Panel VII: Port Sustainability in a Changing Climate

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Outline

- Sustainability
- Climate Change Scenarios
- Adaptation
- Mitigation
- Conclusions

Sustainability

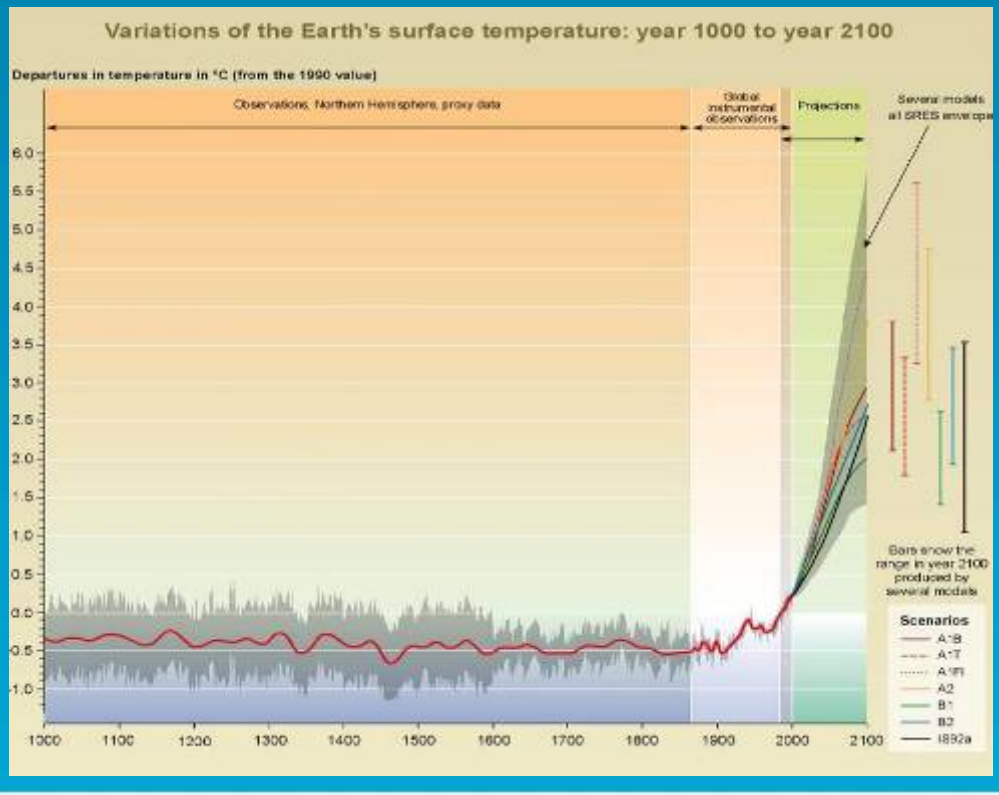
- **'Sustainability' is a rich concept, but difficult to capture in a single succinct definition**
- **The Brundtland Report** (The 1987 UN World Commission on Environment and Development Report) **definition is well known:**

"Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs"

- **Adaptation – planning to adapt to the committed changes in climate**
- **Mitigation – actions to reduce future climate change**

