

Navy Ship-specific Considerations for Decarbonization Research

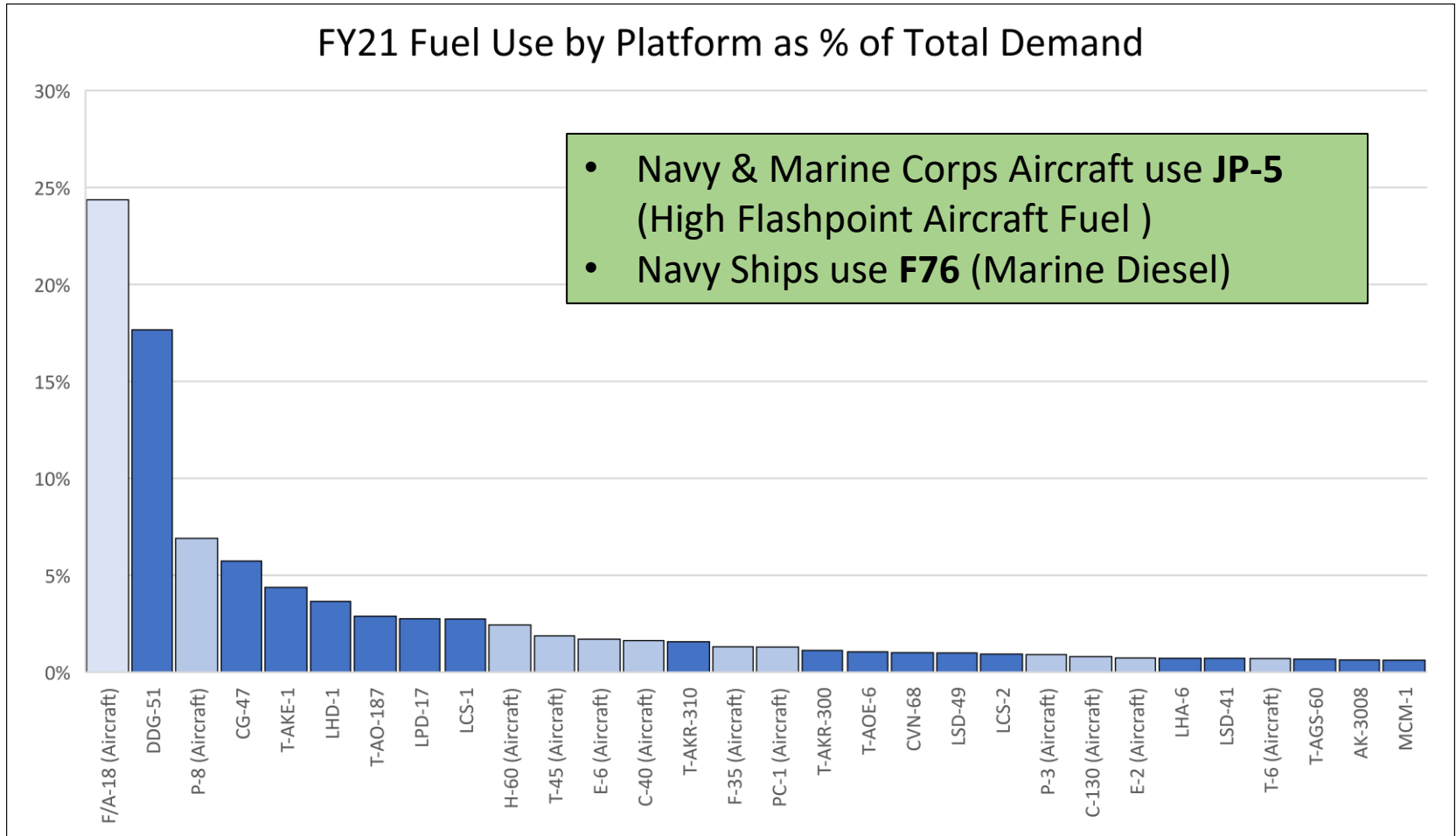
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Agenda

