuels were “**one size fits all.**”
- Shipping as an industry was **not on the radar screen** (as long as we avoided big oil spills)
What are we facing now?

- Increased transparency
- Increased accountability
- Increased & changing regulation
- Increased customer expectations
- Increased competition
Vessel fuel prices have soared since 2010 and are volatile.

**Bunker fuel ($/metric ton)**
- 2010: $440 - 520
- 2011: $520 - 680
- Q1 2012: $680 – 740
- Q2 2012: $740 - 611
- Q3 2012: $580 - 680
- Q4 2012: $620 – 660

**Marine Gas Oil ($/metric ton)**
- 2010: $670 - 800
- 2011: $800 - 1040
- 2012: $900 - 1060

Use: California and voluntary fuel switches.
The North American Emissions Control Area (ECA) now requires lower sulfur fuel.

- Effective Aug. 2012
  - Caribbean ECA 1/2014

- 200 nautical mile zone around the US and Canada

- Fuel sulfur max:
  - 2012-2014 <1%
  - Jan. 2015 <0.1%

- Cost premium $50-150/T.
Vessels are increasingly fuel efficient. This reduces fuel use, CO2 and other air emissions.

- CO2 and other emissions were reduced 25% per TEU km from 2007 to 2012.
- CO2 reduction goal has now been raised to 40% for 2020
- Reductions were achieved through a combination of vessel size, technologies, route planning and operational changes.

Maersk Line CO2 Reductions

2007-2011 data was verified by:

Met 2020 CO2 reduction goal 8 years early!
Innovation is essential for sustainability

Other Initiatives
- Alternative fuel tests
- New propulsion technologies
- ISO 14001 certified
- Crew awareness and engagement
- Maintenance of hull and propeller
- Voyage Efficiency System (VES)
- Trim optimization
- SOx scrubber studies
- Antifouling hull paint
- QUEST: Low energy chilled containers
- Modified bulbous bow
- Micro bubbles
- Ballast water optimization and treatment systems

- Propeller, hull & trim optimization
- Waste heat recovery system
- Slow steaming and super-slow steaming
Vessel size drives much of energy and CO\textsubscript{2} performance.

Source: BSR Clean Cargo Working Group, 2012 Environmental Performance study.
All Maersk Line new builds are more energy efficient, and some being delivered today are 28 to 50% better.

**Triple E – 18,000 TEU**
- Coming in 2013
- 50% more efficient

**WAFMAX class – 4500 TEU**
- 28% less CO2 per TEU
- 10 in service (2011)
- 12 more delivered by 2012

**SAMMAX class – 7500 TEU**
- 50% less CO2 per TEU
- 6 vessels in service in 2011
- 10 more by 2012.
Vessel environmental improvements take time and partnerships.

**New vessels**
- Optimize vessels for intended services
- Potential energy efficiency improvements 20-50%
- Work with shipyards, equipment and fuel suppliers
- Long-term view plus short-term impact

**Existing fleet**
- Identify or develop technologies
- Work with Charter vessel owners
- Partner with technology, software and engine suppliers
- Identify the right mix for each vessel

**Personnel**
- Vessel crews
- Shore side teams
- Structures, metrics, idea sharing
Improvements go beyond the vessels

- Refrigerated (“reefers”) – a new, innovative control system reduces energy consumption by 50 to 63%.

- Container flooring is now recycled plastic, bamboo or FSC certified timber.

- Slow or “steady” steaming – voyage efficiency systems improve on-time delivery at the same time they are minimizing fuel usage.

- Testing alternative fuels and propulsion.

- Using our vessels to assist ocean scientists.

<table>
<thead>
<tr>
<th>Study Period</th>
<th>On-Time %</th>
<th>Ranking Among Top 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>3Q11</td>
<td>83</td>
<td>1</td>
</tr>
<tr>
<td>2Q11</td>
<td>76</td>
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<tr>
<td>1Q11</td>
<td>66</td>
<td>3</td>
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<td>4Q10</td>
<td>70</td>
<td>1</td>
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<tr>
<td>3Q10</td>
<td>79</td>
<td>1</td>
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<tr>
<td>2Q10</td>
<td>77</td>
<td>1</td>
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<td>1Q10</td>
<td>69</td>
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<tr>
<td>4Q09</td>
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<td>3Q09</td>
<td>71</td>
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<tr>
<td>2Q08</td>
<td>76</td>
<td>1</td>
</tr>
<tr>
<td>1Q08</td>
<td>63</td>
<td>3</td>
</tr>
</tbody>
</table>
Cleaner fuel reduces toxic air emissions in ports significantly.