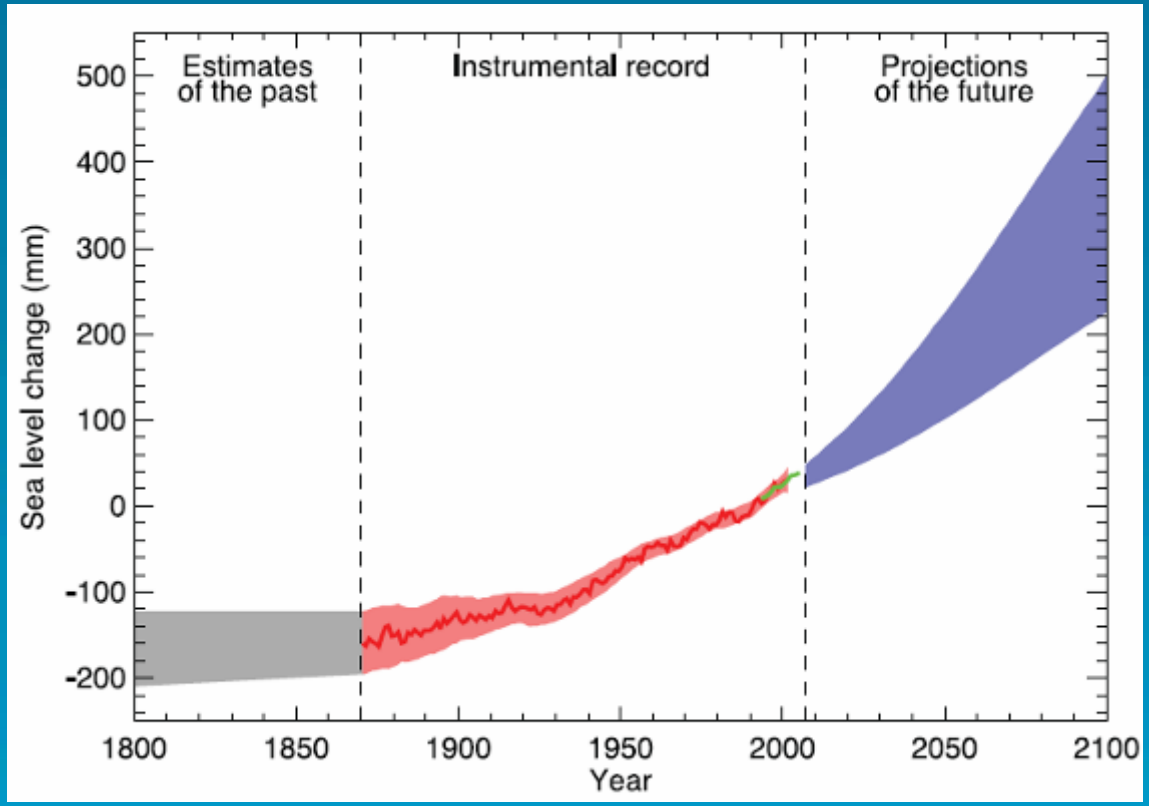
Climate Change Scenarios

- High levels of uncertainty in most predictions
- Variations largely based upon emissions scenarios
- General agreement in direction of change for most key variables, e.g. sea level rise



