Comparing Offshore Wind Energy Procurement and Project Revenue Sources Across U.S. States

Philipp Beiter[1], Jenny Heeter[1], Paul Spitsen[2], and David Riley[1]

1 National Renewable Energy Laboratory
2 U.S. Department of Energy

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Executive Summary

The pace of offshore wind energy procurement in the United States has rapidly accelerated in recent years. U.S. states along the Atlantic Coast have set procurement goals for offshore wind energy to meet renewables portfolio standards and serve state policy needs. By the end of 2019, projects with a total capacity of 6.4 gigawatts had established long-term contracts or equivalent regulatory requirements with utility off-takers. The prices established in these contracts since 2017 have been well below expectations from many industry observers, prompting stakeholders to compare price levels across U.S. states and globally. However, comparing procurement prices across projects and jurisdictions is often challenging because of differences in project parameters, support regimes, and the applicable tax and regulatory environment. These characteristics provide critical context for understanding project revenue streams, delivery obligations, and risk allocation, which need to be accounted for when comparing across different projects. In combination, variation in these characteristics between projects results in measurable differences in project costs and revenue and, consequently, in different offer bids.

In this report, we systematically analyze offshore wind energy support regimes across U.S. states. The comparison is made along several dimensions, including statutory authority, solicitation procedures, procurement goals and awards, and the structuring of physical and transactional delivery of energy services. We find that state agencies and utilities have deployed two procurement instruments to date, which are both awarded through competitive bidding procedures. In Massachusetts, Rhode Island, and Connecticut, states have mandated utilities to enter power purchase agreements (PPAs) with offshore wind generators for a specified nameplate capacity. PPAs are standardized long-term contractual agreements for the purchase of power from a specific renewable energy generator (i.e., the seller) to a purchaser of electricity (i.e., the buyer). The second procurement instrument, competitive bidding for offshore wind renewable energy certificates (ORECs), has been adopted for solicitations in New Jersey, Maryland, and New York. ORECs represent the environmental attributes of one megawatt-hour of electric generation from an offshore wind project and are used to comply with state offshore wind-specific renewables portfolio standard provisions. Both procurement instruments have been awarded competitively based on price offers and other criteria (e.g., economic development, ratepayer, and environmental impacts). They provide a high degree of hedging benefits against otherwise fluctuating prices for delivered services (i.e., the generator receives a fixed price for services delivered, regardless of the price that the generation sells for in the wholesale market). The resulting de-risked revenue profile creates a degree of financial certainty that is often needed for securing long-term project financing.

The two policy instruments have originated within the federal and specific state regulatory environments and through policy diffusion from one state to another. The Federal Power Act and recent court decisions (e.g., Hughes v. Talen 2016) have stipulated that states incentivizing generation with certain environmental attributes do not require the generator to participate in a federally regulated market. In effect, these legal provisions prevent U.S. states from using European-style contract for difference schemes, which have been deployed in recent auctions of established offshore wind markets in the United Kingdom, Germany, Denmark, and the Netherlands. The report discusses how U.S. support regimes and procurement compare conceptually to those in established offshore wind markets in Northern Europe.

The content of this report was derived from a literature review, primarily regulatory filings and summary reports, and 16 interviews with leading industry experts from state agencies, energy sector consultancies, and law practices. The findings from this report are intended to inform validation of bottom-up cost estimates and a future research effort to comparatively assess revenue profiles of U.S. and global offshore wind projects.

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1 Introduction

The pace of offshore wind energy procurement in the United States has rapidly accelerated in recent years. U.S. states along the Atlantic Coast have set procurement goals for offshore wind energy to meet Renewable Portfolio Standards (RPS) and serve state policy needs. By the end of 2019, projects with a total capacity of 6.4 gigawatts (GW) had established long-term contracts or equivalent regulatory requirements with utility off-takers. The prices established in these contracts since 2017 have been well below expectations from many industry observers, prompting stakeholders to compare price levels across U.S. states and globally. However, comparing procurement prices across projects and jurisdictions is often challenging because of differences in project parameters, support regimes, and the applicable tax and regulatory environment. These characteristics provide critical context for understanding project revenue streams, delivery obligations, and risk allocation, which need to be accounted for when comparing across different projects. In combination, variation in these characteristics between projects results in measurable differences in project costs and revenue and, consequently, in different offer bids.

Support regimes are used by government entities to provide economic incentives for investment in various types of electricity generation, including offshore wind. In this report, we systematically analyze offshore wind energy support regimes across U.S. states. Because offshore wind energy procurement prices from U.S. projects are often compared not only among states but also with European tenders, this report also provides an overview of support regimes and taxonomy used in European offshore wind markets. Offshore wind energy procurement is set within the broader legal, regulatory, and policy framework of renewable energy contracting in each state. This framework includes but is not limited to established contract structures, responsible state authorities, state agency competences, tax provisions, and RPS and clean energy standards.[1] The comparison between U.S. states focuses on several dimensions, including statutory authority, solicitation procedures, procurement goals and awards, and the structuring of physical and transactional delivery of energy services. The content of this report was derived from a literature review, primarily regulatory filings and summary reports, and 16 interviews with leading industry experts from state agencies, energy sector consultancies, and law practices.

This report is intended to inform validation of bottom-up cost estimates and provide a systematic comparison of U.S. offshore wind procurement mechanisms. We will use the findings from this report in a future research effort to comparatively assess revenue profiles of U.S. and global offshore wind projects. An understanding of the policy instruments and procurement mechanisms implemented by U.S. states helps to identify whether the compensation for a particular energy service delivered by an offshore wind generator (e.g., energy, capacity, environmental attributes, ancillary services) is covered under a support regime or subject to participation in wholesale markets. If the remuneration and delivery obligations for an energy service are set forth in a support regime, project revenue needs to be modeled according to the terms and design of the support regime. If an energy service is sold directly on the spot market or through a bilateral agreement, a different set of modeling assumptions might apply (e.g.,

[1] A clean energy standard can include generation from zero- or low-carbon sources, such as nuclear generation (see e.g., the New York State clean energy standard).

projections about future electricity or capacity prices). A comprehensive accounting of expected project revenue can serve as a critical reference point for validating bottom-up cost modeling estimates of U.S. offshore wind projects, which, to date, have made limited cost and experience data available.

The report is structured as follows: Section 2 provides an overview of the taxonomy used in this report covering common offshore wind policy instruments and procurement terminology used in the United States and Europe; Section 3 compares support regimes across U.S. states with respect to statutory authority and solicitation procedures, and provides a summary of state procurement goals and awards; and Section 4 provides an analysis of procurement structures of U.S. states for commonalities and differences in the physical and transactional delivery of energy services. Conclusions are drawn in Section 5.

2 A Taxonomy of Global and U.S. Offshore Wind Energy Procurement Structures

Throughout this report, we will refer to a set of regulatory and financial procurement terminology applicable to the U.S. and global offshore wind energy sector. In the broader literature on renewable energy auctions and procurement, key terms are often used interchangeably (Hochberg and Poudineh 2018). Hence, in this section, we introduce a taxonomy of policy instruments (Section 2.1) and general procurement structures (Section 2.2), as well as common terminology used in the offshore wind sector in Northern Europe and the United States. This section introduces U.S. state policy instruments for the sole purpose of illustrating how they can broadly be distinguished from those used in Europe. We consider this necessary because price comparisons are often made between the nascent United States and more mature Northern European offshore wind markets. The design and implementation of U.S. procurement mechanisms and how they vary between U.S. states are described in greater detail in Section 3 and Section 4 of this report, as well as in the appendices.

2.1 Policy Instruments

Offshore wind support regimes can broadly be distinguished by the policy instruments and their specific design (e.g., duration, requirements, and penalties) used to incentivize generation from a power system asset. In the global renewable and offshore wind energy market, several instruments are common:[2]

- Feed-in tariffs (FITs)
- Feed-in premiums (FIPs) (with a fixed or sliding premium)
- Competitive bidding for a (floating-to-fixed) contract instrument (e.g., Power Purchase Agreements [PPAs],[3] renewable energy certificates [RECs])
- RECs[4]
- Tax credit and relief.

The revenue profile and risk exposure of these policy instruments is illustrated in Figure 1 and discussed in general terms in this section. Two main dimensions that characterize a policy instrument are the extent of the underlying commodity price hedge (x-axis in Figure 1),[5] and the mechanism for allocating the benefits of a policy instrument (y-axis in Figure 1). The policy instruments are presented here in simplified form. Real-world representations might deviate from this stylized representation and might be deployed in combination. The exact design of a policy instrument might also impact where these policy instruments fall on the two axes shown in

[2] See Polzin et al. (2019) for an overview of policy instruments used commonly in renewable energy markets. [3] PPAs are used as standardized long-term contractual agreements for the purchase of energy, capacity, energy services, and environmental attributes from a specific renewable energy generator (i.e., the seller) to a purchaser of electricity (i.e., the buyer) (Environmental Protection Agency 2019).

[4] A REC represents the environmental attributes of one megawatt-hour of electric generation from a renewable energy project and is used to meet compliance with renewables portfolio standard provisions, voluntary renewable energy sales, and sometimes emissions provisions.

[5] Throughout this report, (commodity) price risk is described from the perspective of a generator (versus e.g., a ratepayer or state agency), unless indicated otherwise.

Figure 1. In addition to these two dimensions represented in Figure 1, there are other design characteristics of offshore wind policy instruments, which include (but are not limited to):

- **Commodity price risk.** The exposure of a generator's financial performance from fluctuations in commodity prices (e.g., the market prices for wholesale energy, capacity, and environmental attributes).
- **Allocation mechanism**. The mechanism implemented to award one or several projects the benefit(s) of a policy instrument. The choice of an allocation mechanism can influence the risk of receiving support from a policy instrument (e.g., if the support to projects is awarded though a competitive bidding or auction process, there is usually higher risk than awarded through an administrative procedure).

- **Administrator.** The entity designing, administrating, implementing, and evaluating a policy instrument or renewable energy purchase. Several entities can serve as administrators to a policy instrument, including state agencies or utilities.
- **Offtaker.** The counterparty to a renewable energy contract buying the product from a generator (e.g., energy or environmental attributes). Typically, an offtaker to a renewable energy project is a utility or corporate entity, which each come with their own risk profile (e.g., as measured through their respective credit rating).
- **Reference price**. The price that forms the basis for calculating the benefits from a policy instrument. For instance, this can be the electricity price at the node or hub where a project interconnects with the bulk power system, or a composite index of a wider price zone that might be averaged over different time periods (e.g., hourly, 1–3 months).
- **Strike price.** A predetermined contract price at which a buyer and seller of energy agree to settle differences with the prevailing wholesale commodity (e.g., electricity) spot price. Typically, the strike price is also the lowest bid price in a renewable energy auction at which an offering is sold.
- **Indexation**. The periodic adjustment of the reference price to a price index (such as the Consumer Price Index).
- **Tenor**. The length of time of a financial or policy instrument. If a policy instrument's tenor is shorter than the financial lifetime of a project, the project might have a "merchant tail" (i.e., the period after expiration of the support regime when the project is fully exposed to wholesale market prices).
- **Prequalification criteria**. Requirements on projects that must be met to qualify for participation in bidding or award of a policy instrument (e.g., as demonstrated through material criteria [e.g., site control, relevant experience, permits, licenses, grid connection, environmental mitigation plans], financial criteria [e.g., bid bonds, power purchase agreements (PPAs), financial track record], or a combination of the two).
- **Nonexecution penalty**. The monetary and/or regulatory penalty imposed by an administrator if the generator does not meet contracted performance or construction requirements designated under the policy instrument. Sometimes awarded bidders are required to issue a bid bond, whereby administrators retain some or all of the bid bond security if the awarded bidder does not meet contracted performance or construction requirements or incurs delays in the delivery of services.
- **Development costs**. The cost of site selection, assessment, acquisition, and permitting can be allocated to a public body (e.g., federal or state government), a private entity (i.e., the developer), or shared between both.

- **Interconnection cost**. The cost of connecting a plant to the bulk power system (e.g., export cable(s), land-based cable(s), offshore substation(s), land-based substation(s), and any necessary transmission system upgrades) can be allocated to a public body (e.g., federal or state government), a private entity (i.e., the developer), or shared between both.
- **Delivery obligations during negative energy price events**. Delivery obligations and conditions for the seller during periods of negative wholesale electricity pricing.

Figure 1. Types of common policy instruments in global offshore wind procurement

Note: Figure 1 is intended for illustration and not drawn to scale. "Merchant" is not a policy instrument and included here for comparison only. Note that the New York State Energy Research and Development Authority solicited bids for both index offshore renewable energy certificates (ORECs) and Fixed ORECs, ultimately awarding the index approach only in 2019.

Acronyms: FIT = feed-in tariff; FIP = feed-in premium; PPA = power purchase agreement; CFD = contract for difference.

The policy instruments shown in generalized form in Figure 1 are ordered left to right from the lowest commodity price risk to highest commodity price risk.[6] The financial certainty associated with reduced commodity price risk leads to lower project finance costs (e.g., Fouquet and Johansson 2008), and is necessary for securing long-term project financing (i.e., making a project "bankable").[7] The fixed-rate policy instruments (i.e., feed-in tariff [FIT], contract for difference [CFD], and fixed-rate PPA/renewable energy certificate [REC]) effectively serve as a floating-for-fixed swap[8], while the fixed premium (i.e., #4 and #5 in Figure 1) and quota instruments typically result in a floating price and remuneration. At the far end of the spectrum, merchant projects (on the far right in Figure 1) are exposed entirely to fluctuations in the commodity price. Merchant projects are included in Figure 1 for illustration purposes only; this type does not represent a policy instrument. Merchant generators receive the wholesale price for each megawatt-hour (MWh) of electricity; renewable generators may also be able to sell certificates into the voluntary, customer-driven market. A project exposed to merchant pricing may choose a financial hedging product to mitigate near- to medium-term commodity price fluctuations, such as a bank hedge, synthetic PPA, electricity forward contract, proxy revenue swap, or a natural gas forward contract (Bartlett 2019). Key characteristics of these policy instruments are described in Table 1 through Table 7. The tables include a reference to the numbering included in Figure 1.

Table 1. Feed-In Tariff (FIT)

Figure 1	# 1
Key Characteristics	Generator receives a fixed price for each megawatt-hour (MWh) of electricity. Total remuneration is not exposed to changes in the commodity price. The fixed-rate tariff is typically set administratively with the procured quantity varying.
Description	Through a FIT, the generator is paid a fixed tariff (see the blue hatched area in Figure 1) by the administrator for the delivery of energy, capacity, and services, regardless of the prevailing reference (e.g., wholesale electricity) price. Because of its independence from changes in the prevailing commodity price, a FIT is generally considered a very strong commodity price hedge.[9]
Examples	*Germany (2010–2019); Netherlands (2006–2008)* FITs have been used in the earlier phases of offshore wind market development, such as under the Erneuerbare-Energien-Gesetz (EEG) (2010–2019) in Germany or the Environmental Quality of Electricity Production (MEP) scheme in the Netherlands (2006–2008).

[6] The commodity price referred to in Figure 1 and in this section is commonly the wholesale electricity price (e.g., the locational marginal price in U.S. markets) but could also be for another power commodity (e.g., capacity, environmental attributes, ancillary services). Any portfolio effects of (commodity price) hedging are not considered in this report for simplification purposes.

[7] Kitzing and Mitchell (2014) highlight that a fixed-price regime is particularly relevant for "risk reduction efforts and creating an enabling environment for […] new technology."

[8] A swap contract is a financial derivative in which two parties exchange cash flows from different financial instruments (Bartlett 2019).

[9] FITs and fixed-rate instruments are commonly described as very strong (or "near-to" perfect) commodity price hedges; often, "basis risk" and volume risk remain. Further, the duration of the hedge may not cover the entire financial lifetime of the project (i.e., "merchant tail").

Table 2. Competitive Bidding for a Power Purchase Agreement (PPA) or Renewable Energy Certificate (REC) (Fixed-Rate Instruments)

Figure 1	# 2A
Key Characteristics	Generator receives a fixed-rate price from a contractual instrument (e.g., PPA or REC) or a regulatory order for a fixed quantity mandated by a government entity. Total remuneration is not exposed to changes in the commodity price. The fixed rate is set through competitive bidding (e.g., an auction). The commodity produced is usually sold to an intermediary (e.g., electric distribution company) who sells it into the wholesale market.

Description	Competitive bids for a fixed rate/price from a PPA, REC, or regulatory order over a predetermined nameplate capacity quota has been instituted by several U.S. states. In effect, this policy instrument offers very strong commodity price hedging benefits, similar to a FIT.[10] A fixed-rate instrument is distinct from a FIT in two ways. First, FITs set a tariff and the quantity varies, whereas under competitive bidding for fixed rate instruments, the quantity is fixed, and the price varies. Second, the fixed-rate instruments tend to be awarded in a competitive bidding process (e.g., through an auction) whereas FITs have historically been set and allocated through an administrative process based on the projected cost of generation (Couture et al. 2010).[11] Because of its independence from changes in the prevailing commodity price, a contractual instrument (e.g., PPA or REC), typically with a utility as counterparty, offers very strong hedging against commodity price risks.
Examples	*Massachusetts (2018), Connecticut (2018), Rhode Island (2018), Maryland (2017), New Jersey (2018)* Competitive bidding for a fixed-rate instrument, such as a PPA, REC, or regulatory order has been employed in several U.S. states. These bids can be distinguished by the fixed-price instrument. Massachusetts, Connecticut, and Rhode Island have awarded PPAs; Maryland and New Jersey have awarded fixed-rate Offshore Renewable Energy Certificates (ORECs).