**US & Canada:**
- Over 2800 port calls 3/06 to 12/12
- Fuel is MGO 0.1%S vs. 2.7%S bunker
- Reduced over 5000 MT of emissions:
  - SOx: 95%
  - Particles (PM): 86%
  - NOx: 6-10%

- Now a global Maersk initiative
  - Hong Kong 9/2010
  - Singapore 7/2011
  - Gothenburg Sweden 1/2012

Changing the way we think about shipping:

• **It isn't only the biggest ships -- it's the right ships.** This means optimizing the ships for the service, and upgrading the whole portfolio -- new, existing and charter.

• **“Steady Steaming”** delivers more environmental benefits than just slow steaming.

• **Reliability / On-time delivery** benefits the customer and can also benefit the environment.

• Leading in **transparency** -- publishing every vessel's performance using global standard methods, and third-party verification.

• Sustainability is the right thing to do and also **makes good business sense.**
Our customers are demanding more sustainable supply chains.

“Supply chain collaboration plays a crucial role to become faster, more cost efficient and more sustainable in our end to end operation. We are looking to others outside our industry to help us improve this. Our partnership with Maersk Line is a great example”.

- Simon Smith
Vice President, Logistics

“Maersk Line as a global leader in sustainability enables us to differentiate service providers by their carbon emission intensity and integrate that into our future cargo allocation plans”.

- Neil McKenna,
Vice President, Transportation

“Our expectations for Maersk Line are that we together go as far as we can with the well known factors of environmental logistics. We also need to focus on innovation to secure that next generation logistics can start to reduce the major impact that transportations has on emissions globally”.

- Robert Ingvarsson
Group Transport Manager
The World Economic Forum has identified these opportunities for supply chain impact reduction:

- De-speeding the Supply Chain (18%)
- Low Carbon Sourcing & Manufacturing (16%)
- Near Shoring (9%)
- Packaging Reduction (14%)
- Modal Switches (12%)
- Reverse Logistics (9%)
- Energy Efficient Buildings (<5%)
- Clean Vehicle Technologies (18%)
- Optimized Networks (13%)
- Packaging Reduction (14%)

Insert department name via

Standard methods exist to report environmental impacts of shipping.

Clean Cargo Working Group is a business-to-business forum with the goal “to promote more sustainable product transportation.”

- Clean Cargo members carry over 60% of all TEU shipped globally
- Annual environmental performance survey
- Standardized CO₂ analysis
  - Third party verification
- Annual publication of trade lane averages.

CCWG publishes CO\(_2\) methods and industry averages by trade lane.

- Methods based on fuel efficiency
- Enable CO\(_2\) benchmarking and supply chain CO\(_2\) calculations
- Verification guideline

These factors allow us to compare routes for CO2 emissions. 

*Example: Central America to Atlanta GA*

<table>
<thead>
<tr>
<th>Route</th>
<th>Data source</th>
<th>From</th>
<th>To</th>
<th>Distance (km)</th>
<th>Emission Factor</th>
<th>Kilograms of CO2 per FFE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ocean to Miami, truck to Atlanta GA</strong></td>
<td>Ocean: CCWG 2011 Intra-Americas Industry Average</td>
<td>Santo Tomas</td>
<td>Miami</td>
<td>1533</td>
<td>87.9 g CO2/TEU/Km</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>Truck: SmartWay</td>
<td>Miami</td>
<td>Atlanta</td>
<td>1041</td>
<td>1148 g CO2/km</td>
<td>1195</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>2575</td>
<td></td>
<td>1465</td>
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<tr>
<td><strong>Ocean to Savanna, truck to Atlanta</strong></td>
<td>Ocean: CCWG 2011 Intra-Americas Industry Average</td>
<td>Santo Tomas</td>
<td>Savannah</td>
<td>2228</td>
<td>87.9 g CO2/TEU/Km</td>
<td>392</td>
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<tr>
<td></td>
<td>Truck: SmartWay</td>
<td>Savannah</td>
<td>Atlanta</td>
<td>373</td>
<td>1148 g CO2/km</td>
<td>429</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>2601</td>
<td></td>
<td>820</td>
</tr>
</tbody>
</table>

