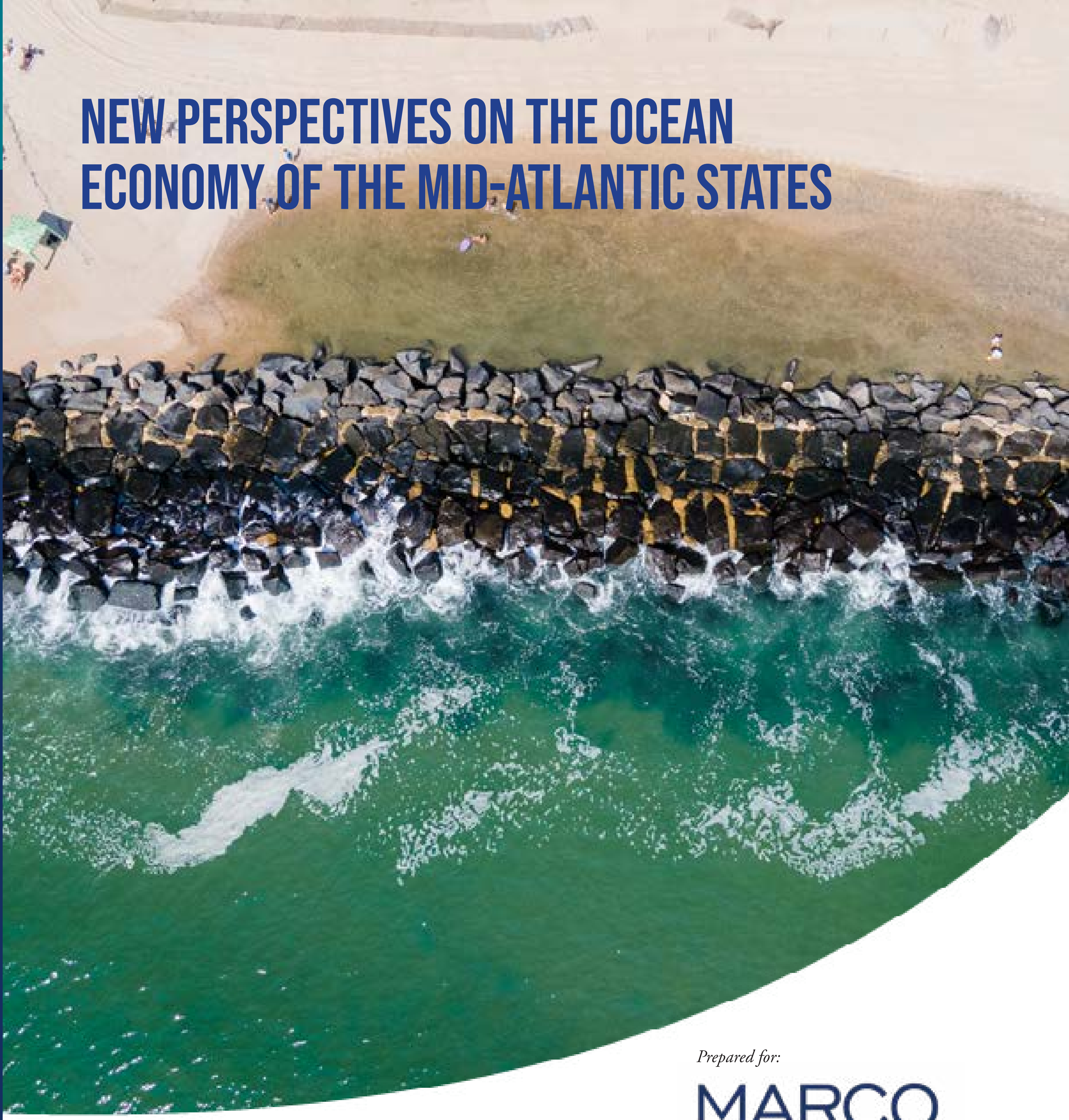
NEW PERSPECTIVES ON THE OCEAN ECONOMY OF THE MID-ATLANTIC STATES



Prepared for:

MARCO
MID-ATLANTIC REGIONAL COUNCIL ON THE OCEAN

By

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EXECUTIVE SUMMARY

The contributions of oceans and coasts to national, state, and local economies in the U.S. has been tracked for nearly two decades through a data series originally developed by the National Ocean Economics Program (NOEP), which is now maintained by the Office for Coastal Management of the National Oceanic and Atmospheric Administration. This data is made available both through the Economics National Ocean Watch (ENOW) section of the NOAA digital coast website and also through the data portal of the National Ocean Economics Program at the Center for the Blue Economy. Data is available for employment, wages, value added (contributions to gross domestic product) and the number of establishments and can be accessed for county, state, and national levels. The ENOW data series provides data on ocean related economic activity for 6 sectors and 21 industries.

The federal government has begun the process of expanding the measurement of the ocean-related economy, at least at the national level. The Marine Economy Satellite Account (MESA) was published by the Bureau of Economic Analysis in June 2021. The MESA data expands the definition of economic activities related to the oceans and coasts and improves the accuracy of the measurement. But the MESA data is constructed from highly detailed data that is only available at the national level. While plans exist to expand the MESA to include state and county level data, this lies sometime in the future.

This report has been prepared to provide a partial bridge between the two different measurements of the ocean economy for the states of the Mid-Atlantic Regional Council on the Ocean. It adds to the existing ENOW data measures of ocean related economic activity in marine research and education, state government, and the electric power generation industry. It improves the measurement of tourism and recreation to better focus on economic activity related to coastal and ocean resources. With these changes additional detail on the ocean economy is provided using methods consistent with the estimates of the Marine Economy Satellite Account.

Attention is increasingly being paid to the economic value of specific marine and coastal ecosystem assets. One of the most frequently investigated ecosystem values is blue carbon, which is a shorthand for the ability of various forms of aquatic vegetation to store carbon that would otherwise be released to the atmosphere and exacerbate climate change. Preventing the release of carbon already stored in aquatic vegetation has economic value as part of strategies to become carbon neutral. Annual changes in the amount of carbon in aquatic vegetation (called sequestration) also has value as an offset to other carbon releases.

The data reported here should be thought of as "ENOW+" in that it is built from state level data and supplements the existing ocean economy data series from ENOW. The area considered for measurement is the same as the definition of geography used in both the ENOW and MESA data series and is shown for the MARCO states in Figure 1. This geography includes counties for which economic data is available in the ENOW data series. This report does not include the Great Lakes region of New York State since the focus is on the ocean; however, all the data herein can be also collected for the Great Lakes.

The following modifications were made to the NOAA Economics National Ocean Watch (ENOW) accounts. All figures are for calendar year 2018, the most recent year for which ENOW data is available.

State government expenditures related to the oceans in the categories of resource management, parks and recreation, and law enforcement were identified from individual state sources. A partial review of state data for this study showed:

- **$654.6 million in budgeted commitments in 2018 and over 6,300 employees for the state governments of the MARCO states.** This includes funding from all sources. No estimates were made for local governments or the federal government.
- New Jersey and New York had the largest budgets at about $260 million each.
- New Jersey had the largest expenditures per mile of shoreline at $144,000 per mile. The regional average state government budgeted amount per mile of shoreline was $62,000.

Marine Research and Education was measured, like state government, from budgets of relevant organizations supplemented by other economic data. The focus was on public and private institutions of higher education with identifiable organizational components dedicated to marine research and education.

- Across the region, marine research and education is estimated to account for **$317 million in spending in 2018, supported by 7,200 employees.**
- **Virginia has the largest marine research expenditures.**

Electric Power Generation. Electric power plants within 5 km (~3 miles) of the shoreline were selected and the proportion of GDP in the utilities sector was calculated for these plants based on generating capacity.

- **Electric power generation is a major sector in the ocean economy.** At $22.4 billion in output and 24,500 jobs, it is second only to tourism and recreation.
- **New York has the largest coastal electric power industry**, followed by New Jersey.
- **Electric power generation is the largest share of the ocean economy in Delaware.**

Together, State Government Expenditures, Marine Research and Education, and Electric Power Generation add $23.5 billion and 38,000 jobs to the regional ocean economy.

Tourism and Recreation is generally the largest sector in the coastal economy in employment and usually in GDP. ENOW data utilizes annual average data which can both overstate and understate ocean-related tourist and recreation economy. To provide alternative perspectives on tourism and recreation, two alternative measures of tourism and recreation for each county and state are developed. First estimates of the summer peak economic activity in each county are made. These were then adjusted to account for those who travel for primarily recreational purposes (excluding those who travel for business or to visit friends and relatives.).

During the peak summer tourism and recreation season, **employment in the MARCO region's coastal communities rises by about 280,000 jobs** (19%) versus the annual average estimates provided in ENOW. However, a**djusting the estimates to reflect only people who travel specifically for recreation reduces the estimated summer peak job increase to 166,000, or 24% lower than ENOW.**

New Jersey and Delaware had the largest peak summer economy, with employment in ocean tourism and recreation 54% higher than the annual average in New Jersey and 39% higher in Delaware. **New York shows the smallest peak summer economy** at just 7% higher than the annual average. **Cape May County, New Jersey has by far the largest peak** to annual average difference in employment.

Delaware and Virginia had the largest share of its summer economy associated with travelers who come for recreation (at 67% of employment). **New York has the smallest share** at 55%.

Resources such as coastal wetlands are known to produce variety of what are called ecosystem services such as habitat for economically important fish species, protection against flooding and storms, and storage of carbon that could otherwise contribute to atmospheric carbon and climate change. Particular attention is being paid to carbon storage functions because of concerns about climate change. This is termed **"blue carbon"**.

The value of blue carbon is partly a function of the amount of carbon already in the aquatic vegetation of wetlands. This is a stock of value which is already present. The amount of additional carbon stored each year, called sequestration, is a flow of value that adds to the stock of stored value. The value of stored carbon is derived from keeping that carbon in the vegetation; if the wetlands are destroyed and carbon is released into the atmosphere then additional damage from climate change could result. The value of the stock of carbon is, therefore, the value of the costs of climate change avoided by maintaining the wetlands. Similarly, the value of sequestered carbon depends on avoiding damages from climate change from the additional amount of carbon kept from the atmosphere each year in the future.

At any point the value of blue carbon is a function of the area of wetlands and carbon stored there and the possible future damages that result from that carbon being in the atmosphere rather than the wetlands. Both stored and sequestered carbon values depend on events in the future, and so must be expressed as a present value over some period. The choice of a discount rate (a way to equate future and present values) is an important part of the calculation. The monetary value can be taken as an estimate of future climate damages, called the social cost of carbon. It can also be taken as the price paid to preserve wetlands for carbon storage.

To estimate the blue carbon values of the Mid-Atlantic, a study of blue carbon stored and sequestered conducted by Duke University for the region was used to estimate amounts of carbon. The study incorporated the potential effects of sea level rise on the amount of aquatic vegetation capable of storing carbon, thus modeling a feedback loop of carbon removed from the atmosphere in the future offset by reductions caused by climate change. There is thus no single "value of blue carbon", but a range of estimates depending on the choice of discount rate, the monetary value for costs avoided, and the assumptions about how much climate change will affect future levels of carbon removal. Several different assumptions are used to estimate the blue carbon values.

Using a low discount rate (future climate costs are reduced only slightly), an assumption of 1 meter of sea level rise, and both **the current official U.S. government social cost of carbon and a social cost of carbon reflecting very high levels but low probabilities of future damages, the total value of currently stored and future sequestration of carbon ranges from $10.1 billion to $29.5 billion depending on the choice of carbon price.** Of these amounts, **currently stored carbon accounts for 88% of the value**.

Virginia ($3.0 billion) at current social cost of carbon and New Jersey ($2.8 billion) have the largest blue carbon values. Maryland (at $2.7 billion) is third.

A key aspect of blue carbon value is that **greater amounts of climate change increase the value of avoided costs** but also **reduce the number and extent of wetlands** and thus carbon storage.

The data presented here will be most useful if it is kept continually updated on a regular basis so that important changes in the economic activity associated with the ocean are detected and can be investigated. Recommendations for keeping the data updated are provided. This can be done at modest cost using publicly available information or information accessible within state government and higher education institutions.


CAPE MAY

1. INTRODUCTION

The contributions of oceans and coasts to national, state, and local economies in the U.S. has been tracked for nearly two decades through a data series originally developed by the National Ocean Economics Program (NOEP), which is now maintained by the Office for Coastal Management of the National Oceanic and Atmospheric Administration. This data is made available both through the Economics National Ocean Watch (ENOW) section of the NOAA digital coast[1] website and also through the data portal of the National Ocean Economics Program at the Center for the Blue Economy.[2] Data is available for employment, wages, value added (contributions to gross domestic product) and the number of establishments and can be accessed for county, state, and national levels. Data is available from 2005-2018.

The ENOW data series provides data on ocean related economic activity for 6 sectors and 21 industries. It is constructed from other regularly published national economic data series from the Bureau of Labor Statistics, the Bureau of Economic Analysis, and the Bureau of the Census. The data has the advantage of being estimated on a consistent basis across more than 1,000 counties and coastal states all of which sum to the national total. The data is published consistent with federal rules concerning protection of confidentiality of data. Details on the construction of the data series are available in Colgan (2013).

The ENOW data series provides perspectives on the economic importance of oceans and coasts that were previously unavailable. But the use of other data series that are built for purposes other than measuring the contributions of oceans and coasts means that there are inevitably some compromises in the data that affect the accuracy of the depiction of the ocean relationship. There are several industries and economic activities related to the ocean that are included in the ocean accounts of other countries but are not in ENOW. There are also estimating methods that are more accurate measures of ocean/coastal relationship in some regions than others.

The federal government has begun to address some of these issues by constructing a new ocean (or marine) economy data series. The Marine Economy Satellite Account (MESA) is published by the Bureau of Economic Analysis. It was released in experimental form in 2020 and the first full release took place in June 2021. This account was developed by BEA together with NOAA and a team of researchers including the Center for the Blue Economy. The MESA data expands the definition of economic activities related to the oceans and coasts and improves the accuracy of the measurement. But the MESA data is constructed from highly detailed data that is only available at the national level. While plans exist to expand the MESA to include state and county level data, this lies sometime in the future.

Currently, therefore, ocean economic data contains considerable detail at the national level, but this detail is not available at the state and local level. Geographically extensive data is available at the state and local level, but without the industrial detail available at the national level. This report has been prepared to provide a partial bridge between the two different measurements of the ocean economy for the states of the Mid-Atlantic Regional Council on the Ocean. It adds to the existing ENOW data measures of ocean related economic activity in marine research and education, state government, and the electric power generation industry. It improves the measurement of tourism and recreation to better focus on economic activity related to coastal and ocean resources. With these changes additional detail on the ocean economy is provided using methods consistent with the estimates of the Marine Economy Satellite Account.