Table 3. Contract for Difference (CFD): Two-Sided (Cap)

Figure 1	# 3A and # 2B
Key Characteristics	The generator receives the difference between the strike price and the reference price if the reference price is lower than the strike price. If the reference price exceeds the strike price, the generator does not retain the "upside" from the higher reference price but is required to pay it back to the administrator. The strike price is typically determined through competitive bidding (e.g., an auction) for a fixed quantity (or a budget) mandated by a government entity. Total remuneration is not exposed to changes in the commodity price. The electricity produced is typically sold directly into the wholesale market and receives the spot price.
Description	Under a Contract for Difference (CFD) (# 3A in Figure 1), also known as a "sliding FIP," electricity is sold directly on the spot market (black area in Figure 1) and the premium (blue hatched area in Figure 1) varies as a function of the spot market electricity price (Couture et al. 2010). A two-sided CFD (in contrast to a one-sided CFD) requires generators to return any excess income to the CFD counterparty (or the administrator) if the wholesale electricity price is above the strike price. Hence,

[10] If a fixed price is awarded through a regulatory order, the commodity price hedge is commonly perceived as weaker (see Section 4 for a more detailed discussion).
[11] Note that FIT policies vary in their implementation globally (for further discussion, see Couture et al. [2010]).

	the income from this policy instrument is "capped." In effect, a two-sided CFD has a similar commodity price risk as a fixed-rate instrument (#1 and #2A in Figure 1) from a seller's (i.e., generator) perspective. It is shown with a higher exposure to commodity price risk in Figure 1 because the premium paid by the CFD counterparty and the reimbursement of excess income by the seller depends on the commodity price. A variation of the two-sided CFD has emerged in New York state in 2019 in the form of an Index Offshore Renewable Energy Certificate (Index OREC) (# 2B in Figure 1).[12] From a remuneration and commodity price risk perspective, this policy instrument can be described as a type of two-sided CFD. However, two key differences exist. First, this instrument has the "top-up" payments tied to a reference price that is different from the local hub or nodal electricity price. For instance, the New York Index OREC reference energy and capacity price comprises a simple average of the load-weighted hourly average prices (location-based marginal price) across zones J and K of the New York Independent System Operator zones. The local hub or nodal electricity price often serves as the reference price for a traditional two-sided CFD. Second, the Index OREC is an instrument that represents the legal property rights to certain (renewable energy) environmental attributes, which is different from a CFD, which is primarily a financial instrument.
Examples	*United Kingdom (2017-2028); Denmark (2019-2021); New York (2019)* Two-sided CFDs were implemented in the United Kingdom (2017–2028) and for current support regime rounds in Denmark (2019–2021) (e.g., for the Kriegers Flak offshore wind park). A variation of the two-sided CFD is New York's Index OREC, which was awarded to the Empire Wind and Sunrise Wind projects in 2019.

Table 4. Contract for Difference (CFD): One-Sided (Floor)

Figure 1	# 3B
Key Characteristics	The generator receives the difference between the strike price and the reference price, if the reference price is lower than the strike price. If the reference price exceeds the strike price, the generator retains the "upside" from the higher reference price. The strike price is typically determined through competitive bidding (e.g., an auction) for a fixed quantity (or a budget) mandated by a government entity. Total remuneration is exposed to changes in the commodity price only on the upside. The electricity produced is typically sold directly into the wholesale market.
Description	One-sided CFDs are similar to two-sided CFDs in that they are a FIP. However, under a one-sided CFD, the seller (i.e., generator) retains the "upside," if the reference price is higher than the strike price. Notably, one-sided (floor) CFDs have shown a tendency to produce so-called "zero-subsidy bids," wherein the strike price level as determined in recent auctions (e.g., in Germany and Denmark) has declined to zero because of high competition among bidders, effectively exposing the winning projects to fully merchant prices (with commodity price risk more akin to a "merchant" generator). In effect, a one-sided CFD has a similar commodity price risk as a fixed-rate instrument (#1 and #2A in Figure 1) and two-sided CFD (# 3A)

[12] Offshore wind renewable energy certificates (ORECs) issued by U.S. states represent the environmental attributes of one megawatt-hour of electric generation from an offshore wind project. They are used to meet compliance with state offshore-wind-specific renewables portfolio standard provisions. OREC price schedules are determined through a bidding and negotiation process by offshore wind developers, load serving entities, and state regulators. See Section 4 for more information.

	from a seller's (i.e., generator) perspective. It is shown with a higher exposure in commodity price risk in Figure 1 because the premium paid by the CFD counterparty and "upside" by the seller depends on the commodity price.
Examples	*Germany (2024-2026+); Netherlands (2020-2024)* CFDs have been used widely in recent renewable and offshore wind energy markets in Northern Europe. These include Germany's auctions held under the WindSeeGesetz 1 and 2 (Offshore Wind Energy Act) (2024–2026+) and the Dutch auction rounds for Borssele 1 & 2, Hollandse Kust Zuid 1 & 2, and Noord (2020– 2024).

Table 5. Feed-In Premium (FIP)

Figure 1	# 4
Key Characteristics	The generator receives a fixed premium on top of the reference price. Total remuneration is exposed to changes in the commodity price. The fixed price premium is usually set administratively and the quantity varies.
Description	FIPs provide a "top up" over the prevailing commodity price. Although the premium itself is fixed, total remuneration varies with the commodity price. The exposure to fluctuations in commodity prices is higher than under a CFD or fixed-rate instrument (e.g., PPA or REC).
Examples	*United States* An example of a FIP in the offshore wind sector is the U.S. production tax credit (PTC).[13]

Table 6. Competitive Bidding for PPA/REC (Fixed Premium)

Figure 1	# 5
Key Characteristics	The generator receives a fixed premium from a contractual instrument (e.g., PPA or OREC) or a regulatory order for a fixed quantity mandated by a government entity. Total remuneration is exposed to changes in the commodity price. The premium is typically determined through competitive bidding. The electricity produced is usually sold directly into the wholesale market and if applicable, environmental attributes (e.g., RECs) are sold to an intermediary (e.g., a distribution utility, state agency, or escrow account).
Description	This type is similar to the FIP (Table 5) with the allocation mechanism as the key difference. Although FIP rates are typically set administratively with the quantity varying, the fixed premium under this type is awarded through a competitive bidding procedure for a fixed quantity mandated by a government entity. The exposure to commodity price risk is similar to a FIP.

Examples	*New York (2019)* The New York State Energy Research and Development Authority solicited bids for Fixed (Premium) ORECs (and Index ORECs), ultimately awarding the Index approach only; however, if the Index OREC is invalidated by a court, it would be replaced by a Fixed OREC regime.

[13] Alternatively, U.S. offshore wind projects may elect the investment tax credit (ITC). The PTC is listed as an example of a FIP because this policy instrument typically incentivizes generation based on the unit of energy (e.g., $/MWh). The benefits from the ITC are derived from capital expenditure rather than production (Poudineh et al. 2017).

Table 7. Quota

Figure 1	# 6
Key Characteristics	The generator receives a certificate price on top of the reference price. Typically, a government entity sets a target quantity and the price is determined in a certificate market. Total remuneration is exposed to changes in both commodity price and certificate price.
Description	Quota instruments typically use renewable (or clean) energy certificates that represent the environmental attributes of electricity generation and are traded in a market. The quota corresponds to a predetermined capacity target for a specified generation resource (or combination of generation resources). Total remuneration depends on the prevailing electricity price, the supply of renewable energy resources, and the level at which the quota is set. Because total renumeration is exposed to fluctuations in prices of both the commodity and certificate, it is shown with higher exposure than all the other policy instruments in Figure 1.
Examples	*United States* Examples of quota regimes include state renewables portfolio standards in the United States, which use RECs as the compliance mechanism.

2.2 General Procurement Structure

Figure 2 provides the procurement terminology used throughout this report, which applies to the broader renewable energy sector and offshore wind energy procurement. Government entities and utilities commonly invite bids for a renewable electricity purchase or project through a call for tenders. These tenders are often for a predetermined capacity of renewable-energy-based electricity and may be structured as an open tender, direct purchase, or negotiated purchase (Organisation for Economic Co-operation and Development 2019).

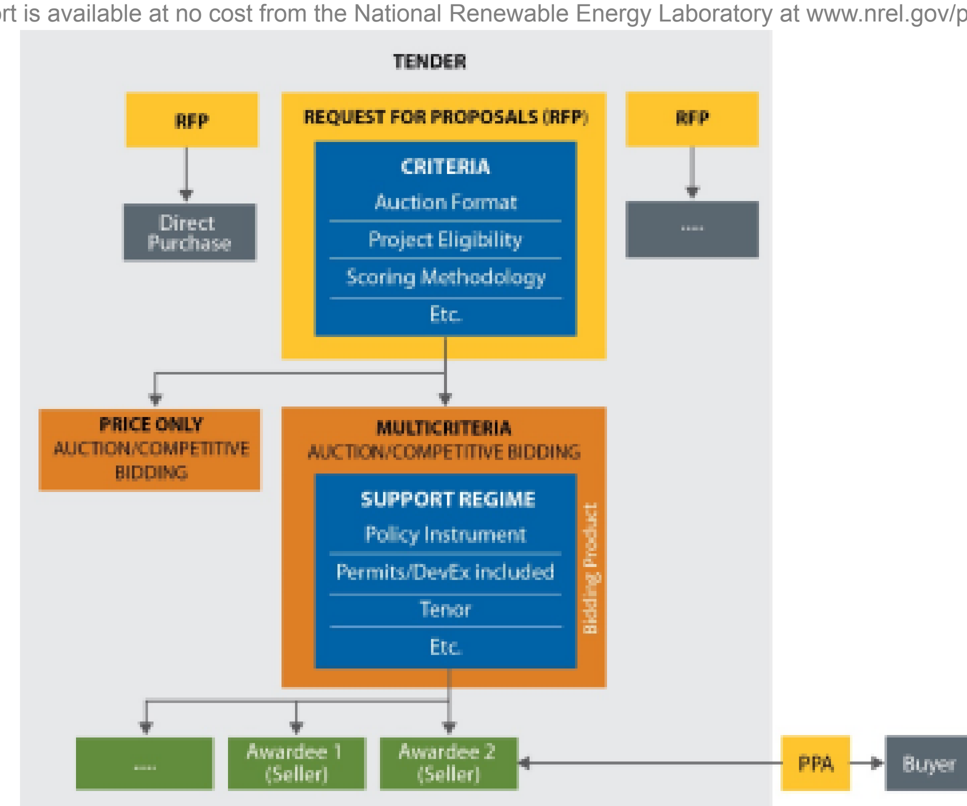


Figure 2. Common offshore wind energy procurement terms in global markets
Note: DevEx = Development expenditures

The terms of the tender are commonly specified in a request for proposals (RFP), a solicitation device used by agencies during the tender process to obtain products or services from potential providers. The RFP specifies the product or service requirements, the contract terms, and the bidding process (if applicable). Once proposals are received, they are evaluated against the predetermined criteria of the issuing agency and a vendor (i.e., renewable energy generator) is selected (National Renewable Energy Laboratory 2019). In renewable energy markets, procurement or "demand" auctions are often used to award the benefits associated with a policy instrument to the lowest bidder. The government entity or utility (or their subcontractors) evaluates the bid offers based on the submitted price per unit of electricity, experience of the developer, or other criteria that are articulated in the RFP. Following the selection of a successful bidder(s), a PPA is commonly established between the awardee and the procuring entity (International Renewable Energy Agency 2016).

3 U.S. Offshore Wind Energy Support Regimes

State governments drive offshore wind procurement goals in the United States.[14] This decentralized approach creates a variety of regulatory structures derived from different statutory authorities that are implemented by various state entities. In general, offshore wind energy procurement goals are set by state legislatures via statute or by executive orders that are subsequently turned into statute. Per the procurement statute or executive order, either the electric distribution companies (EDCs), state energy agency or the Public Utility Commission (PUC) holds offshore wind solicitations. In some cases, solicitations may be held jointly by a collection of the aforementioned entities. The state energy agency or PUC reviews project proposals and makes awards based on price and other criteria either defined in a statute or identified in the solicitation. Upon receipt of offers, the PUC and other legal bodies review awards or contracts to ensure they comply with other state laws and do not have unjust impacts on ratepayers.

A key difference between U.S. and European energy procurement is the absence of a CFD scheme in the United States. In a narrow ruling, the Supreme Court in Hughes v. Talen (2016) limits states from using European-style CFDs to procure new capacity.[15] Hughes v. Talen found the use of CFDs by government entities[16] unconstitutional because the state required the generator to clear the capacity auction in a federally regulated wholesale market while receiving an out-of-market payment from the state for the same service (capacity) at a different price (CFD stipulated price). In its justification, the Supreme Court found that the proposed CFD scheme preempted the federal government's ability to regulate competitive electricity markets, which is guaranteed by the Federal Power Act (New York Public Service Commission [NYPSC] 2019). CFDs may be permissible by U.S. states as long as they do not require the generator to participate in a federally regulated market and "through measures 'untethered' to a generator's wholesale Federal Energy Regulatory Commission (FERC)-approved rate" (NYPSC 2018) (Allco v. Klee 861 F.3d [2d Cir.2017]).

With respect to ORECs, federal vs. state jurisdictional boundaries seem to be established. NYPSC (2018) in its "Order establishing Offshore Wind Standard and Framework for Phase 1 Procurement" argued that "FERC has held that REC programs (i.e., purchasing "attributes") are for a commodity created by states that is not within the wholesale sale of electricity jurisdiction of FERC." Further, the recent U.S. Supreme Court cases would "make it clear that all retail sales of electricity, as well as 'any other sale' not considered a wholesale transaction, are under State Commission Authority' (NYPSC 2018).

[14] In contrast to other major offshore wind markets, such as northern Europe where the federal government typically sets procurement goals.
[15] Hughes v. Talen is considered a narrow ruling because it only overturned one specific CFD scheme proposed by Maryland and did not limit states to propose other schemes. Justice Ginsburg concluded, "Neither Maryland nor other States are foreclosed from encouraging production of new or clean generation through measures that do not condition payment of funds on capacity clearing the [PJM] auction."
[16] In states with competitive power markets.

3.1 Statutory Authority and Solicitation Procedures

Against the backdrop of the Hughes v. Talen decision, states have facilitated offshore wind procurement through two primary policy instruments: (1) mandated PPAs for a predetermined capacity quota and (2) ORECs. Under a PPA, the offshore wind generator contracts its energy, energy services (e.g., capacity), and/or associated environmental attributes at a specified price to a third party, and injects its power into a specified grid system.[17] State PUCs evaluate the impact of PPAs signed between the utility and wind generator to ensure there are minimal impacts to ratepayers. OREC agreements compensate offshore wind developers for their environmental attributes (e.g., zero carbon emissions) and do not directly tie compensation to wholesale market participation or prices.

States' divergent institutional structures and regulatory authorities can impact how procurement goals and terms are set, solicitations rules are issued and reviewed, and contracts are approved. Figure 3 illustrates this divergence by comparing Massachusetts and New York procurement.

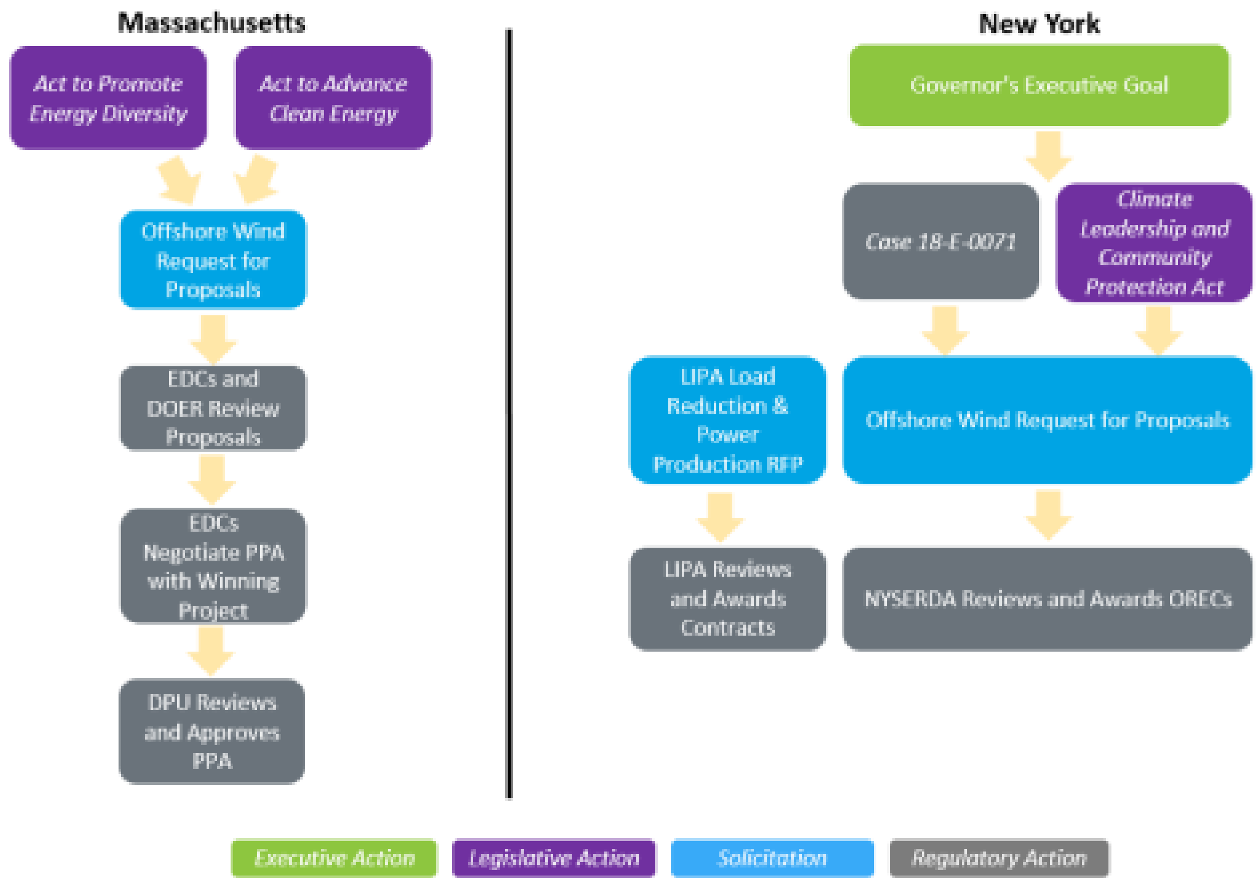


Figure 3. Statutory process for offshore wind procurement in Massachusetts and New York

[17] If the PPA stipulates a generator sells power into a competitive market, the generator acts as a price taker and bids $0 (compensation comes from the PPA partner not the market) (ISO-New England 2019).

