Finance Gap by Market Segments - Consolidated

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Blue Economy Financing Gap: Sector Summaries

Finance Gap by Region: Investments Needed by 2030 for SDG Goals (million $)						
Themes	**Segments**	**Pacific**	**SE Asia**	**South Asia**	**Totals**	**Blue Economy Score**
Ecosystem and Natural Resource Management	Marine & River Ecosystems	121	44	51	216	23
	Fishing	22	200	2,001	1,427	15
	Fisheries	14	-27	28	15	15
	Seafood Processing & Distributions	930	4,775	3,429	9,134	19
	Aquaculture & Algaculture	1,001	9,782	9,843	20,626	23
Pollution Control	Solid Waste Management	80,500	145,000	47,400	272,900	17
	Resource Efficiency And Circular Economy	9,000	58,600	69,900	137,500	20
	Non-point Source Pollution Management	26,300	87,100	463,800	577,200	21
	Wastewater Management	13,900	97,000	150,400	261,300	23
Sustainable Coastal and Marine Development	Coastal and Marine Tourism	1,776	1,396	773	3,945	14
	Coastal Resilience	1,700	3,600	6,340	11,640	23
	Resilient Ports	881,000	1,510,000	1,280,000	3,671,000	22
	Green Ports	8,858	63,641	22,086	94,585	22
	Green Shipping	2,171	5,649	5,532	13,352	22
	Marine Offshore Wind Renewable Energy	25,200	151,800	235,900	412,900	22
	Marine Tidal, Wave, Geothermal Renewable Energy	100	500	800	1,400	22
	Total	**1,052,593**	**2,139,060**	**2,298,283**	**5,489,140**	

Focus Area: ECOSYSTEM AND NATURAL RESOURCE MANAGEMENT

- **MARINE ECOSYSTEM & RIVER TO OCEAN MANAGEMENT, CONSERVATION AND RESTORATON, FISHING, FISHERIES, SEAFOOD PROCESSING AND DISTRIBUTION, and AQUACULTURE AND ALGACULTURE**

1. Marine Ecosystem & River To Ocean Management, Conservation, and Restoration

Blue Infrastructure Finance[1] has been outlined in a recent paper by IUCN with the same goal: attracting private investment in ecosystem management. With a $200 billion green bond market, $500 billion impact investments and 1300 investors committed to sustainability, the call is out for ecosystem projects to be structured and scaled up. We previously hinted at the potency of ecosystem restorations across the Blue Economy and their strong cost-effectiveness to achieve impact[2]. There is interest from Corporate Players to invest in these projects, not only for brand awareness but to solidify their supply chains. They increasingly recognise the value of ecosystems for their business resources. ADB can promote marine ecosystem projects and improve the economics for investors. We further discuss the interests and strategies of corporate players in Section 4.

	ECOSYSTEM INVESTMENTS		(in $ million)	
	MPAs	BLUE INFRA RESTORATION	Smaller Country Budget	Larger Country Budget
Assumption for Needs	2 per smaller country @$2mn over 5yrs. 3 per larger country @ same	Mangrove & reef restoration. Same budget as for MPAs.	8	12
Data	PI. Blue Alliance MPA Budget: Oriental	Infra Report		

ECOSYSTEMS GAP HYPOTHESIS 1: JOHANSEN & VESTVIK, 2020 (in $ million)	
NEEDS ESTIMATES - SDG 14 & SECTORS	COST/YEAR (in $ million)
SDG 14: GLOBAL NEEDS	174
GLOBAL MARINE ECOSYSTEMS	40
ASIA-PACIFIC MARINE ECOSYSTEMS	**10**
GLOBAL FISHERIES	28
GLOBAL MARINE POLLUTION	87

(in $ million)				
ADB Regional Dept	CAPITAL NEEDED	ONGOING INVESTMENT	GAP TO 2025	GAP TO 2030 (2025 GAP X 5)
Pacific	136	15	121	605
Soouth-East Asia	64	20	44	220
South Asia	56	5	51	255
All DMCs ex-China	256	40	216	1,080

DATA / REFERENCES
UN-ESCAP
CIPC BLUEPRINTS
BLUE INFRASTRUCTURE, IUCN
OCEAN HEALTH INDEX
GLOBAL CORAL REEF FUND
OCEAN FINANCE HANDBOOK
BLUE BONDS, IUCN
CAPITALISING CONSERVATION, WWF & CLARMONDIAL
NATUREVEST: SEYCHELLES & OTHER MODELS

1 IUCN, 2020, Blue Infrastructure Finance, where all win, https://www.iucn.org/news/marine-and-polar/202003/report-blue-infrastructure-finance-where-all-win

2 Mangrove forests have for example many environmental utilities: Coastal barriers against floods and tsunamis, Marine sanctuaries for marine wildlife, Water filtering systems.

We submit two alternative approaches for the Marine Ecosystem Financing Gap:

i. **According to a recent SDG study** (Johansen & Vestvik, 2020): The cost to achieve SDG14 globally is estimated at $174 billion annually, of which Ecosystems represents $40 billion of annual needs. For ADB's DMCs, which are exceptionally rich in marine/coastal ecosystems, we can hypothesize that some $10 billion per year is needed to keep the region's ecosystems at a sustainable level. The needs for global fisheries and marine pollution control on a global basis are also noted in the table below.
ii. **Our Budget-based Approach:** We refer to known budgets for model MPA and Blue Infrastructure projects, then we apply them across the region according to country size (larger/smaller). This method identifies a gap of only $214 million to achieve minimum sustainability by 2025 - possibly $1 billion to achieve by 2030. Conclusion: Assumptions one chooses will drive the gap calculation.

We also consider two different Hypotheses:

i. **Hypothesis 1:** See SDG14 references to Johansen & Vestvik, 2020 in UN-ESCAP Changing Sails report. Using information from the proceedings of the Convention on Biological Diversity and the 2017 UN Ocean Conference, this paper presents the first ever attempt to present a likely cost for saving our oceans and a likely estimate of the funding gap for implementing SDG 14 until 2030. Full paper here
ii. **Hypothesis 2:** We take a practical approach with actual MPA budgets and references given for mangrove/reef restoration costs. In addition to the high return on investment, these relatively low capital projects employ local labour. One could make these recommended investments in greater numbers or annually, instead of over 5 years. We also focus only one these two investment needs, rather than a broader Ecosystem investment view taken by the SDG paper. We treat coastal resilience, pollution control and sustainable fisheries in separate chapters of this Section3.

