Offshore Wind Industry Opportunities

Andy Geissbuehler

Virginia Energy Plan Listening Session on Offshore Wind Energy

Christopher Newport University

25 July 2018

BVGassociates

Offshore Wind Industry Opportunities

US offshore wind market today

30 MW in commercial operation (Block Island)

~ 1.9 GW of active Power Purchase Agreements (PPA's)

12 active BOEM leases, large enough for ~30 GW ~ 3,000 WTGs

More BOEM leases and PPA's scheduled for 2018 and years to come

© BVG Associates 2018

BVG Associates

Our clients choose us when they want to do new things, think in new ways and solve tough problems

Who we are, and what we do

Founded in 2006

Over 270 Clients

170 years staff industry experience

49 landmark publications

Economics

LCOE/NPV Modelling

Supply chain analysis

Economic impact

Business

Market assessment

Business strategies

Industry enablement

Technology

Due diligence

Asset management

Technology support

Onshore wind

Offshore wind

Wave and tidal

Energy Systems

© BVG Associates 2018

BVG Associates

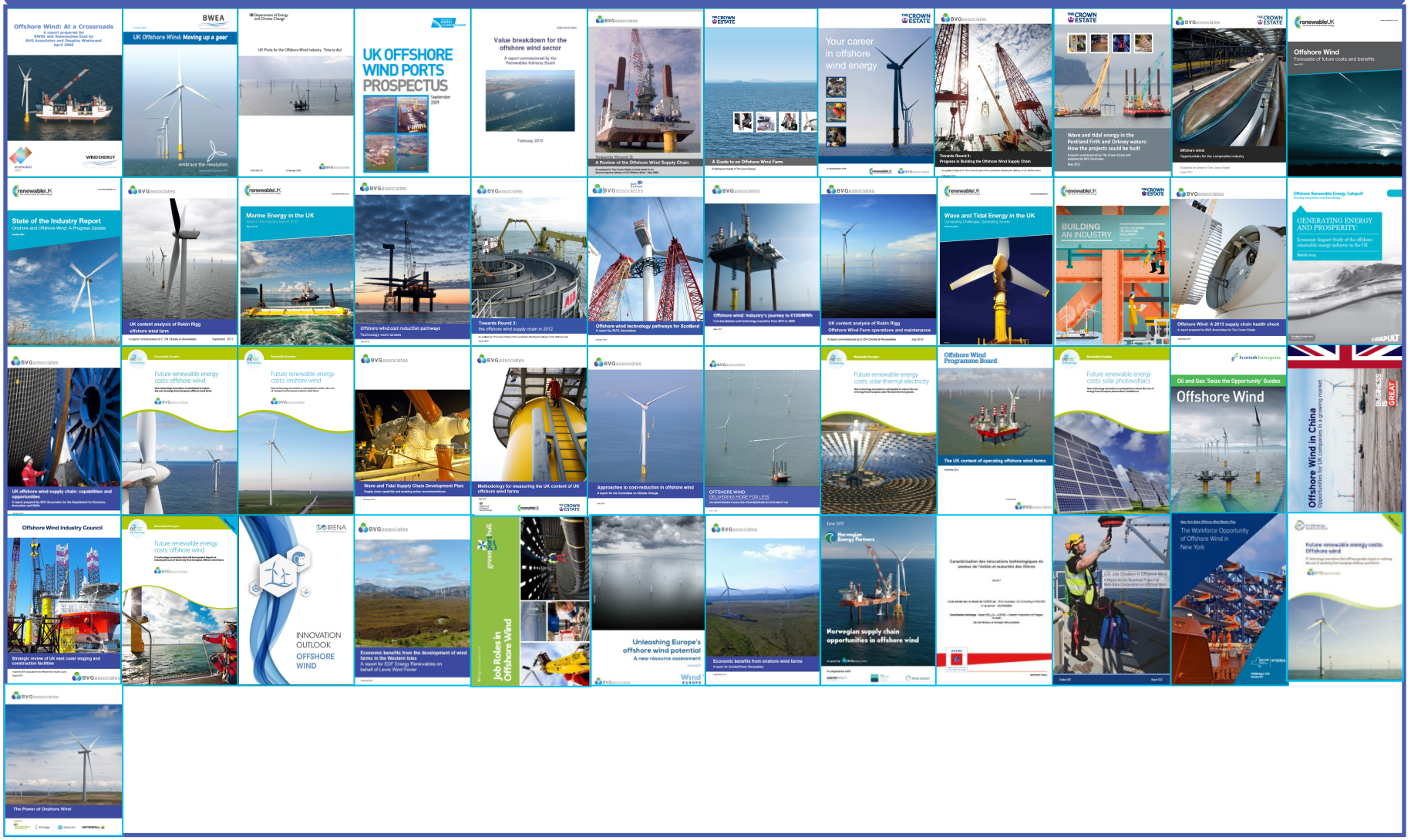
Public reports

2006-11

2011-14

2014-16

2016/18

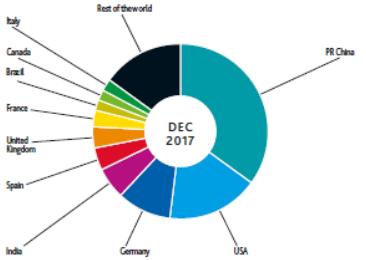


© BVG Associates 2018

Offshore Wind Industry Opportunities

Onshore and offshore market sizes - by end 2017 - GWEC

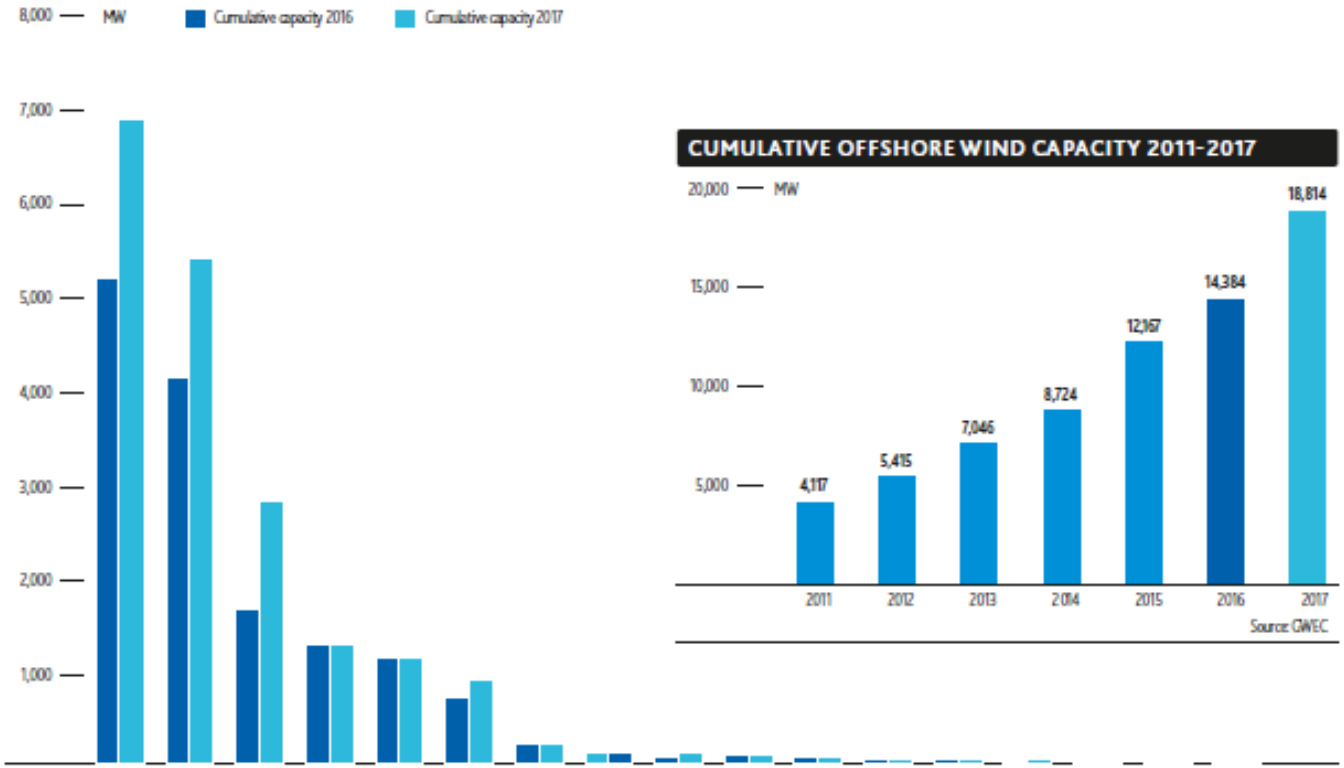
TOP 10 CUMULATIVE CAPACITY DEC 2017



Country	MW	% Share
PR China	188,392	35
USA	89,077	17
Germany	56,132	10
India	32,848	6
Spain	23,170	4
United Kingdom	18,872	4
France	13,759	3
Brazil	12,763	2
Canada	12,239	2
Italy	9,479	2
Rest of the world	82,391	15
Total TO P10	456,732	85
World Total	539,123	100

Source: GWEC

GLOBAL CUMULATIVE OFFSHORE WIND CAPACITY IN 2017



CUMULATIVE OFFSHORE WIND CAPACITY 2011-2017

Source: GWEC

	UK	Germany	PR China	Denmark	Netherlands	Belgium	Sweden	Vietnam	Finland	Japan	South Korea	United States	Ireland	Taiwan	Spain	Norway	France	Total
Total 2016	5,156	4,108	1,627	1,271	1,118	712	202	99	32	60	35	30	25	0	5	2	0	14,483
New 2017	1,680	1,247	1,164	0	0	165	0	0	60	5	3	0	0	8	0	0	2	4,334
Total 2017	6,836	5,355	2,788	1,271	1,118	877	202	99	92	65	38	30	25	8	5	2	2	18,814

Source: GWEC

© BVG Associates 2018

Offshore Wind Industry Opportunities

US Offshore market growth

Project pipeline with PPA's awarded (per July 2018)

Developer	Project	State	MW	COD
Deepwater Wind	South Fork	NY	90	2019
Deepwater Wind	Skipjack	MD	120	2021
Deepwater Wind	Revolution Wind	RI	400	2023
Deepwater Wind	Revolution Wind	CT	200	2023
US Wind	Maryland	MD	248	2020
Vineyard Wind (CIP/Avangrid)	Vineyard Wind	MA	800	2022
Total - active			**1,858**	

Upcoming offtake agreements (per July 2018)