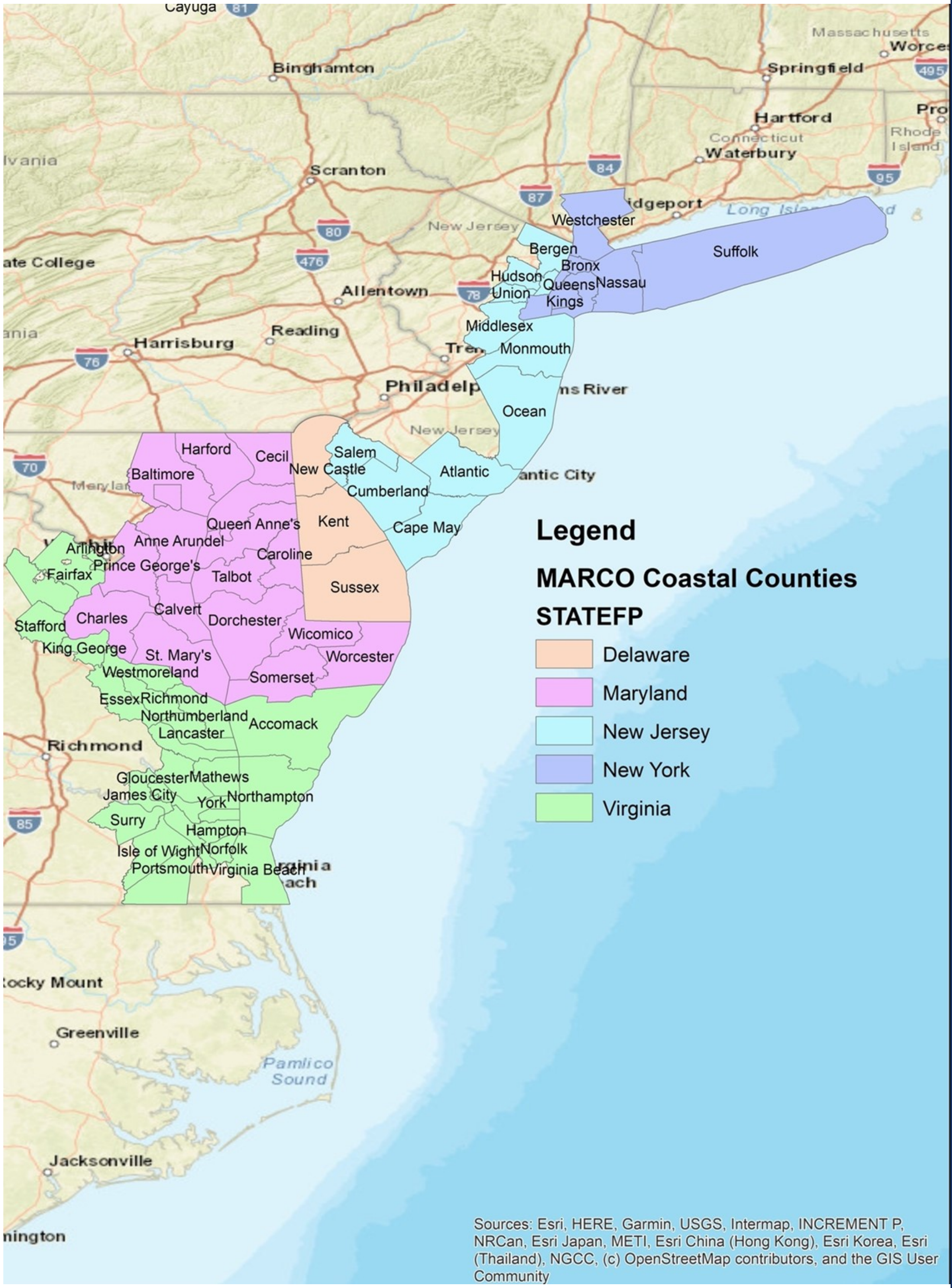
1 https://coast.noaa.gov/digitalcoast/data/enow.html

2 www.oceaneconomics.org

Other changes in accounting for the economic value of oceans are occurring. Attention is increasingly being paid to the economic value of specific marine and coastal ecosystem assets. International standards have been established for combining the values associated with industries such as fisheries or tourism with the values of ecosystems. One of the most frequently investigated ecosystem values is blue carbon, which is a shorthand for the ability of various forms of aquatic vegetation to store carbon that would otherwise be released to the atmosphere and exacerbate climate change. Preventing the release of carbon already stored in aquatic vegetation has economic value as part of strategies to become carbon neutral. Annual changes in the amount of carbon in aquatic vegetation (called sequestration) also has value as an offset to other carbon releases.

The data reported here should be thought of as "ENOW+" in that it is built from state level data and supplements the existing ocean economy data series from ENOW. The area considered for measurement is the same as the definition of geography used in both the ENOW and MESA data series and is shown for the MARCO states in Figure 1. This geography includes counties adjacent to the shores of the ocean, of major estuaries such as Chesapeake Bay and Delaware

Figure 1 Ocean Economy Region of the MARCO States



Bay. This report does not include the Great Lakes region of New York State since the focus is on the ocean; however, all of the data herein can be also collected for the Great Lakes. The report also does not include the Hudson River counties north of Westchester as these are not included in the ENOW data series. There are also some counties and cities in Virginia which are part of the state coastal zone for which ENOW data is not estimated.

While the methods used to assemble this data are consistent with other ocean economy data collection, this report should be considered a prototype. The ultimate value of the data rests primarily in the continual updating of the data so that trends and significant changes can be identified. There are also numerous opportunities available to further improve the accuracy of the estimates which should be considered with each update. A discussion of updating and improving the data is included in the report.

This report adds three new sectors to the measure of the ocean related economies of the Mid-Atlantic, improves the accuracy of measurement of ocean-related tourism & recreation, and takes a first step towards creating an integrated economic-ecosystem account of ocean values.

NEW SECTORS:

Marine Research & Education is a sector that is included in most national ocean accounts and is included in the U.S. Marine Economy Satellite Account beginning in 2020. The sector is measured primarily by the budget outlays of institutions involved in marine research and education; these are primarily academic institutions in higher education that combine research and education so that it is not practical to separate the two functions. Some marine research is conducted by nongovernmental organizations (NGO's).

State Government. The largest difference between the Marine Economy Satellite Account and the ENOW accounts is the inclusion of government, particularly the Federal government in the former. State and local governments were also included, but the focus is on state governments because of the difficulties in gathering data from the more than 1,000 coastal counties and more than 10,000 other units of local government in coastal areas. State government ocean-related expenditures were defined as being of three types: resource management (including regulation, conservation, and fisheries management), parks and recreation provided by state government, and law enforcement specifically related to marine/coastal resources. Ports owned or operated by state governments are accounted for in the marine transportation sector of the standard ENOW data.[3]

Electricity Generation. Electric power generation has not been considered a traditional "coastal" industry, but it is included in the marine economy satellite account for two reasons. First, electric power generation has frequently used coastal locations because they offer access to water for steam generation and discharge and also for delivery of fuels such as oil and coal. Second, one of the largest anticipated changes in the ocean economy is the addition of renewable electricity generation, primarily in the form of offshore wind but also including tidal and thermal generation. To set a baseline against which the coastal electric industry will involve, estimates of the economic activity associated with the current industry are included.

3 Public agencies such as the Port Authority of New York-New Jersey or the Maryland Ports Authority are accounted for as "public enterprises" in the satellite account since these organizations operate with their own revenue sources and often use private sector firms to carry out essential tasks.

IMPROVED ESTIMATES OF TOURISM & RECREATION

The ENOW data defines tourism and recreation as economic activity in a defined set of industries where establishments are located in a shore-adjacent zip code. This geographic criterion for defining tourism and recreation greatly improves the accuracy of estimates compared with county-based estimates, but it still overestimates the ocean relationship, sometimes quite considerably, as is the case in New York County (Manhattan). Because hotels and restaurants make up by far the largest proportion of the tourism & recreation sector, it is important to separate out resident from nonresident uses and among nonresident users to separate people who visit coastal regions for recreation and leisure purposes from those who visit for other purposes. Visitor survey data for each state (and New York City) are used to narrow the estimates of tourism and recreation to exclude business travel and focus on leisure travel. Further refinements are possible and are described with an example in Appendix 3.

Another feature of tourism & recreation economic activity is that in the Mid-Atlantic states this activity is highly seasonal, with many parts of the coastal areas in the region having summer activity substantially higher than winter activity or higher than annual average activity, which is the frequency of the ENOW data. The reduction in estimated activity required to more accurately measure ocean-related recreation needs to be adjusted upwards to account for seasonal peaks. For this reason, a second estimate of peak ocean-related tourism & recreation employment is provided for each state and for each county. These summer peaks are calculated using monthly and quarterly data from each state's department of labor.

INCLUDING THE VALUE OF ECOSYSTEMS

Wetlands are known to have extensive economic value because they provide a variety of ecosystem services such as nursery habitat for fisheries, flood resilience, and storage of carbon that would exacerbate the damages from climate change if released to or allowed to remain in the atmosphere. This latter service, called blue carbon, is an increasingly important value of the natural capital of coastal wetlands. This value is an important addition to the overall perspective on the economic value of the ocean.

2. MARCO REGIONAL SUMMARY

Table 1 Ocean Economy Summary for MARCO Region

Ocean Sector	Establishments	Employment	Wages ($M)	GDP ($M)
Marine Construction	595	8,977	$769.09	$1,422.41
Living Resources	1,668	14,026	$619.88	$1,923.38
Offshore Mineral Extraction	289	1,527	$107.04	$292.01
Ship and Boat Building	154	40,837	$3,024.82	$4,278.06
Tourism and Recreation	39,597	628,927	$18,616.81	$41,596.83
Marine Transportation	2,326	153,373	$10,203.62	$17,384.25
ENOW Ocean Sectors	44,612	847,667	$33,341.25	$66,896.93
Marine Research and Education	37	7,231	$235.35	$316.87
State Government*	31	6,360	$397.64	$654.66
Tourism & Recreation Revised	21,852	417,411	$2,615.40	$5,810.70
Electric Power Generation	328	24,522	$3,182.37	$22,408.61
ENOW +	21,920	431,003	$3,248.39	$6,782.22
TOTAL REVISED OCEAN ECONOMY	26,935	649,743	$17,972.83	$32,082.32
Tourism & Recreation Peak	37,534	696,447	$4,531.02	$10,093.85
				PV 30 Years 1% DR
Coastal Blue Carbon PV Annual Sequestration (Low Social Cost of Carbon)				$1,198.91
Coastal Blue Carbon PV Annual Sequestration (High Social Cost of Carbon)				$3,511.09

3. STATE SUMMARIES

Table 2 New York

Ocean Sector	Establishments	Employment	Wages ($M)	GDP ($M)
Marine Construction	213	2,711	$262.83	$463.97
Living Resources	742	5,019	$218.77	$552.31
Offshore Mineral Extraction	139	254	$16.81	$38.01
Ship and Boat Building	NA	NA	$74.35	$143.07
Tourism and Recreation	22,269	359,193	$12,628.44	$29,039.53
Marine Transportation	656	26,245	$1,961.50	$3,333.28
ENOW Ocean Sectors	24,058	394,309	$15,162.70	$33,570.16
Marine Research and Education	7	729	$23.73	$31.95
State Government*	5	2,226	$152.29	$256.89
Tourism & Recreation Revised for Trip Purpose	11,392	195,082	$1,640.94	$3,770.31
Electric Power Generation	115	11,924	$1,514.96	$8,902.74
ENOW +	11,519	209,962	$3,331.92	$12,961.89
TOTAL REVISED OCEAN ECONOMY	13,308	245,078	$5,866.17	$17,492.51
Tourism & Recreation Peak	20,828	357,591	$3,010.44	$6,922.04
				PV 30 Years 1% DR
Coastal Blue Carbon PV Annual Sequestration (Low Social Cost of Carbon)				$109.63
Coastal Blue Carbon PV Annual Sequestration (High Social Cost of Carbon)				$321.06

Table 3 New Jersey

Ocean Sector	Establishments	Employment	Wages ($M)	GDP ($M)
Marine Construction	133	2,847	$270.49	$546.53
Living Resources	289	2,444	$116.31	$282.76
Offshore Mineral Extraction	67	633	$46.20	$106.90
Ship and Boat Building	NA	NA	-$0.01	-$0.01
Tourism and Recreation	7,949	96,260	$2,201.62	$4,299.31
Marine Transportation	776	58,238	$3,476.73	$5,762.24
ENOW Ocean Sectors	9,242	162,016	$6,192.10	$11,166.54
Marine Research and Education	8	815	$26.52	$35.70
State Government*	7	2,539	$166.97	$258.09
Tourism & Recreation Revised for Trip Purpose	4,737	94,516	$399.19	$785.74
Electric Power Generation	107	6,023	$835.30	$8,046.06
ENOW +	4,859	103,892	$1,427.98	$9,125.60
TOTAL REVISED OCEAN ECONOMY	6,152	169,648	$5,418.46	$15,992.83
Tourism & Recreation Peak	7,897	144,904	$637.93	$1,249.97
				PV 30 Years 1% DR
Coastal Blue Carbon PV Annual Sequestration (Low Social Cost of Carbon)				$413.52
Coastal Blue Carbon PV Annual Sequestration (High Social Cost of Carbon)				$1,211.03

* Establishments for State Government are counted as agencies included
NA=Not available for confidentiality reasons

Table 4 Delaware

Ocean Sector	Establishments	Employment	Wages ($M)	GDP ($M)
Marine Construction	23	90	$6.53	$13.44
Living Resources	34	220	$9.90	$19.96
Offshore Mineral Extraction	9	67	$3.74	$6.05
Ship and Boat Building	NA	NA	-$0.01	-$0.01
Tourism and Recreation	1,383	22,881	$441.71	$914.33
Marine Transportation	105	5,842	$274.18	$373.89
ENOW Ocean Sectors	1,556	29,126	$737.46	$1,330.30
Marine Research and Education	7	160	$5.22	$7.03
State Government*	5	170	$9.19	$17.48
Tourism & Recreation Revised for Trip Purpose	957	21,307	$90.29	$188.26
Electric Power Generation	21	1,446	$179.12	$997.29
ENOW +	990	23,084	$283.81	$1,210.07
TOTAL REVISED OCEAN ECONOMY	1,163	29,329	$579.56	$1,626.04
Tourism & Recreation Peak	1,429	31,797	$134.74	$280.95
				PV 30 Years 1% DR
Coastal Blue Carbon PV Annual Sequestration (Low Social Cost of Carbon)				$91.47
Coastal Blue Carbon PV Annual Sequestration (High Social Cost of Carbon)				$267.88

* Establishments for State Government are counted as agencies included
NA=Not available for confidentiality reasons

Table 5 Maryland

Ocean Sector	Establishments	Employment	Wages ($M)	GDP ($M)
Marine Construction	108	1,625	$115.83	$198.42
Living Resources	213	2,052	$95.01	$244.10
Offshore Mineral Extraction	47	395	$26.21	$101.62
Ship and Boat Building	NA	NA	$26.97	$83.48
Tourism and Recreation	4,048	70,242	$1,586.95	$3,637.17
Marine Transportation	363	33,408	$2,588.92	$4,605.77
ENOW Ocean Sectors	4,810	108,216	$4,439.89	$8,870.55
Marine Research and Education	6	2,470	$80.38	$108.22
State Government*	6	771	$45.68	$71.24
Tourism & Recreation Revised for Trip Purpose	2,564	57,318	$285.87	$661.96
Electric Power Generation	59	3,937	$511.83	$3,352.81
ENOW +	2,635	64,496	$923.76	$4,194.23
TOTAL REVISED OCEAN ECONOMY	3,397	102,470	$3,776.70	$9,427.62
Tourism & Recreation Peak	4,058	87,824	$447.09	$1,030.21
				PV 30 Years 1% DR
Coastal Blue Carbon PV Annual Sequestration (Low Social Cost of Carbon)				$168.84
Coastal Blue Carbon PV Annual Sequestration (High Social Cost of Carbon)				$494.46