2. Fishing, Fisheries, Seafood Processing and Distribution, and Aquaculture and Algaculture

We consider four segments as part as a Seafood Gap analysis*: Fishing (vessels/equipment), Fisheries, Aquaculture/Algaculture, Processing/Distribution*.

Seafood Value Chain	Investment Gap for Sustainability by 2030 (USD Millions)			
Segments	**Pacific**	**SE**	**South**	**Total**
Fishing	22	200	1'205	**1'427**
Fisheries	14	-	28	**42**
Aqua/AlgaCulture	981	9'782	9'843	**20'607**
Processing and Distribution	930	4'775	3'429	**9'135**
Total	**1'947**	**14'758**	**14'506**	**31'210**

2.1. Fishing Vessels

FISHING GAP SUMMARY (in $ million)						
ADB Regional Dept	**Vessels1**	**ONGOING INVEST**	**A. Sustainable Fishing:** Gear, Equipment, Software	**B. INVEST NEEDED by 2030: ZEST RETROFITS ***	**C. INVEST NEEDED: ZEST NEWBUILDS***	**FINANCE GAP (2020-2030)**
Pacific	1,252	46	13	25	30	22
Sout-East Asia	14,213	286	142	284	60	200
South Asia (x India)	23,531	-	235	471	90	796
All DMCs ex-India & China	**38,996**	**332**	**390**	**780**	**180**	**1,018**
India only	80,000	1,195	800	1,600		1,205
Total with India	95,465	1,527	955	1,909	90	1,427
	# Vessels					
Assumptions for Financing Needs			vessel 1 data	large ships add	per new H2	(A+B+C)-Ongoing Invest

Most DMC fishing fleets have an average age >20 years, requiring upgrades and new vessels to meet sustainability standards by 2030. We address these needs in our calculations by making **allocations to 3 investment categories** for DMC fishing fleets:

i. **Sustainable Fishing Gear:** This includes improved catch hardware and tracking software to reduce by-catch and discards, limit environmental impacts, and improve traceability. We assume: $50k investment for 20% of each country's fleet.
ii. **ZEST retrofits:** We take a similar approach for fishing vessels as described in our Green Shipping analysis. To achieve the commitment (which several DMCs have made) of 100% decarbonised shipping by 2050, investment needs are: 30% of large ships should be retrofitted with auxiliary power @ $100k/vessel by 2030. This average cost refers to wind sails, waste-heat capture and efficiency upgrades.
iii. **New Builds:** Ageing fleets represent an opportunity for low/zero emission new builds. Again, sharing the assumptions used for cargo and ferry fleets under Green Shipping, we make a simple recommendation based on average cost @ $300k per new vessel (hydrogen/ammonia/methane powered), by region: 100 in Pacific, 200 in Southeast Asia, 300 in South Asia.

To determine the financing gap to 2030 that puts the region on course for decarbonisation by 2050, we add the three calculations above, minus confirmed ongoing investments.

Note: Gathering fishing vessel data is difficult, as there are many sources inconsistent with one another due to questions of vessel ownership, operating status and length/tonnage. Thanks to our relationship with Lloyds Register, we were able to source vessel data by Country

of Beneficial Ownership - enabling accurate attribution for vessel investment needs by country. We check this against current government data and some private sources.

2.2. Fisheries

Fisheries is the segment that is the most dependent on public funding because it is a public asset; it is unattractive or mostly inaccessible to private funds. The space is however prone to public investment as the overall Benefit/Cost ratio in sustainable fisheries is 10:1 (Source: World Resources Institute, *A Sustainable Ocean Economy for 2050).* This is an area for ADB to make direct investments and foster government support.

However, the wild catch segment faces pressures from its own unsustainable practices. It is now compounded by the effects of climate change, which may reduce the maximum catch in tropical fisheries by 40% by 2050[3]. In spite of the segment's anchored role providing nutrition and livelihoods across the DMCs, the outlook is not favourable for attracting more investment – whether private or public – as the industrial fishing interests are accelerating the depletion of fish stocks.

We nonetheless make a series of investment recommendations to improve the sustainability of the Fishing/Fisheries segment. The transition to Sustainable Fishing needs to be supported and its importance is high for local communities. Part of that transition implies a growth of the Aqua/Alga-culture segment. This is where private capital has been going for two decades and will continue to go. ADB will find bankable projects within this segment of the Seafood Supply-Chains theme.

FISHERIES GAP SUMMARY (in $ mio)							
ADB Regional Dept	**FAO data Production MT**	**ONGOING INVESTMENTS**	**A. Enforcement Vessels**	**B. Annual invest needed Labour / Management**	**B. INVEST NEEDED by 2030: Fishery Labour / Management**	**C. INVEST NEEDED: Monitoring Software**	**FINANCE GAP (2020-2030)**
Pacific	1,675,999	42	14	21	210	21	14
Sout-East Asia	13,013,320	77	14	18	180	18	-27
South Asia	6,355,941	9	14	16	160	16	37
All DMCs ex-China	**21,045,260**	**127**	**42**	**55**	**550**	**55**	**24**
	# Production MT						
Assumptions for Financing Needs			*Allocations: 1. MT <100k = 5 boats ; 2. MT >100k < 1mn = 20 boats ; 3. MT >1mn = 30 boats (1 boat = $100k)	*Assume: <100k MT = $1mn ; 100kMT < 1mn = $2mn ; > 1mn MT = $4mn	x10	*Assume: <100k MT = $1mn ; 100kMT < 1mn = $2mn ; > 1mn = $4mn	(A+B+C)-Ongoing Invest

As with vessels, fishery data is subject to irregularities depending on the source and reporting standards. Research was prioritised into two parts:

i. Data from FAO, used as our primary source only because of consistency (i.e., there are many systemic flaws in FAO data, which FAO acknowledges)
ii. Data from government files (Ministries of Fishing or Agriculture)
iii. Data from independent sources: Although difficult to access, their assumptions are helpful as a reality check against FAO and government sources

