Blue Economy and Blue Carbon
Beyond fish and ships, our oceans provide...

**Climate Regulation**
- Covering 70% of the earth's surface, the ocean transports heat from the equator to the poles, regulating our climate and weather.

**The Air We Breathe**
- The ocean produces over half of the world's oxygen and stores 50 times more carbon dioxide than our atmosphere.

**Blue Carbon**
- Mangroves, seagrass and salt marshes remove CO₂ from the atmosphere 10 times more than a tropical rainforest — and store 3 to 5 times more carbon, thus decreasing the impacts of climate change.
- Estimated blue carbon value in the EAS Region:
  - ~ $111 B for mangroves
  - ~ $77.95 B for seagrass

**Shoreline Protection**
- Mangroves, seagrass, and coral reefs are natural barriers... saving money and reducing impacts of storm surge, erosion and flooding.
  - Coral reefs reduce 97% of wave energy.
  - Mangroves reduce 66% of wave height.

**Ocean Energy**
- The ocean can produce thermal energy from the sun's heat, and mechanical energy from the tides and waves. It is estimated that 0.1% of the energy in ocean waves could be capable of supplying the entire world's energy requirements five times over.

**Offshore Wind Power**
- Higher wind speeds are available offshore compared to on land.

**Home**
- The East Asian Seas (EAS) region is home to 35% of the world’s mangroves, 33% of seagrass beds, and 33% of the world’s coral reefs, supporting diverse species of flora and fauna, and an array of ecosystem services.

**Food**
- 15% of animal protein comes from fish.

**Trade and Transportation**
- 63% of total global fisheries
- 90% of world trade through shipping.

**Tourism and Recreation**
- > $200B in tourism revenues. The EAS region accounts for 26% of worldwide tourist arrivals.

**Oil and Gas**
- There are around 1400 offshore oil and gas platforms in the EAS region... with production of 2 million barrels of oil per day.

**Income and Jobs**
- The ocean economy contributes 3% - 87% of the GDP of five countries in the EAS region.
- Many medicinal products come from the ocean, including ingredients that help fight infections, cancer, arthritis, heart disease, and Alzheimer’s disease.
Ocean as source of income, livelihood, jobs

Ocean Economy

- Fisheries and aquaculture
- Coastal and marine tourism
- Offshore oil and gas
- Energy
- Marine business and services
- Ports and shipping
- Marine manufacturing: seafood processing; ship-building; biotechnology
- Marine construction
- Water
- Marine education, and R&D
Ocean as driver of innovations and growth

**BLUE ECONOMY**

- **Food security**
  - Climate-smart aquaculture
  - Marine ranching
  - Crab condominium
  - Sustainable tuna fisheries

- **Water security**
  - Desalination
  - Wastewater reuse

- **Climate Action**
  - Blue Carbon
  - Green Ports

- **Energy security**
  - Ocean energy
  - Offshore wind power
  - Floating solar farms

- **Drugs and Food**
  - Marine biotechnology

**Desalination**

**Wastewater reuse**

**Blue Carbon**

**Green Ports**

**Energy security**

**Ocean energy**

**Offshore wind power**

**Floating solar farms**

**Drugs and Food**

**Marine biotechnology**

**Climate-smart aquaculture**

**Marine ranching**

**Crab condominium**

**Sustainable tuna fisheries**
Ocean as natural capital

Major coastal ecosystems – What is the value?

Near-shore terrestrial
- Dunes, cliffs, rocky and sandy shores, coastal xeromorphic habitats

Intertidal
- Estuaries, deltas, lagoons, mangrove forests, mudflats, salt marshes

Benthic
- Kelp forests, seagrass beds, coral reefs, and soft bottom environments

Pelagic
- Open waters above the continental shelf
Why value coastal and marine resources?

- Coastal ecosystems in the EAS region are one of the most productive and biologically diverse in the world.

- Coastal ecosystems in the EAS region are under severe stress from human over-exploitation, physical disturbance, pollution, sedimentation, and general neglect.

- Improved management of coastal ecosystems through putting economic values on their presence, products and uses
Irreversibility

- Each choice or option for the environmental resource – to leave it in its natural state, allow it to degrade, or convert it to another use – has implications in terms of values gained and lost.

- The decision as to what to pursue and whether current use or rates of resource loss are excessive – can be made only if these gains and losses are properly analyzed and evaluated.
Total economic value

Use Values
- Direct use values
- Indirect use values
- Option values
- Quasi-option values
- Existence value
- Bequest value

Non-use Values

Provisioning services:
- fish; fuel wood; recreation; transport / navigation

Supporting and regulating services:
- flood control; storm protection; carbon storage and sequestration; nutrient recycling; waste assimilation

Insurance value of preserving options for use

Value of increased information in the future ‘natural laboratory’

Cultural services
- value derived from just knowing a species or system is conserved
- value of passing on natural assets ‘intact’ to future generations
- ‘moral resource’ value motivations
# Economic Value of Wetlands