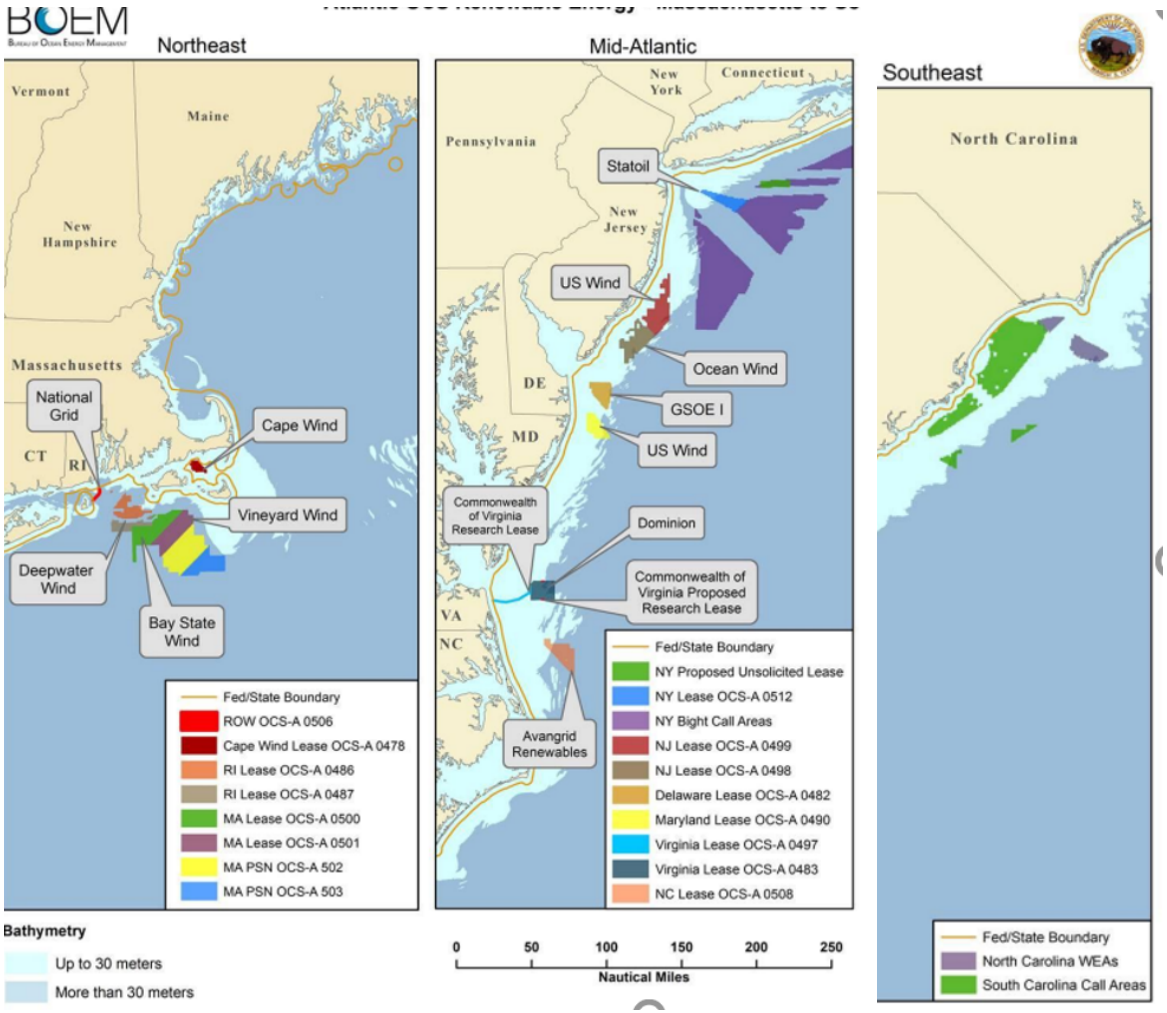
Developer	Project	State	MW	Bid	Award	COD
Dominion / Orsted	Coastal Virginia OSW	VA	12	N/A		2020
EDF	Fishermens	NJ	24	N/A		2020
UMaine	Alpha Ventus (floating)	ME	12	N/A		2020
Orsted/CIP_Avangrid/DWW	Massachusetts #2	MA	800	Q2 2019	2020	
Equinor/Orsted/CIP/Av./DWW	NY Bight	NY	800	Q4 18	TBD	
Equinor/Orsted/DWW/USWind	TBD	NJ	1,100	Q4 18	TBD	
	TBD					
Total - upcoming			**2,748**			

Grand Total known & announced	**4,606**

© BVG Associates 2018

Offshore Wind Industry Opportunities

US East Coast offshore wind lease areas



© BVG Associates 2018

Offshore Wind Industry Opportunities

US East Coast industry growth

North East scaling up enables BUSINESS CASE for wave #2 - Midatlantic and wave #3 – West Coast