* Establishments for State Government are counted as agencies included
NA=Not available for confidentiality reasons

Table 6 Virginia

Ocean Sector	Establishments	Employment	Wages ($M)	GDP ($M)
Marine Construction	145	1,969	$139.88	$247.08
Living Resources	249	2,714	$117.80	$665.70
Offshore Mineral Extraction	53	300	$19.94	$53.54
Ship and Boat Building	NA	NA	$2,861.22	$3,940.02
Tourism and Recreation	3,270	65,072	$1,167.77	$2,368.33
Marine Transportation	344	22,843	$1,485.55	$2,520.02
ENOW Ocean Sectors	4,128	131,514	$5,792.17	$9,794.69
Marine Research and Education	9	3,057	$99.50	$133.96
State Government*	8	454	$21.78	$36.54
Tourism & Recreation Revised for Trip Purpose	2,202	49,187	$199.11	$404.43
Electric Power Generation	26	1,192	$141.17	$1,109.70
ENOW +	2,219	52,698	$320.39	$1,684.64
TOTAL REVISED OCEAN ECONOMY	3,077	119,140	$4,944.79	$9,111.00
Tourism & Recreation Peak	3,322	74,331	$300.82	$610.69
				PV 30 Years 1% DR
Coastal Blue Carbon PV Annual Sequestration (Low Social Cost of Carbon)				$415.45
Coastal Blue Carbon PV Annual Sequestration (High Social Cost of Carbon)				$1,216.66

* Establishments for State Government are counted as agencies included
NA=Not available for confidentiality reasons


NORD SUMMIT
SINGAPORE

4. SECTORAL DETAIL

STATE GOVERNMENT

Across the MARCO region, 31 state government agencies were contacted to get relevant budget information. This was similar to the process used in the Marine Economy Satellite Account. The definition of ocean related economic activity for these accounts covers marine-related law enforcement; the provision of parks and other recreation services and facilities; and resource management, which covers functions such as fisheries and coastal zone management. State governments are all organized very differently to provide these services. Some are provided in large agencies such as a department of natural resources and others are provided by stand-alone agencies.

The detailed data necessary for precise estimates of ocean/coastal expenditures is contained in only detailed documentation which is not generally published. (Table 7).

It should be noted that the data in this report is incomplete with respect to all of the states and agencies because of difficulties acquiring historical data. The discussion here should be considered only as illustrative of the size of the state government sector and of the process for including it in ocean economy accounts for each state.

Determining the coastal share of expenditures for these purposes can be difficult because budget and other financial documents are written for purposes of financial control, not economic accounts. For this reason, in this study the share of ocean and coastal related expenditures in agencies not solely ocean/coastal related is approximated using three measures. For general purposes agencies such as a department of natural resources, the share of the total budget was calculated as a function of the share of population in coastal counties. For parks and recreation agencies, the coastal/ocean share was either the share of attendance at coastal parks (if available) or the share of total parks facilities in coastal areas if attendance data was not available. For state conserved lands, the share was calculated as the share of the state's area (combined land and water) in coastal counties.

Table 7 Budget/Expenditure for Ocean Related Activities by State ($ Millions)

	NY	NJ	DE	MD	VA
Law Enforcement	$30.58		$1.21	$11.51	$3.84
Parks & Recreation	$129.16		$23.78	$12.37	$4.10
Resource Management	$97.16	$258.09	$6.90	$47.36	$28.61
Total State Government	$256.89	$258.09	$31.89	$71.24	$36.54

To connect the budgetary data on the relevant agencies with the ENOW data series, the budgeted expenditure data is considered as contribution to GDP. Data for wages and employment were computed by calculating the ratio of wages/dollar of output in state and local government and employment/dollar of output in state and local government, both from Bureau of Economic Analysis data. State and local government together must be used since that is the level at which GDP data is published. Using those ratios, the employment and wages can be estimated.

The concept of "establishments" is somewhat difficult because state government services are often provided from some combination of regional and central offices in the capital. For reporting purposes here, the number of agencies from which budget data was requested are used. These agencies are listed in Appendix A. The ENOW-adjusted data for state governments are shown in Table 8.

Table 8 ENOW Data Estimates for State Government

	Agencies	Employment	Wages $ Millions	Output $ Millions
Delaware	5	309	$16.75	$31.89
Maryland	6	771	$45.68	$71.24
New Jersey	7	2,539	$166.97	$258.09
New York	5	2,226	$152.29	$256.89
Virginia	8	454	$21.78	$36.54
REGION	31	6,360	$397.64	$654.66

An important reason for assembling ocean accounts is to be able to compare economic circumstances across geographies and time. As an example of the former, a question might be raised as to the comparative expenditures in Mid-Atlantic states on management and use of coastal and ocean resources. Using total levels of expenditures or derived employment data provides one perspective, but New York will always substantially exceed Delaware. An alternate approach would be to normalize the budget data by a common variable. This is done in Table 9, where the budgeted amounts from Table 7 are recalculated on a per mile of shoreline (ocean shores only) to derive an estimate of state government output per mile of shoreline. On this basis New Jersey leads the MARCO region, followed by New York.

Table 9 Estimated State Government Output per Linear Mile of Shoreline by State

	Output $ Millions)	Shoreline Miles	Output per Mile $ Millions
Delaware	$31.89	381	$0.084
Maryland	$71.24	3,190	$0.022
New Jersey	$258.09	1,792	$0.144
New York	$256.89	1,925	$0.133
Virginia	$36.54	3,315	$0.011
REGION	$654.66	10,603	$0.062

MARINE RESEARCH & EDUCATION

For these estimates, budget information was sought from the major institutions involved in marine research and education in each state as well as any other institutions that listed marine specializations. Information was requested from 41 institutions and received from 25. The information requested was for total expenditures in 2018 (if available) or budgeted (if expenditure data is not available). Sea Grant programs were separately contacted, and the Sea Grant expenditures obtained. The information requested was for Federal Sea Grant funds plus local match.

Estimates of employment and compensation paid were derived by using the relationship between output, compensation and employment for the national Marine Research and Education sector in the 2021 version of the Marine Economy Satellite Account.

	Academic		Nongovernmental Organizations			Total	
	Establishments	GDP (&M)	Establishments	GDP (&M)	Sea Grant	Establishments	GDP (&M)
NY	6	$12.85	1	$19.10	N/A	7	$31.95
NJ	7	$31.52	1	$1.82	$2.36	8	$35.70
DE	4	$1.96	3	$2.97	$2.10	7	$7.03
MD	4	$51.02	2	$52.18	$5.02	6	$108.22
VA	6	$53.03	3	$4.43	$76.50	9	$133.96
Total	27	$150.38	10	$80.51	$85.98	37	$316.87

ELECTRIC GENERATION

The Mid-Atlantic is widely expected to be a major center of development for offshore wind generation, though the industry is still in the development and permitting stages. Including the electric generation industry in the extended ocean account at this point sets a baseline against the future evolution of this industry may be measured and changes noted. At the same time, coastal locations for electric power generation facilities are quite common for access to cooling water and for ports for delivery of fuels.

For this purpose, "coastal electric generation" is defined as electric power plants that lie within 5 km (3 miles) of the shoreline for the Mid-Atlantic. These are shown in Figure 2. The data comes from the Energy Information Administration and includes the physical location of each facility (latitude and longitude), the number of generators at each location, the nameplate capacity (the theoretical maximum megawatts that can be generated in an hour), and the capacity factor (the actual output of electricity after reductions for thermal losses, etc.).

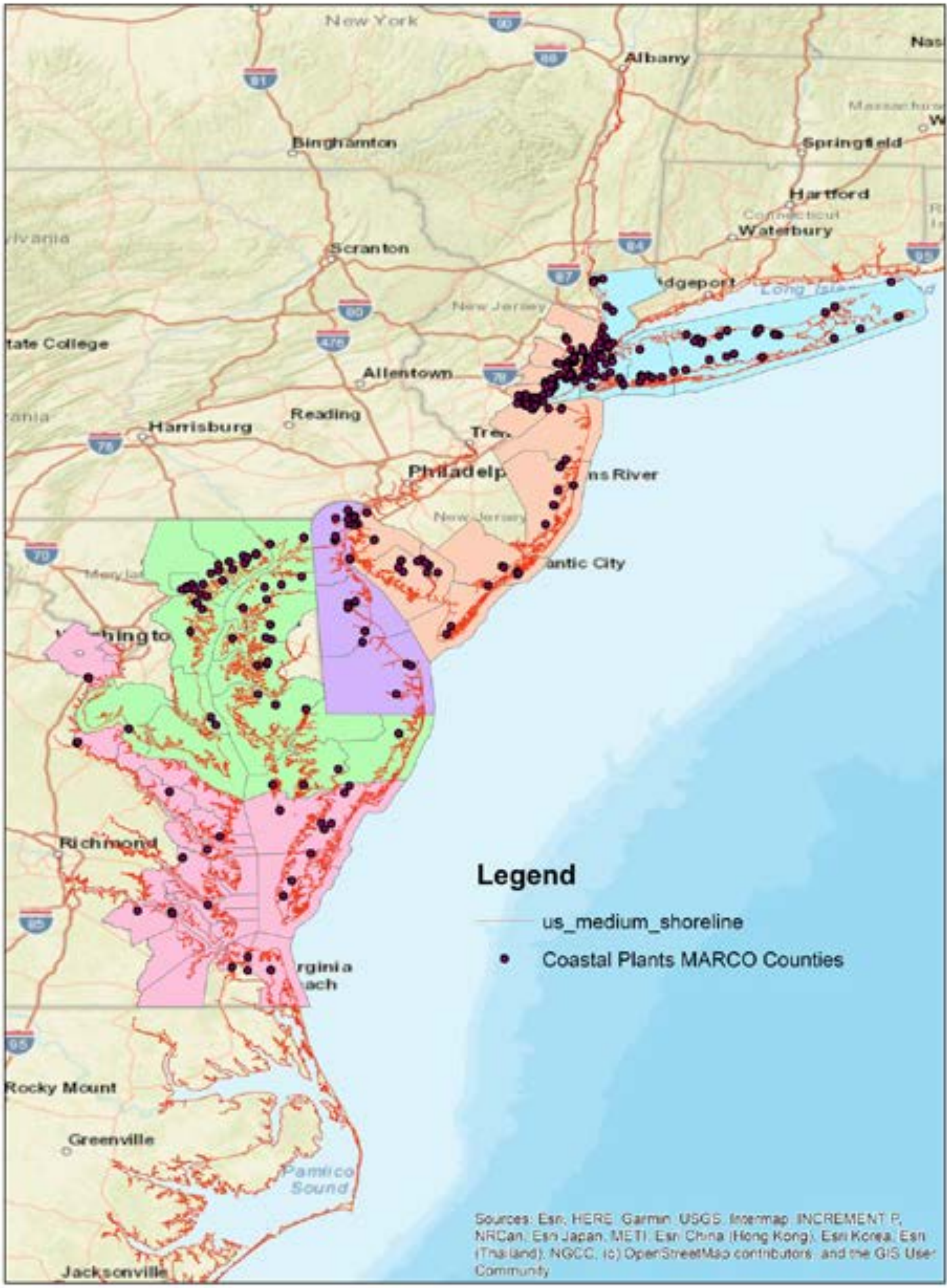
Table 10 shows the total number of electric generation plants in each state, the number that meet the coastal location criterion (and percent of the total, along with the capacity in megawatts of all plants and of coastal location plants. Capacity in this calculation is the adjusted capacity, that is nameplate multiplied by capacity factor. Table 10 shows that the largest plants (by generator capacity) are on the coast in Delaware and New Jersey. Virginia, however, has most of its generation away from the coast.

Table 10 Coastal Electric Generation Summary

	Total Plants	Coastal Plants	Percent Coastal	Total Capacity (MW)	Coastal Capacity (MW)	Percent Coastal
Delaware	30	21	70.0%	3,593.3	3,476.5	96.7%
Maryland	121	59	48.8%	16,337.0	7,329.6	44.9%
New Jersey	184	107	58.2%	19,203.2	15,432.8	80.4%
New York	434	115	26.5%	44,236.9	16,520.6	37.3%
Virginia	249	26	10.4%	31,626.3	4,510.1	14.3%

Table 11 shows the ENOW data for the electric utilities industry. The establishments data is taken from the EIA data shown in Table 10. Employment and wages are derived by applying the percent of statewide generating capacity in the coastal areas to the statewide data for NAICS 2211, the electric generating industry from the Quarterly Census of Employment and Wages from the Bureau of Labor Statistics. The disaggregation of the statewide figures avoids suppressions of data at the county level. The GDP data is calculated in the same way using the statewide GDP data for the utilities sector from the Bureau of Economic Analysis. It should be noted that the BEA estimation of GDP for utilities is primarily composed of the electric generation industry but contains other industries such as water and sewer utilities. The result is an overestimation of the GDP figures for this industry which requires more detailed data on GDP in this sector not yet published by BEA.

Figure 2 Coastal Electric Generating Plants



The ocean accounts data for the electric power generation industry in each state is estimated using a method similar to that used for state government, calculating employment and wage per dollar of GDP, and then using these ratios to estimate wages and employment. The establishments were the count of plants meeting the geographic criterion described above from the EIA data.

Table 11 Economic Contributions of Electric Power Generation

	Establishments	Employment	Wages ($M)	GDP ($M)
Delaware	21	1,446	$179.12	$997.29
Maryland	59	3,937	$511.83	$3,352.81
New Jersey	107	6,023	$835.30	$8,046.06
New York	115	11,924	$1,514.96	$8,902.74
Virginia	26	1,192	$141.17	$1,109.70

TOURISM AND RECREATION

In all the Mid-Atlantic states, the ocean related tourism and recreation sector (Table 12)is the largest of the ocean economy sectors in employment and establishments as defined in the ENOW data series. In New York, Delaware, and Maryland, tourism & recreation is also the largest in wages and gross domestic product. The size of the tourism and recreation sector is driven primarily by hotels and lodging places along with eating and drinking places, both of which are characterized by large numbers of small, labor-intensive establishments. Unlike sectors such as marine transportation, where the ocean connection is inherent in the definition of the industries, tourism and recreation industries connections to the ocean are in part a function of where the activity takes place and who is undertaking the activity.

Table 12 Ocean Tourism & Recreation Sector Industries

Amusement and Recreation Services
Boat Dealers
Eating and Drinking Places
Hotels and Lodging Places
Marinas
RV Parks and Campgrounds
Scenic Water Tours
Sporting Goods Manufacturing
Zoos and Aquaria

The base ENOW data identifies tourism & recreation economic activity by location, including those establishments in the selected industries (Table 12) that had a physical location in a zip code bordered by the ocean shoreline. This permits a much tighter geographic focus than is possible with the county-level data that is the smallest geographic unit for most economic data. Zip codes are, of course, an administrative unit defined for purposes of the Postal Service. Because they are attached to every record used to create the ENOW tourism and recreation data they are a convenient if imperfect measure of ocean related tourism and recreation activities. There are two important ways in which the use of zip code geographies distorts the measurement of ocean-related tourism and recreation.