3 University of Wollogong Australia, 2020, Tropical fisheries projected to decline 40 per cent by 2050s https://www.uow.edu.au/media/2020/tropical-fisheries-projected-to-decline-40-per-cent-by-2050s-.php

We use FAO data to calculate a consistent baseline for the Fishery financing gap. Bear in mind, however, that countries are more likely to report low catch data for fear of sanctions. Furthermore, the data refers to landings - thereby ignoring the cost of by-catch and discards, which may account for 25%+ of true catch. Independent researchers Pauly and Zeller have reconstructed data to show that global marine fisheries catch is substantially higher (up to 50%) than reported and declining each year since 1990 (i.e., more effort to generate ever-declining results). This, combined with climate and pollution pressures, reinforces our pessimistic view of Wild Catch as an investment opportunity.

Nonetheless, because Fishing is important for DMC livelihoods and nutrition, we consider three investments in order to improve the sustainability of fisheries by 2030:

i. New Enforcement Vessels (@ $100k/boat) by country production levels (annual metric tons = MT):
   a. MT <100k = 5 boats
   b. MT >100k < 1mn = 20 boats
   c. MT >1 million = 30 boats
ii. Additional Management/Labor, again by country production levels: <100k MT = $1 million ; 100kMT < 1million = $2 million ; > 1MN MT = $4 million
iii. Monitoring Software (data/satellite systems for traceability and quota management), investment allocations by country production levels: <100k MT = $1 million ; 100kMT < 1 million = $2 million ; > 1million = $4 million.

2.3. Aquaculture, Mariculture & Algaculture

Sustainable aquaculture is regrouping its set of opportunities across 3 segments: *Aquaculture, Algaculture, Mariculture*. We also compute a single investment gap for these segments, since there is limited distinct data available and production facilities are often shared together. The space faces its own set of sustainability challenges, similar to agriculture: Overcapacity and chemical reliance. These and other sustainability issues must be addressed with standards and impact measurement, which are demanded by investors.

AQUACULTURE GAP SUMMARY (in $ million)					
ADB Regional Dept	FAO data Production MT	ONGOING INVESTMENTS	A. SCALING UP INVESTMENT	B. INVEST NEEDED by 2030: NEW FACILITIES	FINANCE GAP to 2030
Pacific	841,372	-	771	210	981
South East Asia	10,936,044	220	9,842	160	9,782
South Asia	10,791,478	9	9,712	140	9,843
All DMCs ex-China	22,568,894	229	20,326	510	20,607
	# Production MT				
Assumptions for Financing Needs			USD $18mn	100k MT =	

We did substantial research on these segments, using FAO data for its virtue of consistency but also checking with other sources. We make two investment recommendations:

Scale up existing production facilities (@Cost: $18 million for 10'000MT production increase):

i. Pacific Island Countries (PICs) are allocated resources to increase production by 100% by 2030

ii. All other countries: Scale up by 50% by 2030, due to higher current baselines.
iii. The difference between each country's production goals and their current baseline production is calculated and with this "Production Gap" we are able to calculate how many $ millions each country needs. The model used for this calculation is Australis Fish Investment in Vietnam: $18 million per 10'000MT production gap.

Build new production facilities @Costs by production level per country:

i. Countries < 100k MT = $20 million
ii. Countries 100k < 1mn MT = $25 million
iii. Countries > 1mn MT = $30 million:

Our cost models are based on those used by Australis Corp (recent aquaculture scale-up in Vietnam) and Sustainable Ocean Fund of Althelia/Mirova.

2.4. Seafood Processing & Distribution

Seafood Processing & Distribution is another favourite segment for private investment. Technology has improved to alleviate harsh labour conditions, for those who can afford the CapEx. Processing at sea is another trend that favours industrialised countries over DMCs, at a cost to local communities and fisheries. However, aquaculture growth favours the expansion of land-based processing as DMCs move to capture more of the downstream seafood value chain. In this analysis, we assume investments will be made on land by individual DMCs (scaling local coops) and regional consortia (eg, Palau-Nauru Agreement). Distribution is also enhanced by technology, enabling more direct boat (or farm)-to-customer sales that favours smaller producers. These are trends with positive poverty environment impacts that can empower local communities.

SEAFOOD PROCESSING GAP SUMMARY (in $ million)				
ADB Regional Dept	**FAO data Production MT**	**Value of Processing Assets (USD MN)**	**A. NEEDED INVESTMENT TO INCREASE LOCAL**	**FINANCE GAP to 2030 (USD MN)**
Pacific	**5,012,488**	1,861	2,791	930
South East Asia	**23,876,161**	9,550	14,326	4,775
South Asia	**17,147,388**	6,859	10,288	3,429
All DMCs ex-China	**46,036,037**	**18,270**	**27,405**	**9,135**
	# Production MT			
Assumptions for Financing Needs		*5'000MT local processing = $5mn*	*Current local value (USD mn) * 150%*	

For Processing, we recommend one investment between now and 2030: increase local processing capacity by 50% above current production levels. Smaller countries have fewer processing facilities than those with larger land mass and populations. Also, processing at sea is a mega-trend favouring industrial fishing - but we assume DMC investments for this segment will be on land.

Distribution functions are often integrated with processing, so a separate calculation was not made. However, communications and blockchain are transforming distribution in ways

potentially favourable to SMEs and artisanal fishermen - although markets are indeed consolidating around major players. Sustainability certification of the processing industry is underway with MSCs Chain of Custody certification, so traceability continues after catch.

Our process for determining the financing gap for Processing/Distribution is: from the baseline (total fisheries + aquaculture + algaculture) production we made the following assumptions:

i. For PNA Agreement countries: 20% of total production is locally processed
ii. For all other countries: 40% of total production is locally produced
iii. Baseline local production for each country was monetized by estimating that a plant which produces 5'000 MT per year costs $5mn (ref: Sustainable Ocean Fund, Mirova Capital).