Similarities and differences between the two institutional structures can be found in:

- **Procurement goals**. The Massachusetts state legislature passed two bills (An Act to Promote Energy Diversity [2016] and An Act to Advance Clean Energy [2018]) identifying the cumulative amount of offshore capacity to solicit and procure (1,600 megawatts (MW) by 2027 and 3,200 MW by 2035, respectively), setting price restrictions, identifying implementing agencies, and procurement processes. In New York, offshore wind procurement goals were identified by the governor's office in the "State of the State" report and were later codified by the NYPSC in Case 18-E-0071 (2,400 MW by 2030) and by the state legislature in the Climate Leadership and Community Protection Act (9,000 MW by 2035). State power authorities (e.g., Long Island Power Authority and New York Power Authority) are also permitted to conduct their own procurements outside of New York State Energy Research and Development Authority's (NYSERDA's) procurement schedule to achieve the state's overall offshore wind and clean energy goals.[18]

- **Rules for solicitations**. In Massachusetts, the timing (at least every 24 months) and intent of solicitations are stipulated in An Act to Promote Energy Diversity (Dempsey et al. 2016). EDCs were selected to issue the solicitation in coordination with Massachusetts

Department of Energy Resource (DOER) with the intent of offering offshore wind developers 15- to 20-year bilateral power purchase agreements for energy and/or RECs. In Case-18-E0071, NYPSC identified procurement guidelines and delegated NYSERDA the power to issue solicitations aligned with state goals, set review criteria, create incentives, and issue awards.

- **Solicitation reviewers and review criteria**. In Massachusetts, the Department of Public Utilities must review and approve the solicitation's timeline and selection methodology (e.g., price, impact on ratepayers, net economic benefits). DOER and the distribution utilities then use these criteria to evaluate one or more project(s). The electric distribution companies then select and negotiate a PPA for the selected project(s). In New York, NYSERDA sets the solicitation criteria (a three-part weighted score comprising 70% for the price, 20% for the economic benefits, and 10% for the viability offering), reviews proposals, and awards ORECs (NYSERDA 2018b).
  - **Contract approval**. In both Massachusetts and New York, the respective public utility commission and other legal bodies[19] review the contract to ensure they comply with other state statutes and do not adversely impact end-use customers or other market participants.
- **Labor requirements**. Per the Act to Promote Energy Diversity, specialized labor contracts are not required in Massachusetts. The act only instructs DOER to consider employment impacts when evaluating proposals. Although New York does not require any labor requirements by law, NYSERDA has the discretion to implement requirements

[18] In 2015, the Long Island Power Authority (LIPA) issued an open-source, technology-neutral RFP for new generation. In 2017, the LIPA Board of Trustees approved a PPA to buy energy and RECs from the 90-MW South Fork project. In 2018, LIPA augmented the contract to procure 130 MW.

[19] Other legal bodies may include the Attorney General, Division/Office of the Rate Payer Advocate, and so on.

in each solicitation. In New York's Round 1 solicitation, NYSERDA required a prevailing wage requirement and project labor agreements.

Appendix B includes annotated state policy and regulatory flow charts; Appendix C provides an overview of state-level offshore wind labor requirements.

3.2 U.S. Offshore Wind Procurement Goals and Awards

State offshore wind procurement goals continue to increase as earlier goals are met by successful rounds of solicitations and awards (Figure 4). In parallel, offshore wind contract prices continue to decrease (Figure 5). Below we discuss the procurement goals and awards made by states to date.

Massachusetts

In 2016, the General Assembly of the Commonwealth of Massachusetts passed An Act to Promote Energy Diversity directing the electric distribution utilities in coordination with DOER to hold offshore wind solicitations at least every 2 years to procure 1,600 MW of offshore wind by 2027 (General Assembly of the Commonwealth of Massachusetts 2016). In May 2018, Vineyard Wind LLC was awarded two 400-MW, 20-year PPAs at levelized prices of $74/MWh and $65/MWh (real 2017 USD), respectively (Massachusetts Department of Energy Resources 2018).[20] In August 2018, the General Assembly of the Commonwealth of Massachusetts passed

An Act to Advance Clean Energy that gave DOER the discretion to increase the state's offshore wind procurement goal from 1,600 MW by 2027 to 3,200 MW by 2035 (General Assembly of the Commonwealth of Massachusetts 2018). After studying impacts of the enhanced goal, DOER exercised the option to increase it in May 2019. The Massachusetts utilities and DOER also issued a second offshore wind solicitation in May 2019, and awarded Mayflower Wind's 804-MW proposal with a 20-year levelized PPA price of $58.47/MWh (real 2019 USD) (Mayflower Wind 2020). In order to meet the 3,200-MW goal, DOER may hold a solicitation for an offshore wind transmission system in 2020 and additional offshore solicitations for up to 800 MW in 2022 and 2024.

Rhode Island

In 2010, National Grid signed an agreement to procure 30 MW from the Block Island Wind Farm demonstration project at a levelized price of $244/MWh after the project was approved by the Rhode Island Office of Energy Resources. In 2014, Rhode Island passed the Affordable Clean Energy Security Act, allowing the state to coordinate and participate in power procurements with other states in the New England region (Rhode Island Legislature 2014). The Rhode Island Office of Energy Resources used this authority to review proposals from Massachusetts' first solicitation and award the 400-MW Revolution Wind project a 20-year fixed-price PPA at $98.43/MWh (Rhode Island Public Utility Commission 2018). Rhode Island does not have an explicit offshore wind procurement goal, but Governor Gina Raimondo recently

[20] See Section 4 for an expanded discussion of state-level offshore wind contract mechanisms (e.g., specifying if RECs are bundled or unbundled).

implemented a 100% renewable goal for the state in Executive Order 20-01 (Governor Gina M. Raimondo 2020).

Connecticut

In 2017, Public Act 17-144, An Act Promoting the Use of Fuel Cell Vehicles for Electric Distribution System Benefits and Reliability and Amending Various Energy-Related Programs and Requirements, allowed the Connecticut Department of Energy and Environmental Protection (DEEP) to solicit clean energy projects of various technology types, including a carve out for offshore wind (Connecticut Legislature 2017). In 2018, DEEP, in conjunction with the Office of Consumer Counsel, Attorney General, procurement manager of the Public Utilities Regulatory Authority, and EDCs released a Notice of Request for Proposals from Private Developers for Clean Energy to procure up to 825,000 MWh of offshore wind generation. DEEP ultimately selected the 200-MW Revolution Wind proposal for a 20-year fixed-PPA at $99.50/MWh. Under June Special Session Public Act 17-3, An Act Concerning Zero Carbon Solicitations and Procurement, DEEP selected an incremental expansion of the Revolution Wind project, resulting in another PPA for 104 MW at $98.43/MWh (Connecticut Legislature 2018). In 2019, the Connecticut state legislature passed Public Act 19-71, An Act Concerning the Procurement of Energy Derived from Offshore Wind, which directed DEEP to procure up to 2,000 MW by 2030, with the first solicitation occurring in 2019 and a schedule for subsequent solicitations established through DEEP's Integrated Resources Plan (Connecticut Legislature 2019). A solicitation was issued in August 2019 and Vineyard Wind's 804 Park City Wind proposal was selected on December 5, 2019, for a 20-year PPA at a yet to be disclosed price. DEEP's draft

Integrated Resources Plan is expected to be released in summer 2020.

New York

In 2017, Governor Andrew Cuomo announced that New York would aim to develop 2,400 MW of offshore wind by 2030. Through a 2015 RFP, Long Island Power Authority procured 90 MW from the South Fork project via a 20-year PPA at $163/MWh (Long Island Power Authority 2019). The contract was increased by 40 MW in 2019, bringing the new project size to 130 MW. In 2018, the NYPSC operationalized the governor’s goal in Case 18-E0071, thereby enabling NYSERDA and other public power authorities to carry out offshore wind solicitations (New York Public Service Commission 2018). In November 2018, NYSERDA issued its first offshore wind solicitation, ultimately awarding the 816-MW Empire Wind and 880-MW Sunrise Wind projects 25-year indexed OREC contracts at a strike price of $83.36/MWh (New York Research and Development Authority 2019). In 2019, the New York legislature passed the Climate Leadership and Community Protection Act, codifying a 9,000-MW-by-2035 offshore wind procurement goal (New York State Legislature 2019). NYSERDA announced another 1,000-MW to 2,500-MW offshore wind solicitation is expected to take place in summer 2020 (New York State Research Development Authority 2020).

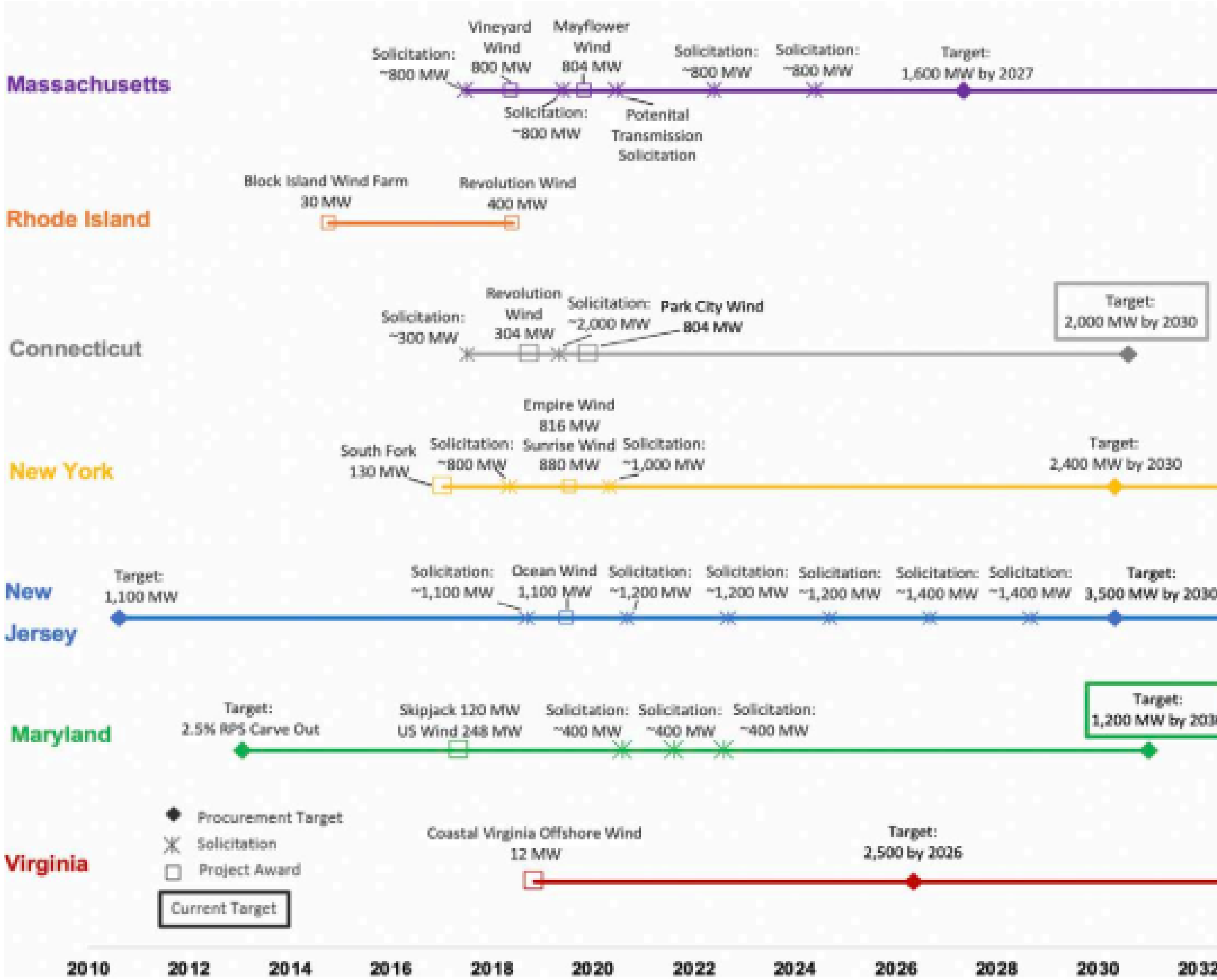


Figure 4. Timeline of U.S. offshore wind procurement policy, solicitations, and awards

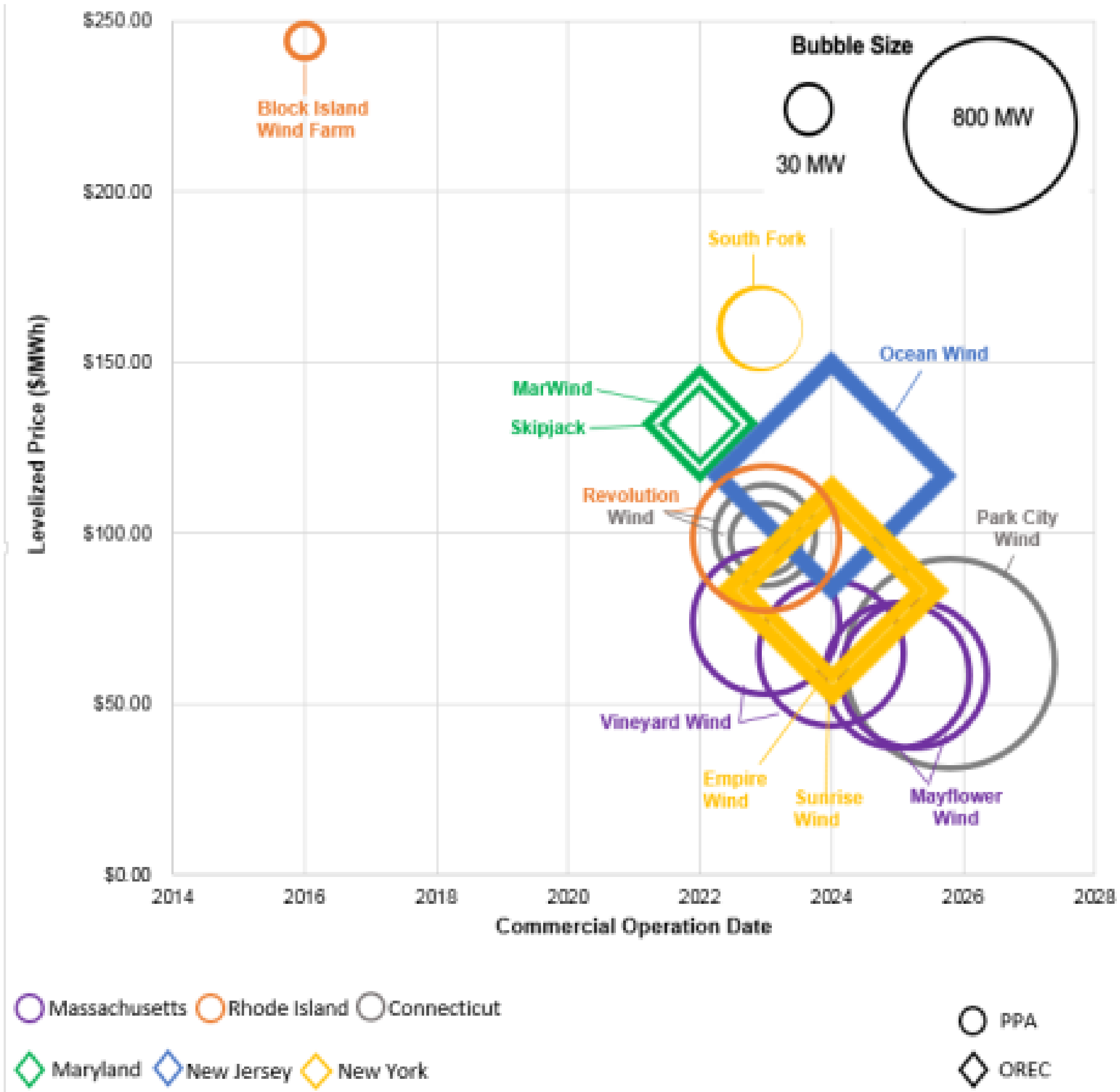


Figure 5. Levelized offshore wind offtake agreement prices[21]

[21] Levelized price refers to the amount a developer needs to recover on a per-megawatt-hour basis to pay off their initial investment and satisfy their revenue requirements over the life of a contract. Block Island Wind Farm commanded a premium price relative to later projects because it was the first offshore wind project installed in the United States and classified as a demonstration. The 12-MW Coastal Virginia Offshore Wind demonstration project was not included in the figure because it is only 12 MW and has an expected levelized price of $780/MWh. The Park City Wind PPA in Connecticut has not been made public. Park City Wind's contract price is supposedly substantially lower than all other U.S. contracts; it is estimated here as $61/MWh.