- The ENOW data series reports only annual average levels of data for employment and establishments and total annual data for wages and GDP. This runs the risk of significantly undercounting the activity during peak seasons, which for the Mid-Atlantic states is roughly June to August. Ignoring these important aspects of ocean-related tourism and recreation can lead to misunderstanding the role of this industry in relationship to the economy and to the resources on which it is based.
- Many trips involving lodging or restaurants are for purposes other than for recreation and use of coastal resources. This is particularly true in cities such as New York, where business-related travel obviously comprises a major part of the consumption of lodging and restaurant services. Information on the purpose of trips allows a tighter focus on direct users of coastal resources.

These aspects of tourism and recreation means that no single economic measure is likely to capture the multiple dimensions of tourism and recreation, so multiple measures are needed to reflect multiple dimensions. This study provides three measures; each is the “right” measure from one context but not necessarily in all.

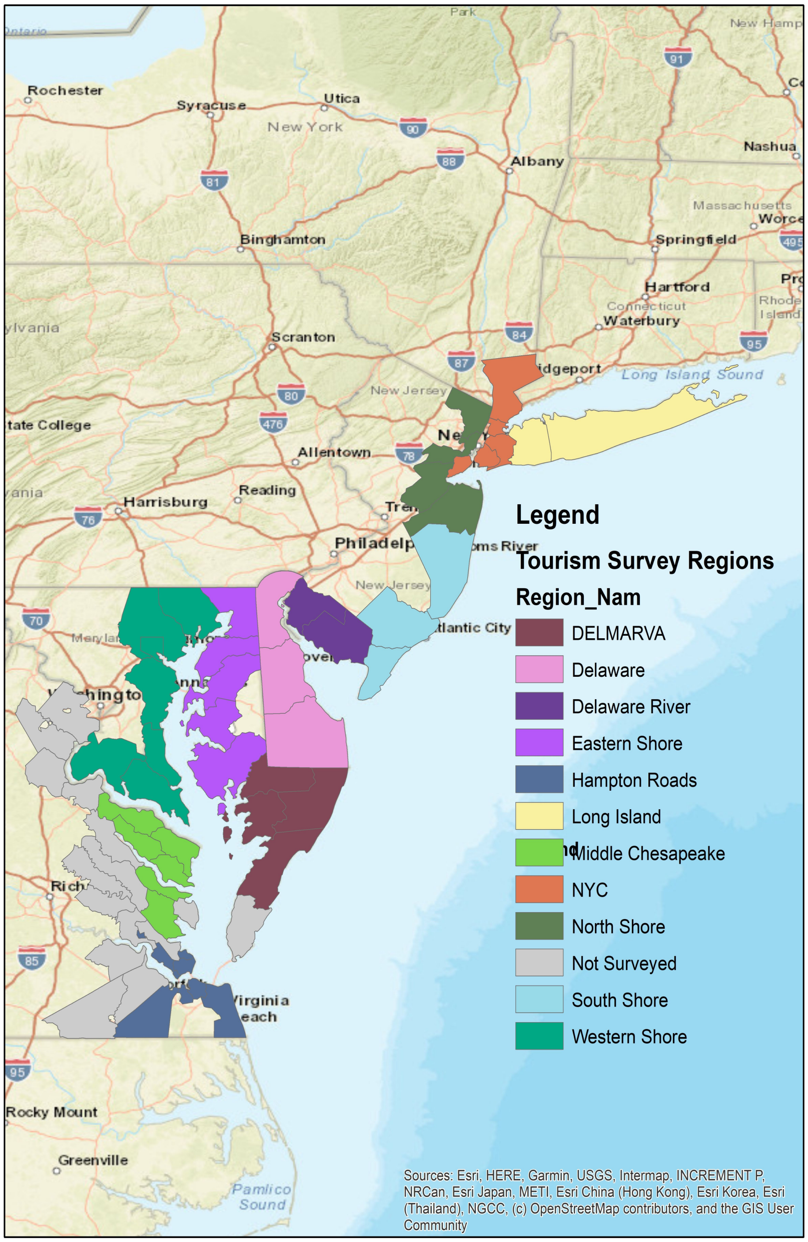
- **Baseline ENOW measure.** This measure has advantages as well as disadvantages. The tourism and recreation sector takes up a great deal of space in small amounts of coastal areas, so its total size is of interest. Space is needed for infrastructure, parking, commuting for employees, etc. Too narrow a focus would miss these potential implications. The annual average measurement is also very important for comparison with many other economic statistics that measure long term trends.
- **Peak tourism and recreation.** Coastal Tourism and Recreation throughout the Mid-Atlantic region is primarily a seasonal activity, with peak activity taking place in June, July, and August, with some higher activity in September. The winter months see relatively low levels of activity. This pattern is not consistent through the whole region as the larger cities are year-round centers of activity. The much higher economic activity in parts of the region’s ocean economy should be reflected in the data on the ocean economy.

To show the peak tourism & recreation economy in each county, the county-level data from the base ENOW estimates for 2018 are shown followed by the estimates of peak economic activity, and then the adjusted results focusing on leisure travel. The estimates of peak employment and establishments are a multiple of the base estimate to reflect the higher activity in ocean-related tourism and recreation in the summer. The peak wages and GDP are shares of the annual wages paid and GDP attributable to the summer peak. The third quarter share of wages is used to calculate the peak share of GDP as quarterly estimates of GDP are not available.

- **Recreation focused travel.** The connection to ocean and coastal resources in this sector is primarily through recreation-related uses, so it is important to separate travel to the coast for those purposes from other travel purposes and to separate travelers from area residents uses of the coast. These adjustments require information on trip purpose and on the number of visitors to a coastal region compared with residents. To focus on recreation related users requires data from surveys.

Understanding the purpose that people have for travel is an important piece of information for organizations in the travel and tourism industry, including state tourism promotion agencies. The information is collected by a number of private sector firms through large scale national surveys. For this study, data was obtained from 8,361 surveys conducted by DK Shifflet & Associates for nine regions within the Mid-Atlantic states, covering forty-six counties. Not all counties for which tourism & recreation data is available were included in the surveys; these counties used the values from the nearest region. (Figure 3). These counties are noted as "non-survey" counties in Figure 3.

Figure 3 Regions for Trip Purpose Analysis of Tourism & Recreation



These surveys inquired of visitors to the region whether their trip was for business or leisure purposes, and if for leisure purposes whether the trip was for purposes of visiting friends and relatives or for other leisure purposes. It is this latter category that most closely measures trips for outdoor recreation visits that are related to coastal and ocean resources. Region-wide, 18.8% of trips were for business purposes, 24.8% were to visit friends & relatives, and 56.4% were for other recreation purposes. The distribution of these purposes across the nine regions are shown in Table 13.

Table 13 Trip Purposes from DK Shifflet Surveys Mid-Atlantic Survey Areas

	Business	Visiting Friends & Relatives	Recreation Related
Delaware	14.0%	19.0%	62.3%
DELMARVA	6.5%	7.4%	86.1%
West Shore - MD	15.0%	30.9%	54.1%
North Shore NJ	16.9%	34.8%	48.2%
South Shore - NJ	5.9%	13.9%	80.2%
NYC - NY	19.1%	26.5%	54.4%
Long Island - NY	14.5%	20.9%	64.5%
Hampton Roads - VA	14.5%	20.9%	64.5%
Middle Chesapeake - VA	15.3%	10.7%	73.9%

The DELMARVA counties and south New Jersey have the highest portion of recreational visitors at over 80%. There are other parts of the region that most likely have high levels of recreational visitors, but the Shifflet sample did not have enough detail to measure these counties, which included Suffolk County, New York, and Sussex County, Delaware. The proportions shown in column 4 of Table 13 were used as adjustment factors for the peak economy measures discussed above. In the case of establishments and employment, the recreation share of trips was used directly. In the case of wages and GDP, the adjustment factor was the value from Table 13 less 25% of the annual wages and GDP. Twenty five percent of the annual total would be the Q3 share if there were no seasonal peaks in the data.

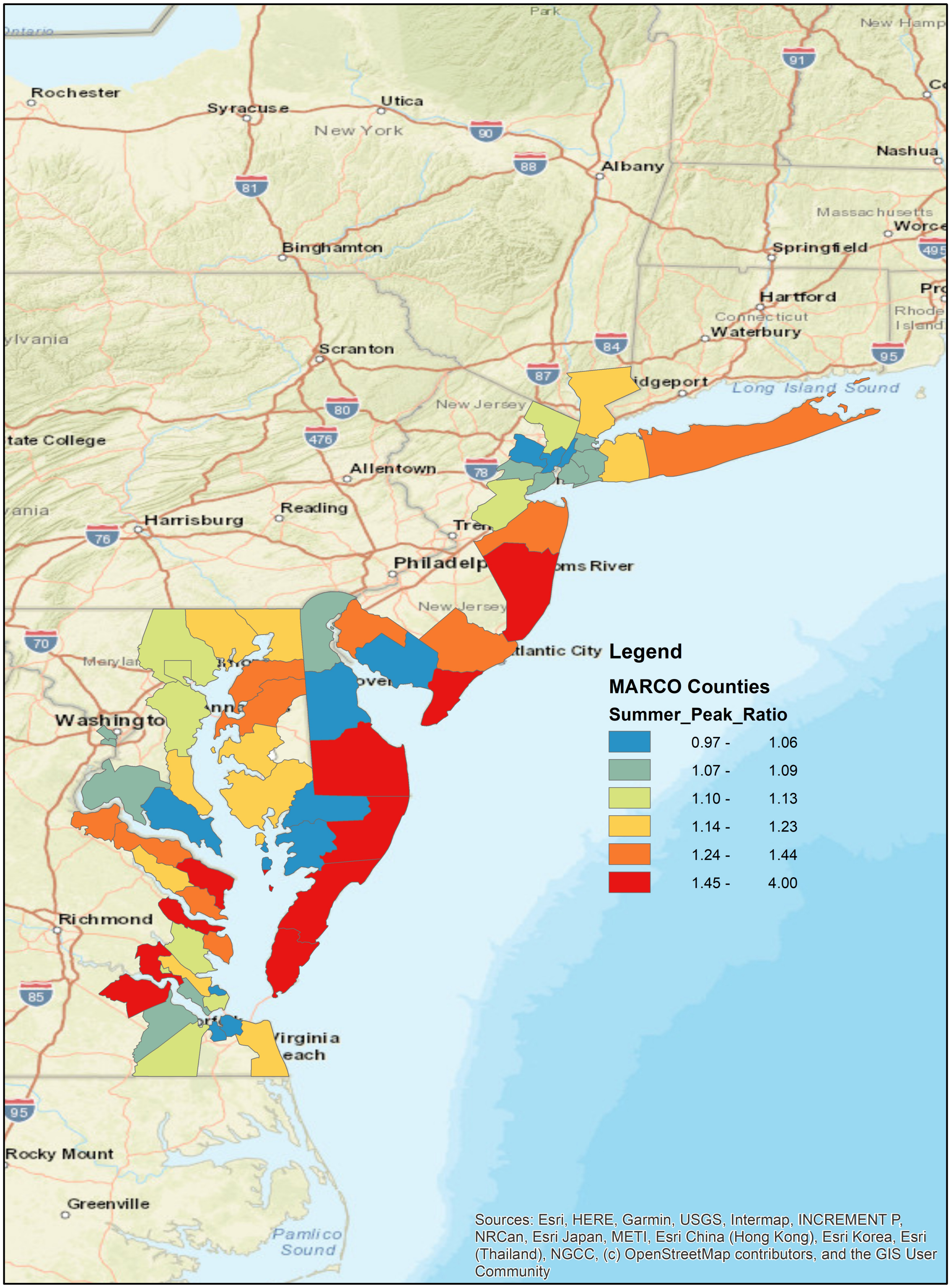
The combination of annual average, peak, and trip-adjusted purpose economic measures for tourism & recreation in the Mid-Atlantic states are shown in Table 14. These are state summaries of county-level data and calculations. The individual county level data is provided in Appendix 2

Table 14 Alternative Perspectives on the Ocean Tourism & Recreation Economy

	Base ENOW Estimates (2018)			
	Establishments	Employment	Wages (Millions)	GDP (Millions)
Delaware	1,383	22,882	$441.71	$914.33
Maryland	4,048	70,243	$1,586.95	$3,637.17
New Jersey	7,742	93,657	$2,156.04	$4,212.25
New York	20,681	334,042	$12,156.62	$28,059.72
Virginia	3,291	63,152	$1,125.27	$2,283.14
	Peak Estimates			
Delaware	1,883	31,797	$24.31	$52.37
Maryland	5,095	87,824	$51.86	$124.05
New Jersey	12,335	144,904	$102.48	$203.84
New York	22,522	357,591	$62.94	$127.95
Virginia	3,886	73,907	$17.88	$36.69
	Leisure Travel Adjusted Estimates			
Delaware	407	6,957	$137.39	$295.63
Maryland	8,947	115,136	$2,727.16	$5,632.17
New Jersey	21,174	339,810	$12,273.03	$28,293.88
New York	384	5,889	$114.42	$239.25
Virginia	2,727	60,425	$94,097.71	$3,993.03

The ratio of the summer peak to the winter off peak (Q3 to Q1) employment for each of the counties is shown in Figure 4. This figure uses the "Leisure & Hospitality" sector rather than the ENOW ocean economy data to measure quarterly levels of employment, which are not available in the ENOW data. The ratios shown in Figure 4 are used to adjust the ENOW tourism and recreation data. Cape May County, New Jersey, stands out as having the largest difference between summer and winter employment; the ratio is 3.73 to 1. Other shoreline counties along the Atlantic in New Jersey, Delaware, and Virginia have ratios showing summer employment between 45% and 120% higher than winter. On the other hand there is little summer peak in Kent County, Maryland and middle Chesapeake counties in both Maryland and Virginia.

Figure 4 Ratio of Summer Peak to Off Peak Leisure & Hospitality Sector Employment




CYCLONE

5. BLUE CARBON

The contributions of oceans and coasts to the national economy, as measured along the various dimensions of the ENOW data set are an important part, but only a part of the economic value of marine and coastal resources. There is a great deal of economic value in ecological resources that is not captured in the transactions that are the essential ingredient in the standard government economic data. These values, known as ecosystem service or natural capital values, are increasingly being incorporated into accounts of ocean values, though these efforts are lagging somewhat in the U.S.

One ecosystem service that is the focus of a great deal of research is “blue carbon”, which is a general term for the carbon stored in aquatic vegetation. Blue carbon is analogous to “green carbon”, the storage of carbon in terrestrial vegetation, primarily forests. Blue carbon values differ from those measured in ENOW in three important ways:

1. Blue carbon can be measured as either a stock or a flow, while ENOW measures are for flows only.
2. The value of blue carbon is the value of costs of climate change avoided, and there is no single way to measure this value.
3. ENOW data shows current period economic activity for the year of reporting, while blue carbon values are determined by events that may, or may not, happen in the future. This means that the value today is determined as the present value of a set of future values reflecting potential avoided climate change effects.