➢ Assumption for Needed Investment: To increase local processing value (in $) by 50% by 2030, current local production value was multiplied by 150%

➢ Gap = Needed Investment *less* Current local processing value

Our assessment of seafood processing activity within each country was helped by a list of companies that covers all functions (source: Sea-ex). Finding data on seafood-only processing facilities in Asia is no easy task as most companies process a variety of foods. Also, fishing and aquaculture producers often integrate processing within the business, so separate data is not revealed. However, we used this multi-function list to determine activity levels per country, estimating 40% of companies (excluding those of PNA Consortium who process 20% of production locally) were engaged in processing or distribution. Complete analysis of the segment may be purchased (for $3600) in this excellent report Asia-Pacific Fish Processing Market report 2020-2025.

Private investors (ie, non-strategic) see Processing/Distribution as a favourable risk/return way to invest in sustainable seafood. Flexibility of this segment to receive raw materials from any number of production sources, rising demand for seafood and labour/energy saving technologies make Processing/Distribution a good long-term value. Yet returns are within the target 3-5 years private equity cycle. For sustainability issues, seafood has the virtue as a low-carbon protein and processing provides community empowerment for developing countries, as they seek to capture more of seafood's downstream value chain. We therefore rate this segment as a high priority for the Healthy Ocean Action Plan.

Focus Area: POLLUTION CONTROL

- **SOLID WASTE MANAGEMENT, RESOURCE EFFICIENCY AND CIRCULAR ECONOMY, NON-POINT SOURCE POLLUTION MANAGEMENT, WASTEWATER MANAGEMENT**

The total investment required by DMCs to reduce marine pollution is $1.82 trillion, with ongoing investments of $72 billionn and therefore a gap of 60.7%.[4] The ongoing investments represent the current expenditures of the last decade extrapolated up to 2030. They represent a business-as-usual scenario where the financing needs show what is necessary to achieve sustainable solutions in these segments.

Government spending represents the major source of financing for every country, especially in Solid Waste Management and Non-Point Source Pollution. Private capital was brought into the mix for Water infrastructure investments, Water Resource Efficiency and Wastewater Management. These themes are expected to grow in importance with water scarcity and pollution. This is a space where private capital can further flow as the need for solutions becomes more evident.

POLLUTION CONTROL GAP SUMMARY															
Summary Table	Solid Waste Management			Resource Efficiency and Circular Economy			Non-point Source Pollution Management			Wastewater Management			Total		
	Needs	Current	Gap	Needs	Current	Gap	Needs	Current	Gap	Needs	Current	Gap	Needs	Current	Gap
East	1.6	0.9	40.0%	303.9	462.8	0.0%	439.6	413.6	5.9%	303.9	462.8	0.0%	1,049.0	1,340.0	0.0%
Pacific	158.3	77.8	50.8%	14.5	5.5	61.9%	37.6	11.2	70.1%	14.5	5.5	61.9%	224.9	100.1	55.5%
SE	290.4	145.3	49.9%	97.6	39.0	60.0%	154.0	66.9	56.6%	97.6	39.0	60.0%	639.6	290.3	54.6%
South	117.7	70.3	40.3%	150.8	80.9	46.4%	568.8	105.0	81.5%	150.8	80.9	46.4%	988.2	337.1	65.9%
All DMCs	**567.9**	**294.4**		**566.9**	**588.2**		**1,200.0**	**596.7**		**566.9**	**588.2**		**2,901.7**	**2,067.55**	

All non-% amounts are displayed in USD billions

POLUTION CONTROL GAP SUMMARY (Ex China)															
Summary Table	Solid Waste Management			Resource Efficiency and Circular Economy			Non-point Source Pollution Management			Wastewater Management			Total		
	Needs	Current	Gap	Needs	Current	Gap	Needs	Current	Gap	Needs	Current	Gap	Needs	Current	Gap
Pacific	158.3	77.8	50.8%	14.5	5.5	61.9%	37.6	11.2	70.1%	14.5	5.5	61.9%	224.9	100.1	55.5%
SE	290.4	145.3	49.9%	97.6	39.0	60.0%	154.0	66.9	56.6%	97.6	39.0	60.0%	639.6	290.3	54.6%
South	117.7	70.3	40.3%	150.8	80.9	46.4%	568.8	105.0	81.5%	150.8	80.9	46.4%	988.2	337.1	65.9%
Total	**566.4**	**293.5**	**48.2%**	**263.0**	**125.5**	**52.3%**	**760.4**	**183.2**	**75.9%**	**263.0**	**125.5**	**52.3%**	**1,852.7**	**727.52**	**60.7%**

All non-% amounts are displayed in USD billions

1. Solid Waste Management

Solid Waste Management is where concessionary capital is necessary to fill the gap. Close cooperation with national and regional governance frameworks is essential, including UNEP and UNDP, since solid waste crosses borders once at sea. ADB can participate in such cooperation and improve the economics for investors with concessionary and long-term capital. Marine plastic solutions are now a high priority for many investment funds.

The financing needs for the Solid Waste Management section were retrieved from the World Bank Report What a Waste 2.0 that provides the amount of waste per country in tons and its related cost per ton. We used these numbers as financing needs. The World Bank further

[4] China is covering almost all of its goals on its own and has a higher capacity to attract foreign capital. We therefore did not include it in the summary table, but we do provide details about their investments seperatly.

reported the percent of waste that is currently handled, and we use this number as the financing gap for each country when available. The ongoing investments were therefore extrapolated from these two sets of numbers to get the complete picture.

Most countries however did not report how much of their waste was disposed of. Therefore, we assumed an average number of 50%. Furthermore, these numbers do not account for the quality of the disposal where for some countries they can just represent landfill solutions. Unfortunately, no estimates were found of what would be the financing needs to achieve sustainable waste management solutions across the DMCs. This also implied we do not have a differentiation between private and public expenditures, but we can assume that most financing comes from government financing.