Source: IPCC 4th Assessment Report, 2007

Sea level rise

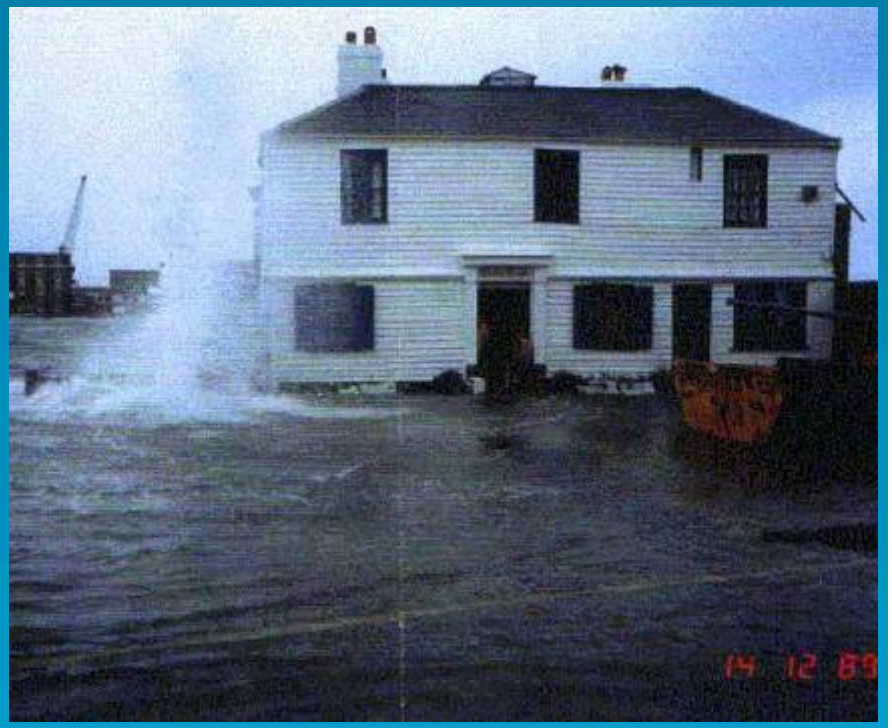


Source: IPCC 4th Assessment Report, 2007

- **Global average (eustatic) sea level rise projections from IPCC 4th Assessment Report range from 18cm to 59cm, or 1.5 to 9.7mm/year, by 2099**
- **Does not include subsidence**

Changes at the coast and estuaries

- Mean sea-level rise accelerating
- Tidal patterns could be influenced
- Increased storminess
  - Storm Surges may increase in height
- Increase in wind speeds
- Wave heights may change



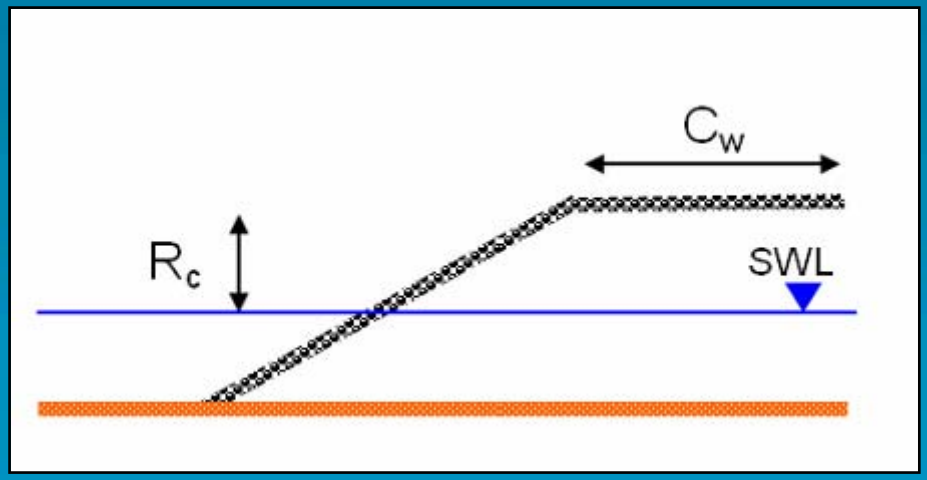
Estuary landform impacts

- Insufficient sediment to accrete vertically to match sea level rise
- Increased tidal prism, increasing tidal energy - erosion
- Landward structures prevent the ‘natural’ migration, resulting in narrowing intertidal areas
- This could result in increased energies at structures, and operational implications

Potential Impacts on Port Structures

- Assessment of potential impacts of increased sea levels on port operations
- Considered two typical port structures
  - Quaywall (vertical wharf)
  - Breakwater
- Water level increases of:
  - 125mm, 200mm, 250mm, 500mm
- Assumed wave height (2m) and period (8.5sec) for storm condition
- Deep water structures (-15m)
- Calculated increase in overtopping