New Jersey

New Jersey was the first state to pass offshore wind procurement legislation with the Offshore Wind Economic Development Act in 2010 (New Jersey Legislature 2010). The rule directed the Board of Public Utilities (BPU) to create an offshore renewable energy credit to remunerate offshore wind power plants for the environmental attributes of their generation with the ultimate aspiration of acquiring 1,100 MW. OREC requirements were not finalized until Executive Order 8 was implemented in 2018 (Governor Philip D. Murphy 2018). Alongside the executive order, the New Jersey legislature passed a statute codifying a goal of procuring 3,500 MW by 2030 and directing the BPU to conduct periodic solicitations (New Jersey Legislature 2018). The BPU held its first solicitation and awarded Ocean Wind a 20-year OREC contract at a levelized \$116.82/MWh price (Ocean Wind LLC 2018). The BPU plans to hold 1,200-MW solicitations in 2020 and 2022. In 2019, Governor Phil Murphy signed Executive Order No. 92, increasing the state's offshore wind goal to 7,500 MW by 2035 (Governor Philip D. Murphy 2020).

Maryland

Maryland added a 2.5% offshore wind carve out to its renewables portfolio standard statute in 2013 via the Maryland Offshore Wind Energy Act of 2013 (Maryland General Assembly 2013). In 2017, Maryland's PSC awarded 20-year OREC contracts for 368 MW of capacity from two projects, Skipjack (120 MW) and US Wind (240 MW), at a levelized price of \$131.93/MWh (Public Service Commission of Maryland 2017). In 2019, the Maryland legislature passed the Clean Energy Jobs Act, adding a 1,200-MW procurement goal by 2030 (Maryland Senate 2019). Maryland intends to hold additional offshore wind procurements in 2020, 2021, and 2022.

Virginia

In 2018, the Virginia State Corporation Commission approved the cost of Dominion Energy's 12-MW Coastal Virginia Offshore Wind demonstration project to be recovered through general generation and distribution retail services rates (Virginia State Corporation Commission 2018). The project is under construction and is expected to be online in 2020. In 2019, Governor Ralph Northam signed Executive Order 43, creating a 2.5-GW offshore wind goal by 2026 Governor Ralph S. Northam 2019). In 2020, the state legislature passed the Virginia Clean Economy Act, which set a 100% renewable energy goal by 2050 and set an offshore wind procurement goal of 5,200 MW by 2035 (Virginia Legislature 2020).

Refer to Table A-1 and Table A-2 for more information on procurement policies and existing offtake agreements.

4 U.S. State Procurement Mechanisms

Offshore wind procurement mechanisms are influenced by their state-specific regulatory and market environment. Importantly, all current mechanisms in U.S. states were implemented in an open wholesale market structure; it has not yet been determined how offshore wind procurement would be structured in a state with vertically integrated utilities.[22] This section will discuss the evolution of these mechanisms, their integration with existing renewables portfolio standards, and how the state mechanisms are structured and compared to each other. To date, U.S. states have deployed two policy instruments: PPAs and ORECs, which are awarded by state government entities through a competitive bidding procedure for a fixed quantity of offshore wind capacity (#2A in Figure 1).[23] These are both described in more detail as follows.

4.1 Procurement Structures

In this section, the generic structuring of the two procurement vehicles is presented, including the physical and transactional flow of energy services. State-specific diagrams are presented in Appendix D.

In general terms, a PPA is used as a standardized long-term contractual agreement for the purchase of energy, capacity, energy services, and environmental attributes from a specific renewable energy generator (i.e., the seller) to a purchaser of electricity (i.e., the buyer) (Environmental Protection Agency 2019).[24] Offshore wind procurement through PPAs (# 2A in Figure 1) started in Massachusetts and is now used in Rhode Island and Connecticut as well. Massachusetts passed An Act to Promote Energy Diversity (2016), which required the state's distribution utilities to sign long-term contracts for offshore wind energy generation (Dempsey et al. 2016). Subsequently, the state's distribution utilities, in conjunction with the state energy agencies, issued joint RFPs for bundled energy and RECs, which they would procure via a PPA. The procurement does not cover capacity or ancillary services, but those services can be provided by the generator directly into the wholesale market.

Under the PPA regimes established in the United States to date, offshore wind generators generally sell energy, energy services, and RECs to the electric distribution utility, who in turn sells the energy to the wholesale market and the RECs to the electricity supplier (Figure 6). The PPA governs the payment, delivery, and performance terms between the generator and the counterparty (i.e., electric distribution company). Ratepayers pay the costs of the offshore wind

[22] Although no commercial-scale projects have been developed in vertically integrated markets, the Virginia State Corporation Commission did approve the construction of the 12-MW Coastal Virginia Offshore Wind demonstration project and allowed Dominion Energy to recover costs through general generation and distribution retail rates.

[23] Connecticut DEEP was authorized to procure up to 825,000 MWh of offshore wind generation; other states set minimum procurement quantities.

[24] Importantly, we note that a PPA is a long-term, standardized contractual agreement between sellers and buyers of power that is commonly used as an effective tool for commodity price hedging purposes, regardless of whether it is integrated with a support regime or not. In fact, it is commonly used in conjunction with any of the policy instruments shown in Figure 1 or as a contract for corporate procurement (in various structures, such as a physical, virtual PPA, or sleeved PPA), sometimes in combination with financial hedging products.

generation through charges on their distribution utility bill. This structure is used in Connecticut (Figure D-1), Massachusetts (Figure D-2), and Rhode Island (Figure D-3). In these states, payments for the provision of capacity and ancillary services are not included in the PPA but can be provided by the generator directly to the wholesale market (i.e., outside of the PPA). Under the PPA structure used in these states, the developer receives a predetermined payment for its generation, regardless of the price that generation sells for in the wholesale market. This structure provides revenue certainty for the developer (NYSERDA 2018a) and an ability to obtain lower-cost financing compared to a merchant structure or a Fixed-Premium OREC structure. PPA prices must be determined to be in the best interest of ratepayers (see more in Section 4.3). The exclusion of capacity sales from the PPA means that some level of revenue uncertainty remains.

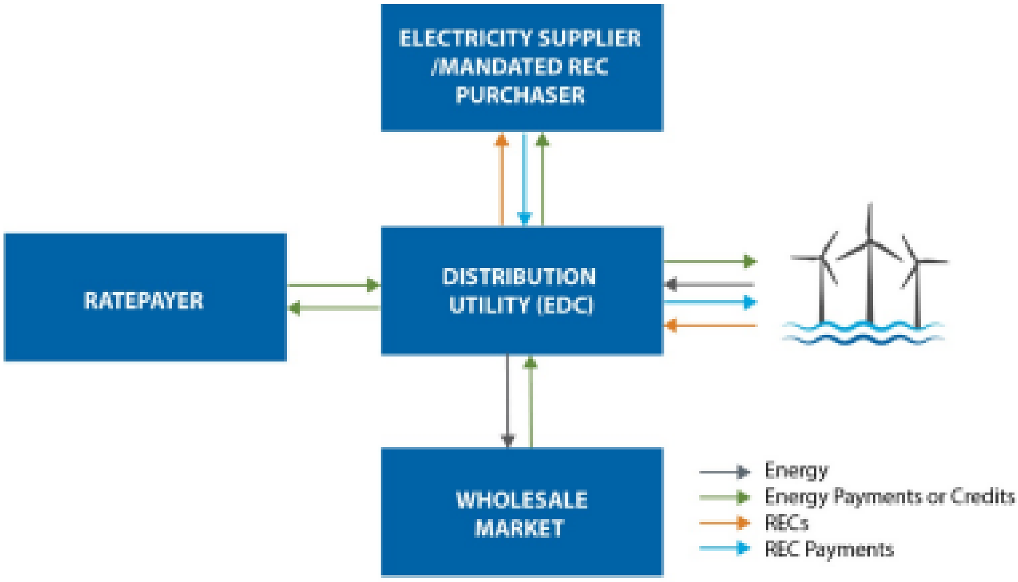


Figure 6. Generic PPA scheme

Note: In Rhode Island's PPAs, the offshore wind generator sells energy directly into the wholesale market, instead of selling to the distribution utility, who then sells it to the wholesale market.

ORECs issued by U.S. states represent the environmental attributes of one megawatt-hour of electric generation from an offshore wind project. They are used to meet compliance with state offshore-wind-specific renewables portfolio standard provisions. ORECs emerged in New Jersey and were subsequently adopted and implemented in Maryland and New York. New Jersey began crafting an OREC mechanism in the late 2000s to support implementation of the Governor's Energy Master Plan, and later, the Offshore Wind Economic Development Act (New Jersey Legislature 2010). The creation of an OREC procurement mechanism was subsequently adopted in Maryland, with HB226, the Maryland Offshore Wind Energy Act of 2013 (Maryland General Assembly 2013). HB226 distinguished ORECs from RECs, noting that ORECs would include energy, capacity, ancillary services, and environmental attributes. In contrast, RECs are generally separate from energy, capacity, and ancillary services in the PJM market, in which Maryland participates. This distinction is important because it results in OREC procurement to provide for greater revenue certainty to a project developer than a REC-only procurement. The bill also established a process to transfer OREC revenue between an offshore wind generator and the

state's electricity suppliers, noting that the offshore wind generator would sell energy, capacity, and ancillary services directly into the wholesale market.

In a generic OREC structure, the offshore wind generator sells energy into the wholesale market and ORECs to an intermediary (this could be a distribution utility, state agency, or escrow account) (Figure 7). In turn, the ORECs are sold to the electricity suppliers. Ratepayers pay the OREC costs through charges on their utility bill.

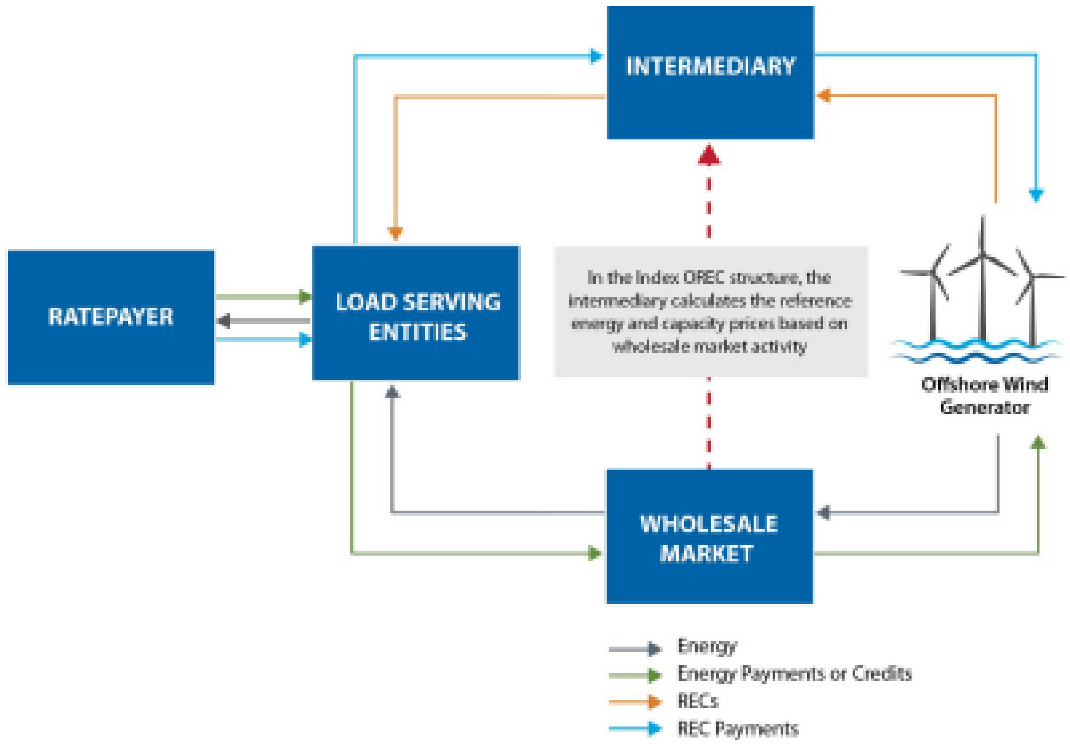


Figure 7. Generic OREC scheme

The "fixed-price" OREC structure (# 2A in Figure 1) is used in Maryland (Figure D-6) and New Jersey (Figure D-7) and was proposed as part of New York's Phase 1 solicitation in 2019 (Figure D-5), though each state differs in how they implement ORECs. ORECs may include sales of energy, capacity, and ancillary services.

In New York, NYSERDA solicited bids for both Index ORECs (shown as # 2B in Figure 1 and in Figure D-4) and Fixed(-Premium) ORECs (#5 in Figure 1), ultimately selecting the Index OREC approach for the 816-MW Empire Wind project and 880-MW Sunrise Wind project. From a conceptual perspective, Index ORECs compare most closely to a two-sided indexed CFD (#2B in Figure 1), whereas the Fixed(-Premium) OREC resembles the attributes of a FIP (#5 in Figure 1) that is awarded competitively. NYSERDA noted that it made the selection between these two instruments based on the "strong index OREC prices" that were submitted and the "reasonable and efficient hedge against energy and capacity market uncertainty that the structure provides, leading to more viable projects from an execution standpoint in the long run" (NYSERDA 2019). The project contracts include backup provisions to use a Fixed OREC price structure if the Index OREC structure is invalidated by a court.

Notably, as shown in Table 8, the price proposals submitted by Ørsted (Sunrise Wind) and Equinor (Empire Wind) for a Fixed(-Premium) price OREC were both significantly lower at face value than the bids submitted for a support regime deploying the Index OREC instrument. This can be explained by the different design of these two policy instruments. Under the Fixed(-Premium) OREC, a fixed premium is established on top of the prevailing energy and capacity price (which are both sold directly into the wholesale market). Remuneration under the Index OREC, on the other hand, acts like a two-sided CFD where the strike price effectively defines the "all-in" remuneration for energy, capacity, and support services (i.e., a total remuneration price level). Hence, the offer price level under the Fixed(-Premium) regime should be expected to be lower than under the Index OREC, as the former only comprises the premium payment (over the prevailing energy and capacity price), whereas the latter represents the "all-in" renumeration for energy and capacity. Further, the support payments under the Index OREC are calculated under consideration of a zonewide index, which results in "basis risk,"[25] and is usually accounted for with a higher strike price. The difference in the submitted (strike) prices between bidders might be explained by cost, risk, and performance differentials between the two project proposals, a different expectation of future energy service (e.g., energy, capacity, ancillary services) prices, and deviations in targeted returns on investment.

Table 8. Fixed OREC and Index OREC Prices in NYSERDA Approved Contracts

	Fixed(-Premium) OREC Strike Price	Index OREC Strike Price
Sunrise Wind LLC	$61.87/MWh (contract years 1–25)	$110.37/MWh (contract years 1–25)
Equinor Wind LLC (Empire Wind Project)	$36.35/MWh in contract year 1, escalating annually to $58.46/MWh in contract year 25	$99.08/MWh in contract year 1, escalating annually to $159.36 in contract year 25

Source: NYSERDA (2019)

In New Jersey, the OREC price includes capacity, energy, and other elements of generation (New Jersey Administrative Code 14:8-6.5(a)(12)(iii)), which is far more extensive than an environmental-attribute-only price. Winning bidder Ørsted noted that their proposed OREC price included all of the total revenue requirements of their project over a 20-year period, including equipment, financing, taxes, construction, and operation and maintenance costs, offset by any federal or state tax or production credits and other subsidies or grants (Ocean Wind, LLC 2018).

Some key differences between procurement through PPAs, Fixed(-Premium), and Index ORECs were recently highlighted by NYSERDA (2018a), which are summarized in Table 9. These include price hedging benefits, the extent to which the generator would be incentivized to respond to locational signals of price and transmission constraints, the ease of implementation, and ratepayer impact and risk. Further, PPAs and some ORECs (e.g., in New York) are structured as contracts, whereas in Maryland and New Jersey OREC purchases are only

[25] "Basis risk" refers to a misalignment between the realized revenue from the sale of electricity (e.g., at a local node where a generator interconnects with the grid) and the sale's contractual settlement point (e.g., at a larger trading hub or through a contractually set "index" reference price) (adapted from Bartlett 2019).

approved by regulatory order. The regulatory order in these states could be modified by the state energy regulatory commissions for "good cause" at any time, which might leave offshore wind developers exposed to higher risk than under a contract structure.

Table 9. Key Differences in Procurement Mechanisms

Procurement Mechanism	Hedging Benefit	Cost of Financing	Grid and Ratepayer Impacts
PPA (Energy and REC)	Strong[26]	Low	Project is not incentivized to maximize locational value; ratepayers benefit if wholesale market prices rise
Fixed(-Premium) OREC	Weak	High	Project is incentivized to maximize locational value; ratepayers would not benefit if wholesale market prices rise
Index OREC	Strong, but not as strong as a PPA	Low, but not as low as a PPA	Project is incentivized to maximize locational value; ratepayers benefit if wholesale market prices rise

Source: Adapted from NYSERDA (2018) and NYPSC (2016)

4.2 Integration with RPS Schemes

Offshore wind procurement mechanisms are not new constructs; they use features of renewable procurement for state RPSs that have been in place for decades. State RPSs have many provisions, including setting timetables for procurement and determining where renewable resources can be located, but two provisions are relevant for offshore wind procurement: supporting a specific resource type and requiring long-term contracting.