2. Resources Efficiency & Circular Economy

Circular Solutions for consumer staples products is another compelling segment for private investors because the economic incentives are getting aligned. Many big companies are already adapting to circular business models. Coca-Cola is among the companies with which the UNEP is working closely. The world's biggest beverage company, which uses 120 billion bottles a year, announced targets to collect and recycle all its packaging by 2030 and to lift its use of recycled content in its packaging from 10% to 50% by that date. Since these investments are attractive in their own right, we expect investors to welcome these new opportunities and therefore do not recommend any further incentives.

The data for these two segments has come from the same source on water infrastructure needs from the OECD through their report on the Asian Water Development Outlook (AWDO) commissioned by ADB. They have been providing country-specific investment needs as well as government and private expenditures to achieve water quality, efficiency, and security, which are labelled under the WASH (Water, Sanitation, and Hygiene) objectives. These goals coincide with the need of reducing bacterial pollution from Wastewater and improving the efficiency and quality of water use. The numbers were attributed arbitrarily between the two segments. We finally added further ADB's initiatives to complete the pictures in terms of countries. They can be found under:

i. ADB Sanitation project
ii. ADB Water Priorities Project
iii. ADB Pacific Private Projects
iv. ADB's Pacific Approach

Finally, regarding the consumer staples part of the Circular Economy, the Ellen McArthur Foundation states that this is already a $55 billion business opportunity for the chemical sector alone. The WEF suggests that it can finally amount to $1 trillion per year of revenue generation for companies implementing circular models across industries. Since these numbers represent attractive business opportunities, the incentives for private capital to do good are aligned and do not require any public investment. They were therefore not included in the gaps for this segment.

3. Non-Point Source Pollution Management

Non-Point Source Pollution Management shows the highest investment needs and gaps, mostly due to the costs of transitioning to sustainable agriculture. Investable solutions focus on saline, chemical, and organic pollutants. This segment also shows the highest financial gaps per country. This is the area with the most pressing needs within the pollution control

theme and where ADB's Healthy Ocean Action Plan can find synergies with the bank's Agriculture Department.

The numbers for the Non-Point Source segment mainly stem from ADB's program on agribusiness who assessed a need of $250 billion per year for the entire continent. This amount expresses what is necessary to achieve sustainable food challenges. This implies a reduction in food waste, the need for better irrigation, and a reduction of fertilizers. These goals readily and respectively translate to reductions in chemical, saline, and organic water pollution under the ADB's Healthy Ocean Action Plan. The yearly total of $250 billion in financing was then divided by population size to get a granularity by country. We therefore assume that the agricultural needs of a country are linearly dependent on its population.

Regarding the ongoing investments in this segment, ADB's agriculture department reports an average of $2.5 billion of annual investments in agriculture which we used which we similarly attributed amongst countries. This represents our current estimates of private investments and we used an average of 3.03% in agriculture expenditures from governments across Asia and the Pacific given by the FAO.

4. Water Efficiency and Wastewater Management

Water Efficiency and Wastewater Management goals are also undertaken under the *Asian Water Development Outlook*[5] (AWDO) commissioned by ADB and reported by the OECD for its fourth edition in 2020. These numbers represent the needs for water infrastructure to achieve safe access to drinking water and hygiene. This translates to a reduction in bacterial pollution and an improvement in water efficiency and quality in our mission. This means high potential for further synergies with the Water Department of ADB. These issues can all be holistically integrated within ADB's 2030 strategy. Because family health impacts are so high in this sector, women and poor communities can derive significant positive benefits. Closing this gap is therefore vital to advancing PEA objectives in Asia and the Pacific.

5 The Asian Water Development Outlook is a publication commissioned by the Asian Development Bank to increase importance of water in the future development scenarios of the Asia and Pacific region. https://www.adb.org/publications/series/asian-water-development-outlook?page=1

Focus Area: Sustainable and Coastal Marine Development

- **Coastal and Marine Tourism, Coastal Resilience, Green Shipping, Green Ports, Resilient Ports, and Marine Renewable Energy**

We estimated the finance gaps for the following segments across all DMCs: Coastal and Marine Tourism, Coastal Resilience, Green Shipping, Green Ports, Resilient Ports, and Marine Renewable Energy. We did not estimate the gap for Community Infrastructure, which is simply too broad and subjective for this exercise.

1. Coastal and Marine Tourism

A post-Covid19 investment strategy for tourism must prioritise sustainability of both environmental and social aspects (see APAC-Covid19 travel statistics[6]). Restarting tourism responsibly requires that future operations be guided by a science-based approach in order to support governments, business, and local communities to understand the trade-offs of decision-making processes that aim to align hygiene and health protocols with sustainability criteria. There is an opportunity for the tourism sector to build back better including to address marine plastic pollution through new UNEP recommendations for the tourism sector to continue taking action on plastic pollution during COVID-19. Making this transition means a more active role for ADB, UNEP, UNDP, impact investors, governments' regulatory frameworks and waste management systems, and marine NGOs. Also, the high interdependence between coastal and land tourism requires consideration of both, prior to investment decisions. Private investment has often been made by foreign-owned companies that do not place sustainability or local values at the centre of their decisions. Governance and local ownership are the best tools to change this trend. Investments in waste management can contribute to sustainable tourism but is covered under section 3.9.

TOURISM - INVESTMENTS METHOD: CAPITAL NEEDED FOR SUSTAINABLE TOURISM BY 2030				
3 SAMPLE	**1. NEW BUILDS:**	**CLEAN ENERGY**	**MANAGE: MARINE**	
Cost per Investment	1x = $10MN	1x = $5MN	1x = $2MN	
4 SCENARIOS:	*Allocated per Country Needs*			COST (USD MN)
A	2 Eco resorts + 10 Energy Upgrades + 2 Marine Parks			74
B	50% increase over Scenario A			111
C	2x increase over Scenario A			148
D	4x increase over Scenario A			296

TOURISM GAP SUMMARY: INVESTMENT METHOD	
ADB REGIONAL DEPT	**GAP (in $ million))**
Pacific	1,776
South-East Asia	1,396
South Asia	773
All DMCs ex-China	**3,945**

TOURISM GAP SUMMARY: OHI/EMPLOYMENT METHOD	
REGION	**GAP (in $ million)**
Pacific	2,350
South-East Asia	1,460
South Asia	1,515
All DMCs ex-China	**5,325**