Breakwater



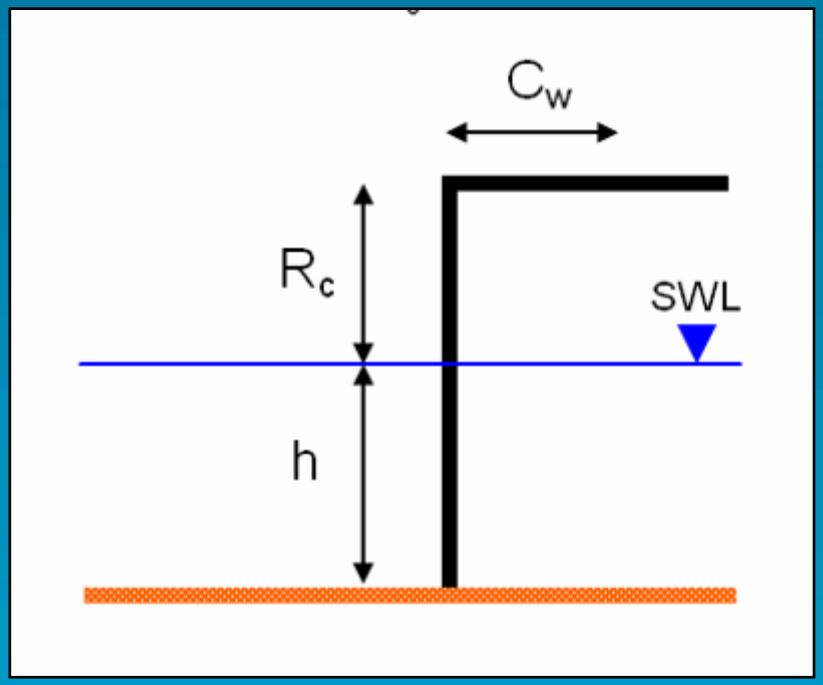
Breakwater overtopping

Water Level (m)	Offshore Wave Height (m)	Wave Period (s)	Crest Height (m)	Overtopping	
				Volume (l/s/m)	Percentage increase
0	2	8.5	1.81	200	-
0.125	2	8.5	1.81	223	11%
0.2	2	8.5	1.81	248	24%
0.25	2	8.5	1.81	262	31%
0.5	2	8.5	1.81	344	72%

Implications

- Increased wave agitation in port basin
  - exceed movement criteria for berthed vessels = downtime
- Also, increased storminess would cause this to occur more frequently
- Increased downtime can have severe impacts where operating to fixed schedules
  - Potential loss of trade to ‘better protected’ ports

Quawall structures



Quaywall overtopping

Water Level (m)	Offshore Wave Height (m)	Wave Period (s)	Crest Height (m)	Overtopping	
				Volume (l/s/m)	Percentage increase
0	2	8.5	4.53	0.40	-
0.125	2	8.5	4.53	0.47	16%
0.2	2	8.5	4.53	0.54	35%
0.25	2	8.5	4.53	0.58	45%
0.5	2	8.5	4.53	0.85	112%

Implications

- Higher water levels may affect vessel elevation relative to wharf
- Significant overtopping could cause flooding
- Likely to exceed yard drainage system – designed for lower volumes
- Extremely disruptive to operations
  - E.g. impacts at container terminals where area behind wharf used for container storage
  - Costs of damage to goods, plus future insurance costs
- Regular flooding could affect viability of port operation

Remedial Actions?