→ US learning curve catching up

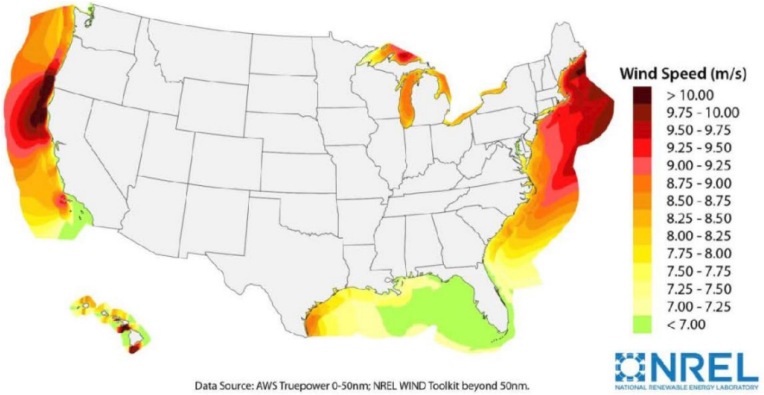
→ Developers / owner / operators building moderate scale

→ US supply base & marine logistics following evolving demand

→ European Levelized Cost of Energy (LCoE) improvements materializing

→ Waves #2 and #3 enabled to secure business case

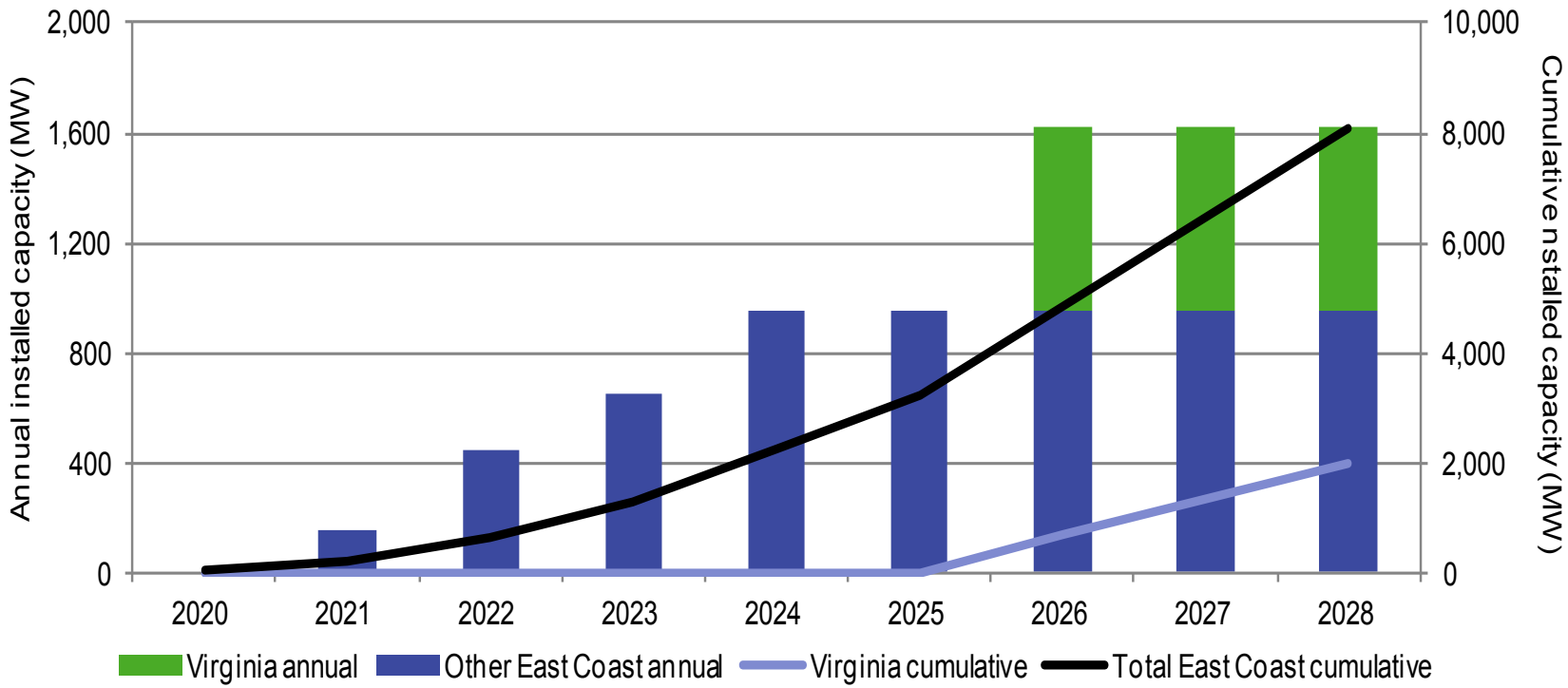
→ US economic benefit accelerating



© BVG Associates 2018

Offshore Wind Industry Opportunities

Scenario for Virginia and the rest of the Atlantic coast by the end of 2030