Offshore wind procurement expands upon existing mandated technology type carve outs that have been features of state RPSs. Most RPSs contain provisions to support specific resource types, because they may provide greater resource diversification, may be more costly, may help achieve other state objectives, or other reasons. RPS carve-out provisions for specific resource types initially focused on the use of solar or distributed energy (Wiser, Barbose, and Holt 2010). For example, as of June 2019, 22 states and Washington, D.C., had provisions requiring some amount of solar or distributed energy. As new renewable technology types are being developed, such as offshore wind, they are being incorporated as resource carve outs into existing RPSs (see Section 3 for details).

Offshore wind procurement also relies on the competitive, long-term procurement framework that has been established by states via their RPS policies. In restructured states, where electricity suppliers are less likely to sign long-term contracts for generation because of their uncertain future demand, many RPSs have included requirements for long-term purchasing (Table 10). These long-term contracting requirements vary by state, but in general, cover only part of the RPS requirement. Similarly, the OREC and PPA structures for offshore wind procurement provide long-term contracts, which allow the offshore wind generator to obtain lower-cost financing for their projects.

[26] NYSERDA (2018a) refers to the "bundled PPA" as a "perfect hedge."

Table 10. Long-Term Procurements for Non-Offshore Wind RPS Supply by State

	Long-Term Contract Duration	**Product Purchased**	**Source**
California	10 years or more	At least 65% of investor-owned RPS procurements, beginning in 2021	[a]
Connecticut	15 years	Investor-owned utilities must spend $12 million annually on 15-year contracts with individual small generators	[b]
Delaware	20 years	20-year purchases of solar RECs	[c]
Illinois	15 years	Illinois Power Agency has procured 15-year contracts for renewables to meet the RPS	[d]
Massachusetts	10—20 years	The Solar Massachusetts Renewable Target (SMART) program purchases energy and RECs from solar facilities	[e]
New York	10–20 years	NYSERDA has procured contracts ranging from 10 to 20 years for RECs	[f]
Pennsylvania	5–20 years	Alternative energy credits and solar RECs from large- and small-scale projects	[a]
Rhode Island	10–15 years; longer than 15 years subject to PUC approval	Energy and RECs for projects between 20 and 200 MW	[a]

[a] Exeter Associates, Inc. (2019)
[b] Database of State Incentives for Renewables & Efficiency (2019)
[c] InClime (2017)
[d] Illinois Power Agency (2018)
[e] Solar Massachusetts Renewable Target Program (2020)
[f] NYSERDA (2018b)

4.3 Comparison of State Procurement Mechanisms

This section highlights commonalities and key differences between state procurement mechanisms among U.S. states. Comparisons are made along the dimensions wholesale market participation, revenue allocation and cost containment, and transmission cost considerations.

Wholesale Market Participation

State offshore wind procurement mechanisms all rely on wholesale energy market participation but vary in how capacity market participation is assumed. All mechanisms allow for capacity market participation, but some require that generators apply to participate, whereas other states leave that consideration up to the generator.

Capacity market participation presents several considerations for offshore wind generators. First, for generators to participate in capacity markets, they must first apply to participate. If they qualify, then they are obligated to provide services when called upon or make a noncompliance payment. Second, PJM and ISO-New England both have forward periods of 3 years, meaning that generators must bid into the capacity market 3 years prior to when they will be committed to provide services. Third, capacity markets have been known to produce highly volatile prices (Jenkin et al. 2016). However, the actual revenue realized is typically more modest than energy revenue. Because of these considerations and the uncertainty in future capacity market

participation market rules, offshore wind procurements typically allow generators to participate but do not require it (Table 11 provides more detail on specific provisions).

Table 11. Offshore Wind Procurement Energy and Capacity Market Participation

State	Agreement	Wholesale Energy Market	Wholesale Capacity Market	Source
New Jersey	OREC RFP	Allowed	Allowed; all project revenue is used to offset the generator's costs and project's effects on customer rates	[a]
Maryland	Skipjack and US Wind OREC agreements	Required	Forward capacity market (FCM) participation is required	[b]
New York	South Fork OREC agreement	Allowed	Voluntary participation in FCM	[c]
Connecticut	Revolution Wind PPA	Allowed	Voluntary participation in FCM but must apply to participate	[d]
Massachusetts	Vineyard Wind PPA Mayflower PPA	Allowed	Voluntary participation in FCM but must apply to participate	[e]
Rhode Island	Revolution Wind PPA	Allowed	Voluntary participation in FCM but must apply to participate	[f]

[a] New Jersey Board of Public Utilities (2018)
[b] Annotated Code of Maryland, Utilities, §7–704.2.(C)(3)(i)
[c] Thomas Falcone (2018)
[d] Connecticut Public Utility Regulatory Authority (2018)
[e] Massachusetts Department of Energy Resources (2017)
[f] Rhode Island Public Utility Commission (2018)

Revenue Allocation and Cost Containment

Differences in procurement structures impact how revenues from energy and capacity markets are treated. In Maryland and New Jersey, the offshore wind generator receives the OREC payment, whereas energy and capacity revenues from selling into the wholesale market are returned to the ratepayers. In Connecticut, Massachusetts, and Rhode Island, the PPAs do not include the purchase of capacity, and generators are permitted to retain the revenue they receive from forward capacity markets. They pass through any other revenue (e.g., energy) to ratepayers. Allowing generators to retain some revenue means that there is a stronger economic signal to the offshore wind generator to sell into the forward capacity market as well as maximize their production during critical peak periods when the amount of capacity that the project is deemed to

provide is typically established, though the ultimate decision to participate is likely based on many factors. It also has implications for how the PPA is priced. Because the Connecticut, Massachusetts, and Rhode Island PPAs do not include capacity, this results in an unhedged revenue component that reduces credit quality.

All states all focus on cost containment, with Maryland, Massachusetts, and New York having explicit caps or other provisions and other states taking costs into account when evaluating bid proposals. In Maryland, the Offshore Wind Energy Act of 2013 set both a rate impact cap and an OREC price cap. There is a maximum of $1.50/month (2012$) projected net rate impact for the average residential customer, a 1.5% annual increase cap for nonresidential customers, and an OREC price cap of $190/MWh (2012$) (Public Service Commission of Maryland 2017). Starting in 2020, the prescribed rate impact declines to a maximum of $0.88/month (2018$) for the average residential customer and nonresidential rates are capped at 0.9% annually (Maryland General Assembly 2019). Massachusetts requires that future projects have lower levelized prices per megawatt-hour, plus the associated transmission costs, than previous offshore wind procurements (The General Assembly of the Commonwealth of Massachusetts 2016; Massachusetts Department of Energy Resources 2018). This cap was suspended for the 2019 solicitation amid concerns that the levelized price could be open to interpretation, thus causing regulatory delays, and ultimately leaving projects unable to receive the highest federal investment tax credit level (H 4019, An Act Relative to Offshore Wind Contract Pricing 2019; Mohl 2019). In New York, NYSERDA uses a confidential price benchmark that acts as a ceiling price for OREC bids.

In other states, there are no explicit rate caps, PPA or OREC price caps, but prices are evaluated in the bidding process. New Jersey, Connecticut, and Rhode Island require projects to demonstrate net-economic benefits. Table 12 provides more detail.

Table 12. Offshore Wind Procurement Revenue Allocation and Cost Containment

State	Revenue Allocation	Cost Containment	Source

Connecticut	All revenues except forward capacity revenue are returned by generator to ratepayers	Projects are evaluated based on ratepayer impact, among other measures	[a]
Massachusetts	All revenues except forward capacity revenue are returned by generator to ratepayers	The levelized price of each subsequent project must be lower than levelized price of the previous project (amended for the 2019 solicitation)	[b]
Rhode Island	All revenues except forward capacity revenue are returned by generator to ratepayers	The project must have net benefits to the state and its ratepayers	[c]
New York	-	NYSERDA uses a confidential levelized net OREC cost benchmark that acts as a ceiling price for OREC bids; bids in excess of the benchmark are ineligible for an award	[d]
Maryland	All revenues are returned by generator to ratepayers	Monthly rate impact cap of $1.50 (2012 $), 1.5% percent annual increase cap for nonresidential customers, and an OREC price cap of $190/MWh (2012$) The project must have a net benefit to the state's economy, environment, and public health	[e]
New Jersey	All revenues are returned by generator to ratepayers	Project must have net-economic benefit to the state	[f]

[a] General Statutes of Connecticut § 16a – 3h (2018)
[b] Massachusetts Department of Energy Resources (2018)
[c] Rhode Island General Laws §§ 39-26.1-3(a) and (c)1(d)(1)
[d] NYSERDA (2018b)
[e] Public Service Commission of Maryland (2017); Annotated Code of Maryland, Utilities, §7–704.1.(D)(1)(vi).
[f] New Jersey Administrative Code 14:8-6.5(a)

Transmission Cost Considerations

Transmission can be planned and developed in multiple ways, including through the regional transmission operator's generator interconnection process, via merchant transmission, or through regional planning projects in Regional Transmission Organizations (RTOs) (Daniel et al. 2014). FERC Order 1000 mandated that RTOs take state public policy goals (such as Renewable Portfolio Standards) into account when planning transmission. To date, offshore wind generators have typically used the generator interconnection process, which leaves them responsible for interconnection and transmission upgrades (Table 13). These costs then get passed onto ratepayers via either the OREC or PPA price. Maryland's regulations allow for a one-part or two-part OREC price; the one-part price includes transmission costs in the OREC and the developer assumes the risk if costs are higher than anticipated. The two-part OREC price does not include transmission costs until they are known later, at which point a true-up occurs (Code of Maryland Regulations 20.61.06.02). Skipjack proposed a one-part OREC price and US Wind proposed a two-part OREC price; the projected transmission interconnection upgrade costs are zero (Public Service Commission of Maryland 2017).[27]

One notable exception is for the Block Island project in Rhode Island. In that case, the buyer covered the costs of interconnecting Block Island to the mainland, whereas the seller covered the costs of interconnecting the project to Block Island.

Having individual generators pay their own interconnection and transmission upgrade costs also has implications for the technology that is used; generators may be less likely to invest in more costly, but more efficient technologies like high-voltage DC transmission lines (Deign 2017). Generators are likely to develop many radial connections or split connections, which could complicate land-based connections and/or make offshore connections more expensive (Daniel et al. 2014). Massachusetts is investigating whether and/or how independent transmission (i.e., not

[27] Although US Wind projects transmission upgrade costs to be zero, proposing a two-part OREC price gives them flexibility to recover any unanticipated transmission upgrade costs.

developed, owned, or operated by the offshore wind developer) should occur. State agencies opened a request for comment process and hosted technical conferences to gather feedback from the public (Commonwealth of Massachusetts 2020). An Act to Advance Clean Energy (2018) gives authority to DOER to require electric distribution companies to procure offshore wind transmission.

Table 13. Offshore Wind Procurement Transmission Cost Considerations

State	**Project**	**Transmission Costs**	**Cost Details**	**Source**
New Jersey	OREC RFP	Unknown	Redacted in RFP response	[a]
Maryland	Skipjack	Included in OREC bid	Ratepayers compensate seller for interconnection costs via the OREC price; seller covers required transmission upgrades, but no upgrades anticipated	[b]
Maryland	US Wind	Included in OREC bid	Ratepayers compensate seller for interconnection costs via OREC pricing; seller covers required transmission upgrades, but no upgrades anticipated	[b]
New York	South Fork	Included in PPA terms	EDCs compensate seller for interconnection and transmission costs covered by the PPA, this compensation is assumed by ratepayers	[c]

Connecticut	Revolution Wind	Included in PPA bid	Seller covers all interconnection and necessary or elective transmission improvement costs	[d]
Massachusetts	Vineyard Wind Mayflower	Included in PPA bid	Transmission construction costs covered by PPA, assumed by ratepayers; construction cost overruns not borne by ratepayer	[e]
Rhode Island	Revolution Wind	Included in PPA terms	Seller covers transmission costs to delivery point; buyer covers transmission costs after	[g]

[a] Ocean Wind, LLC (2018)
[b] Public Service Commission of Maryland (2017)
[c] Thomas Falcone (2018)
[d] Deepwater Wind, LLC (2018)
[e] Massachusetts Department of Energy Resources (2017)
[f] From interview notes.
[g] Rhode Island Public Utility Commission (2018)

5 Conclusions

U.S. states along the Eastern Seaboard have set procurement goals for offshore wind energy for a cumulative total of over 26.5 GW by the end of 2019, of which nearly 6.5 GW have been solicited to date. In this report, we compared policy instruments and procurement mechanisms established by U.S. states to develop generation from offshore wind energy. We have argued that a detailed understanding of the terms, structure, and process of procurement is necessary to properly model the revenue from offshore wind projects and to compare procurement pricing among jurisdictions, both across U.S. states and globally.

Building on goals set by state legislators via a statute or executive order, state agencies and utilities have procured offshore wind energy services through a competitive bidding process for PPA and OREC awards. Both instruments generally provide a fixed price for the delivery of energy services. A fixed-price instrument offers a hedge against commodity price fluctuation, which lowers financing costs and is needed to create the financial certainty for securing long term project financing. The offtaker of the awarded instrument is commonly a utility (for PPAs and some ORECs) or a facilitating state agency (for some ORECs). The two policy instruments have originated within the federal and specific state regulatory environments and through policy diffusion from one state to another. The Federal Power Act, as recently highlighted in the Hughes v. Talen (2016) Supreme Court decision, stipulates that states incentivizing generation with certain environmental attributes do not require the generator to participate in a federally regulated market and only "through measures 'untethered' to a generator's wholesale FERC approved rate" (NYPSC 2018). In effect, these legal provisions prevent U.S. states from using European-style CFD schemes, which are very common in recent auctions of established offshore wind markets in the United Kingdom, Germany, Denmark, and the Netherlands.

PPAs are widely used as standardized long-term contractual agreements for the purchase of power from a specific renewable energy generator (i.e., the seller) to a purchaser of electricity (i.e., the buyer). They have been employed as a policy instrument for offshore wind procurement in Massachusetts, Rhode Island, and Connecticut with states mandating utilities to enter PPAs with offshore wind generators for a specified nameplate capacity. Offshore wind generators are selected through competitive bidding procedures, which are based on PPA price offers and other criteria (e.g., economic, ratepayer and environmental impacts). The structure is most touted for its ability to provide a "perfect hedge" (NYSERDA 2018a) against uncertain revenue streams. Under the PPA structure used in these states, the developer receives a set payment for its generation, regardless of the price that generation sells for in the wholesale market.

ORECs were originally developed in New Jersey and have been adopted for solicitations in New Jersey, Maryland, and New York. They represent the environmental attributes of one megawatt hour of electric generation from an offshore wind project and are used to comply with state offshore-wind-specific renewables portfolio standard provisions. Fixed-price OREC structures (used in Maryland and New Jersey) and the Index OREC structure employed in New York provide a strong hedging benefit for the generator against uncertain revenue streams. From a risk perspective, two unique attributes of the OREC procurements in these states should be noted. First, OREC procurements in Maryland and New Jersey are not set contractually but by regulatory order, which could expose them to modifications by state energy regulatory commissions and consequently to higher risk than the contractual PPA structures. Second, the

Index OREC adopted by New York in its 2019 solicitation implements a "CFD-like" scheme, which is based on an index reference price (rather than the local node/hub price). Under this scheme, the generator receives the difference between the strike price and an "index" price, which is based on an average of location-specific marginal prices across NYISO zones J and K. This deviation of the reference price (i.e., the price that forms the basis for compensation under the support regime) from the commodity price (i.e., the price the generator obtains from selling into the spot market), leaves the project with "basis risk."

Although each state differs in their fixed-price OREC implementation, generally energy is sold directly into the wholesale market and RECs to an intermediary (e.g., a distribution utility, state agency, or escrow account). In turn, the ORECs are sold to the electricity suppliers. Similar to PPA procurement structures, offshore wind generators under OREC schemes are selected through competitive bidding procedures, which are based on the OREC price offers and other criteria (e.g., economic, ratepayer, and environmental impacts).

Some differences that were highlighted in recent state procurements between PPA and OREC procurement relates to their respective hedging benefit, ratepayer costs and effectiveness, ease of implementation and legal considerations, and sensitivity to locational price signals and transmission constraints. These hedging benefits have been summarized recently by NYSERDA (2018a) and NYPSC (2016), suggesting the greatest hedging benefits to be associated with a PPA structure (reflecting in lower costs of finance), whereas an Index OREC was evaluated to be deemed best suited to accommodate locational signals of price and transmission constraints while offering similarly high hedging benefits as a PPA structure. A fixed-price OREC was assessed to offer the greatest ease of implementation in some states because of its well established design to reach state-mandated renewable energy targets. Further comparisons between U.S. states were drawn with respect to wholesale and capacity market participation, provisions related to transmission interconnection, and solicitation requirements related to (in state) economic, ratepayer, and environmental impacts.

References

Bade, Gavin. 2019. "ISO-NE Capacity Prices Fall Amid Controversy over Vineyard Wind Participation." *Utility Dive*, February 8, 2019. https://www.utilitydive.com/news/iso-ne-capacity prices-fall-amid-controversy-over-vineyard-wind-participati/548037/.