- Navy Tactical Fuel Use by Platform
- Force Architecture and Challenges
 - USS/Commissioned Vessels (Warships)
 - Combatant Ships and Amphibious Warships
 - USNS Vessels (Ships of Military Sealift Command)
 - Combat Logistics Force
 - 30 Year Shipbuilding Plan
- Priority Platforms for Decarbonizing
- Technology Readiness Levels

Navy Fuel Use by Platform/Airframe




USS/Commissioned Ships (Warships)

Surface combatant

Guided missile cruiser

Ticonderoga Class CG

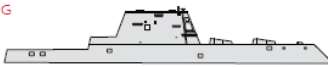
USS Bunker Hill	CG-42	USS Chancellorsville	CG-62
USS Mobile Bay	CG-53	USS Congress	CG-63
USS Annapolis	CG-54	USS Gettysburg	CG-64
USS Layton Gulf	CG-55	USS Cheval	CG-65
USS San Jacinto	CG-56	USS Strathairn	CG-67
USS Lake Champlain	CG-57	USS Vicksburg	CG-69
USS Pillsbury Sea	CG-58	USS Lake Erie	CG-70
USS Princeton	CG-59	USS Cape St George	CG-71
USS Normandy	CG-60		



Guided missile destroyer


Zumwalt Class DDG

USS Zumwalt	DDG-1000
USS Michael Monrroe	DDG-1001
Lyndon B Johnson	DDG-1002




Arleigh Burke Class DDG Flight I and Flight II

USS Arleigh Burke	DDG-51	USS Fitzgerald	DDG-42	USS Gonzalez	DDG-46	USS The Sullivans	DDG-48
USS Barry	DDG-52	USS Stephen	DDG-53	USS Cole	DDG-47	USS Millus	DDG-49
USS John Paul Jones	DDG-53	USS Zumwalt	DDG-54			USS Higgins	DDG-50
USS Curtis Wilbur	DDG-54	USS Berford	DDG-55			USS Row	DDG-51
USS Stout	DDG-55					USS Mahan	DDG-52
USS John S McCain	DDG-56					USS Dewar	DDG-53
USS Mitscher	DDG-57					USS McFaul	DDG-54
USS Lamson	DDG-58					USS Donald Cook	DDG-55
USS Russell	DDG-59					USS Higgins	DDG-56
USS Paul Hamilton	DDG-60					USS O'Keefe	DDG-57
USS Ramage	DDG-61					USS Porter	DDG-58



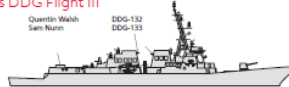
Arleigh Burke Class DDG Flight IIA

USS Oscar Austin	DDG-79	USS James E Williams	DDG-95	USS Dewey	DDG-105	USS Spruance	DDG-111
USS Roosevelt	DDG-80	USS Banziger	DDG-96	USS Stockdale	DDG-106	USS Michael Murphy	DDG-112
USS Winston S Churchill	DDG-81	USS Haley	DDG-97	USS Gravely	DDG-107	USS John Finn	DDG-113
USS Lassen	DDG-82	USS Forrest Sherman	DDG-98	USS Forrest Sherman	DDG-108	USS Ralph Johnson	DDG-114
USS Howard	DDG-83	USS Farragut	DDG-99	USS Jason Dunham	DDG-109	USS Rafael Peralta	DDG-115
USS Hulth	DDG-84	USS Kidd	DDG-100	USS William P Lawrence	DDG-110	USS Thomas Hudner	DDG-116
USS McCarrell	DDG-85	USS Grady	DDG-101			USS Paul Ignatius	DDG-117
USS Shoup	DDG-86	USS Sampson	DDG-102	USS Daniel Broyne	DDG-118	USS Daniel Broyne	DDG-119
USS Mason	DDG-87	USS Truxtun	DDG-103	USS Delbert D Black	DDG-120	Carl M Levin	DDG-121
USS Pringle	DDG-88	USS Stewart	DDG-104	USS Frank E Peterson Jr	DDG-121	John Basilone	DDG-122
USS Mustin	DDG-89			USS Frank E Peterson Jr	DDG-121	Lenaik W Scott/Ethel Higgins	DDG-123
USS Chafee	DDG-90			John Basilone	DDG-122	Harvey C Barnum Jr	DDG-124
USS Probst	DDG-91			Lenaik W Scott/Ethel Higgins	DDG-123	Patrick Gallagher	DDG-127
USS Momsen	DDG-92						
USS Chung-Hoon	DDG-93						
USS Nitze	DDG-94						