© BVG Associates 2018

Offshore Wind Industry Opportunities

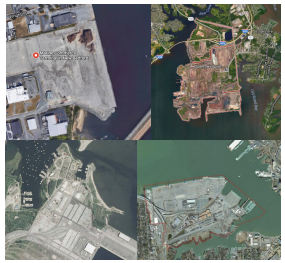
Manufacturing port model

O & M

Project management

Component manufacturing

Community integration



Component assembly

Workforce training

Installation logistics

Industrial services

R&D and testing

Engineering & prototyping

Bremerhaven

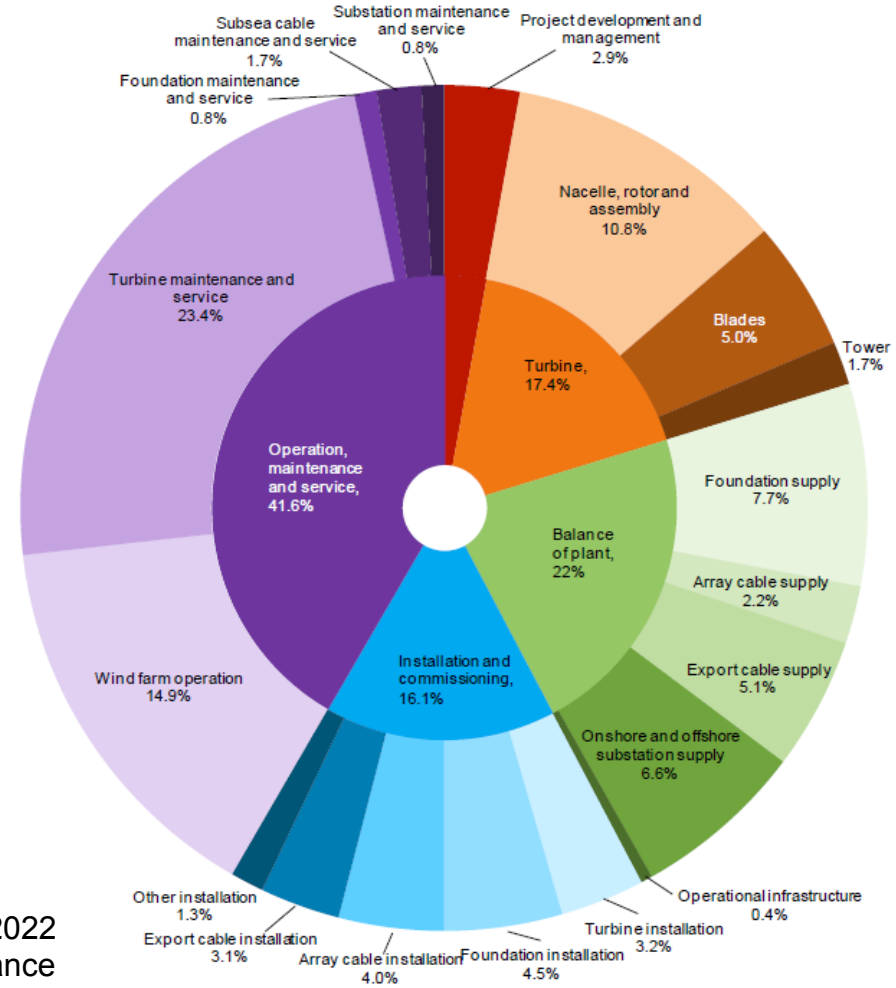
30 MW → 90 MW → 120 MW + → 400 MW → Scaling takes off → Cost reduction follows → **Cumulative >5 GW**