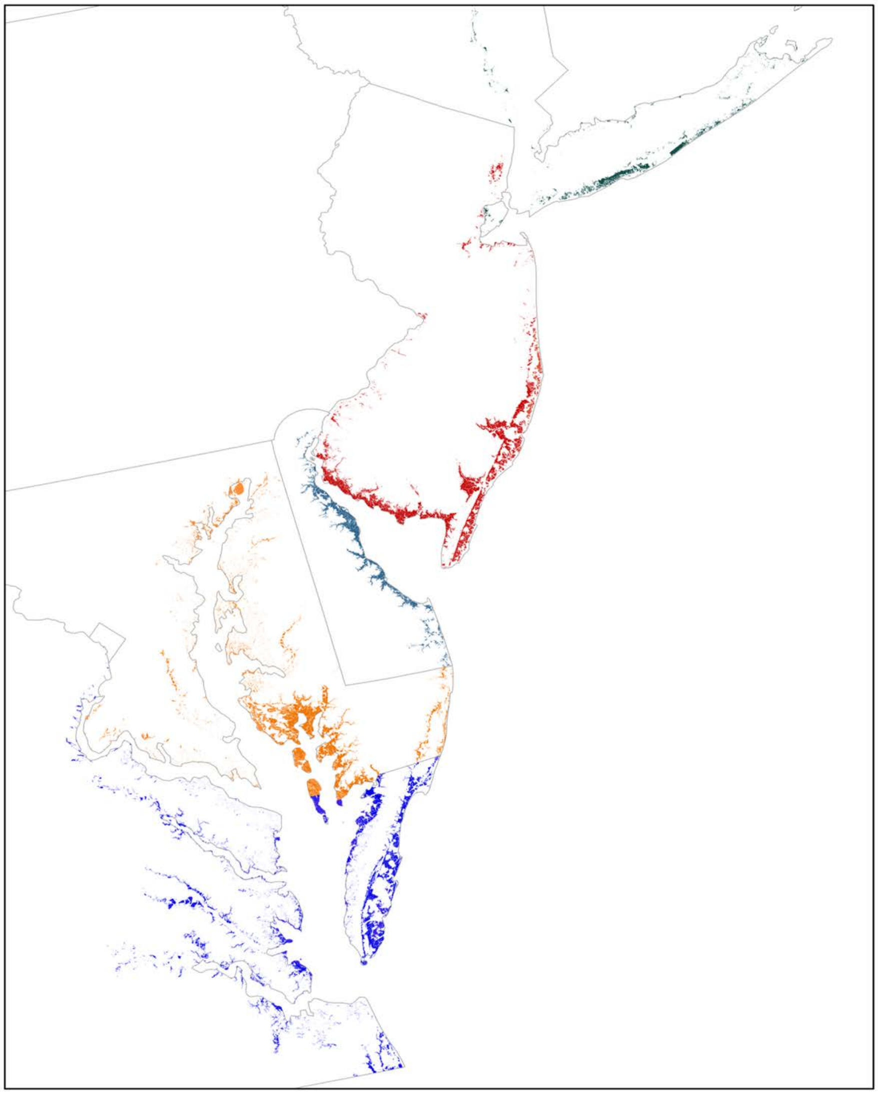
To understand the distinction between stocks and flows, the fishing industry provides a useful analog. The ENOW accounts report the annual volume of industry output (the amount of fish caught times the price of the fish sold) and the associated labor input (employees and wages) as well as the number of places of employment. It does not count the value of the fishing vessels (except when they are new and are thus the output of boat building), nor the value of the equipment on the boat. The vessels and equipment are described as capital from which values of fish caught flow.

Blue carbon is a form of natural capital. It produces services of value over time. The value of annual services can be measured as can the value of the aquatic vegetation which provides those services. Here the analogy with fishing becomes more complicated. The nature of the services provided are not obvious and so must be defined and the amounts per period determined, which will then lead to the issue of how to value the services.

The service provided by wetlands, or more accurately, marine aquatic vegetation, is to reduce the potential damages to the economy resulting from climate change. Aquatic vegetation removes carbon from the atmosphere and converts it to biomass, which builds up over time. The carbon removed from the atmosphere is not available to contribute to climate change and its associated possible damages. This type of value is called an avoided cost. It is a difficult concept to measure because everyone can understand the value of a fish or a beach vacation, blue carbon’s value depends on something that does not happen.

The starting point for estimating values is determining the amount of carbon stored in marine aquatic vegetation. This is a very complex issue as the amount of carbon is determined by the type of vegetation, the area, depth, and salinity of the waters in which the vegetation is located. Precise estimates of carbon require actually sampling the soils at specific locations and testing the chemistry of the sample to determine precise amounts. The amount of carbon in larger areas of vegetation must be extrapolated from these samples, which are collected as part of specific studies rather than as part of large-scale systematic sampling. There are, as yet no definitive or official estimates of the amount of carbon stored in the U.S.

Figure 5 Blue Carbon Stocks in Mid-Atlantic States in 2010



It is important in creating regional scale estimates of blue carbon values to use estimates of carbon that are consistently made. For this report, a study of blue carbon in the Mid-Atlantic region by the Nicholas Institute of Duke University which examined the blue carbon potential of coastal wetlands in the five MARCO states plus North Carolina. (Warnell, 2019a, 2019b). Figure 6 shows the wetlands areas in the five MARCO states that the Nicholas Institute for which blue carbon values are estimated.[4]

While there is blue carbon estimated throughout the coastal regions of the Mid-Atlantic, the primary locations for blue carbon are to be found in the southern part of the New Jersey shore, the lower Delaware River, the DELMARVA Peninsula, extending into the southern Eastern Shore of Maryland and the lower Chesapeake Bay and estuaries in Virginia. The stock of blue carbon in metric tons estimated by the Nicholas Institute is shown in Table 15.

4 The Nicholas Institute study did not include wetlands in the Lake Ontario region of New York state

Table 15 Carbon Stock Estimates in Mid-Atlantic

State	Metric Tons of Stored Carbon
NY	10.80
NJ	60.00
DE	22.80
MD	63.50
VA	64.00
TOTAL	221.10

Table 15 shows the amount of carbon that would, if the aquatic vegetation were eliminated, be added to the atmosphere, furthering climate change and related damages. The value of this stored carbon can be considered as the value of the economic damages from climate change avoided by keeping the carbon stored in the aquatic vegetation. That is a straightforward idea, but its practical application is highly complex, and in some ways controversial.

There are two basic approaches to calculating the value of avoided climate costs. Economic theory says that the value should be equal to what people are willing to pay to avoid the possible costs. In a world in which people had perfect information about what those costs will be, it would be relatively easy to indicate what that amount would be particularly if there was a transaction which required that amount to be paid. This is done in carbon offset markets, though without perfect information. Carbon markets are an integral part of cap-and-trade systems which limit total emissions but allow emitters the choice of how to reduce emissions. One of those choices is to buy an "offset", a commitment to reducing or preventing other emissions. A commitment to purchase and conserve coastal wetlands so that they cannot be developed is an example of an offset.

Another approach to valuing the avoided costs from a carbon release is to try to address the condition noted above that the price paid in an offset should be based on complete information about future damages. Obviously, such information is not available to anyone. In particular, no one knows how much the climate will actually change. Will efforts such as the Paris Accord and other attempts to limit emissions and climate change be successful? If not, how far short will they fall? Despite the vast array of unknowns, it is possible to construct approximations of what the avoided costs might be. The result is an estimate called the social cost of carbon.

One element common to all avoided cost-based estimates is the issue of what to do about the fact that most of the values of maintaining carbon stored in marine aquatic vegetation will be realized in the future, often decades from now. The standard method for equating values received (or lost) in the future with those received in the present is the discount rate, which is simply an interest rate that equates present and future values. The choice of a discount rate is a matter of judgment and depends on numerous factors. In general, a higher discount rate emphasizes the present, while a lower discount rate emphasizes the future. Since there is no single right answer, it is best to consider a range of discount rates for analysis and then decide which interpretation is most appropriate.

The final element in the calculation of values is the problem of how to measure the extent and rate of carbon that might be lost from the stored stocks of carbon in marine aquatic vegetation. This necessarily requires an arbitrary assumption. For this study a rapid decline in the amount of stored carbon in each state is assumed taking place over a 20-year period. (Gordon et al., 2011) This is unrealistic in one sense; it is highly unlikely that all of the wetlands would be lost in so short a period of time or in the immediate future. The purpose of this assumption is to emphasize the importance of taking action to preserve the stored carbon in the near future so as to avoid additional climate change costs in the more distant future.

The results of the assumptions spelled out above are shown in Table 15. The calculations in this table use a 3% discount rate, which is approximately equal to a standard federal discount rate. Three values of the per metric ton price of carbon kept in storage are used. The first is a carbon offset market price being used in the states of the Regional Greenhouse Gas Initiative (RGGI), a regional compact of states in the northeast including the MARCO states. This is approximately the price someone would currently pay for a blue carbon offset credit. The second is the current U.S. government social cost of carbon (SCC) of $51.91. This is the amount designated for use by U.S. agencies by the Biden Administration. The third is the "high impact" social cost of carbon, a variation on the baseline social cost that considers the possibility of very high damage but very low probability climate scenarios.

Table 16 Present Value of Blue Carbon in Mid-Atlantic Measured as Present Values at 3% DR

Discount Rate	3.0%	Source of Avoided Cost Estimates		
	MT Carbon currently stored	RGGI	SCC	SCC High Impact
Price/MT		$6.07	$51.91	$152.02
NY	10.80	$43.27	$370.23	$1,084.23
NJ	60.0	$240.36	$2,056.82	$6,023.52
DE	22.8	$91.34	$781.59	$2,288.94
MD	63.5	$254.39	$2,176.80	$6,374.90
VA	64.0	$256.39	$2,193.94	$6,425.09
TOTAL	**221.10**	**$885.74**	**$7,579.37**	**$22,196.69**

All figures in millions

This analysis indicates that at the current official social cost of carbon, the stored blue carbon in the Mid-Atlantic states is worth about $7.6 billion. Maryland and Virginia have the highest values at about $2.2 billion, followed closely by New Jersey at just over $2.0 billion. The value at offset market prices in the RGGI market is considerably less, at only $900 million. This much lower price is a function of current market conditions for offsets. On the other hand, the "high impact" social cost of carbon indicates a blue carbon value of over $22 billion. This value may be considered the value keeping the carbon in storage if "worst case" climate scenarios were to come to pass.

These estimates are based on a 3% discount rate, which is considered by some as too high because it undervalues the future damages that might be incurred (or avoided). Table 16 recalculates the values from Table 10 using a 1% discount rate. The effect is to increase the values to over $1 billion even using the RGGI price. At the official social cost of carbon, the value increases to nearly $9 billion, and to over $26 billion at the "worst case" value for the social cost of carbon.

As noted, there is no obviously right choice for which discount rate or value of a metric ton of carbon not emitted is to be used. However, current trends in discussions indicate that the most appropriate values will lie at the higher end of the range shown and may even be higher than the "high impact" social cost of carbon. There are several reasons to expect this. First, the RGGI market price will increase over time towards the social cost of carbon estimates assuming aggressive steps to mitigate climate change are initiated. The low estimates in the table reflect current conditions that are unlikely to last. Second, the Biden Administration has initiated a review of the official social cost of carbon. The figure used is essentially the same as in the Obama Administration; this price was reinstated at the beginning of the Biden Administration pending a review of the social cost of carbon to be reported in January 2022. There is concern that the current methodology does not reflect human mortality costs; if these were included the social cost of carbon would rise to over $200 a ton. The likelihood is that the official social cost of carbon will rise next year.[5]

Table 17 Present Value of Blue Carbon in Mid-Atlantic Measured as Present Values at 1% DR

Discount Rate	1.0%	Source of Avoided Cost Estimates		
	MT Carbon	RGGI	SCC	SCC High Impact
Price/MT		$6.07	$51.91	$152.02
NY	10.80	$50.68	$433.69	$1,270.09
NJ	60.0	$281.57	$2,409.39	$7,056.08
DE	22.8	$107.00	$915.57	$2,681.31
MD	63.5	$297.99	$2,549.94	$7,467.68
VA	64.0	$300.34	$2,570.02	$7,526.48
TOTAL	**221.10**	**$1,037.58**	**$8,878.62**	**$26,001.64**

All figures in millions

The discussion so far has focused on the stock value of blue carbon in the Mid-Atlantic states. There remains the question of the values of the flows. The flows of blue carbon are the amounts sequestered every year by the living vegetation in the wetlands, which annually converts carbon dioxide into oxygen through plant respiration. The amount of carbon sequestered is actually in some ways the more important value of blue carbon because it represents future possible reductions in atmospheric carbon dioxide that would be essential to achieve net carbon neutrality goals. The amounts of carbon sequestered, like that stored, can be estimated by analyzing the ecological and chemical conditions of wetlands using the same methods described above used to estimate values.

But sequestration values present a different problem from storage values. If wetlands are left completely intact, then the sequestration values would be stable over time. Unfortunately, the same forces of climate change, particularly sea level rise, that blue carbon is fighting against are also working to undermine the future ability of wetlands to sequester carbon. The Nicholas Institute study examines the question of sequestration and concludes that several forces will determine future sequestration rates, the most important of which will be sea level rise. Sea level rise will have several effects. In the next several decades it will push marshes into

[5] It should be noted that a number of Republican Attorneys General have filed lawsuits asking that courts order a return to the Trump Administration social cost of carbon of $1.00 per metric ton. These suits are still under litigation at the time of this report.

upland space now occupied by dry land; inundated land will be exposed to saline water which will replace saline-intolerant species with saline-tolerant species. This process of marsh migration will increase the area of marshlands but may reduce sequestration rates depending on the terrestrial species replaced.

Over time however, sea level rise will overwhelm both the newly created and the older wetlands creating open water that no longer supports vegetation capable of sequestering carbon. This effect is somewhat offset in certain locations where sea level rise could reconnect wetlands that have been broken up by development or other causes; these reconnected wetlands would resupply saline water and restore marsh lands. Wetlands could also be restored as a result of direct policy interventions. Extensive investments in wetlands restoration have been made throughout the region. The Nicholas Institute analysis did not consider such restoration projects, however, as they are far too difficult to predict. Marsh restored by reconnection of wetlands, can be estimated from geographic analysis, and so is included.

The Nicholas Institute analysis assumes a sea level rise of 4 feet (122 cm) between their baseline year of 2010 and 2100, a rate of 1.36 centimeters per year. This is an average rate over the 90-year period. Sea level rise prediction models tend to show a slower rate of increase out to 2050 and a faster rate of increase thereafter, consistent with IPCC projections of climate change. The effects of such a rate of sea level rise would be to reduce the amount of carbon sequestration capacity in the Mid-Atlantic states by up to 87% by 2100. The results of this analysis are shown in Table 6-4 and Table 6-5.