Breakwaters

- Increase crest height/size
- Install wave wall on crest

Quaywall

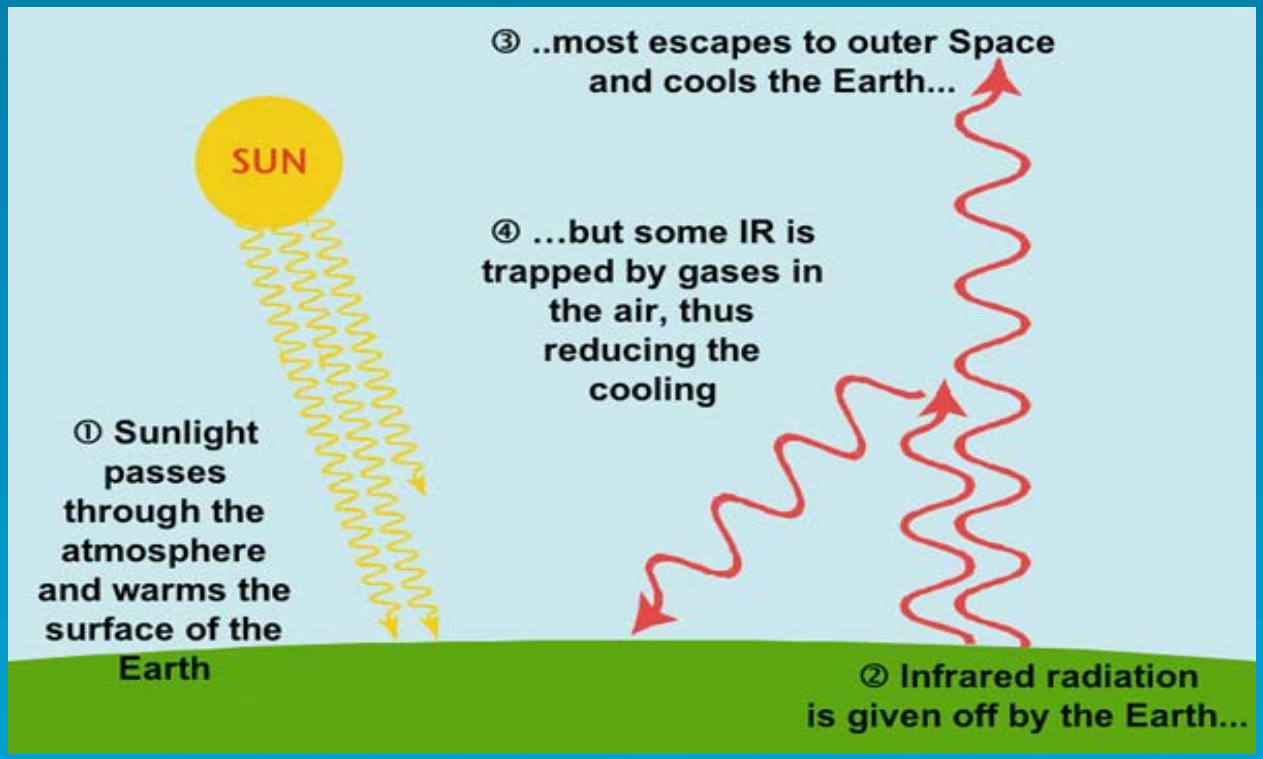
- Raise cope level - extremely disruptive
- Install wave wall along crest – very restrictive on quayside/landside operations
- Install set-back flood wall – possibly demountable structures?
- Modify drainage system to increase capacity
- Modify operations to remove facilities from flood prone areas
- Possible need to change height of fenders and mooring rings to maintain optimal performance

Cost Implications

- Cost implications will be very site specific
- Worst case:
  - Need to raise cope level of existing structures
  - Very costly construction, plus major impact on operations
  - Global shortage of (container) wharf capacity – can't afford loss of berth while remedial works undertaken
- Demurrage not payable for 'environmental' delays
  - but frequent delays may cause shipping lines to consider alternative ports
- Increased flood damages, would result in increased insurance premiums
  - Passing on costs to shippers could make port less competitive

Climate change considerations must be incorporated into future port planning and design: adaptable, resilient

Mitigation



Stern Review

Port traffic and global warming

- Growing recognition of impact of shipping on CO2 emissions
- Shipping responsible for transporting 90% of world trade (doubled in 25 years) continued growth forecast
- Media spotlight turning on impacts of shipping emissions
  - UK Guardian, March 2007 "*CO2 output from shipping twice as much as airlines… Aviation is in the firing line now but shipping needs to take responsibility*"

Impact of Shipping

- Figures from BP, and research by the Institute for Physics and Atmosphere in Wessling:
  - shipping responsible for up to 5% of the global GHG total
- Lloyd's Register Quality Assurance (London):
  - shipping traffic generates 7% of the total worldwide output of sulphur dioxide (SOx) - a key contributor to climate-change
- **Without action** the IMO predicts that by 2020, emissions from ships will increase up to 72%.

Way forward?