© BVG Associates 2018

Offshore Wind Industry Opportunities

Typical scope break down

Bladt Industries - Denmark

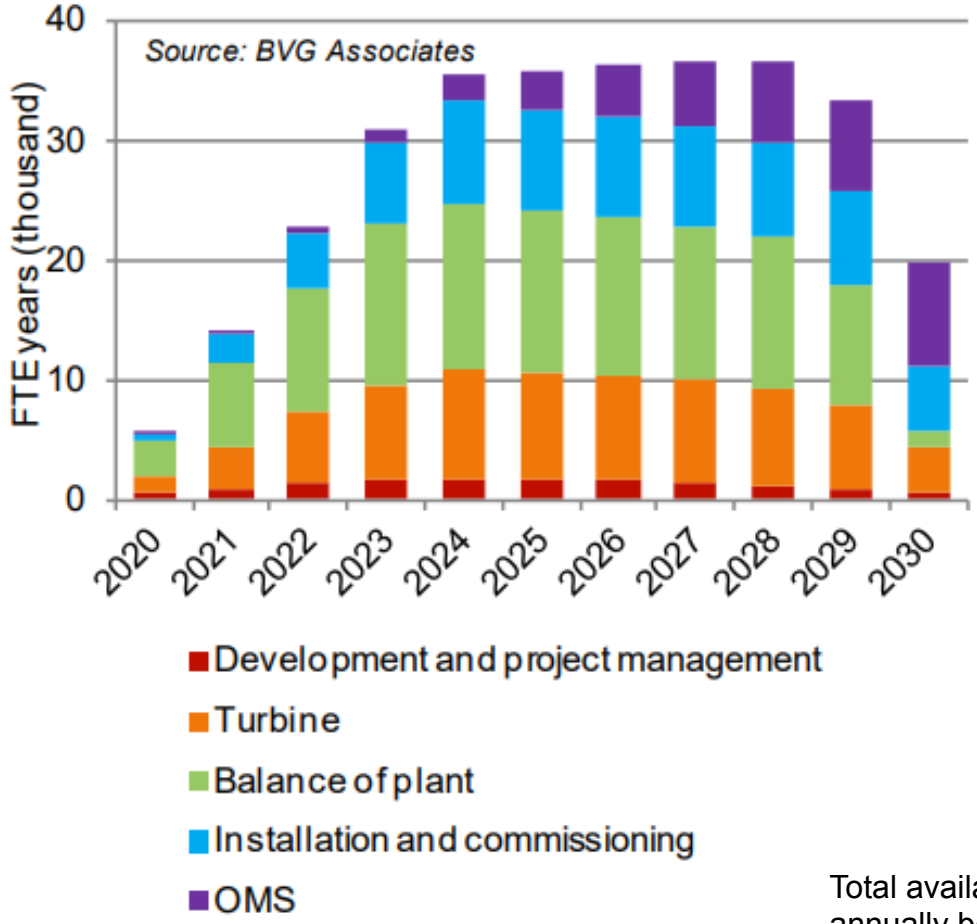


Anticipated US Offshore Windfarm costs for 2022
BVG Associates for Clean Energy States Alliance

© BVG Associates 2018

Offshore Wind Industry Opportunities

Job creation potential for 8 GW scenario



Total available direct and indirect FTE years created annually between 2020 and 2030 (8GW scenario)

© BVG Associates 2018