Arleigh Burke Class DDG Flight III



Jack H. Lucas	DDG-128	Quantz Walsh	DDG-132	John E Kilmer	DDG-134
Louis H Wilson Jr	DDG-129	Sami Nouri	DDG-133	Thad Cochran	DDG-135
Ted Stevens	DDG-130			Richard G Lugar	DDG-136
Arnold J. Disant	DDG-131			John F Antea	DDG-137
William Chavette	DDG-132			J William Mendenhall	DDG-138
George M. Bush	DDG-133			Seawolf Trinidad	DDG-139



Littoral combat ship

Freedom Variant

USS Meigs	LCF-5	Casperman	LCF-23	USS Jackson	LCF-6	USS Kansas City	LCF-27
USS Stout City	LCF-11	Marquette	LCF-25	USS Montgomery	LCF-8	USS Oakland	LCF-24
USS Whitby	LCF-13	Beloit	LCF-27	USS Catherine Gifford	LCF-10	USS Mobile	LCF-26
USS Billings	LCF-15	Cleveland	LCF-31	USS Oriskany	LCF-12	USS Semmes	LCF-28
USS Indianapolis	LCF-17			USS Manchester	LCF-14	Carberra	LCF-30
USS St Louis	LCF-19			USS Tulsa	LCF-16	Santa Barbara	LCF-32
USS Minneapolis-Saint Paul	LCF-21			USS Charleston	LCF-18	Augusta	LCF-34
				USS Cincinnati	LCF-20	Kingsville	LCF-36
						Plains	LCF-38





Independence Variant

Guided missile frigate

Constellation Class

Constellation	FFG-62
Compass	FFG-63
Chesapeake	FFG-64




Amphibious

Amphibious assault ship

America Class LHA

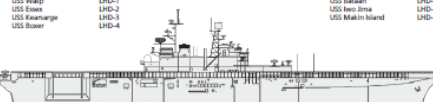
USS America	LHA-6
USS Tripoli	LHA-7
Bougainville	LHA-8



Wasp Class LHD

USS Wasp	LHD-1
USS Essex	LHD-2
USS Kearsarge	LHD-3
USS Bower	LHD-4


USS Bateman	LHD-5
USS New Irons	LHD-7
USS Makin Island	LHD-8



Amphibious transport dock

San Antonio Class LPD


USS San Antonio	LPD-17	USS Arlington	LPD-24	USS John P Murtha	LPD-26
USS New Orleans	LPD-18	USS Somerset	LPD-25	USS Portland	LPD-27
USS Mesa Verde	LPD-19			USS Fort Lauderdale	LPD-28
USS Green Bay	LPD-20			Richard M McCool Jr	LPD-29
USS New York	LPD-21			Hannburg	LPD-30
USS San Diego	LPD-22			Pittsburgh	LPD-31
USS Anchorage	LPD-23				



Dock landing ship


Harpers Ferry Class LSD

USS Harpers Ferry	LSD-40
USS Carter Hall	LSD-50
USS Carl Hall	LSD-51
USS Pearl Harbor	LSD-52



Whidbey Island LSD


USS Germantown	LSD-42	USS Tortuga	LSD-46
USS Gannett Hall	LSD-44	USS Rushmore	LSD-47
USS Comstock	LSD-45	USS Ashland	LSD-48



Command ship

Blue Ridge Class LCC

USS Blue Ridge	LCC-19
USS Mount Whitney	LCC-20



- Commissioned as “United States Ship” (USS)
- Designed to Navy/MIL Standards
- Modernization tightly controlled by Technical Warrant Holders at Naval Sea Systems Command (NAVSEA)
- Non-developmental upgrades generally preferred
- New construction performed at private shipbuilding with NAVSEA overseeing contracts
- Space, Weight, Power, and Cooling limited (very limited)