- Currently undertaking study of forecast emissions resulting from predicted 300% growth in shipping in BC to 2020
- BC Chamber of Shipping Study indicates that in the Lower Fraser Valley Area, more than 50% of GHG emissions from shipping occur at berth
- Focus is on potential benefits of "cold-ironing" - connecting to lower emission shoreside energy supply while in dock

Key Issues:

1. Supply capacity
2. Port supply side infrastructure
3. On-board electrical connection (no standard)
4. Calling frequency
5. Vessel replacement rate
6. Costs

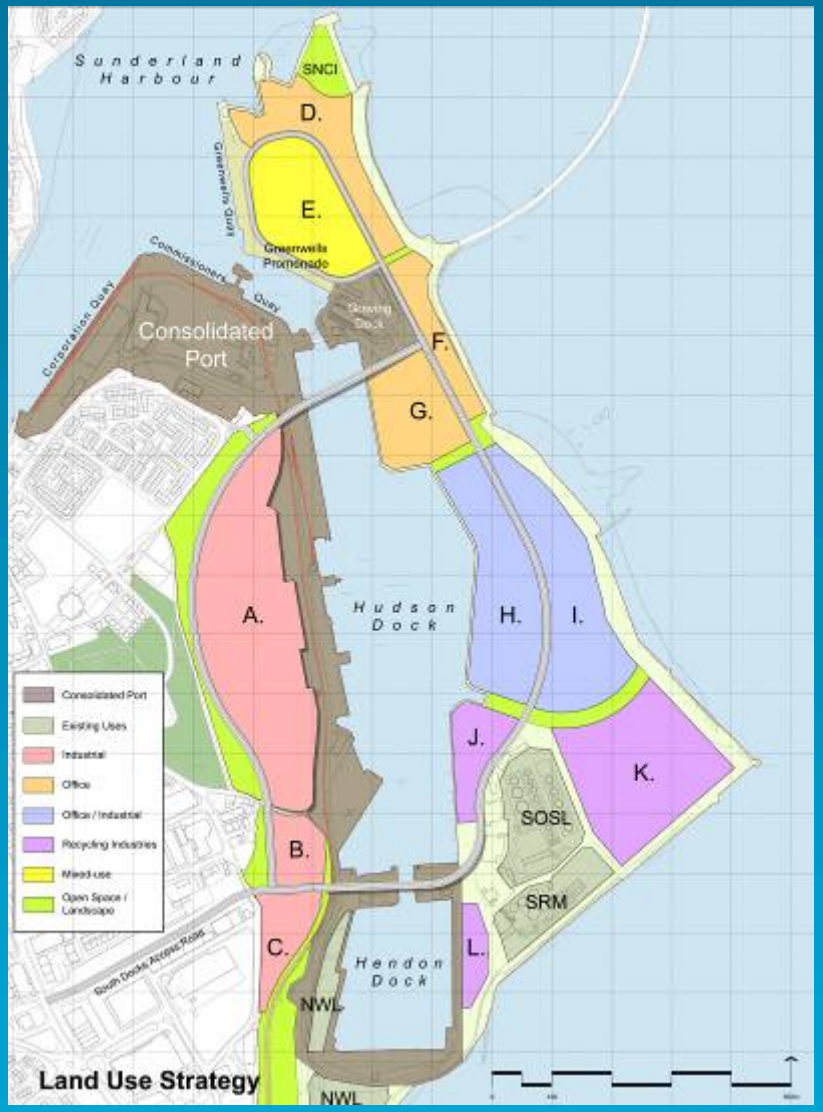
Alternative approaches

- **Port of Oakland:**
  - **supply side capacity, infrastructure and cost issues. Mobile LNG generator demonstration project**
- **Port of Gothenburg (Sweden):**
  - **tax exemption for use of shoreside power = parity with costs of bunker fuel**
- **Port of Los Angeles and Port of Long Beach:**
  - **Co-operative effort between authorities, shipping companies and ports to promote and install shoreside power at numerous berths**
- **Port of Vancouver:**
  - **Harbour dues program – reduction for using low sulphur fuel**