Table 18 Value of Sequestered Carbon in Mid-Atlantic States- No Sea Level Rise

Discount Rate	1.0%	Value ($Millions)		
	MT Carbon Sequestered	RGGI	SCC	SCC High Impact
Price/MT		$6.07	$51.91	$152.02
NY	57,000	$18.64	$159.48	$467.04
NJ	215,000	$70.30	$601.54	$1,761.65
DE	47,000	$15.37	$131.50	$385.10
MD	140,000	$25.45	$217.75	$637.71
VA	216,000	$70.62	$604.34	$1,769.84
TOTAL	**675,000**	**$200.37**	**$1,714.61**	**$5,021.34**

All figures in millions

Table 17 shows the values of additional carbon removed (sequestered) from the atmosphere over the period from 2010 to 2090 by the coastal wetlands of the Mid-Atlantic region. The same values per metric ton of carbon used in the analysis of stored carbon are used in this analysis. Since the benefits of the sequestered carbon will primarily be realized as offsets over the remainder of this century a 1% discount rate is used. The assumption in Table 17 is that there is no sea level rise and thus no change in the annual amount of carbon sequestered over the period. The results show that at the current RGGI price the value of sequestered carbon is over $200 million, and over $1.7 billion at the current social cost of carbon. Using the "high impact" or "worst case" price per ton, the value of sequestered carbon is over $5 billion.

But Table 18 shows what happens when sea level rise of 4 feet is taken into account, with its combined effects of restoring some wetlands but drowning much more. The total reductions in sequestered carbon by 2100 vary slightly from state to state, so a single assumption of 80% reduction in sequestration is used. The reductions in annual carbon sequestration in 2100 compared with 2010 are shown, along with total value of these reductions at the various prices per metric ton. At the relatively low RGGI price, the reduction is over $60 million, while it is over $515 million at the current social cost of carbon, rising to a loss of over $1.5 billion under the "high impact" price.

Table 19 Reductions in Value of Sequestered Carbon - Assuming 4 feet of Sea Level Rise

Discount Rate	1.0%	Value ($Millions)		
	Reductions in MT Carbon Sequestered by 2100	RGGI	SCC	SCC High Impact
Price/MT		$6.07	$51.91	$152.02
NY	(45,600)	-$5.83	-$49.85	-$145.98
NJ	(172,000)	-$21.97	-$188.02	-$550.62
DE	(37,600)	-$4.68	-$40.03	-$117.22
MD	(112,000)	-$5.72	-$48.91	-$143.25
VA	(172,800)	-$22.07	-$188.89	-$553.18
TOTAL	**(540,000)**	**-$60.27**	**-$515.70**	**-$1,510.25**

All figures in millions

Table 19 shows the final sequestration values for the Mid-Atlantic states taking into account sea level rise. There is still substantial value in sequestered carbon, but most of this value will be from approximately the next 30 years before cumulative sea level rise begins to drain away the amount of carbon that can be removed by coastal wetlands.

Table 20 Value of Sequestered Carbon - Assuming 4 feet of Sea Level Rise

Discount Rate	Value ($Millions)		
1%	RGGI	SCC	SCC High Impact
Price/MT	$6.07	$51.91	$152.02
NY	$12.81	$109.63	$321.06
NJ	$48.33	$413.52	$1,211.03
DE	$10.69	$91.47	$267.88
MD	$19.73	$168.84	$494.46
VA	$48.55	$415.45	$1,216.66
TOTAL	**$140.11**	**$1,198.91**	**$3,511.09**

Table 20 brings the analysis carbon storage and sequestration together for the Mid-Atlantic region based on the Nicholas Institute estimations of the amount of carbon stored and sequestered and on the three different prices reflecting the value of avoided costs from climate-related damages. This table utilizes the Nicholas Institute assumptions regarding sea level rise and the extent of net degradation in wetlands area and carbon sequestration capacity.

Table 21 Estimated Blue Carbon Values for the Mid-Atlantic Region (Present Values)

Discount Rate	1.0%	RGGI	SCC	SCC High Impact
	Dollars/MT	$6.07	$51.91	$152.02
NY	Stored	$50.68	$433.69	$1,270.09
	Sequestered	$12.81	$109.63	$321.06
	Total	$63.49	$543.32	$1,591.16
NJ	Stored	$281.57	$2,409.39	$7,056.08
	Sequestered	$48.33	$413.52	$1,211.03
	Total	$329.89	$2,822.92	$8,267.10
DE	Stored	$107.00	$915.57	$2,681.31
	Sequestered	$10.69	$91.47	$267.88
	Total	$117.69	$1,007.04	$2,949.19
MD	Stored	$297.99	$2,549.94	$7,467.68
	Sequestered	$19.73	$168.84	$494.46
	Total	$317.72	$2,718.78	$7,962.14
VA	Stored	$300.34	$2,570.02	$7,526.48
	Sequestered	$48.55	$415.45	$1,216.66
	Total	$348.89	$2,985.47	$8,743.14
MARCO Region	Stored	$1,037.58	$8,878.62	$26,001.64
	Sequestered	$140.11	$1,198.91	$3,511.09
	Total	$1,177.68	$10,077.53	$29,512.73

Millions of Dollars

The results show that at the current market price for carbon offsets, the value of blue carbon is nearly $1.2 billion. This should be considered a very conservative figure since the offset price is almost certain to rise. Using the current U.S. government social cost of carbon as a measure of avoided cost, the value exceeds $10 billion. Again, this should be considered a conservative estimate because the current official cost of carbon is likely to rise when the current review is completed in 2022. At the "high impact" level of the social cost of carbon the value exceeds $29 billion.

These estimates should be considered with a great deal of care. The nature of calculations and computer models yields estimates that appear very precise, but this precision is illusory as there are many assumptions and unknowns that affect the results. This analysis does point out what is perhaps the most essential feature of blue carbon: it is highly valuable, but that value is perilous. To see why, consider the value of stored blue carbon as similar to a trust fund. It is a valuable trust fund, which will retain its value as long as there is no dramatic loss of the wetlands assets that create the value. But this value will not greatly affect the future as it is already factored into consideration of possible climate futures. The carbon is already out of the atmosphere.

What matters for the future is the value of the sequestered carbon- the additions to the stock of carbon kept out of the atmosphere. This value is also considerable viewed in present value terms through the remainder of the century. But the very forces that make it valuable- climate change and sea level rise- are also acting to diminish that value every year. The "income" from the trust fund is being spent faster than it can be replenished without interventions in wetlands ecosystems far in excess of historic patterns. The real value of blue carbon rests, therefore, only partly with what is done to conserve or restore wetlands but on the ability of people to keep climate change, including sea level rise, to a level low enough that there will still be enough wetlands to make a difference in sequestering carbon.

6. MAINTAINING THE DATA

The economic data collected in the ENOW data series and augmented by the modifications presented in this report has its greatest use when it is placed in either a comparative or a trend context. A comparative context is illustrated by the estimated state government output per shoreline mile. The inclusion of the electric generation industry anticipates measurement of key future trends in the Mid-Atlantic ocean economy. This report is thus most useful if the data contained in it are updated on a regular basis. Keeping the data updated is not difficult and will not require large resources. Each state's coastal program can keep the data updated with internal staff or small expenditures for external support. This section provides guidance on keeping the data updated.

BASE OCEAN ECONOMY

The basic ocean economy data is published 18-24 months after the close of the calendar year being measured; the reason it takes this long is that it takes 18 months for the Bureau of Economic Analysis to complete its estimates of state level GDP. Publication of the ocean economy data was delayed by the pandemic so the next version of the data for 2019 will likely be made available in late 2021. The data can be retrieved here:

NOAA ENOW. **www.digitalcoast.noaa.gov/enohw**
Center for Blue Economy NOEP: **www.oceaneconomics.org**

UPDATING STATE GOVERNMENT AND MARINE RESEARCH

The data required for the state government and marine research & education sectors is all contained within the administrative records of the relevant organizations, including the state budget offices. The data used here is from publicly available sources which tend to be at a summary level for agencies. But many of the relevant agencies are located within departments and their data is not easily available. Thus, allocation mechanisms such as shares of park visitor is used.

But detailed budgets are available in each state's budget system. Examples include individual park budgets, fish and wildlife warden divisions in coastal areas, and staff assigned to state coastal programs. Each state will have to make its own arrangements as every state budget is arranged and reported differently. But the list of agencies covered in Appendix A provides the starting point. Additional agencies not covered here can be added. The selection of appropriate agencies for inclusion is best decided at the state level, and then the appropriate budget information systems consulted. The first iteration of improvements on the data presented here will be the most labor intensive, but once the appropriate agencies and budgets are identified, annual updating can become a matter of routine requests for data issued once a year.

There are several technical issues that require attention:

- **Budgets v. Expenditures.** All states have budgets which must be approved by the Executive and Legislative budget processes. Some states also produce reports of actual expenditures (sometimes called annual reports). In general, actual expenditure data is preferred to budgeted data, but budgeted data can be used if actuals are not available. However only budgets approved through the legislative process should be used, as governor's budgets are frequently changed by legislatures.
- **Employment.** Many budgets also authorize the number of personnel who are assigned to the agency. This normally includes full and part time employees, though there may be special categories such as seasonal employees at parks. This data should be used for the employment reported in the ocean accounts. The data should be jobs, not full-time equivalent jobs as the BLS data in the ENOW accounts includes both full and part time jobs. It may be desirable, if summer peak tourism and recreation employment is reported, to report seasonal jobs in parks, law enforcement, etc. as a separate category. A special case may be contract employees who fulfill functions similar to those of regular state employees; inclusion of these employees may be confusing since their employment is also reported in the industry (such as consulting services) that actually employs the worker. Inclusion of these employees is a matter of discretion.
- **Capital expenditures.** Capital expenditures, for example the construction of a new park facilities or dredging a harbor, or purchase of new boats for the marine wardens may be noted but should not be included in the government accounts as the government's purchase of these goods shows up as the output (sales) of the providing industry. For example, the state portion of a dredging project would also appear in the output of the construction industry, while the new boat for law enforcement could show up in boat building and boat dealers. These expenditures may be noted but should not be included in the accounts.
- **Fiscal v. Calendar years.** States operate their budgets in fiscal years, generally July 1 to June 30, while economic data is reported in calendar years. This creates an unavoidable mismatch in the timing of data. There are three strategies for dealing with the mismatch. The first is to use actual quarterly expenditure data if available to match calendar quarters. If quarterly expenditure data is not available, budget offices may have conversion factors for reporting fiscal year data in calendar years. Finally, it may be necessary to report the fiscal year as calendar year data. That is the approach taken here. FY 18 data was reported as calendar 2018.
- **Establishments.** While there are many state services related to the coast and ocean that take place in specific locations at or near the coast (state parks, warden stations), the majority of expenditures likely take place in the state capital. This makes the concept of establishments, as it is used to measure different hotels or restaurants, a somewhat inappropriate measure. The approach here is to count the number of state agencies as establishments. Marine research organizations may have distinct establishments (a main campus and a coastal campus) that can also be counted as establishments.
- **Sources of Funds.** A question may arise about whether to include funds from different sources in the budgets, particularly federal funds. The rule in national income accounting is that government funds are accounted for at the level at which the expenditure is made. So federal funds used by state governments (or educational institutions) are counted at the state level. This would include Coastal Zone Management Program funds as well as programs such as Sea Grant. This raises a question of whether state funds transferred to local governments should not be counted at the state level. Following the above rule, the answer is that funds transferred to local governments should be subtracted from state expenditures. This would be particularly important if a local government coastal and ocean account is used. But including the state funds transferred to local governments in the state budgets may be easiest. This should be noted in the metadata, so users know what is included and what is not.

Using budget and expenditure data as outlined above can yield appropriately measured data for employment directly from official state records. It may not be possible, however, to identify the full range of data for the ocean economy accounts. In this case, the estimation methods used for this report may be applied. These methods start with treating the reported budget/expenditure amounts for the relevant agencies, adjusted for coastal/ocean characteristics as necessary, as the GDP for the state government sector. Publicly available data can then be used to estimate a ratio that converts budgeted/expenditure data into employment and wages. This is done using data from the Bureau of Economic Analysis regional economic data series for GDP, employment, and wages.

For GDP, go to **https://www.bea.gov/data/gdp/gdp-state** and select *Interactive Tables*. The required data is the table GDP in Current Dollars; select the appropriate state, then under industry select "State and Local Government" and the year. Then from *Annual Personal Income and Employment by State* select *Wages and Salaries by Industry* and *Full and Part-time Wage and Salary Employment by Industry*. Select the appropriate state and year for State and Local Government. (Note that the employment and wage data is separately available for state government and local government but select the combined totals because the GDP data is only available at the combined level.)

From this data, calculate a GDP per employee ratio and wages as a percent of GDP ratio. In order to avoid confusion with units, it is best to convert all of the downloaded data to its native units (millions, thousands, or units). The result is similar to Table 21, which shows the data as described above and was used to calculate the state government account in this report. The final two columns show the estimated GDP in state and local government in each state per state and local employee in that state, along with the proportion of GDP accounted for by wages and salaries.

Table 22 Calculation of Employment and Wages from State GDP Figures

	GDP	EMP	Wages	GDP/Employee	Wage Ratio
Delaware	$6,169,000,000	59817	$3,240,832,000	103131.2	0.525
Maryland	$32,219,225,000	348558	$20,657,958,000	92435.8	0.641
New Jersey	$54,745,000,000	538554	$35,416,040,000	101651.8	0.647
New York	$153,754,600,000	1332591	$91,150,099,000	115380.2	0.593
Virginia	$44,207,825,000	548697	$26,346,693,000	80568.7	0.596
REGION	$291,095,650,000	$2,828,217	$176,811,622,000	102925.5	0.607

All of the same methods for examining budget data in state government are also appropriate for organizations involved in marine research and education. Most of the organizations are institutions of higher education with similar budgets to state agencies. Nongovernmental organizations, which also play a large role in marine research and education, may have different budgeting approaches, fiscal years, etc. These can be identified and adjusted as needed by working with the organizations.

UPDATING ELECTRIC GENERATION

The data on statewide output of the electric power generation industry (NAICS 2211) is available from BEA for GDP (**https://www.bea.gov/data/gdp/gdp-state**) and from the Bureau of Labor Statistics (BLS) (**https://www.bls.gov/data/**), select Quarterly Census of Employment and Wages under Employment.

Data on the facilities and generating capacity is available from the Energy Information Administration's Form 860 data, available online at **https://www.eia.gov/electricity/data/eia860/**. The needed data is in two separate spreadsheets, one on plants and their ownership and location and the other generation capacity. The Mid-Atlantic states should be selected from each file and the records merged; to merge the records, the "ownership code" and "plant code" are concatenated to form a unique ID. The generation data should be summed by plant prior to merging using an Excel Pivot Table or similar summarizing program. The combined location-total generation file with latitude and longitude can then be entered as XY coordinates in a GIS file together with the NOAA medium resolution polyline (**https://shoreline.noaa.gov/data/datasheets/medres.html**). Plants located within some distance of the shoreline are then selected for all onshore power stations. The number of plants and generating capacity in the coastal area can the be summed by state, proportions of state total facilities and capacities calculated and applied to the economic data above.

It is not clear yet how offshore wind generating facilities will be captured in the EIA 860 data, so this may require some experimentation to select the appropriate data once it becomes available. Offshore power facilities can then be combined with onshore facilities for a full picture of coastal and ocean related electric generation. It will most likely be desirable to report offshore and onshore separately to track the changes in the industry.

Note that this method measures only the output and related data for the electric generation industry. It does not measure the role of related and supporting industries such as onshore support facilities for the offshore production facilities or manufacture of turbines, blades, cables, etc. Including these indirect industries in offshore wind will require detailed local studies of the industry once it is established.