Bartlett, Jay. 2019. "Reducing Risk in Merchant Wind and Solar Projects through Financial Hedges." Working Paper 19-06. Resources for the Future. https://media.rff.org/documents/WP_19-06_Bartlett.pdf.

Commonwealth of Massachusetts. 2020. "Request for Comment on Massachusetts Offshore Wind Transmission and Notice of Date for Technical Conference." https://www.mass.gov/doc/request-for-comment-and-notice-of-conference-on-massachusetts offshore-wind-transmission/download.

Connecticut Legislature. 2017. *Public Act No. 17-144 (An Act Promoting the Use of Fuel Cells for Electric Distribution System Benefits and Reliability and Amending Various Energy-Related Programs and Requirements).* https://www.cga.ct.gov/2017/act/pa/pdf/2017PA-00144-R00HB 07036-PA.pdf.

Connecticut Legislature. 2018. *Public Act No. 17-3 – June Special Session (An Act Concerning Zero Carbon Solicitation and Procurement).* https://www.cga.ct.gov/2017/ACT/pa/pdf/2017PA 00003-R00SB-01501SS1-PA.pdf.

Connecticut Legislature. 2019. *Public Act No. 19-71 (An Act Concerning the Procurement of*

Energy Derived from Offshore Wind). https://www.cga.ct.gov/2019/ACT/pa/pdf/2019PA-00071-R00HB-07156-PA.pdf.

Connecticut Public Utility Regulatory Authority. 2018. "PURA Review of Clean Energy and Renewable Resource Agreements Selected in Response to DEEP's January 31, 2018 Request for Proposals from Private Developers for Clean Energy." http://publicpolicycenter.org/wp/wp content/uploads/2018/02/CT_RFP_2018.01.31_FINAL-RFP.pdf

Couture, Toby, Karlynn Cory, Claire Kreycik, Emily Williams. 2010. *A Policymaker's Guide to Feed-in Tariff Policy Design* (Technical Report). NREL/TP-6A2-44849. National Renewable Energy Laboratory (NREL). https://www.nrel.gov/docs/fy10osti/44849.pdf.

Daniel, J. P., Shu Liu, Eduardo Ibanez, Ken Pennock, Gregory Reed, Spencer Hanes. 2014. *National Offshore Wind Energy Grid Interconnection Study*. ABB, Inc. https://www.energy.gov/sites/prod/files/2014/08/f18/NOWEGIS%20Executive%20Summary.pdf.

Database of State Incentives for Renewables and Efficiency. 2019. "Eversource - ZREC and LREC Long Term Contracts." June 27, 2019. https://programs.dsireusa.org/system/program/detail/5692.

Deepwater Wind, LLC. 2018. "Notice of Request for Proposals from Private Developers for Clean Energy." Connecticut Department of Energy & Environmental Protection. http://publicpolicycenter.org/wp/wp-content/uploads/2018/02/CT_RFP_2018.01.31_FINAL RFP.pdf.

Deign, Jason. 2017. "To Slash Offshore Wind Costs, Developers Need to Think Carefully About Transmission Technology." *Greentech Media*, August 3, 2017. https://www.greentechmedia.com/articles/read/could-smart-grid-thinking-cut-u-s-offshore-wind costs.

Environmental Protection Agency (EPA). 2019. "Physical Power Purchase Agreements (Physical PPAs)." https://www.epa.gov/greenpower/physical-power-purchase-agreements physical-ppas.

Exeter Associates, Inc. 2019. *Final Report Concerning the Maryland Renewable Portfolio Standard as Required by Chapter 393 of the Acts of the Maryland General Assembly of 2017*. https://dnr.maryland.gov/pprp/Documents/FinalRPSReportDecember2019.pdf.

Falcone, Thomas. 2018. *Authorization to execute Amendment No. 1 to the Power Purchase Agreement with Deepwater Wind South Fork, LLC and Extension of Waiting List Enrollment Period for Commercial Solar Feed-in Tariff III*. https://www.lipower.org/wp content/uploads/2018/12/DWW-CES-Final-PDF.pdf.

Fouquet, D., and T. B. Johansson. 2008. "European renewable energy policy at crossroads Focus on electricity support mechanisms." *Energy Policy* 36 (11): 4079–92. https://doi.org/10.1016/j.enpol.2008.06.023.

General Assembly of the Commonwealth of Massachusetts. 2016. *Massachusetts Energy Diversity Act of 2016. Mass. Acts 169 § 83C(b).* https://malegislature.gov/Bills/189/H4568.

General Assembly of the Commonwealth of Massachusetts. 2018. *An Act to Advance Clean Energy*. https://malegislature.gov/Bills/190/H4857.

Golden, Jr., Thomas A., Patricia A. Haddad, Michael. Barrett Bradley H. Jones, Jr., and Patrick M. O'Connor Marc R. Pacheco. 2018. *An Act to Advance Clean Energy*. https://malegislature.gov/Bills/190/H4857.

Governor Philip D. Murphy. 2018. *Executive Order No. 8*. https://nj.gov/infobank/eo/056murphy/pdf/EO-8.pdf.

Governor Philip D. Murphy. 2020. *Executive Order No. 92*. https://nj.gov/infobank/eo/056murphy/pdf/EO-92.pdf

Governor Gina M. Raimondo. 2020. *Executive Order No. 20-01* (Advancing a 100% Clean Energy Future For Rhode Island). https://governor.ri.gov/documents/orders/Executive-Order-20-01.pdf.

Governor Ralph S. Northam. 2019. *Executive Order No. 43* (Expanding Access to Clean Energy and Growing the Clean Energy Jobs of the Future). https://www.governor.virginia.gov/media/governorvirginiagov/executive-actions/EO-43-Expanding-Access-to-Clean-Energy-and-Growing-the-Clean-Energy-Jobs-of-the-Future.pdf .

Hochberg, Michael, and Rahmatallah Poudineh. 2018. *Renewable Auction Design in Theory and Practice: Lessons from the Experiences of Brazil and Mexico*. OIES Paper: EL 28. The Oxford Institute for Energy Studies. https://www.oxfordenergy.org/wpcms/wp content/uploads/2018/04/Renewable-Auction-Design-in-Theory-and-Practice-Lessons-from-the Experiences-of-Brazil-and-Mexico-EL-28.pdf.

Hughes v. Talen Energy Marketing. 2016. HUGHES, CHAIRMAN, MARYLAND PUBLIC SERVICE COMMISION, ET AL. v. TALEN ENERGY MARKETING, LLC, FKA PPL ENERGYPLUS, LLC, ET AL. No. 14–614. Argued February 24, 2016—Decided April 19, 2016. https://www.supremecourt.gov/opinions/15pdf/14-614_k5fm.pdf

Illinois Power Agency. 2018. *Long-Term Renewable Resources Procurement Plan*. https://www2.illinois.gov/sites/ipa/Documents/2019ProcurementPlan/Long%20Term%20Renewable%20Resources%20Procurement%20Plan%20%288-6-18%29.pdf.

InClime. 2017. "SRECDelaware Program." 2017. http://www.dev.srecdelaware.com/faq/.

International Renewable Energy Agency. 2016. *Renewable Energy Auctions in Developing Countries*. https://ppp.worldbank.org/public-private-partnership/library/renewable-energy auctions-developing-countries-irena-2016.

ISO-New England. 2019. "ISO-NE Interconnection Request Queue." Public Generator Interconnection Queue. September 26, 2019. https://irtt.iso-ne.com/reports/external.

Jenkin, Thomas, Philipp Beiter, and Robert Margolis. 2016. *Capacity Payments in Restructured Markets under Low and High Penetration Levels of Renewable Energy* (Technical Report). NREL/TP-6A20-65491. National Renewable Energy Laboratory, Golden, CO (US). https://www.nrel.gov/docs/fy16osti/65491.pdf.

Kitzing, Lena, and Catherine Mitchell. 2014. "Achieving energy transitions: Which RES policies are best applied when?" https://pdfs.semanticscholar.org/0dd2/166f01a1a7d6d93e690357cc146fe36196ae.pdf.

Long Island Power Authority. 2019. *South Fork Wind Farm Fact Sheet*. https://www.lipower.org/wp-content/uploads/2019/10/LIPA-First-Offshore-Wind-Farm-DocV19_102819-FINAL.pdf.

Maryland General Assembly. 2013. *Offshore Wind Energy Act.* http://mgaleg.maryland.gov/2013RS/bills/hb/hb0226E.pdf.

Maryland Senate. 2019. *Clean Energy Jobs Act*. https://legiscan.com/MD/text/SB516/2019.

Massachusetts Legislature. 2016. *An Act to Promote Energy Diversity*. https://malegislature.gov/Bills/189/H4568.

Massachusetts Department of Energy Resources. 2017. "Request for Proposals for Long-Term Contracts for Offshore Wind Energy Projects."

———. 2018. "Petitions for Approval of Proposed Long-Term Contracts for Offshore Wind Energy Pursuant to Section 83C of Chapter 188 of the Acts of 2016, DPU 18-76, 18- 77, 18-78."

———. 2019. "Request for Proposals for Long-Term Contracts for Offshore Wind Energy Projects." https://macleanenergy.files.wordpress.com/2019/05/83c-ii-rfp_finalpackage.pdf.

Mayflower Wind. 2020. "Exhibit JU-3-B: OFFSHORE WIND GENERATION UNIT POWER PURCHASE AGREEMENT BETWEEN NSTAR ELECTRIC COMPANY d/b/a EVERSOURCE ENERGY AND MAYFLOWER WIND ENERGY LLC, D.P.U. 20-16/20-17/20-18."

Mohl, Bruce. 2019. "Offshore wind price protection eliminated." *CommonWealth Magazine*, July 31, 2019. https://commonwealthmagazine.org/energy/offshore-wind-price-protection eliminated/.

National Renewable Energy Laboratory. 2019. "Solar Requests for Proposals." https://www.nrel.gov/state-local-tribal/basics-solar-rfps.html.

New Jersey Board of Public Utilities. 2018. "Qualified Offshore Wind Projects. New Jersey Administrative Code 14:8-6.6 and 6.7." https://www.state.nj.us/bpu/agenda/rules/PRN%202018-

078%20(50%20N.J.R.%201879(a))%20Published%20OREC%20Rule%208-20-2018.pdf.

New Jersey Legislature. 2010. *Offshore Wind Economic Development Act*. https://www.njleg.state.nj.us/2010/Bills/AL10/57_.PDF.

———. 2018. *NJ A3723*. https://legiscan.com/NJ/text/A3723/2018.

New York State Energy Research and Development Authority. 2018a. *Offshore Wind Policy Options Paper*. https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar Wind/Master-Plan/Offshore-Wind-Policy-Options-Paper.pdf.

———. 2018b. "Purchase of Offshore Wind Renewable Energy Certificates: Request for Proposals." https://portal.nyserda.ny.gov/servlet/servlet.FileDownload?file=00Pt000000Fx0rjEAB.

———. 2019. *Launching New York's Offshore Wind Industry: Phase 1 Report*. Report Number 19-41. https://www.nyserda.ny.gov/-/media/Files/Programs/offshore-wind/osw-phase-1-procurement-report.pdf.

______. 2020. "2020 Offshore Wind Solicitation." https://www.nyserda.ny.gov/All Programs/Programs/Offshore-Wind/Offshore-Wind-Solicitations/Generators-and-Developers.

New York Public Service Commission. 2016. "Order Adopting a Clean Energy Standard."

———. 2018. *Order Establishing Offshore Wind Standard and Framework for Phase 1 Procurement. Case 18-E-0071 - In the Matter of Offshore Wind Energy*. https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/Offshore-Wind Solicitations/Regulatory-Resources.

———. 2019. *Docket No. EL19-____-000 – New York State Public Service Commission et al. v. New York Independent System Operator, Inc* https://www.troutman.com/images/content/2/0/v2/203627/NYPSC-complaint.pdf.

Ocean Wind, LLC. 2018. "Ocean Wind Application for Offshore Wind Renewable Energy Certificates." Submitted to the New Jersey Board of Public Utilities. https://www.bpu.state.nj.us/bpu/pdf/boardorders/2019/20190621/6-21-19-8D%20-%20Orsted%20Public%20OREC%20Application.pdf.

Organization for Economic Co-operation and Development. 2019. "Public Procurement Toolbox." https://www.oecd.org/governance/procurement/toolbox/about/terminology/.

Polzin, Friedemann, Florian Egli, Bjarne Steffen, and Tobias S. Schmidt. 2019. "How do policies mobilize private finance for renewable energy?—A systematic review with an investor perspective." *Applied Energy* 236 (February): 1249–68. https://doi.org/10.1016/j.apenergy.2018.11.098.

Poudineh, R., C. Brown, B. Foley. "Economics of Offshore Wind Power. Challenges and Policy Considerations." Palgrave Macmillan. https://doi.org/10.1007/978-3-319-66420-0.

Public Service Commission of Maryland. 2017. In the Matter of Applications of U.S. Wind, Inc. and Skipjack Offshore Energy, LLC for a Proposed Offshore Wind Project(s) Pursuant to the Maryland Offshore Wind Energy Act of 2013. http://www.dnrec.delaware.gov/energy/Documents/Offshore%20Wind%20Working%20Group/MD%20PSC%2088192.pdf.

Rhode Island Legislature. 2014. *Affordable Clean Energy Security Act* (Chapter 39-31). http://webserver.rilin.state.ri.us/Statutes/TITLE39/39-31/INDEX.HTM.

Rhode Island Public Utility Commission. 2018. "Offshore Wind Generation Unit Power Purchase Agreement Between the Narragansett Electric Company, D/B/A National Grid, as Buyer and DWW Rev I, LLC, as Seller." http://www.ripuc.org/eventsactions/docket/4929-NGrid-PPA-NG-1.pdf.

Vineyard Wind. 2018. Vineyard Wind, LLC, Reply Brief, Kevin Conroy & Kelly Caiazzo, filed with Commonwealth of Massachusetts Department of Public Utilities opposing D.P.U. 18-76, 18-77, and 18-78. February 13, 2018.

Virginia Legislature. 2020. *Virginia Clean Energy Economy Act* (HB 1526). https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526

Virginia State Corporation Commission. 2018. "For a prudency determination with respect to the Coastal Virginia Offshore Wind Project pursuant to Virginia Code § 56-585.1:4 F, CASE NO. PUR-2018-00121." https://scc.virginia.gov/docketsearch/DOCS/4c%24z01!.PDF. Wiser, Ryan, Galen Barbose, and Edward Holt. 2010. *Supporting Solar Power in Renewables Portfolio Standards: Experience from the United States*. LBNL-3984E. Lawrence Berkeley National Laboratory. https://eetd.lbl.gov/sites/all/files/publications/report-lbnl-3984e.pdf.

Appendix A. Offshore Wind Procurement Goals and Offtake Agreements by State

Table A-1. Offshore Wind Procurement Goals

State Capacity	Target	Amount	Contract	Authority (Year

	Commitment (megawatt [MW])	Year	Solicited (MW)	Type	Enacted)	Renewables Portfolio Standard Goal
MA	3,200	2035	1,604	Power purchase agreement (PPA)	An Act to Promote Energy Diversity (2016); An Act to Advance Clean Energy	35% by 2030
RI	430	-	430	PPA	-	31% by 2030
NJ	7,500	2035	1,100	Offshore renewable energy certificate (OREC)	Offshore Wind Economic Development Act (2010); E. O. 8/Assembly Bill 3723 (2018); E. O. 92 (2019)	50% by 2030
MD	1,568	2030	368	OREC	Maryland Offshore Wind Energy Act (2018); Senate Bill 516 (2019)	50% by 2030
NY	9,000	2035	1,826	OREC	Case 18-E0071 (2018); Climate Leadership & Community Protection Act (2019)	70% by 2030
CT	2,000	2030	1,104	PPA	Public Act 17-144 (2017); House Bill 7156 (2019)	44% by 2030
VA	5,200	2034	12	Utility owned	Virginia Clean Economy Act (2020)	100% by 2050
Total	28,898		6,444			

Table A-2. U.S. Offshore Wind Offtake Agreements

Project Size (MW)	Duration (years)	Offtake	Offtake	Regulator	Levelized	Power	Power

			State	Mechanism	Approved	Price	Delivery	Purchaser
Block Island Wind Farm	30	20	RI	PPA	Yes	$244/megawatt hour (MWh)	2016	National Grid
South Fork	130	20	NY	PPA	Yes	$163/MWh	2022	LIPA
US Wind	248	20	MD	MD OREC	Yes	$131.94/MWh	2022	PJM
Skipjack	120	20	MD	MD OREC	Yes	$131.94/MWh	2022	PJM
Vineyard Wind	400	20	MA	PPA	Yes	$74/MWh	2023	National Grid, Eversource, Unitil
Vineyard Wind	400	20	MA	PPA	Yes	$65/MWh	2024	National Grid, Eversource, Unitil
Coastal Virginia Offshore Wind	12	20	VA	Utility Owned	Yes	$780/MWh	2021	Dominion Energy
Revolution Wind	200	20	CT	PPA	Yes	$99.50/MWh	2023	Eversource & UIL
Revolution Wind	104	20	CT	PPA	Yes	$98.43/MWh	2023	Eversource & UIL
Revolution Wind	400	20	RI	PPA	Yes	$98.43/MWh	2023	National Grid
Ocean Wind	1,100	20	NJ	NJ OREC	Yes	$116.82/MWh	2024	PJM
Empire Wind	816	25	NY	NY OREC	Yes	$83.36/MWh	2024	NYISO
Sunrise Wind	880	25	NY	NY OREC	Yes	$83.36/MWh	2024	NYISO
Aqua Ventus	12	20	ME	PPA	Yes	N/A	N/A	Central Maine Power
Mayflower Wind	400	20	MA	PPA	Yes	$58.47/MWh	2025	National Grid, Eversource, Unitil

Mayflower Wind	404	20	MA	PPA	Yes	$58.47/MWh	2025	National Grid, Eversource, Unitil
Park City Wind	804	20	CT	PPA	Pending	N/A	2025	Eversource & UIL
Icebreaker	21	TBD	OH	PPA	Pending	N/A	TBD	TBD

Appendix B. Details on State-Level Offshore Wind Authority

The state-level offshore wind authority flowcharts are as follows.