<table>
<thead>
<tr>
<th>Direct use</th>
<th>Indirect Use</th>
<th>Option</th>
<th>Existence</th>
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</thead>
<tbody>
<tr>
<td>Fish</td>
<td>Nutrient retention</td>
<td>Potential future uses</td>
<td>Biodiversity</td>
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<tr>
<td>Agriculture</td>
<td>Flood control</td>
<td></td>
<td>Heritage</td>
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<tr>
<td>Fuel/wood</td>
<td>Storm protection</td>
<td>Future value of information</td>
<td>Bequest</td>
</tr>
<tr>
<td>Recreation</td>
<td>Groundwater recharge</td>
<td></td>
<td></td>
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<tr>
<td>Transport</td>
<td>External ecosystem support</td>
<td></td>
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<tr>
<td>Wildlife</td>
<td>Micro-climatic</td>
<td></td>
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<tr>
<td>Harvesting</td>
<td>Shoreline protection</td>
<td></td>
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<tr>
<td>Peat/energy</td>
<td>Stabilization, etc</td>
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</tbody>
</table>
Valuation methods

**Provisioning**
- Fish and seafood
- Water
- Medicines
- Fuelwood

**Supporting**
- Nutrient cycling
- Primary production
- Habitat for species
- Genetic diversity

**Regulating**
- Climate regulation
- Carbon sequestration
- Shoreline protection
- Water purification

**Cultural**
- Recreational
- Educational
- Spiritual
- Aesthetic

**Direct Value**
- Market analysis;
- Travel cost method (TCM);
- Hedonic pricing (HP);
- Contingent valuation method (CVM);
- Indirect substitute (IS)

**Indirect Value**
- Shadow prices;
- Damage cost avoided;
- Preventive expenditures;
- Value of changes in productivity (relocation costs; replacement costs)

**Option Value**
- CVM

**Existence Value**
- Market analysis;
- TCM, CVM

**Bequest Value**
What is Blue Carbon?

• Through photosynthesis and other natural processes mangroves, tidal marshes and seagrasses remove carbon dioxide from the atmosphere and ocean, storing it as carbon in biomass and soil.

• These ecosystems are sequester vast amounts of carbon – each hectare can sequester carbon at rates higher than each hectare of mature tropical forest.

• This ‘commercialisation’ of the sequestered carbon in these coastal and ocean ecosystems is referred to as Blue Carbon.
The Opportunity

Coastal ecosystems have high carbon sequestration rates

Mangroves

Seagrass
The Challenge

- Blue Carbon can be thought of as a means to incentivise habitat protection – Government see it as a preferred mechanism to encourage conservation and sustainable development.

- However, the challenge is to make Blue Carbon work ‘on the ground’.

- While emissions from the degradation and clearance of mangroves can be calculated with some confidence, existing international standards do not allow the estimation of emissions ‘removals’, therefore the quantification of carbon revenue streams is difficult and costly.

- Also, the global carbon price has been volatile in recent years.
More than blue carbon

Valuing co-benefits

<table>
<thead>
<tr>
<th>Carbon</th>
<th>Shoreline Protection</th>
<th>Fish Nursery Habitat</th>
<th>Biodiversity</th>
<th>Water Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mangroves</td>
<td>Store carbon in aboveground tree biomass as well in belowground roots and soils</td>
<td>Absorb and wave and wind energy; reduce erosion and storm surges; accrete sediment for adaptation to sea level rise</td>
<td>Maintain important and high land (e.g., birds and mammals), coastal (invertebrates and fish), and ocean (e.g., coral reefs as part of the complex of tropical ecosystems) biodiversity</td>
<td>Filter pollution and waste (solid and dissolved), treat excess nutrients (e.g., nitrogen and phosphorus from land) and trap sediments</td>
</tr>
</tbody>
</table>

- Mapping of our coastal and marine ecosystems
- Assessment of the condition of habitats
- Evaluation of the carbon sequestration
- Valuing the potential blue carbon and ecosystem services
Ocean as natural capital

Ecosystem Services

Provisioning
- Fish and seafood
- Medicines
- Timber; fuelwood

Supporting
- Nutrient cycling
- Habitat for species
- Genetic diversity

Regulating
- Climate regulation
- Carbon sequestration
- Shoreline protection
- Waste assimilation

Cultural
- Recreational
- Educational
- Spiritual
- Aesthetic

Valuation of Ecosystem Services (in billion US$)

- US$ 684 billion
- Blue carbon value (est):
  - Mangroves: $111 B
  - Seagrass: $77-95 B
Conclusion

- The concept of Blue Carbon is fast becoming mainstream, with public funding increasingly flowing into research to understand the potential, risks and economics. Progress at an international level is however slow…

- The lack of a global emissions reduction methodology and volatile carbon price for Blue Carbon is however hindering private sector investment – which is required to get it to scale.

- There is an enormous opportunity to sequester carbon in marine ecosystems while improving ecosystem services and flow-on long-term economic benefits.

- In this regard, our East Asian seas are likely to be an important supplier of Blue Carbon offsets in the coming years as the low-carbon economy matures.

- But first, we need to understand and measure the potential of Blue Carbon.