Ships of Military Sealift Command (MSC)

COMBAT LOGISTICS FORCE

FLEET OILER (PM1)

Fleet Replenishment Oiler



Length: 785 Feet, Beam: 120 Feet
Displacement: 49,550 Tons

T-AO 205 USNS John Lewis



Length: 678 Feet, Beam: 98 Feet
Displacement: 40,900-41,225 Tons

T-AO 187 USNS Henry J. Kaiser
T-AO 188 USNS Joshua Humphreys
T-AO 189 USNS John Lenthall
T-AO 194 USNS John Ericsson
T-AO 195 USNS Jerey Gramman
T-AO 196 USNS Kianwa
T-AO 197 USNS Pease
T-AO 198 USNS Sig Horn
T-AO 199 USNS Tippecanoe
T-AO 200 USNS Guadalupe
T-AO 201 USNS Portlock
T-AO 202 USNS Yukon
T-AO 203 USNS Laramie
T-AO 204 USNS Proppahamock

FLEET ORDNANCE AND DRY CARGO (PM6)

Dry Cargo/Ammunition



Length: 489 Feet, Beam: 106 Feet
Displacement: 45,300 Tons

T-AK 1 USNS Lewis and Clark (Prepositioning)
T-AK 2 USNS Seagawag (Prepositioning)
T-AK 3 USNS Ben Shepard
T-AK 4 USNS Richard E. Byrd
T-AK 5 USNS Robert E. Peary
T-AK 6 USNS Amelia Earhart
T-AK 7 USNS Carl Brashear
T-AK 8 USNS Wiley Schirra
T-AK 9 USNS Matthew Perry
T-AK 10 USNS Charles Drew
T-AK 11 USNS Washington Chambers
T-AK 12 USNS William McLean
T-AK 13 USNS Medgar Evers
T-AK 14 USNS Cesar Chavez

Fast Combat Support



Length: 764 Feet, Beam: 107 Feet
Displacement: 45,500 Tons

T-AOE 6 USNS Supply
T-AOE 8 USNS Arctic

FLEET SUPPORT AND SPECIAL MISSION

SPECIAL MISSION (PM2)

Missile Range Instrumentation



Length: 524 Feet, Beam: 69 Feet
Displacement: 12,642 Tons

T-AGM 216 USNS Howard O. Lorenzen

Ocean Surveillance



Length: 235 Feet, Beam: 54 Feet
Displacement: 3,384 Tons

T-AGOS 19 USNS Victorious
T-AGOS 20 USNS Able
T-AGOS 21 USNS Effective
T-AGOS 22 USNS Loyalty



Length: 292 Feet, Beam: 90 Feet
Displacement: 5,370 Tons

T-AGOS 23 USNS Impeccable



Length: 292 Feet, Beam: 64 Feet
Displacement: 3,611 Tons

HOS Red Rock (SURTASS-E)

Oceanographic Survey



Length: 329-353 Feet, Beam: 58 Feet
Displacement: 5,000 Tons

T-AGS 60 USNS Pathfinder
T-AGS 62 USNS Bowditch
T-AGS 63 USNS Hanson
T-AGS 64 USNS Bruce G. Heezen
T-AGS 65 USNS Mary Sears
T-AGS 66 USNS Maury

Sea-Based X-Band Radar



Length: 389 Feet, Beam: 238 Feet
Displacement: 32,600 Tons

SBX-1 Sea-based X-band Radar



Length: 238 Feet, Beam: 42 Feet
Displacement: 9,082 Tons

MV Hercules

Navigation Test Support



Length: 442 Feet, Beam: 69 Feet
Displacement: 12,208 Tons

T-AGS 46 USNS Waters

Cable Laying/Repair



Length: 513 Feet, Beam: 73 Feet
Displacement: 18,174 Tons

T-ARC 7 USNS Zeus



Length: 478 Feet, Beam: 72 Feet
Displacement: 16,158 Tons

CS Global Sentinel

Submarine Support



Length: 250 Feet, Beam: 54 Feet
Displacement: 2,850 Tons

T-AGSE 1 USNS Black Powder
T-AGSE 2 USNS Westwind
T-AGSE 3 USNS Eaglebow
T-AGSE 4 USNS Arrowhead