**CO2 Savings via Savannah (Kilograms per forty foot container)**: 645

**% Reduction**: 44%

Note 1. Clean Cargo Working Group report "Beyond the Factory Gates: Global Trade Lane Emissions Factors", page 2

Note 2. The US EPA SmartWay Shipper Logistics Model states that if carrier-specific emissions factors are unavailable, the model will estimate CO2 emissions using a factor of 1,847.5 g/mile. This was converted to 1,148 g CO2/kilometer.
Alignment will add credibility and drive environmental improvements

- CCWG is working to align and harmonize environmental methodologies globally across modes.
- Collaboration and dialogue between existing and emerging initiatives will drive transparency and improvements.
- Some existing initiatives:
Case study: Nike

Target: 30% reduction of GHG for 2020

FY2009 Result: 12% reduction (-39% in air freight, some lower volume)
Transportation CO₂ Emissions can be reduced.

<table>
<thead>
<tr>
<th>Part of supply chain</th>
<th>Driver of emissions</th>
<th>Ways to reduce emissions (examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ocean transportation</strong></td>
<td>• Volume moved</td>
<td>• Higher container utilisation</td>
</tr>
<tr>
<td></td>
<td>• km covered</td>
<td>• Use of more eco-friendly carriers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Air transportation</strong></td>
<td>• kg moved</td>
<td>• Air to Sea-Air conversion</td>
</tr>
<tr>
<td></td>
<td>• km covered</td>
<td></td>
</tr>
<tr>
<td><strong>Port moves</strong></td>
<td>• Number of containers</td>
<td>• Higher container utilisation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 20’ to 40’ conversion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CFS-CY conversion</td>
</tr>
<tr>
<td><strong>Domestic distribution</strong></td>
<td>• Transportation mode (truck vs. rail)</td>
<td>• Higher utilisation of delivery trucks/vans</td>
</tr>
<tr>
<td></td>
<td>• km covered</td>
<td>• Double-decker trailers</td>
</tr>
<tr>
<td></td>
<td>• Volume moved</td>
<td>• Increased use of rail</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use of bio-fuel</td>
</tr>
<tr>
<td><strong>Warehousing</strong></td>
<td>• Number of days in warehouse</td>
<td>• Reduce safety stock</td>
</tr>
<tr>
<td></td>
<td>• Number of CBM</td>
<td>• DC bypassing</td>
</tr>
</tbody>
</table>

• Volume moved
• km covered
• kg moved
• km covered
• Number of containers
• Transportation mode (truck vs. rail)
• km covered
• Volume moved
• Number of days in warehouse
• Number of CBM

• Higher container utilisation
• Use of more eco-friendly carriers
• Air to Sea-Air conversion
• Higher container utilisation
• 20’ to 40’ conversion
• CFS-CY conversion
• Higher utilisation of delivery trucks/vans
• Double-decker trailers
• Increased use of rail
• Use of bio-fuel
• Reduce safety stock
• DC bypassing
What we’ve learned about supply chain calculations:

1. Use a consistent calculator approach

2. Transportation footprints can and have been reduced

3. It’s the total lifecycle footprint that matters
   - Transportation is just part of the total.
   - You have to do the full analysis to see the big picture

4. Focus on improvements and incorporating CO₂ into business decisions

5. Opportunity: work together to reduce both CO₂ emissions and costs
Surprising facts about Liner Shipping that impact planning for research and developing regulations:

1. Liner shipping is like an air line or bus line – **not a taxi**.

2. **International vessels spend only about 5% of their lifetimes in the waters of any one country or state.**

3. **Schedule conformance is critical in cost and air emissions.**
   - Higher speeds dramatically increase fuel use and air emissions.

4. Vessels operate with total crews of only 16 to 24.

5. **Homeland Security and other rules require notice and planning to visit or sail with a vessel.**
   - Anyone doing this work should have a TWIC card.

6. **The rest of the world uses metric units for environmental, supply chain and other calculations.**
Thank you