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	ADB's Pacific Approach
	Pacific Renewable Energy Investment
	India National Infra Pipeline, p34
	ADB: Cambodia coastal tourism project. No published investment data
	Towards Investment and Financing for Sustainable Tourism. OECD Tourism Trends & Policies, 2018.
	Sustaining Tourism and increasing resilience through better planning coastal cities, Development.asia/explainer
	Metrics for Sustainable Tourism. Verge Hawaii, 2018
	PEMSEA: State of Oceans & Coasts 2018
	Toward Sustainable Tourism. WWF

[6] Statista, 2019, *Impact of coronavirus (COVID-19) on tourist arrivals in the Asia Pacific region in 2020, by country or region*, https://www.statista.com/statistics/1103147/apac-covid-19-impact-on-tourist-arrivals-by-country/

We use two alternative methods, described under Methodology, to derive the finance gap for marine/coastal tourism. Summary results of these two approaches are as follows:

OHI/Employment Method: We use the Ocean Health Index (OHI) to examine the status (pre-Covid19) of each country for Marine & Coastal Tourism. This OHI goal measures the proportion of the total labour force engaged in the coastal tourism and travel sector, factoring in unemployment and sustainability. Countries are rank ordered on the basis of that proportion. The gap is based on the difference of a perfect 100 and the country's current score. Each 1 point in this gap equals $5mn of needed investments to advance toward the goal of 100% sustainability by 2030.

Investments Method: Alternatively, we consider 3 standard investments to move towards sustainable tourism:

i. New Builds: Eco-Resorts at average cost of $10mn per resort
ii. Upgrades: Clean Energy for resorts at avg cost of $5mn per resort
iii. Establish & Manage: Marine Parks at avg cost of $2mn per park

We assign investments based on 4 scenarios that reflect categories of tourism development/needs for each country. The smallest needs - represented by Scenario A - are magnified according to 3 larger scenarios for larger tourism markets. Allocations are made of these 3 investments and 4 scenarios accordingly.

2. Coastal Resilience

Coastal Resilience is highly interdependent with ecosystem management, sustainable infrastructure and tourism. Therefore, the financing gap as a whole must include these three sectors, which are treated separately by us in this Section 3. We do not want to overestimate the Coastal Resilience gap by double-counting these three sectors, so we took a limited view of the Coastal Resilience data since complementary investments are recommended elsewhere. Also, private investors expect to see risk management integrated with investment vehicles for this theme. Vulnerability of poor communities to coastal climate risk makes this a social imperative as well as economic.

Our Coastal Resilience Financing Gap calculation is a composite of *Pacific Catastrophe Risk Assessment and Financing Initiative* (*PCRAFI*), *The Organisation for Economic Co-operation and Development (OECD), Ocean Health Index (*OHI) data (described under Methodology) with our own judgment to reduce inconsistencies. In short, more robust results are obtainable only by in-depth analysis of currently unavailable and unpublished data from all sectors that impact coastal resilience investments for every country in the region. Our summary by regions is as follows:

COASTAL RESILIENCE GAP SUMMARY (in $ million)			
ADB Regional Dept	**ANNUAL INVEST NEEDED 2020-2030**	**ONGOING INVESTMENT**	**GAP**
Pacific	3,780	2,080	1,700
South-East Asia	10,200	6,600	3,600
South Asia	11,200	4,860	6,340
All DMCs ex-China	25,180	13,540	11,640

i. PCRAFI: For Pacific Islands climate risk assessments. Some are surprisingly low, but this is baseline data for further analysis by managers of this risk facility.
ii. *Asian Water Development Outlook (AWDO) by OECD:* For SE Asia and South Asia. Publication of this report is due by Q4 2020. Here we use one data point: Coastal Flood Risk. However, this does not include all coastal climate risks (wind, etc).
iii. Ocean Health Index (OHI): The Coastal Resilience score given to each country is a helpful and consistent baseline from which to project Needed Investments. We used OHI data for several other sectors in this report, for the same reason. The sustainability goals articulated by OHI are monetised at the cost of $10mn per year to advance 1% to 2030. *OHI Definition:* Coastal Protection compares the current extent and condition of protective habitats to their condition and extent in the early 1980s.

3. Resilient Ports

Climate Resilient Ports is the essential precondition for pursuing green port investments and for national development and security as a whole. Engineering solutions within the ports include elevating yards and warehouse areas. For solutions in the marine environment, a combination of built and natural protections (eg, restored mangroves, reefs) are advised. We calculate the port resilience gap here based on these solutions. The finance gap per country is based on a high-risk climate scenario and conservative engineering cost model.

In addition, three complementary investments must be considered with the above. We first calculate the *Climate Resilience for Ports*: We calculate the cost of this essential strategy for each major DMC port in the next figure. *Smart Ports*[7] also use automation and innovative technologies including Artificial Intelligence (AI), big data, Internet of Things (IoT) and blockchain to improve performance - including sustainability gains. This also favours more jobs for women and better labor conditions overall. *Governance***:** Ports need investments in governance and enforcement in order to protect both ocean and community health, whilst providing competitive services.

RESILIENT PORTS GAP SUMMARY		
ADB Regional Dept	**# Major Ports**	**Gap to Protect (in $ billion)**
Pacific	16	885
South-East Asia	7	1,510
South Asia	9	1,280
All DMCs ex-China	32	3,675
India only (included in South)	4	1,000
China only (not included above)	12	8,500

Climate Assumptions: We used the *High-Risk* scenario (RCP8.5 Representative Concentration Pathway-High Risk), which is only marginally higher (4%) than for the *Moderate-Risk* scenario. Both scenarios and cost models are described in our key reference: Climate Costs for Asia-Pacific Ports, Asia Research & Engagement

[7] Port Technology, 2019, What is a Smart Port? https://www.porttechnology.org/news/what-is-a-smart-port/