PREPOSITIONING AND SEABASING (PM3)

Maritime Prepositioning Force, LMSR, RO/RO, Expeditionary Transfer Dock



Length: 673 Feet, Beam: 100 Feet
Displacement: 46,111 Tons

T-ARL 3008 USNS 2ND Lt John R. Bobo
T-ARL 3009 USNS PFC Derwyns L. Williams
T-ARL 3010 USNS 1ST LT Edmundo Lopez
T-ARL 3011 USNS 1ST Lt Jack Lummaa
T-ARL 3012 USNS SGT William R. Button



Length: 950 Feet, Beam: 106 Feet
Displacement: 62,644 Tons

T-ARL 302 USNS Seay
T-ARL 304 USNS Pilsbury
T-ARL 311 USNS Bider
T-ARL 312 USNS Dahl



Length: 907 Feet, Beam: 105 Feet
Displacement: 55,123 Tons

T-ARL 3017 USNS OSGT Fred W. Stockham



Length: 784 Feet, Beam: 164 Feet
Displacement: 77,385 Tons

T-ESD 1 USNS Montford Point
T-ESD 2 USNS John Glenn

Offshore Petroleum Distribution System



Length: 348 Feet, Beam: 70 Feet
Displacement: 5,992 Tons

T-AG 5001 USNS ADM K.R. Wheeler



Length: 360 Feet, Beam: 30 Feet
Displacement: 611 Tons

T-AG 4907 USNS Fast Tempo

Expeditionary Sea Base

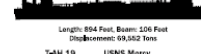


Length: 784 Feet, Beam: 164 Feet
Displacement: 106,644 Tons

ESB 3 USNS Lewis B. Puller
ESB 4 USNS Harshel "Woody" Williams
ESB 5 USNS Miguel Keith
ESB 6 USNS John L. Clerkley

SERVICE SUPPORT (PM4)

Hospital



Length: 864 Feet, Beam: 105 Feet
Displacement: 69,552 Tons

T-AH 19 USNS Merry
T-AH 20 USNS Comfort

Rescue and Salvage



Length: 255 Feet, Beam: 51 Feet
Displacement: 3,338 Tons

T-ARS 51 USNS Grasp
T-ARS 52 USNS Salvor

Submarine Tender



Length: 444 Feet, Beam: 95 Feet
Displacement: 23,020 Tons

AS 39 USNS Emory S. Land
AS 40 USNS Frank Cable

Submarine and Special Warfare Support



Length: 240 Feet, Beam: 54 Feet
Displacement: 3,955 Tons

MV HOS Dominator



Length: 310 Feet, Beam: 52 Feet
Displacement: 1,657 Tons

MV Kille Chouest



Length: 117 Feet, Beam: 22 Feet
Displacement: 140,95 Tons

MV Madama

Fleet Ocean Tug



Length: 226 Feet, Beam: 42 Feet
Displacement: 2,266 Tons

T-ATF 168 USNS Cetaewa



Length: 276 Feet, Beam: 60 Feet
Displacement: 4,065 Tons

MV Gary Chouest

Command



Length: 626 Feet, Beam: 108 Feet
Displacement: 18,000 Tons

LCC 20 USNS Mount Whitney

Fleet Experimentation



Length: 262 Feet, Beam: 60 Feet
Displacement: 3,183 Tons

OSV Ocean Valor



Length: 250 Feet, Beam: 54 Feet
Displacement: 4,263 Tons

OSV HOS Resolution

EXPEDITIONARY FAST TRANSPORT (PM8)