UPDATING TOURISM AND RECREATION

The basic data for tourism and recreation is available from ENOW. The data for estimating peak employment is available from the BLS ((**https://www.bls.gov/data/**, select Quarterly Census of Employment and Wages under Employment). The calculations are straight forward and described in the tourism and recreation section. The focused estimates on non-business non-visiting-friends-and-relatives can be estimated with survey data available to state and local tourism agencies.

UPDATING BLUE CARBON

There are three elements to the estimation of the economic value of wetlands as blue carbon: the amount of carbon stored in existing wetlands, the amount of carbon sequestered (additional carbon stored every year) and the value of stored carbon. Monitoring the evolution of the value of blue carbon requires updating in all three areas. Changes in storage and sequestration are likely to occur over extended periods of time, while changes in the value of carbon are likely to occur more quickly and so initial updating efforts should focus on changes in values.

The estimates of carbon stored and sequestered depend on the amount of wetlands as well as factors such as salinity. Changes in coastal wetlands may be monitored at the state level or through such federal sources as the U.S. Fish & Wildlife Services National Wetlands Inventory (**https://fws.gov/wetlands/**) or NOAA's Coastal Change Analysis Program (**https://coast.noaa.gov/digitalcoast/training/ccap-land-cover-classifications.html**). These are good data sources for the extent of wetlands.

The model that was used by Duke University for its study on which the estimates in this report are based is the Invest Model from the Natural Capital Project. This model is an open-source model that is freely available at **https://naturalcapitalproject.stanford.edu/software/invest**. The model does require fairly extensive localization of data, but it is continually being updated to improve estimates of storage and sequestration based on the latest scientific findings.

The most important update in the near term will be a revision to the U.S. Government's official social cost of carbon. This is expected to be announced in early 2022, and it is likely to significantly alter the dollar values used in the estimates presented here. It is also likely that RGGI carbon offset prices will increase over this decade.

As discussed in the section on blue carbon, the value of blue carbon is significantly affected by the rate of sea level rise. This figure is also continually being updated. The next U.S. update will come in the Fifth Climate Assessment currently being prepared and is expected to be released in draft form in 2022. This Assessment will contain newly updated climate scenarios as well as sea level rise estimates at the national and regional scale. Research on sea level rise is also taking place at numerous institutions in the Mid-Atlantic region, and these can be incorporated to provide more specificity to possible changes in sequestration capacities in the region.

Updating GDP. When updating the ENOW data for GDP it is important to adjust for changes in prices. GDP is the product of the number of items (or units of service) sold times the price. A change in price would result in a change in GDP that did not reflect any real change in the underlying units of goods or services sold. Adjusting for prices is done using various price indexes that track changes in price separate from other changes.

The ENOW data is available in both current prices (prices in the data year) and price adjusted values. Figures in this report are in current prices for 2018. When updates are done, both current and price-adjusted levels of GDP can be used to create estimates for the new year and 2018 can be recalculated using price adjusted levels. This permits comparisons of changes in GDP to focus on actual changes in output rather than just changes in price. GDP data from BEA is also available in both current and price-adjusted levels for calculations.

If price-adjusted data is not available, a price index can be used to control for price changes when comparing two years. There are many different prices that can change at very different rates so there are many different price indexes that could be used. The consumer price index is the best known price index but it is really only relevant for adjusting income variables like wages and salaries. Most products, like a hotel stay or a boat, have price indexes at the producer level (when the product is made and first sold) and at the retail stage (when it is bought by the final consumer). The Bureau of Labor Statistics publishes most price indexes online at **https://www.bls.gov/data/**.

When in doubt the broadest measure of inflation is the GDP price deflator, available at **https://www.bea.gov/data/prices-inflation/gdp-price-deflator**.

PROCEDURAL TIPS:

Don't Duck the Metadata

Whatever methods are used, it is vitally important that every report document the sources, and choices of methods. This metadata is essential for comparability across states and across time. Inconsistencies will exist, most for valid reasons. It is essential to the credibility and usability of the data that documentation of updates accompany the release of the data. The metadata should cover the same issues addressed in this report.

Accounts Focus on Big Picture: Studies Fine Tune Understanding

The ocean economic accounts including additions, extensions, and updates should be as accurate as possible, but there is a point of diminishing returns in acquiring data. Updates should be focused on sufficiently large changes that are clearly related to the activities being measured. For example, there are undoubtedly numerous courses in marine biology or geology taught at most higher education institutions. Some institutions may offer minors or majors in marine subjects. But the budget outlays for individual courses or even majors are likely to be complex to measure on a regular basis. For purposes of the accounts, these should be considered outside the scope of measurement. If there is an interest in more detailed examination of the marine research and education that would examine small scale activities, these can be examined in special studies of the sector.

7. CONCLUSIONS

The creation of ocean economic accounts- consistent measurement of the contribution of oceans and coasts to national and regional economies- is a relatively recent development, lagging many years behind similar economic measures for such other key natural resources as agricultural land or forests. Ocean economic accounts provide a way to consistently measure the contribution of oceans across space and time and thus are a key to detecting and responding to changes that affect how people use oceans and coasts. The U.S., first through the National Ocean Economics Program (now the Center for the Blue Economy), and currently through NOAA have been making such data available at the national, state, and county level for the past 15 years. This data has recently been expanded and improved through the creation of the Marine Economy Satellite Account by NOAA and the Bureau of Economic Analysis. This new dataset, however, is only available for the U.S. as a whole. Extending the data to the state and county level is still some time away.

Other extensions of the concept of ocean accounting to include the economic value of the natural capital of coastal and ocean resources that are either not measured by market prices or imperfectly so are still some distance away in the U.S., although many other countries are already engaged in adding this economic perspective on the value of natural resources to their ocean accounts.

This project is a prototype example of how parts of the extended ocean accounts can be developed at the state level, including adding new economic activity not previously measured at the state or local level and a new element of measurement of the value of a part of the natural capital of wetlands. The project also shows how existing measures of economic activity in tourism and recreation can be improved to provide a more complete and accurate picture of economic activity.

The following modifications were made to the standard measures of the ocean economy in the NOAA Economics National Ocean Watch (ENOW) accounts. All figures are for calendar year 2018, the most recent year for which ENOW data is available. All figures in italics are preliminary estimates subject to revision following additional input.

- **State government expenditures related to the oceans** in the categories of resource management, parks and recreation, and law enforcement were identified from individual state sources. A partial review of state data for this study showed:
    - **$654.6 million in budgeted commitments in 2018** and over **6,300 employees** for the state governments of the MARCO states. This includes funding from all sources. No estimates were made for local governments or the federal government.
    - New Jersey and New York had the largest budgets at about $260 million each.
    - New Jersey had the largest expenditures per mile of shoreline at $144,000 per mile. The regional average state government budgeted amount per mile of shoreline was $62,000.
- **Marine Research and Education** was measured, like state government, from budgets of relevant organizations supplemented by other economic data. The focus was on public and private institutions of higher education with identifiable organizational components dedicated to marine research and education.
    - Across the region, marine research and education is estimated to account for **$317 million in spending in 2018, supported by 7,200 employees**.
    - **Virginia has the largest marine research expenditures**.

- **Electric Power Generation.** Electric power plants within 5 km (~3 miles) of the shoreline were selected and the proportion of GDP in the utilities sector was calculated for these plants based on generating capacity.
    - **Electric power generation is a major sector in the ocean economy.** At $22.4 billion in output and 24,500 jobs, it is second only to tourism and recreation.
    - **New York has the largest coastal electric power industry,** followed by New Jersey.
    - **Electric power generation is the largest share of the ocean economy in Delaware.**
- Together these three sectors add $23.5 billion and 38,000 jobs to the regional ocean economy.

Tourism and Recreation is generally the largest sector in the coastal economy in employment and usually in GDP. ENOW data utilizes annual average data which can both overstate and understate ocean-related tourist and recreation economy. To provide alternative perspectives on tourism and recreation, two alternative measures of tourism and recreation for each county and state are developed. First estimates of the summer peak economic activity in each county are made. These were then adjusted to account for those who travel for primarily recreational purposes (excluding those who travel for business or to visit friends and relatives.).

Accounting for summer peaks, **increases the estimate of tourism and recreation employment in the MARCO region by about 280,000 jobs** (19%) compared with the annual average estimates provided in ENOW. **Adjusting the estimates to reflect only people who travel for recreation, reduces the estimated number of jobs by 166,000 by 24%.**

New Jersey and Delaware had the largest peak summer economy, with employment in ocean tourism and recreation 54% higher than the annual average in New Jersey and 39% higher in Delaware. **New York shows the smallest peak summer economy** at just 7% higher than the annual average. **Cape May County, New Jersey has by far the largest peak** to annual average difference in employment.

Delaware and Virginia had the largest share of its summer economy associated with travelers who come for recreation (at 67% of employment). **New York has the smallest share** at 55%.

The evolving approaches to ocean accounting recognize that measures such as contributions to GDP and employment are only partial measures of the economic value of ocean and coastal resources. Resources such as coastal wetlands are known to produce variety of what are called ecosystem services such as habitat for economically important fish species, protection against flooding and storms, and storage of carbon that could otherwise contribute to atmospheric carbon and climate change. Particular attention is being paid to carbon storage functions because of concerns about climate change. This is termed “blue carbon”.

The value of blue carbon is partly a function of the amount of carbon already in the aquatic vegetation of wetlands. This is a stock of value which is already present. The amount of additional carbon stored each year, called sequestration, is a flow of value that adds to the stock of stored value. The value of stored carbon is derived from keeping that carbon in the vegetation; if the wetlands are destroyed and carbon is released into the atmosphere then additional damage from climate change could result. The value of the stock of carbon is, therefore, the value of the costs of climate change avoided by maintaining the wetlands. Similarly, the value of sequestered carbon depends on avoiding damages from climate change from the additional amount of carbon kept from the atmosphere each year in the future.

At any point the value of blue carbon is a function of the area of wetlands and carbon stored there and the possible future damages that result from that carbon being in the atmosphere rather than the wetlands. Both stored and sequestered carbon values depend on events in the future, and so must be expressed as a present value over some period. The choice of a discount rate (a way to equate future and present values) is an important part of the calculation. The monetary value can be taken as an estimate of future climate damages, called the social cost of carbon. It can also be taken as the price paid to preserve wetlands for carbon storage.

To estimate the blue carbon values of the Mid-Atlantic, a study of blue carbon stored and sequestered conducted by Duke University for the region was used to estimate amounts of carbon. The study incorporated the potential effects of sea level rise on the amount of aquatic vegetation capable of storing carbon, thus modeling a feedback loop of carbon removed from the atmosphere in the future offset by reductions caused by climate change.

There is thus no single “value of blue carbon”, but a range of estimates depending on the choice of discount rate, the monetary value for costs avoided, and the assumptions about how much climate change will affect future levels of carbon removal. Several different assumptions are used to estimate the blue carbon values. Using a low discount rate (future climate costs are reduced only slightly), an assumption of 1 meter of sea level rise, and both the current official U.S. government social cost of carbon and a social cost of carbon reflecting very high levels but low probabilities of future damages, **the total value of currently stored and future sequestration of carbon ranges from $10.1 billion to $29.5 billion** depending on the choice of carbon price. Of these amounts, **currently stored carbon accounts for 88% of the value**.

Virginia ($3.0 billion) at current social cost of carbon) and New Jersey ($2.8 billion) have the largest blue carbon values. Maryland (at $2.7 billion) is third.

A key aspect of blue carbon value is that **greater amounts of climate change increase the value of avoided costs** but also **reduce the number and extent of wetlands** and thus carbon storage.

The data presented here will be most useful if it is kept continually updated on a regular basis so that important changes in the economic activity associated with the ocean are detected and can be investigated. Recommendations for keeping the data updated are provided. This can be done at modest cost using publicly available information or information accessible within state government and higher education institutions.

APPENDIX 1: SOURCES FOR STATE GOVERNMENT AND MARINE RESEARCH

STATE AGENCIES INCLUDED IN STATE GOVERNMENT

State	Function	Ocean Budget ($M)	Total Budget	Department	Coast/ Ocean Share	Allocation Factor by County
NY	Law Enforcement	$30.60	$40,544,000	DEC - Environmental Enforcement	75.40%	Population
NY	Parks & Recreation	$86.60	$129,156,000	Office of Parks, Recreation, & Historic Preservation	67.10%	Attendance
NY	Resource Mgmt.	$93.90	$124,578,000	Dept of Environmental Conservation (DEC)	75.40%	Population
NY	Resource Mgmt.	$3.20	$11,483,000	DEC - Fish, Wildlife, and Marine Resources	28.00%	Area
NY	Resource Mgmt.	$0.00		State Coastal Management Program	100.00%	
NY	Total Law Enforcement	$30.60				
NY	Total Parks & Recreation	$86.60				
NY	Total Ports					
NY	Total Resource Mgmt.	$97.20				
NY	Total Ocean	$214.40				
NJ	Law Enforcement			NJ State Police - Marine Services	100.00%	
NJ	Parks & Recreation			Recreation and Parks Association		Facilities/ Attendance
NJ	Resource Mgmt.	$258.10	$360,113,000	Dept of Environmental Protection	71.70%	Population
NJ	Resource Mgmt.			NJDEP fish and wildlife	61.40%	Area
NJ	Resource Mgmt.			NJDEP Bureau of Marine Fisheries	100.00%	

NJ	Resource Mgmt.			NJDOT Office of Maritime Resources	100.00%	
NJ	Resource Mgmt.			NJDEP Coastal Management Program	100.00%	
NJ	Total Law Enforcement	$0.00				
NJ	Total Parks & Recreation	$0.00				
NJ	Total Ports					
NJ	Total Resource Mgmt.	$258.10				
NJ	Total Ocean	$258.10				
DE	Law Enforcement	$1.21	$1,208,000	DNREC - Natural Resources Police	100.00%	Population
DE	Parks & Recreation	$23.78	$23,778,400	DNREC - Parks and Recreation	100.00%	Facilities
DE	Resource Mgmt.	$6.89	$6,886,200	DNREC - Fish and Wildlife	100.00%	Area
DE	Resource Mgmt.	$0.65	$651,400	Delaware Coastal Management Program	100.00%	
DE	Total Law Enforcement	$1.21				
DE	Total Parks & Recreation	$23.78				
DE	Total Resource Mgmt.	$6.90				
DE	Total Ocean	$31.89				
MD	Law Enforcement	$11.51	$22,854,584	DNR Natural Resources Police	50.40%	Population
MD	Parks & Rec	$0.00	$12,368,570	DNR Park Service		Facilities/ Attendance
MD	Resource Mgmt.	$1.72	$1,719,178	MD Coastal Bays Program	100.00%	
MD	Resource Mgmt.	$41.14	$81,684,329	Dept of Natural Resources (DNR)	50.40%	Population
MD	Resource Mgmt.	$4.50	$4,503,397	DNR Chesapeake & Coastal Service	100.00%	