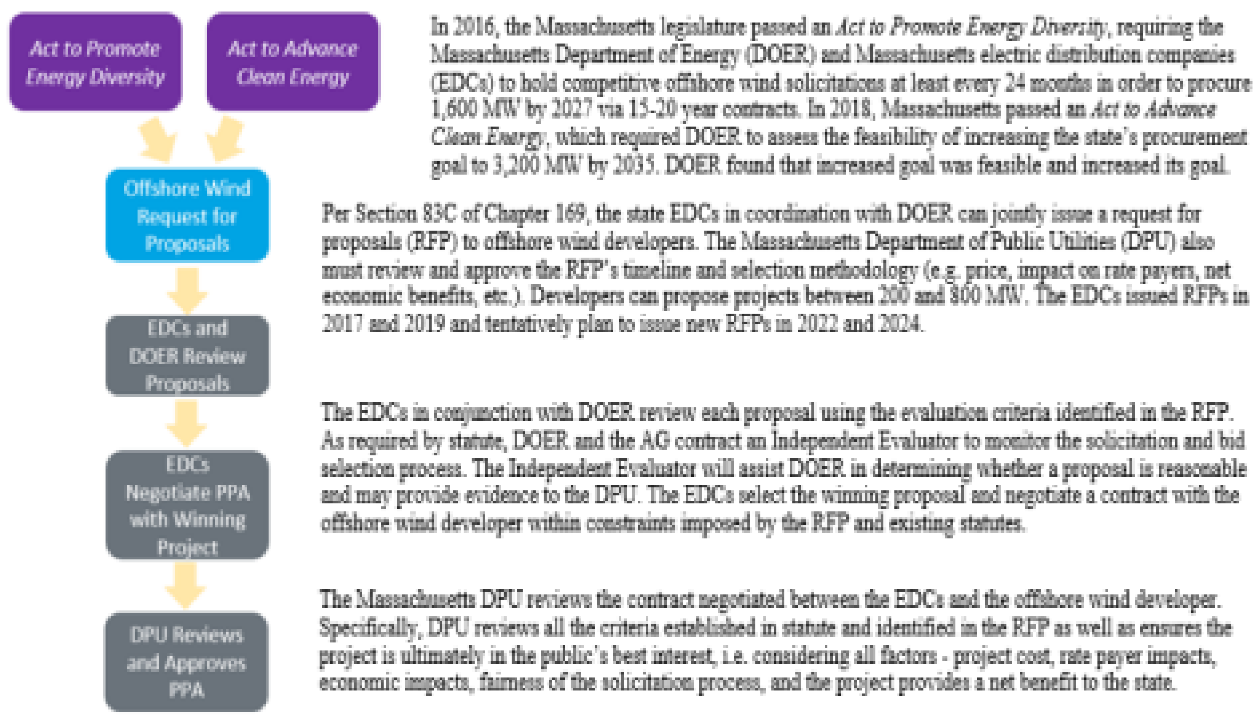


Figure B-1. The Massachusetts offshore wind authority flowchart

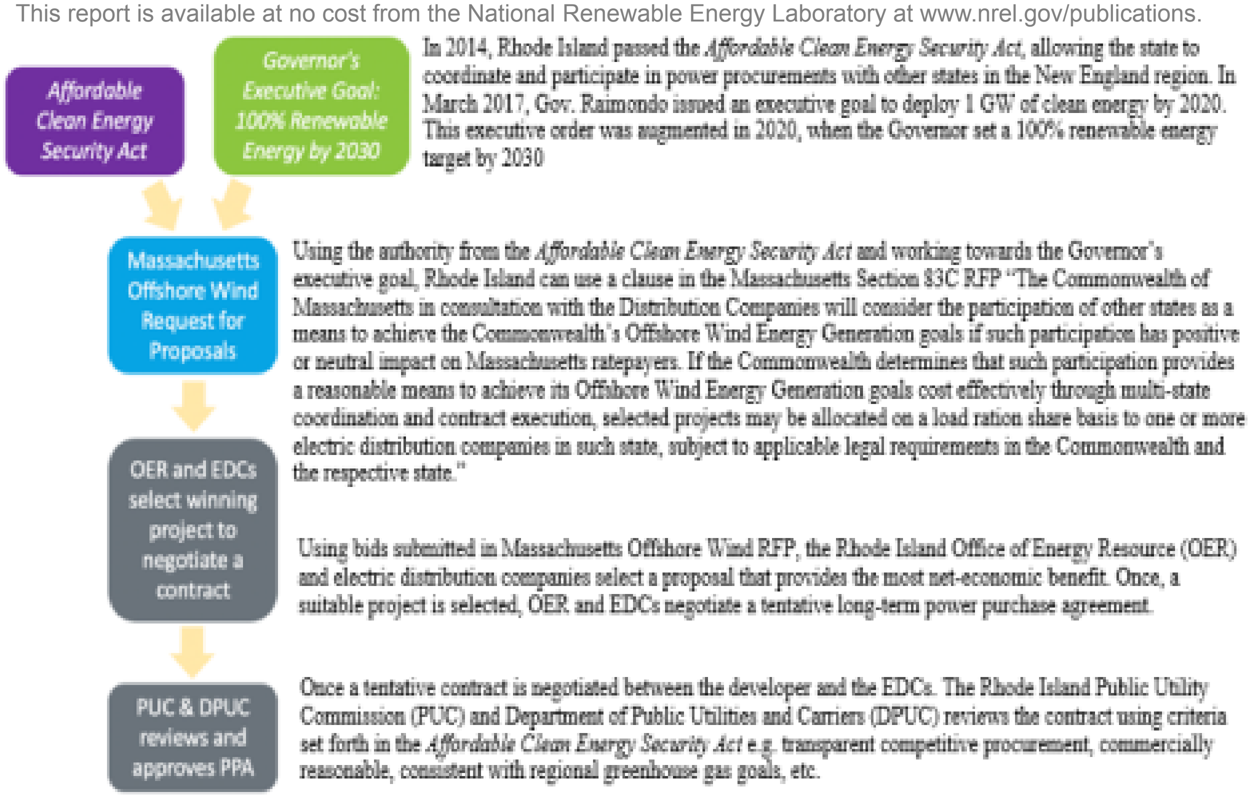
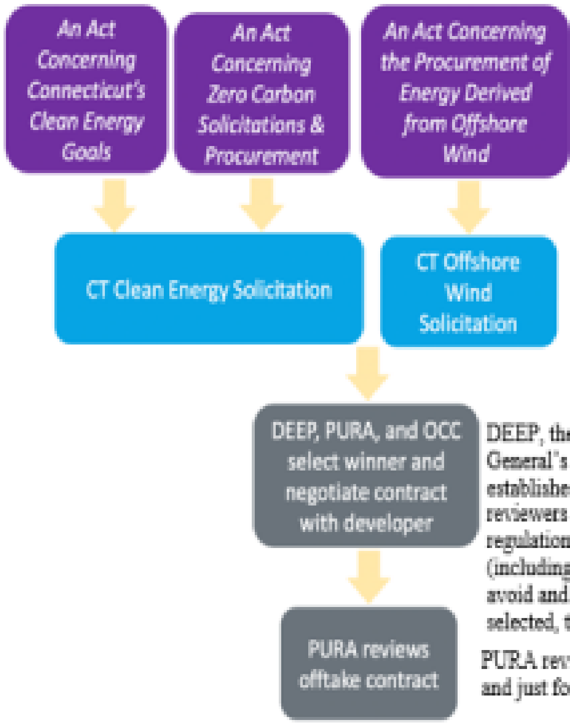


Figure B-2. The Rhode Island offshore wind authority flowchart



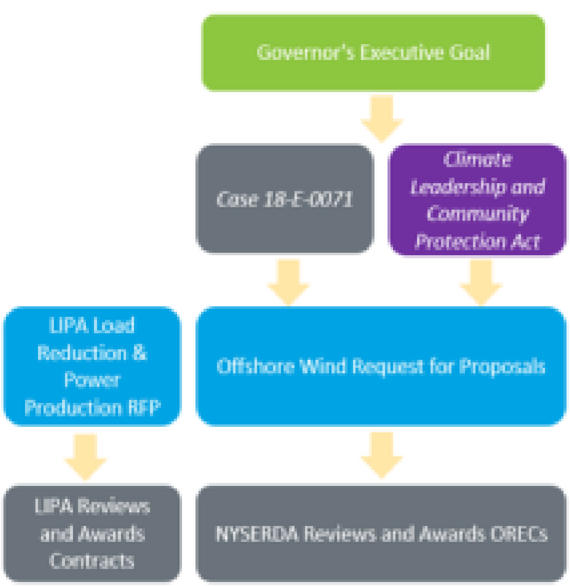
In 2013, Connecticut passed *An Act Concerning Connecticut's Clean Energy Goals*. The act allows Department of Energy and Environmental Protection (DEEP) to solicit clean energy projects of various technology types. DEEP also was able to procure offshore capacity through *An Act Concerning Zero Carbon Solicitations and Procurement*. On June 18, 2019, Connecticut passed *An Act Concerning the Procurement of Energy Derived from Offshore Wind*. The act requires DEEP to offer solicitations for up to 2,000 MW of offshore wind capacity.

In 2018, DEEP in conjunction with the Office of Consumer Counsel, Attorney General, and electric distribution companies (EDCS) released a *Notice of Request for Proposals From Private Developers for Clean Energy* that sought to procure up to 825,000 MWh of offshore wind generation and/or other generation as authorized under *An Act Concerning Connecticut's Clean Energy Goals*. In 2019, as per *An Act Concerning the Procurement of Energy Derived from Offshore Wind*, DEEP released a 2,000 MW offshore wind solicitation, developers could propose projects between 400 MW and 2,000 MW

DEEP, the Public Utilities Regulatory Authority (PURA) procurement manager, the Attorney General's Office, and the Office of Consumer Council (OCC) review proposals using criteria established in both statues identified above. For the 2019 offshore wind solicitation bid, reviewers have to specifically evaluate: 1) whether proposals are consistent with IRP planning regulations, 2) plan for the use of skilled labor, 3) electric distribution system reliability (including during winter peak), 4) impact on the state's economic development, and 5) plan to avoid and mitigate environmental and wildlife impacts, especially fisheries. Once a winner is selected, they negotiate a draft PPA with the EDCs for review by PURA.

PURA reviews the tentative contract between the developer and the EDCs to ensure it is fair and just for ratepayers and coincides with Connecticut statute.

Figure B-3. The Connecticut offshore wind authority flowchart



In 2017 Gov. Cuomo set an executive goal for New York to develop 2,400 MW of offshore wind capacity by 2030. The governor also tasked NYSERDA to develop and Offshore Wind Master Plan that would lay out how the state would achieve its goals. In January 2019, Governor expanded his executive offshore wind goal to 9,000 MW by 2035.

Following directions issued from the governor, the New York Public Service Commission (PSC) established an order clarifying how the state can conduct its Phase 1 procurement (up to 2,400 MW). The PSC gave NYSERDA the authority to conduct solicitations, issue ORECs, and select proposals. The *Climate Leadership and Community Protection Act* codifies, the 9,000 MW by 2025 goal in New York's *Clean Energy Standard*.

On June 24, 2015 PSEG Long Island acting on behalf of Long Island Public Power Authority (LIPA) issued and RFP to acquire up to 169 MW of Load Reduction or Power Production resources. In November 2018, NYSERDA issued its first offshore wind solicitation for ~800 MW using guidelines established in Case 18-E-0071. Based on the results of the Phase 1 solicitations, NYERDA reserves the right to change the solicitation and remuneration structures for future solicitations.

LIPA reviewed the 2015 RFP and awarded 90 MW to Deepwater Wind's South Fork project. The terms of the PPA are undisclosed. NYSERDA reviewed proposals from the Phase 1 solicitations and selected them using criteria identified in *Case 18-E-0071* and the RFP (e.g., wage requirements, public labor agreements, economic impacts, environmental impacts, etc.). For future solicitations these criteria could change at the discretion of NYSERDA.

Figure B-4. The New York offshore wind authority flowchart

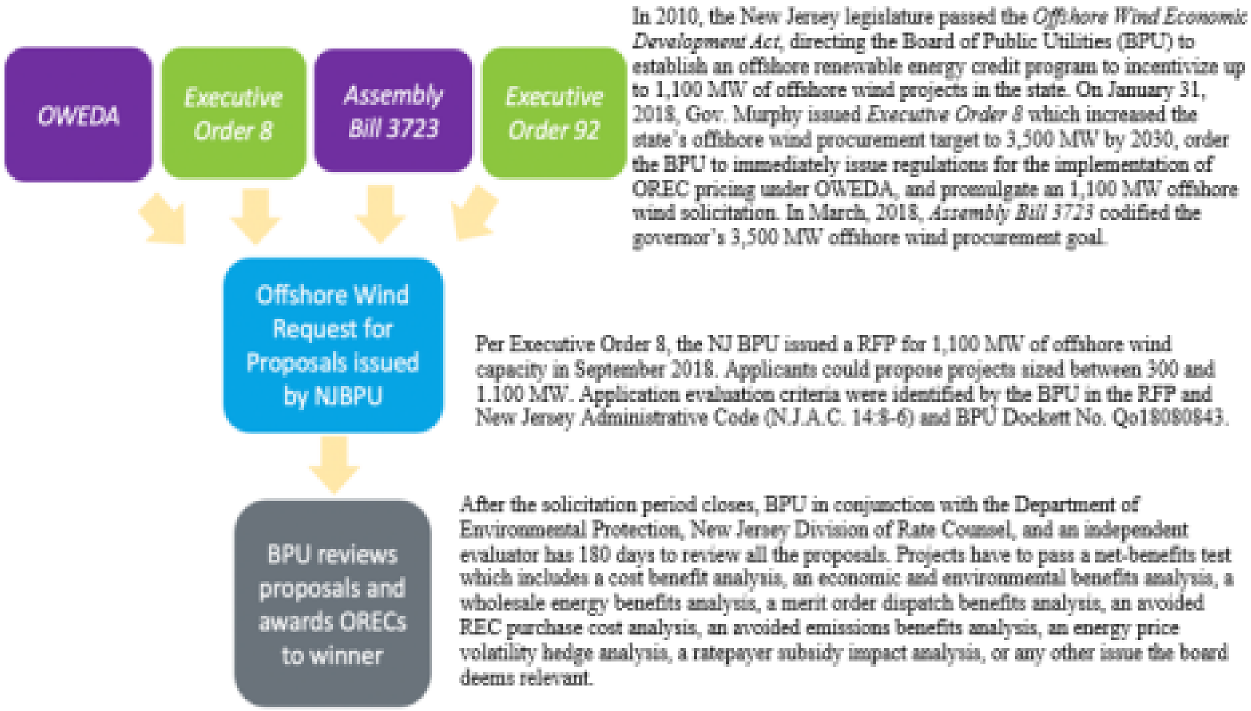


Figure B-5. The New Jersey offshore wind authority flowchart

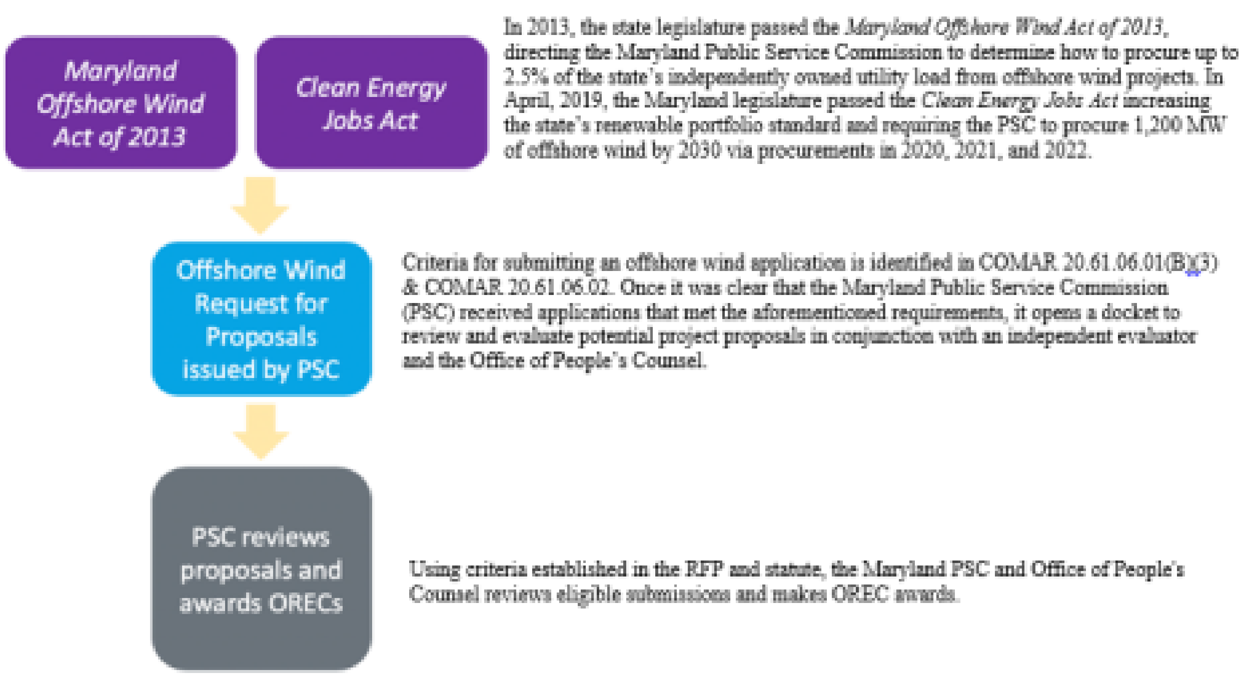


Figure B-6. The Maryland offshore wind authority flowchart

Appendix C. Offshore Wind Labor Requirements

Table C-1. State Offshore Wind Labor Requirements

State Wage/	Labor Language in Statute	Authority Wage/Labor	Language in Request for Proposals (RFP)	RFP Text	Project Agreements (Note many terms power purchase ag (PPA)/offshore ren certificate deal)
Connecticut	Yes	Department of Energy and Environmental Protection commissioner, in conjunction with Public Utilities Regulatory Authority and the Office of Consumer	Yes* (Draft RFP)	The commissioner must include requirements for selected bids that: (a) require payment of not less than the prevailing wage, as described in Section 31-53 of the general statutes, for laborers, workmen, and mechanics performing construction activities within the United States with respect to the project, and (b) require selected bidders to engage in a good faith negotiation of a project labor	**Revolution Wind [MW])** ** PPA requ - Invest $57.5 mill London and sign 2019)