Expeditionary Fast Transport



Length: 338 Feet, Beam: 94 Feet
Displacement: 2,400 Tons

TEFF 1 USNS Spearhead
TEFF 2 USNS Chickaw County
TEFF 3 USNS Millwood
TEFF 4 USNS Fish River
TEFF 5 USNS Trenton
TEFF 6 USNS Drowswick
TEFF 7 USNS Carson City
TEFF 8 USNS Yuma
TEFF 9 USNS City of Elizabeth
TEFF 10 USNS Burlington
TEFF 11 USNS Puerto Rico
TEFF 12 USNS Newport
TEFF 13 USNS Applebeck

High-Speed Transport



Length: 373 / 379 Feet, Beam: 78 Feet
Displacement: 1,646 Tons

HST 1 USNS Guam
HST 2 Formerly MV Alaska

COMBATANT COMMAND SUPPORT

PREPOSITIONING (PM5)

Army Prepositioned Stocks LMSR and Container



Length: 950 Feet, Beam: 106 Feet
Displacement: 62,644 Tons

T-ARL 310 USNS Watson
T-ARL 313 USNS Red Cloud
T-ARL 314 USNS Cloudcroft
T-ARL 315 USNS Winston
T-ARL 316 USNS Pomeroy
T-ARL 317 USNS Soderman



Length: 844 Feet, Beam: 106 Feet
Displacement: 60,079 Tons

T-AK 4543 MV LTC John LD. Page
T-AK 4544 MV SSG Edward A. Carter Jr.

Air Force Container



Length: 652 / 680 Feet, Beam: 105 / 99 Feet
Displacement: 48,012 / 53,878 Tons

T-AK 4396 MV MAJ Bernard F. Fisher
T-AK 5362 MV CAPT David L. Lyon

DRY CARGO AND TANKERS

Dry Cargo



Length: 423 Feet, Beam: 69 Feet
Displacement: 9,295 Tons

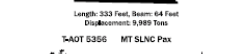
T-AK 5423 SLNC Corsica

Tankers



Length: 603 Feet, Beam: 106 Feet
Displacement: 58,746 Tons

T-AOT 5193 MT Empire State
T-AOT 5205 MT Evergreen State



Length: 333 Feet, Beam: 64 Feet
Displacement: 9,989 Tons

T-AOT 5356 MT SLNC Pax



Length: 601 Feet, Beam: 106 Feet
Displacement: 62,374 Tons

T-AOT 5419 MT SLNC Goodwin




Length: 600 Feet, Beam: 131 Feet
Displacement: 65,200 Tons

T-AOT 5563 MT Stena Polaris

MSC - Combat Logistics Force (CLF)


FLEET OILER (PM1)

Fleet Replenishment Oiler



Length: 746 Feet, Beam: 106 Feet
Displacement: 49,850 Tons

T-AO 205 USNS John Lewis




Length: 678 Feet, Beam: 98 Feet
Displacement: 40,900 - 41,225 Tons

T-AO 187	USNS Henry J. Kaiser
T-AO 188	USNS Joshua Humphreys
T-AO 189	USNS John Lenthall
T-AO 194	USNS John Ericsson
T-AO 195	USNS Leroy Grumman
T-AO 196	USNS Kanawha
T-AO 197	USNS Pecos
T-AO 198	USNS Big Horn
T-AO 199	USNS Tippecanoe
T-AO 200	USNS Guadalupe
T-AO 201	USNS Patuxent
T-AO 202	USNS Yukon
T-AO 203	USNS Laramie
T-AO 204	USNS Rappahannock

FLEET ORDNANCE AND DRY CARGO (PM6)


Dry Cargo/Ammunition



Length: 689 Feet, Beam: 106 Feet
Displacement: 41,000 Tons

T-AKE 1	USNS Lewis and Clark
T-AKE 2	USNS Sacagawea
T-AKE 3	USNS Alan Shepard
T-AKE 4	USNS Richard E. Byrd
T-AKE 5	USNS Robert E. Peary
T-AKE 6	USNS Amelia Earhart
T-AKE 7	USNS Carl Brashear
T-AKE 8	USNS Wally Schirra
T-AKE 9	USNS Matthew Perry
T-AKE 10	USNS Charles Drew
T-AKE 11	USNS Washington Chambers
T-AKE 12	USNS William McLean
T-AKE 13	USNS Medgar Evers
T-AKE 14	USNS Cesar Chavez