Climate Scenario Assumption:	
Emissions scenario	RCP8.5 (Representative Concentration Pathway-High Risk Level: Emissions continue to rise throughout the century, with temperature increases likely between 2.6°C and 4.8°C
Sea level rise	Between 0.45m and 0.8m
Storm intensity	Average storm intensity increases 20% to 30%
Storm surge	Storm surge increases by 1m to 1.5m from base assumption of 5m
Required Elevation	2.3m = 0.8m + 30% x 5m
Source	*ARE-Climate Costs for AsiaPacific Ports*
Notes	Smallest port in ARE Study: Cilacap, Indonesia: 2km2, $65mn est cost for resilience

Engineering Assumptions: We again follow the ARE cost models under a conservative protection strategy. This assumes elevating 30% of warehouses and yards. Because
Port Selection: We selected at least 1 major port per country. We selected 2 each from the Philippines, Indonesia, Malaysia, and 4 from India. Our port data is from World Port Source. Countries may decide it is advisable to protect additional ports.
Ongoing Investment Data specifically for port climate resilience is unavailable. This essential strategy may be included in port infrastructure budgets. However, lacking a clear allocation, we used a Null value for all countries.
Cost Estimates per Port: From the cost models used by the ARE study, we developed estimates for three port sizes based on World Port Source. The cost variation in medium and large ports is due to size differences within these groups:

i. Small: $20 million
ii. Medium: $40 million
iii. Large: $100million

Data on the 8 ports analysed in the ARE study is indicated in the full Table for this chapter. Two major ports in The Philippines, for example, show resilience costs totalling $545 million. Costs in more developed countries are higher, primarily due to labour costs - for example: Malaysia's two major ports require a total $830 million. We avoided distortions from such outliers by considering the estimate for the smallest port in the ARE study (Calaca, Indonesia: 2km2 area: $65 million) and making a comparable size/development stage assumption for other ports to estimate by groups as noted above.

Analysts may therefore alter any of these assumptions to arrive at different estimates for individual countries or the region as a whole. What is important is to begin the process of climate protections for these vital assets to all nations considered. Insurance packages may help in filling the finance gap with preventative investments, rather than paying out for disaster relief that increases every year.

4. Green Ports

We examined three investment opportunities for this green transition. The first is *Renewable Energy* including solar panel installations on warehouse roofs, offshore wind farms and tidal/wave power investments near ports. (Note: The investment gap for clean fuel supplies for ships is calculated under Green Shipping). Allocation to Port Renewable Energy: 7% of port investments.

The second is *Waste Management* including controls and treatment of air, water and solid pollution occurring or collected at ports - and not directly covered by shipowners. This is

separate from the national investments examined under the Pollution Control theme. Allocation to Port Waste Management: 4% of port investments.

The third is *Maritime Accelerators*: Ports are hubs for innovation in the Blue Economy. Hence the new EU strategy[8] to develop and fund accelerators in ports. This strategy can be duplicated across Developing Member Country (DMC) ports in the Asia-Pacific region. The Port of Singapore has already announced a business accelerator strategy to stay relevant and competitive. *Allocation: 1% of total needs.* Whilst this allocation is high for many DMCs, it is recommended for the success of the Healthy Ocean Action Plan and may indeed help attract private capital to the plan. Allocation to Port-based Accelerators: 1% of port investments.

The above sustainability allocations represent a 50% increase over the *Business-as-Usual* allocations to port infrastructure, according to a recent study of European Port Infra needs[9]. A total 12% of ports infra expenditures to these three sustainability needs is, in our view, a reasonable allocation.

GREEN PORTS GAP SUMMARY			
	Investment Needs	Ongoing Investments	Gap
1. Green Onshore Power	55.691	1.103	54.589
2. Waste Mgmt	31.996	0.000	31.996
3. Accelerators	7.999	0.000	7.999
Total	87.688	1.103	94.584

USD billions

GREEN PORTS GAP SUMMARY	ADB Regional Dept	TOTAL GAP (in $ millions)
	Pacific	8,857.78
	South-East Asia	63,640.53
	South Asia	22,085.53
	All DMCs ex-China	94,583.84

5. Green Shipping

Green Shipping involves a complex transition for the full value chain of global trade and transportation. To achieve global climate and IMO goals, it is imperative that we invest for zero emissions rather than fossil fuel alternatives (e.g., LNG) and cheat devices (e.g., fuel scrubbers) that perpetuate both climate and pollution problems.

We therefore analyse 3 opportunities for Asia-Pacific. *Retrofits* of existing ships with auxiliary power: Sails, solar and waste-heat capture. *New-builds* with clean power: Hydrogen, Ammonia, Methanol, Biofuels, *Clean Fuel* supply chains.

Detailed investment recommendations are seen in the assumptions that drive our gap calculations. In summary, sustainable financiers need to invest in all three solutions noted.

8 European Commission, 2020, Cross-sectoral development of innovative port clusters in the Atlantic: Developing a blue accelerator scheme for Atlantic ports https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details

9 European Seaport Organisation, The Infrastructure Investment Needs and Financing Challenge OF European Ports, https://www.espo.be/media/Port%20Investment%20Study%202018_FINAL_1.pdf

Decarbonisation of shipping for the region is indeed possible by 2050 if we follow these recommendations - especially on the timeline to 2030.

GREEN SHIPPING GAP SUMMARY						
ADB Regional Dept	**Largest Emitters: Ships >500GT, based on owner's country**	**ONGOING INVEST**	**A. INVEST NEEDED by 2030: ZEST RETROFITS ***	**B. INVEST NEEDED: ZEST NEWBUILDS***	**C. INVEST NEEDED: ZEST SUPPLY CHAINS***	**FINANCE GAP (2020-2030)**
Pacific	**1,392**	500	42	30	2,600	2,172
South-East Asia	**6,284**	0	189	60	5,400	5,649
South Asia	**1,399**	0	42	90	5,400	5,532
All DMCs ex-China	**9,075**	**500**	**272**	**180**	**13,400**	**13,352**
	# Vessels	in $ millions				
			*Assume: 30% of large ships add auxiliary power @ $100k per vessel by 2030 for 100% decarb by 2050	*Assume: $300k per new H2 vessel, by region: 100 in Pacific, 200 in SE, 300 in SA	*Assume: 1 Ammonia plant (SMR+CCR method) @$2.6bn. See p20, UMAS Slides: Decarb Invest Cost	(A+B+C)-Ongoing Invest

Assumption 1 - ZEST Retrofits: 30% of large ships add auxiliary power @ $100k per vessel by 2030 for 100% decarb by 2050.
Assumption 2 - New Builds: $300k per new H2 vessel, by region: 100 in Pacific, 200 in SE Asia, 300 in South Asia
Assumption 3 - ZEST Supply Chains: 1 Ammonia plant (SMR+CCR method) @$2.6 billion. See p20, UMAS Slides

6. Marine Renewables

The total financing needs for all types of renewable energy in Asia (except China) amount to $4.48 trillion, with current investments of $48 billion and thus an investment gap of $4.44 trillion. These amounts represent the total investment needs in all renewable energy (offshore and onshore) for the continent.