MD	Resource Mgmt.		DNR Coastal Zone Management Program	100.00%		
MD	Total Law Enforcement	$11.50				
MD	Total Parks & Recreation	$0.00				
MD	Total Ports					
MD	Total Resource Mgmt.	$47.40				
MD	Total Ocean	$58.90				
VA	Law Enforcement	$3.84	$20,748,520	DWR - Conservation Police	18.50%	Population
VA	Parks & Recreation	$0.00	$40,950,227	DCR - State Parks		Facilities/ Attendance
VA	Parks & Recreation	$0.00		DCR- Natural Area Preserves	15.90%	Area
VA	Parks & Recreation	$0.00		DWR - Wildlife Management Areas	15.90%	Area
VA	Resource Mgmt.	$7.66	$41,369,007	Dept of Environmental Quality (DEQ)	18.50%	Population
VA	Resource Mgmt.	$0.00		DEQ - Chesapeake Bay Preservation Act	100.00%	
VA	Resource Mgmt.	$0.00		DEQ - Wetlands	100.00%	
VA	Resource Mgmt.	$8.47	$53,406,900	Dept of Wildlife Resources (DWR)	15.90%	Area
VA	Resource Mgmt.	$12.47	$12,470,957	VA Marine Resources Commission	100.00%	
VA	Total Law Enforcement	$3.84				
VA	Total Parks & Recreation	$0.00				
VA	Total Ports					
VA	Total Resource Mgmt.	$28.61				
VA	Total Ocean	$32.45				

MARINE RESEARCH AND EDUCATION INSTITUTIONS INCLUDED

NEW YORK	Amount	Response Pending	No Response
Buffalo State, Great Lakes Center	$450,941.00		
New York Sea Grant		•	
Stony Brook University, School of Marine and Atmospheric Science	$11,200,000.00		•
SUNY College of Environmental Science and Forestry		•	
SUNY Maritime College			•
University at Buffalo, Great Lakes-related research	$1,200,250.00		
Great Lakes Research Consortium			•
New York Aquarium	$19,099,956.00		
TOTAL	$31,951,147		

NEW JERSEY	Amount	Response Pending	No Response	Refused
Center for Aquatic Sciences at the Adventure Aquarium	$1,824,209.00			
Davidson Laboratory at the Stevens Institute of Technology	$2,500,000.00			
Fairleigh Dickinson University			•	
Montclair University, Department of Marine Biology and Coastal Sciences			•	
New Jersey Sea Grant Consortium	$2,360,099.00			
Rowan College				Fee Required
Rutgers University, Department of Marine and Coastal Sciences	$27,329,253.00			
Stockton University, Marine Field Station		•		
The Program in Atmospheric and Oceanic Sciences	$1,689,973.00			
TOTAL	$35,703,534			

MARINE RESEARCH AND EDUCATION INSTITUTIONS INCLUDED

DELAWARE	Amount	Response Pending	No Response
Delaware Sea Grant	$2,100,000.00		
Delware State University College of Agriculture, Sciences and Technology Environmental Institute			•
University of Delaware, Biden School of Public Policy, Special Initiative on Offshore Wind			•
University of Delaware College of Earth, Ocean and Environment	$833,100.00	•	
University of Delaware, Scientific Committee on Ocean Research	$1,122,095.00		
Center for Inland Bays	$1,068,241.00		
Delaware Geological Society	$1,904,904.00		
USGS MD-DE-DC Water Science Center			•
Partnership for the Delaware Estuary	$2,436,028.00		
TOTAL	$9,464,368		

MARYLAND	Amount	Response Pending	No Response	Refused
Institute of Marine and Environmental Technology			•	
Maryland Sea Grant	$5,019,414			
National Aquarium	$52,184,001		•	
Smithsonian Environmental Research Center				•
University of Maryland, College of Agriculture and Natural Resources,			•	
University of Maryland, Center for Environmental Science	$51,021,012			
TOTAL	$108,224,427			

MARINE RESEARCH AND EDUCATION INSTITUTIONS INCLUDED

VIRGINA	Amount	Response Pending	No Response	Refused
Virginia Institute of Marine Science	$48,254,831			
College of William and Mary Coastal Policy Center	$252,656		•	
College of William and Mary Center for Conservation Biology	$85,000			
Old Dominion University - Department of Earth, Ocean, and Atmospheric Sciences	$4,035,955			
University of Virginia - coastal research center	$405,000			
Virginia Sea Grant	$76,500,000		•	
Virginia Tech				•
The Nature Conservancy VA Coast Reserve		•		
Virginia Sierra Club				•
Virginia Aquarium	$4,428,760			
TOTAL	$133,962,202			

APPENDIX 2: PEAK AND LEISURE TRAVEL ADJUSTED TOURISM AND RECREATION ESTIMATES BY COUNTY

Table 2-1: Annual Average, Peak Third Quarter, Recreation Travel-Adjusted Estimates

		BASE ENOW				THIRD QUARTER PEAK T&R ECONOMY				THIRD QUARTER ADJUST FOR RECREATIONAL TRAVEL			
State	County	Estabs	Employ	Wages ($M)	GDP ($M)	Estabs	Employ	Wages ($M)	GDP ($M)	Estabs	Employ	Wages ($M)	GDP ($M)
Delaware	Kent	231	4,311	$70.25	$134.66	238	4,539	$17.82	$34.15	160	3,041	$11.94	$22.88
	New Castle	510	6,888	$121.56	$240.25	529	7,458	$30.71	$60.69	355	4,997	$20.58	$40.67
	Sussex	642	11,683	$249.90	$539.42	661	19,801	$86.22	$186.11	443	13,269	$57.77	$124.71
Maryland	Anne Arundel	1,029	20,497	$463.85	$1,015.27	1,035	22,457	$119.04	$260.56	560	12,153	$64.42	$141.00
	Baltimore	391	5,353	$100.52	$209.43	395	5,989	$23.63	$49.23	214	3,241	$12.79	$26.64
	Calvert	149	2,758	$52.64	$136.85	147	3,162	$13.92	$36.20	80	1,711	$7.53	$19.59
	Cecil	169	3,192	$59.87	$127.41	172	3,917	$16.88	$35.93	148	3,374	$14.54	$30.95
	Charles	96	1,660	$29.60	$61.38	97	1,803	$7.76	$16.09	52	976	$4.20	$8.71
	Dorchester	67	1,175	$27.14	$72.70	68	1,395	$6.97	$18.68	58	1,202	$6.01	$16.09
	Harford	222	3,673	$66.54	$143.93	224	4,507	$19.01	$41.11	121	2,439	$10.28	$22.25
	Kent	84	774	$16.76	$38.60	81	1,118	$4.90	$11.29	70	963	$4.22	$9.72
	Queen Annes	137	2,612	$58.49	$126.21	134	3,326	$15.99	$34.50	116	2,865	$13.77	$29.72
	St. Marys	186	3,571	$62.14	$130.82	185	3,745	$15.95	$33.58	100	2,027	$8.63	$18.17
	Somerset	50	389	$5.52	$12.04	52	413	$1.49	$3.25	45	356	$1.28	$2.80
	Talbot	153	2,443	$53.19	$126.13	150	2,884	$14.67	$34.78	130	2,484	$12.63	$29.96
	Wicomico	8	64	$0.98	$2.16	8	68	$0.25	$0.56	7	58	$0.22	$0.48
	Worcester	477	7,953	$201.73	$496.77	483	17,461	$76.04	$187.25	416	15,040	$65.50	$161.29
	Baltimore City	830	14,129	$387.98	$937.47	825	15,580	$110.59	$267.21	446	8,431	$59.84	$144.60

		BASE ENOW				THIRD QUARTER PEAK T&R ECONOMY				THIRD QUARTER ADJUST FOR RECREATIONAL TRAVEL			
State	County	Estabs	Employ	Wages ($M)	GDP ($M)	Estabs	Employ	Wages ($M)	GDP ($M)	Estabs	Employ	Wages ($M)	GDP ($M)
New Jersey	Atlantic	624	10,764	$266.13	$529.68	634	14,611	$78.01	$155.25	509	11,725	$62.59	$124.58
	Bergen	1,128	12,380	$306.24	$597.73	1,140	13,949	$79.79	$155.74	550	6,728	$38.49	$75.12
	Cape May	1,019	10,158	$250.95	$507.82	1,041	37,885	$111.23	$225.09	836	30,400	$89.26	$180.62
	Cumberland	112	1,309	$22.47	$44.08	110	1,392	$5.69	$11.16	60	753	$3.08	$6.04
	Essex	468	5,232	$129.72	$255.31	473	5,282	$30.17	$59.37	228	2,548	$14.55	$28.64
	Hudson	1,378	16,400	$408.48	$777.09	1,407	17,118	$100.98	$192.10	678	8,257	$48.71	$92.66
	Middlesex	165	1,405	$26.09	$51.26	169	1,548	$6.68	$13.12	82	747	$3.22	$6.33
	Monmouth	1,324	17,767	$368.99	$704.75	1,356	24,476	$108.10	$206.47	654	11,806	$52.14	$99.59
	Ocean	1,155	14,049	$288.16	$569.47	1,192	24,013	$95.01	$187.76	956	19,269	$76.24	$150.67
	Salem	56	694	$10.54	$20.41	58	865	$2.86	$5.55	31	468	$1.55	$3.00
	Union	313	3,499	$78.27	$154.64	317	3,765	$19.41	$38.35	153	1,816	$9.36	$18.50
New York	Bronx	598	4,894	$110.08	$213.56	597	5,305	$34.40	$66.75	325	2,883	$18.70	$36.28
	Kings	3,759	33,229	$899.24	$1,802.67	3,769	35,608	$230.05	$461.17	2,049	19,354	$125.04	$250.66
	Nassau	1,396	17,392	$421.88	$794.14	1,417	20,152	$106.81	$201.06	746	10,611	$56.24	$105.86
	New York	9,621	217,305	$9,207.27	$22,187.75	9,695	221,044	$2,210.27	$5,326.33	5,270	120,145	$1,201.36	$2,895.03
	Queens	1,299	11,581	$277.41	$509.98	1,304	12,438	$73.93	$135.90	709	6,760	$40.18	$73.87
	Richmond	826	8,359	$185.20	$380.76	829	8,952	$46.18	$94.95	451	4,866	$25.10	$51.61
	Suffolk	2,741	36,385	$921.15	$1,916.68	2,769	48,169	$273.74	$569.58	1,458	25,362	$144.13	$299.89
	Westchester	441	4,897	$134.41	$254.18	448	5,922	$35.05	$66.29	386	5,101	$30.19	$57.10

		BASE ENOW				THIRD QUARTER PEAK T&R ECONOMY				THIRD QUARTER ADJUST FOR RECREATIONAL TRAVEL			
State	County	Estabs	Employ	Wages ($M)	GDP ($M)	Estabs	Employ	Wages ($M)	GDP ($M)	Estabs	Employ	Wages ($M)	GDP ($M)
Virginia	Accomack	105	1,206	$20.51	$44.50	106	2,076	$6.74	$14.62	58	1,128	$3.66	$7.95
	Essex	24	390	$6.21	$12.27	23	424	$1.64	$3.24	17	313	$1.21	$2.40
	Gloucester	75	1,063	$17.63	$35.02	78	1,194	$4.59	$9.12	58	883	$3.40	$6.74
	Isle of Wight	40	712	$11.77	$24.38	39	776	$3.04	$6.30	29	573	$2.25	$4.66
	James City	141	3,479	$74.00	$159.33	137	5,033	$20.58	$44.31	101	3,721	$15.21	$32.76
	King George	45	453	$7.22	$14.23	49	595	$2.10	$4.14	36	440	$1.56	$3.06
	Lancaster	41	258	$4.45	$8.37	41	329	$1.24	$2.33	30	243	$0.91	$1.72
	Mathews	14	93	$1.08	$2.13	14	117	$0.30	$0.58	10	86	$0.22	$0.43
	Middlesex	36	224	$5.23	$9.67	38	355	$1.67	$3.09	28	262	$1.23	$2.28
	Northampton	42	548	$8.58	$17.25	42	884	$2.68	$5.39	36	761	$2.31	$4.64
	Northumberland	25	122	$2.09	$3.90	24	218	$0.62	$1.16	18	161	$0.46	$0.86
	Westmoreland	28	293	$5.36	$11.10	28	397	$1.51	$3.12	21	294	$1.11	$2.31
	York	169	3,387	$65.93	$140.74	172	3,860	$17.27	$36.86	127	2,853	$12.77	$27.25
	Hampton	265	5,007	$77.59	$152.04	262	5,480	$19.79	$38.78	169	3,536	$12.77	$25.02
	Newport News	378	7,226	$118.73	$238.41	374	7,727	$30.34	$60.93	241	4,985	$19.58	$39.31
	Norfolk	487	8,995	$155.83	$311.59	491	9,134	$39.17	$78.32	317	5,893	$25.27	$50.53
	Poquoson	21	246	$3.24	$6.38	20	240	$0.80	$1.57	13	155	$0.51	$1.01
	Portsmouth	154	2,569	$39.86	$77.02	151	2,651	$10.17	$19.64	97	1,710	$6.56	$12.67
	Suffolk	134	3,095	$50.27	$99.06	132	3,410	$12.95	$25.53	85	2,200	$8.36	$16.47
	Virginia Beach	1,091	24,176	$455.89	$928.05	1,101	29,432	$123.63	$251.66	710	18,989	$79.76	$162.36

Table 2-2 Recreational Travel Adjustment from DK Shurtleff Surveys and Employment Ratio Summer to Winter (Q3/Q1)

State	County	Recreational Travel Percent	Summer/ Winter Ratio
Delaware	Kent	0.6701	1.053
	New Castle	0.6701	1.083
	Sussex	0.6701	1.695
Maryland	Anne Arundel	0.5411	1.096
	Baltimore	0.5411	1.119
	Calvert	0.5411	1.146
	Cecil	0.8614	1.227
	Charles	0.5411	1.086
	Dorchester	0.8614	1.187
	Harford	0.5411	1.227
	Kent	0.8614	1.444
	Queen Annes	0.8614	1.273
	St. Marys	0.5411	1.049
	Somerset	0.8614	1.062
	Talbot	0.8614	1.181
	Wicomico	0.8614	1.061
	Worcester	0.8614	2.195
	Baltimore City	0.5411	1.103
New Jersey	Atlantic	0.8024	1.357
	Bergen	0.4823	1.127
	Cape May	0.8024	3.730
	Cumberland	0.5411	1.063
	Essex	0.4823	1.010
	Hudson	0.4823	1.044
	Middlesex	0.4823	1.102
	Monmouth	0.4823	1.378
	Ocean	0.8024	1.709
	Salem	0.5411	1.246
	Union	0.4823	1.076

State	County	Recreational Travel Percent	Summer/ Winter Ratio
New York	Bronx	0.544	1.084
	Kings	0.544	1.072
	Nassau	0.527	1.159
	New York	0.544	1.017
	Queens	0.544	1.074
	Richmond	0.544	1.071
	Suffolk	0.527	1.324
	Westchester	0.861	1.209
Virginia	Accomack	0.544	1.722
	Essex	0.715	1.086
	Gloucester	0.739	1.124
	Isle of Wight	0.739	1.089
	James City	0.739	1.447
	King George	0.739	1.313
	Lancaster	0.739	1.274
	Mathews	0.739	1.257
	Middlesex	0.739	1.585
	Northampton	0.861	1.612
	Northumberland	0.739	1.788
	Westmoreland	0.739	1.356
	York	0.739	1.140
	Hampton	0.645	1.095
	Newport News	0.645	1.069
	Norfolk	0.645	1.015
	Poquoson	0.645	0.975
	Portsmouth	0.645	1.032
	Suffolk	0.645	1.102
	Virginia Beach	0.645	1.217

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