Fast Combat Support



Length: 754 Feet, Beam: 107 Feet
Displacement: 48,500 Tons

T-AOE 6	USNS Supply
T-AOE 8	USNS Arctic

- Designated United States Naval Ships (USNS)
- Designed to American Bureau of Shipping (ABS) Steel Vessel Rules
- Modernization controlled by the Technical Directorate at the Military Sealift Command
- New construction performed by private shipbuilders, but NAVSEA and MSC oversee requirements development and contract oversight
- Generally, Space, Weight, Power, and Cooling margins are available

30 Year Shipbuilding Plan

Three “alternatives” described in the plan. Alternative 2 shown here (327 ships by 2052).

- Reducing Large Surface Combatant inventory by 20 ships (DDG-51 Class, then DDG(X) starting around 2035).
- Increasing Small Surface Combatant inventory by 23. Retiring LCS platforms, then adding FFG-62 Class starting in 2026.
- Increasing Amphibious Warfare inventory by 14. Includes LPD-17 Class, LHA-6 Class, and future Light Amphibious Warship.
- Increasing Combat Logistics Force inventory by 18. Retiring T-AO 187 for T-AO 205. Next Generation Logistics Ship in planning.

Fiscal Year	23	24	25	26	27	ALTERNATIVE 2					28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Aircraft Carrier			1								1								1					1					1						1
Large Surface Combatant	3	2	3	3	3		4	1	4	2	5					1		1	2	1	2	2	2	1	2	2	1	2	1	2	1	2	2	1	
Small Surface Combatant	3	4		1	1		2	1	2	2	1					2	2	2	1	1	2	2	2	3	2	3	2	3	2	2	2	2	2	2	2
Attack Submarines	1	2	2	2	1		3	1	2	3						2	2	6	2	2	2	2	1	2	2	3	2	3	2	2	3	3	2	2	3
Ballistic Missile Submarines							1			1	1					1	1	1	1	1	1	1	1												
Cruise Missile Submarines																										1			1				1		
Amphibious Warfare Ships	1		2		1		1	4	1	1	1					1	2	3	2	1	1	1	2	1				2	1	1	3	2	4	2	
Combat Logistics Force	2	1	2	1	1		2	3	2	2	1					3	2	3	3	2	3	3					2		1	2	3	3	3	1	
Support Vessels	2	5	4	4	2		1	2	2	2	1																								
Total Ship Deliveries	12	15	13	11	9		12	14	12	12	14					9	10	15	10	10	9	11	6	9	6	8	7	9	8	9	10	12	12	13	10