Facilitate & Incentivize

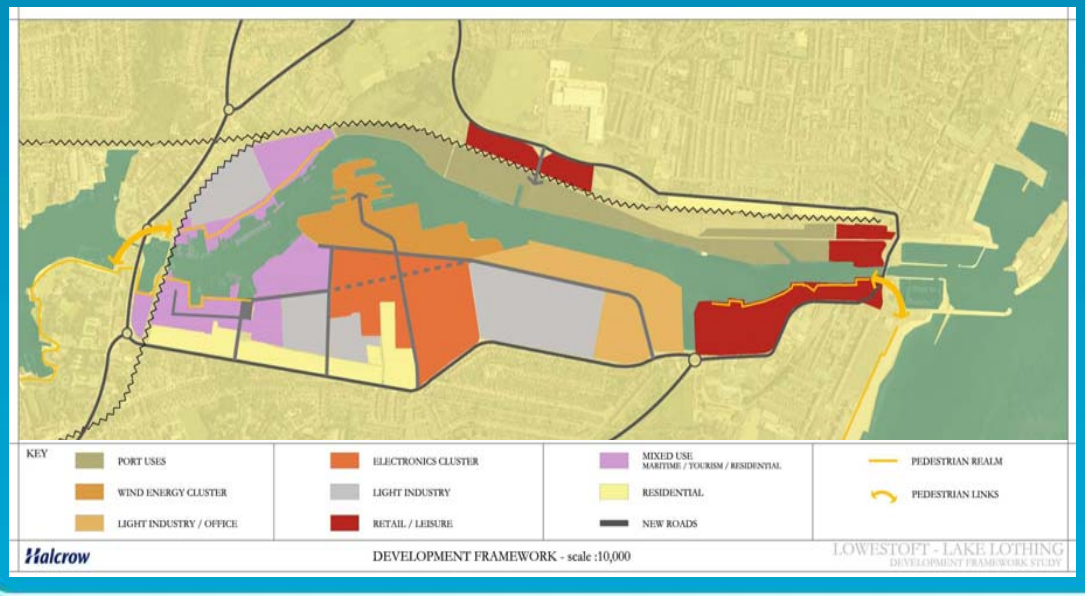
UK: Port of Sunderland

- Masterplan for consolidation of port activity and redevelopment of redundant land
- Includes "recycling industries cluster"
- Potential for inclusion of energy from waste and renewables – including wind energy to serve port
- Energy efficient design solutions for buildings promoted



UK: Port of Lowestoft

- Halcrow prepared a development framework for port area
  - North Sea offshore oil and gas sector has peaked
- Synergies between oil and gas supply chain and offshore wind power acknowledged
- Wind turbine developed by port occupier
- Annual output = 2.75MW, saving 6215 tonnes of greenhouse gas emissions per year



Conclusions

Three Pillars of Sustainability:

Environmental

- Reducing GHG emissions from shipping
- Promotion of renewable energies at ports

Social

- Reducing harmful emissions
- Continued importance to local/regional communities

Economic

- Costs associated with climate change impacts
- Continued importance/growth in world trade
- Potential for green/alternative industries

Thank you

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Implications, contd.

- Conditions exceeding maximum operational wave heights for berthed vessels?
  - Depends on local factors such as fender type, vessel type, etc
- PIANC article estimates wave height values for different directions before loading/unloading operations are suspended.

Vessel Type		Limiting wave height Hs in meters	
		0° (head on or stern on)	45 ° - 90 °
General cargo		1.0	0.8
Container, ro/ro ship		0.5	-
Dry bulk, 30-100,000dwt	loading	1.5	1.0
	unloading	1.0	0.8 – 1.0
Tankers 30,000 dwt		1.5	-
Tankers 30,000 – 200,000 dwt		1.5 – 2.5	1.0 – 1.2
Tankers 200,000+ dwt		2.5 – 3.0	1.0 – 1.5

Source: PIANC Bulletin No. 56