MARINE RENEWABLES GAP SUMMARY (in $ billion)					
Regions	**Financing Needs All Renewables**	**Current Inv. All Renewables**	**Financing Gap All Renewables**	**Financing Gap Offshore Wind**	**Financing Gap Marine Tidal/Wave**
Pacific	276.0	6.0	271.3	25.2	0.1
South-East Asia	1,647.1	14.9	1,632.2	151.8	0.5
South Asia	2,563.9	27.1	2,536.8	235.9	0.8
All DMCs ex-China	**4,486.9**	**48.0**	**4,440.2**	**412.9**	**1.3**

Despite the considerable gap in energy infrastructure, many projects are being undertaken across the DMCs. Pacific countries are leading the charge mainly with onshore projects. Some countries are covered in terms of their needs, but others require an expansion of investments especially in South-Asia and South-East Asia. Regarding Offshore Wind, China has been the sole implementer of this technology so far in the region, but success in Europe can further trigger enthusiasm for the technology. In any regard, the appetite for renewable energy is there and the rest of the DMCs could build on this momentum from the Pacific Nations and China.

Most of the financing comes from private sources at a ratio of 98.5%. There are therefore already significant numbers of bankable projects moving the markets. However, more participation from governments will be necessary to ensure closing the gap. This is also an avenue ADB can work in cooperation with DMCs to make catalytic investments, leading to supportive policies that trigger more private interest in the space, creating a virtuous cycle. The gender and poverty connection with marine energy, as mentioned earlier, is quite strong because women and poor communities are adversely impacted by fossil fuel costs and pollution - whereas the positive impacts are manifold from renewables, with some marine technologies offering easier installation and lower CapEx than their land-based counterparts.

Finally, the reason why we included the entire landscape of renewable energy with onshore projects is that carbon emissions are responsible for ocean acidification. This has cascading effects across ocean health and all Blue Economy sectors. Ocean acidification could deplete $ 1.2 trillion worth of natural resources every year up to 2100. This is a link between this segment on renewables energy and the pollution segment. This is a global issue that will require multiple-stakeholder collaboration and advocacy for decarbonising institutional portfolios including for example through the UNEP supported Portfolio Decarbonization Coalition (PDC). Momentum is also growing to put a price on carbon pollution as a means of bringing down emissions and driving investment into cleaner options. The two main types of carbon pricing are emissions trading systems (ETS) and carbon taxes. An ETS – sometimes referred to as a cap-and-trade system – caps the total level of greenhouse gas emissions for countries or companies and allows those with low emissions to sell their extra allowances to a larger emitter. A carbon tax directly sets a price on carbon by defining a tax rate on greenhouse gas emissions or – more commonly – on the carbon content of fossil fuels. In Asia Pacific there are 17 carbon pricing initiatives[10] implemented or scheduled for implementation, but these initiatives only cover 26 percent of emissions[11] with prices ranging from less than US$1/tCO2e to US$24.5/tCO2e[12]. Despite slow progress to date, there is growing attention to the opportunity that pricing policies offer to drive social, economic, and climate benefits. Synergies with the ADB's energy department also generate much potential to increase bankability in the space.

The financing needs were retrieved from the ADB's report Meeting Asia's Infrastructure Needs. They estimated a $ 14.7 trillions of investment needs in climate-resilient and renewable energy infrastructure for the entire continent and we allocated that amount based on countries' similarly as in the rest of the report.

For the ongoing investments, we took both a top-down and bottom-up approach. The top-down investments were retrieved from the IRENA report and represented $ 14.4 billion for South Asia worth of investments and $ 106.9 billion for South-East Asia, East Asia, and the Pacific. The numbers were once again proportionally allocated with respect to the GDP of the countries. From the bottom-up approach, we were able to retrieve a list of ongoing investments from three different reports that span across many countries, especially in the Pacific: PRIF Renewable Energy Costs in the Pacific, ADB Country Operation Busines Plan (COBP) and ADB Pacific Energy Update 2019

10 The World Bank, *Carbon Pricing Dashboard*, https://carbonpricingdashboard.worldbank.org/
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II. The Parties to the Nauru Agreement (PNA) controls the world's largest sustainable tuna purse seine fishery. PNA Members are Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands and Tuvalu, https://www.pnatuna.com/HomePage

III. *Plastic Bank* is a social enterprise committed to stopping ocean plastic while providing opportunities for brands to have environmental & social impact, https://plasticbank.com/

IV. Circulate Capital is an investment management firm dedicated to financing innovation, companies, and infrastructure that prevent the flow of plastic waste into the world's ocean while advancing the circular economy, https://www.circulatecapital.com/

V. Ocean Conservancy is a nonprofit environmental advocacy group based in Washington, D.C., United States. The organization helps formulate ocean policy at the federal and state government levels based on peer reviewed science. https://oceanconservancy.org/

VI. Closed Loop Partners is a New York based investment firm that provides equity and project finance to scale products, services and infrastructure at the forefront of the development of the circular economy. https://www.closedlooppartners.com/

VII. Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)

VIII. is an intergovernmental organization operating in East Asia to foster and sustain healthy and resilient oceans, coasts, communities and economies across the region. http://www.pemsea.org/

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XII. The Ocean Risk and Resilience Action Alliance, ORRAA, is a multi-sector collaboration between governments, financial institutions, the insurance industry, environmental organisations and stakeholders from the Global South. https://www.oceanriskalliance.org/

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