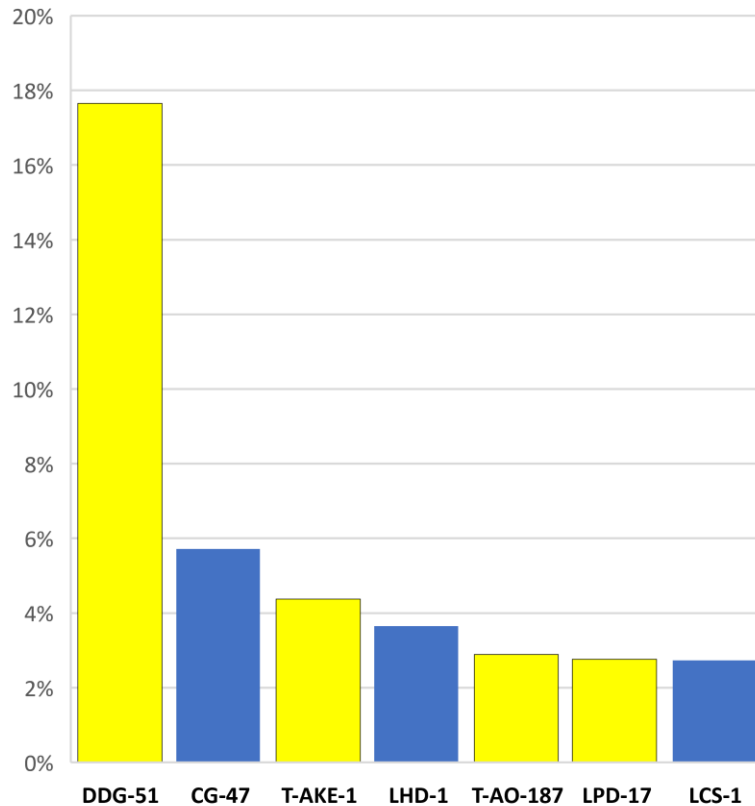
Battle Force Delivery Plan

Fiscal Year	23	24	25	26	27	ALTERNATIVE 1-3					28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Aircraft Carrier			-1	-1							-1								-1			-1		-1				-1		-1					
Large Surface Combatant	-5	-3	-3	-4	-3		-2	-3	-7	-5	-4					-2	-4					-2	-4	-3	-3	-4	-4	-2	-2	-2	-3	-2	-2	-1	
Small Surface Combatant	-9	-2	-4	-4	-4																			-2	-3	-1	-2	-2	-5	-2	-4				
Attack Submarines	-2	-2	-2	-3	-1		-2		-3	-1	-1					-3	-1	-1		-1	-5	-1	-2	-3		-2	-1	-1	-1	-1	-1	-2	-2		
Ballistic Missile Submarines				-2	-1		-1																												
Cruise Missile Submarines				-1			-1	-1	-1	-1	-1					-1	-1	-1	-1	-1	-1	-1		-1	-1										
Amphibious Warfare Ships	-4	-4	-1	-1			-1			-1					-1	-1	-1	-1	-1				-1				-1	-2	-2	-4	-2	-1	-4		
Combat Logistics Force	-2		-1	-3	-1		-2	-1							-1	-2	-1	-1	-1	-1								-1	-2	-2	-4	-3	-3	-1	
Support Vessels	-2	-2	-1	-1	-1		-1	-1	-1	-3	-1				-2	-2	-1	-2	-1	-1	-2	-2			-1	-1	-1	-1	-1					-2	
Total Ship Retirements	-24	-13	-13	-14	-13		-7	-8	-13	-10	-9					-9	-10	-5	-4	-6	-8	-4	-7	-9	-8	-9	-7	-8	-13	-10	-16	-9	-8	-8	

Battle Force Retirement Plan

Targets for Navy Ship Decarbonization Research

FY21 Fuel Use by Platform as % of Total Demand



Near – Mid Term

- **DDG-51:** Still being delivered, will replace CG-47 over the next 7 years, and drives demand for CLF ships (T-AO, T-AOE, and T-AKE)
 - Uses Gas Turbine Engines Only
- **T-AKE:** Relatively new, and will be around 20+ years
- **T-AO 205:** T-AO 187 Class near end-of-service-life, being replaced with T-AO 205
- **LPD-17:** Ships still being delivered, with 30-year service life

Mid-Long Term

- Concepts for **Next Generation Logistics Ship**, **Light Amphibious Warship**, and the next Large Surface Combatant (**DDG(X)**) are in development.
- Unmanned Surface Ships and other unmanned/asymmetric capabilities and concepts could leverage “developmental” technologies

Navy Technology Readiness Levels

TRL	Definitions
1	Basic principles observed and reported.
2	Technology concept and/or application formulated.
3	Analytical and experimental critical function and/or characteristic proof of concept.
4	Component and/or breadboard validation in a laboratory environment.
5	Component and/or breadboard validation in a relevant environment .
6	System/sub-system model or prototype demonstration in a relevant environment .
7	System prototype demonstration in an operational environment .
8	Actual system completed and qualified through test and demonstration.
9	Actual system proven through successful mission operations.

For transition/fielding technologies on ships, think “**relevant operational environment**”

DDG-51



LPD-17



T-AO 205



T-AKE 1 & DDG-1000



Cayle Bradley

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<https://www.navsea.navy.mil/Home/Team-Ships/Media-Gallery/PhotoGallery/>
<https://www.msc.usff.navy.mil/Ships/Ship-Inventory/>