		Counsel		agreement	
Maryland	Yes	Maryland Public Service Commission (PSC)	Yes	**F. The Extent to which an Applicant's Plan for Engaging Small Businesses, Contractors, and Skilled Labor Meets the Goals Specified in State Statute for Engagement, Hiring, and Compensation** The act and the regulations require the commission to evaluate several aspects of how each proposed offshore wind project would affect employment, labor, and small businesses in the state. Specifically, the commission must consider the extent to which the applicants' plans: propose to engage small businesses in furtherance of state goals; provide for the use of skilled labor and appropriate agreements to promote the prompt, efficient, and safe completion of the project; and provide for compensation to employees and subcontractors	**Skipjack (120 MW** $6 million to Mary Wind Business D Fund - 2,635 new employe - 34% of total (CapEx) spent in state - Use a port f marshall - Use a port f an operati (O&M) p - Invest $25 r fabricatio Memorandum of u with PSC for goo minority investors business enterpri **US Wind (248 MW**

State Wage/	Labor Language in Statute	Authority Wage/Labor	Language in Request for Proposals (RFP)	RFP Text	Project Agreements (Note many terms power purchase ag (PPA)/offshore ren certificate deal)
				consistent with the wages outlined in §§ 17-201 through 17-228 of the State Finance and Procurement Article. Order No. 88192	$6 million to Mary Wind Business D Fund - 7,050 new F - 19% of total spent in - Use a port f marshall - Use a port f an O&M - Invest $51 r fabricatio - Invest $26 r Atlantic s MOU with PSC fo target minority inv minority business goals

New Jersey	Yes	New Jersey Board of Public Utilities	Yes	In-state impacts or benefits that need to be included in the cost-benefit analysis include, but are not limited to: employment, wages, indirect business taxes, and output, with a "particular emphasis" on manufacturing employment. Output refers to the sales of sectors or industries that would be supplying the offshore wind project with materials (such as turbines, steel, and cement for support structures; wire for transmission cables) and services (such as construction and installation services, as well as engineering, legal, finance, and other professional services). [DOCKET NO. Q018080851](#)	**Ocean Wind (1,1** $15 million i infrastructure - C - Workforce d students - MOUs with Rowan U - MOU with S and Con Council for a Projec OSW jobs t wage - Invest with E substructur in Paulsb
New York	Yes	New York State Energy Research	Yes	The Offshore Wind Order authorizes NYSERDA to include, at its discretion,	Empire Wind (816 (880 MW)

State Wage/	Labor Language in Statute	Authority Wage/Labor	Language in Request for Proposals (RFP)		RFP Text Project Agreements (Note many terms power purchase ag (PPA)/offshore ren certificate deal)
		and Development Authority (NYSERDA) and New York PSC		certain contract requirements in agreements resulting from this solicitation. NYSERDA has adopted the following requirements and has incorporated them into the agreement…. **Prevailing Wage Requirement** ….and **Project Labor Agreement** [Request for Proposals ORECRFP18-1](#) [(Page 13-15)](#)	- More than 1 by prevail labor agr - $287 million infrastruct - $20 million f training i - $3 million fo Workforc

Massachusetts	No	Massachusetts Department of Energy Resources and Department of Public Utilities	No	Section 83C requires that, where feasible, a proposed project demonstrate that it creates additional employment and economic development in the commonwealth. This requirement can be satisfied, for example, by a showing of direct employment benefits associated with the proposed project, or, indirect employment benefits associated with the proposed project, or, other economic development benefits associated with the proposed project. The evaluation team will consider a broad range of other economic development benefits that could be achieved by a proposed project, including, for example, creating property tax and lease payment revenues, commitments to local workforce training, and providing offshore wind energy generation at lower costs than other potential projects, and potential environmental benefits to ratepayers. The proposal shall include a timeline of the short term and long-term economic development benefits.	Vineyard Wind (80 - 3,600 new F - $10 million o accelera - $2 million of developm - $3 million w - Martha Vine - Port of New

State Wage/	Labor Language in Statute	Authority Wage/Labor Language in Request for Proposals (RFP)	RFP Text Project Agreements (Note many terms power purchase ag (PPA)/offshore ren certificate deal)

				[Request for proposals for long-term contracts for offshore wind energy projects](https://macleanenergy.files.wordpress.com/2017/02/section-83c-request-for-proposals-for-long-term-contracts-for-offshore-wind-energy-projects-june-29-2017.pdf)(83C) Page 30 https://macleanenergy.files.wordpress.com/2017/02/section-83c-request-for-proposals-for-long-term-contracts-for-offshore-wind-energy-projects-june-29-2017.pdf Section 83C requires that, where feasible, a proposed project demonstrates that it creates additional employment and economic development in the commonwealth. This requirement can be satisfied, for example, by a showing of employment benefits associated with the proposed project, or, other economic development benefits associated with the proposed project. The evaluation team will consider a broad range of other economic development benefits that could be achieved by a proposed project. The proposal shall include a timeline of the short-term and long term economic development benefits. The bidder should be prepared to provide factual support for its employment and economic development projections and reflect any associated commitments in agreements with applicable governmental and nongovernmental entities. **[Request for Proposals for Long Term Contracts for Offshore Wind Energy Projects](https://macleanenergy.files.wordpress.com/2019/08/83crfpr2_with-appendices-revised-08.7.19.pdf) (83C II) Page 25** https://macleanenergy.files.wordpress.com/2019/08/83crfpr2_with appendices-revised-08.7.19.pdf	

State Wage/	Labor Language in Statute	Authority Wage/Labor	Language in Request for Proposals	RFP Text Project Agreements	(Note many terms power purchase ag

			(RFP)		(PPA)/offshore ren certificate deal)
Rhode Island	No	Rhode Island			Revolution Wind (**PPA requiremen - Invest $40 infrastructur

Appendix D. Details on Offshore Wind Procurement Mechanisms by State

Connecticut's Power Purchase Agreement Structure

Connecticut uses a standard power purchase agreement (PPA) structure with the distribution utility at the center of the procurement. The offshore wind generator sells energy and renewable energy certificates (RECs) to the distribution utility, who then sells the energy into Independent System Operator (ISO)-New England, either in the day-ahead or real-time energy market. The distribution utility can recover their reasonable costs in connection with their administrative functions. The RECs from the offshore wind generator are transferred to the distribution utility, which can then sell them on a bilateral basis to electricity suppliers who use the RECs to meet their renewables portfolio standard (RPS) requirement. Offshore wind generators can sell into the capacity market and will retain the revenue they receive from any capacity value.

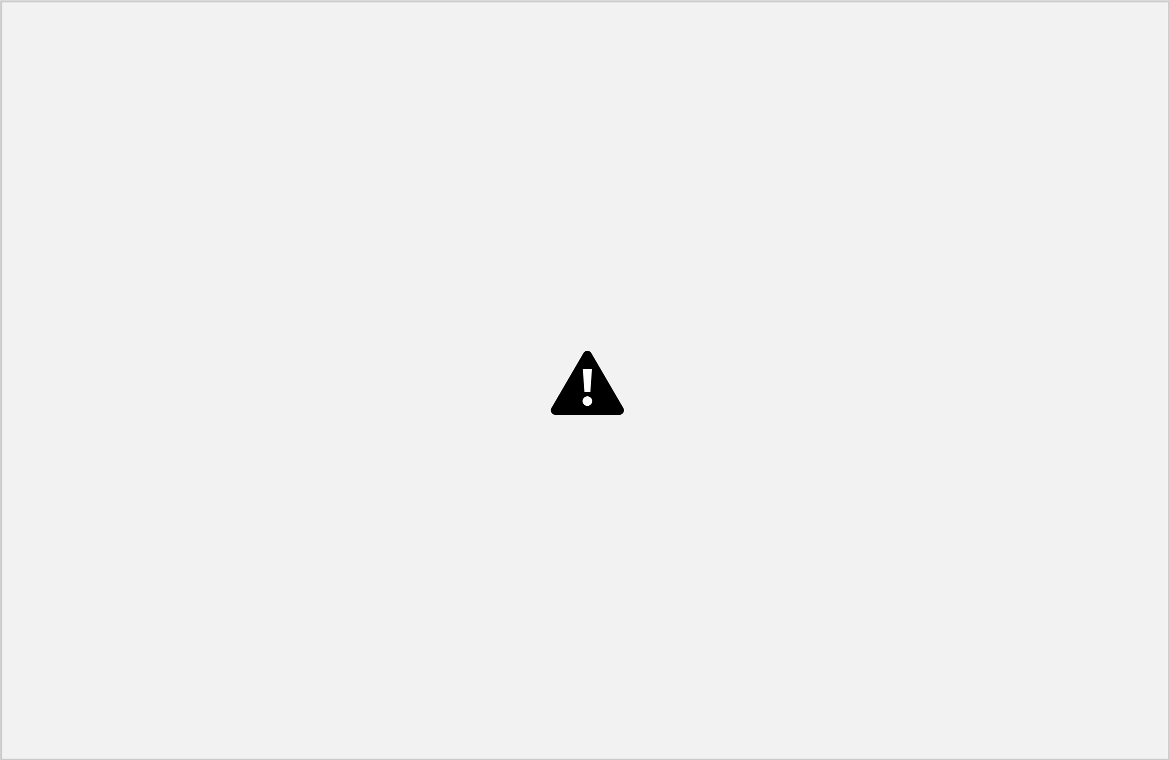


Figure D-1. Connecticut's PPA structure

Massachusetts' PPA Structure

Massachusetts also uses a standard PPA structure with the distribution utility at the center of the procurement. The offshore wind generator sells energy and RECs to the distribution utility, who then sells the energy into ISO-NE that they do not use for their own customers. The distribution utility can recover up to 2.75% of the annual PPA payments to compensate for accepting the financial obligation of the long-term PPA contract.[28] The RECs from the offshore wind generator are transferred to the distribution utility, which can then sell them on a bilateral basis to electricity suppliers, who use the RECs to meet their RPS requirement. Offshore wind generators can sell into the capacity market and will retain the revenue they receive from any capacity value.

In Massachusetts there was debate over whether Vineyard Wind should be required to participate in ISO-New England's forward capacity market (FCM). Vineyard Wind challenged a proposed requirement via a motion submitted to the Massachusetts Department of Public Utilities. Vineyard Wind argued that, because it "is already financially incentivized to do so[,]" mandating FCM participation in the PPA "would place a commercially unreasonable burden on Vineyard Wind where factors beyond Vineyard Wind's control, such as the future structure of the FCM and the distribution companies' performance under the PPAs, could significantly impact Vineyard Wind's ability to satisfy that obligation" (Vineyard Wind 2018).[29] Ultimately, the Department of Public Utilities found Vineyard Wind's argument compelling and ordered this clause removed from the PPA and all future requests for proposals. Specifically, the Department of Public Utilities found that "imposing requirement related to obtaining a capacity supply obligation creates potential financing risks because the forward capacity market may change in unanticipated ways" (Massachusetts Department of Public Utilities 2019).[30]

[28] The remuneration of 2.75% was agreed upon in the Vineyard Wind contract approval; however, remuneration is always reviewed in each contract proceeding before the Department of Public Utilities.

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Capacity market issues came up again in Massachusetts as Vineyard Wind was seeking participation in ISO-New England's 13th forward capacity auction for capacity delivered in 2022–2023. Typically, renewable resources are exempt from the ISO's Minimum Offer Price Rule, which allows them to bid in at lower prices, and thus more likely to secure capacity as part of the auction. However, the ISO's rules stated that renewable facilities must be located within the physical borders of a New England state, which the Vineyard Wind facility would not be. The ISO requested a change from the Federal Energy Regulatory Commission, but the change was not approved in time for the auction, which proceeded with Vineyard Wind participating under the Minimum Offer Price Rule. Subsequently, the commission approved ISO-New England's proposal to allow offshore facilities to be exempt from the Minimum Offer Price Rule in the future (Bade 2019).

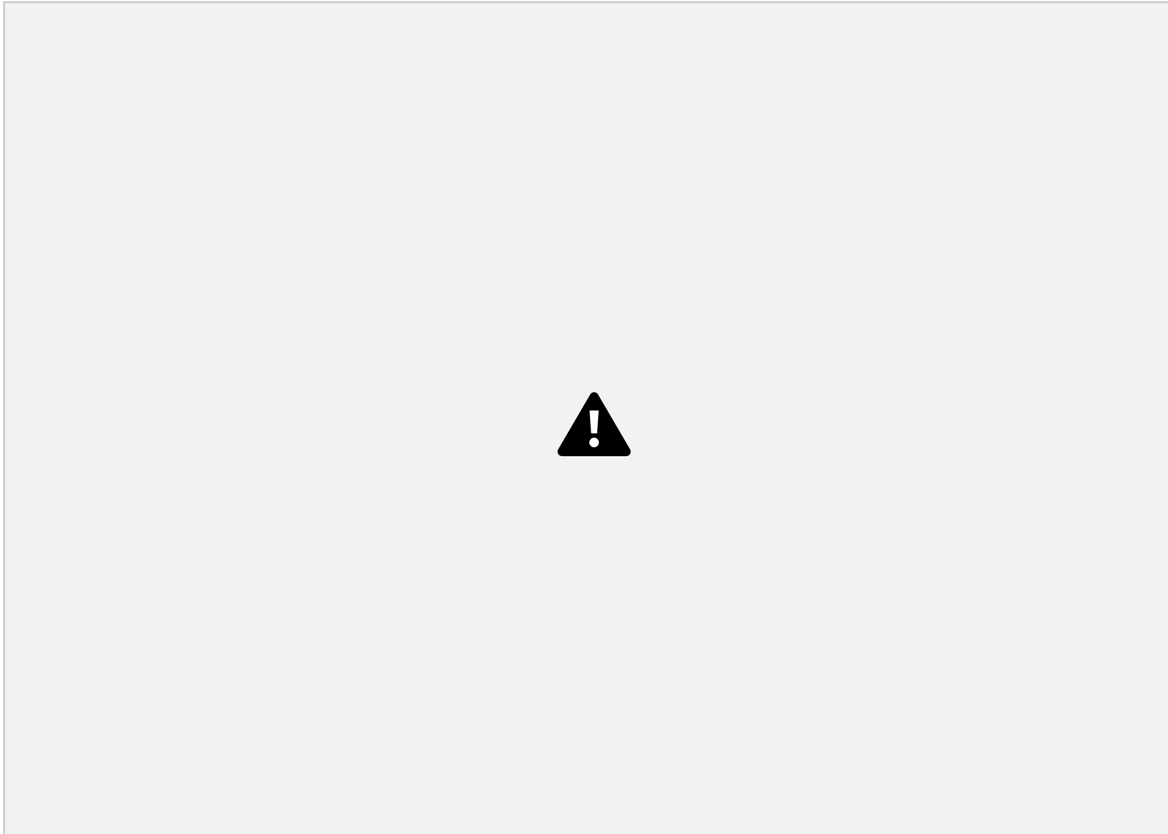

Figure D-2. Massachusetts' PPA structure

Rhode Island

Rhode Island's Revolution Wind PPA is structured as a total dollar amount of $98.425/megawatt-hour (MWh) for energy and RECs. Within that, the energy price is determined by the wholesale market price, and the REC price is $98.425/MWh minus the wholesale market price.[31] Rhode Island's PPA structure differs from Massachusetts and Connecticut in that the generator sells directly into ISO-New England, instead of to the distribution utility. The generator may choose to participate in the forward capacity market but is not required to; the generator retains the revenue they receive from any capacity value.

The distribution utility may keep the RECs or sell them to others. The PPA requires that the seller use New England Power Pool Geographic Information System (NEPOOL GIS) as the REC tracking system and that the generator be registered as a qualified facility in Connecticut, Maine, Massachusetts, New Hampshire, New York, and Vermont. This creates a pathway for the RECs to be sold to entities in those states for RPS compliance.

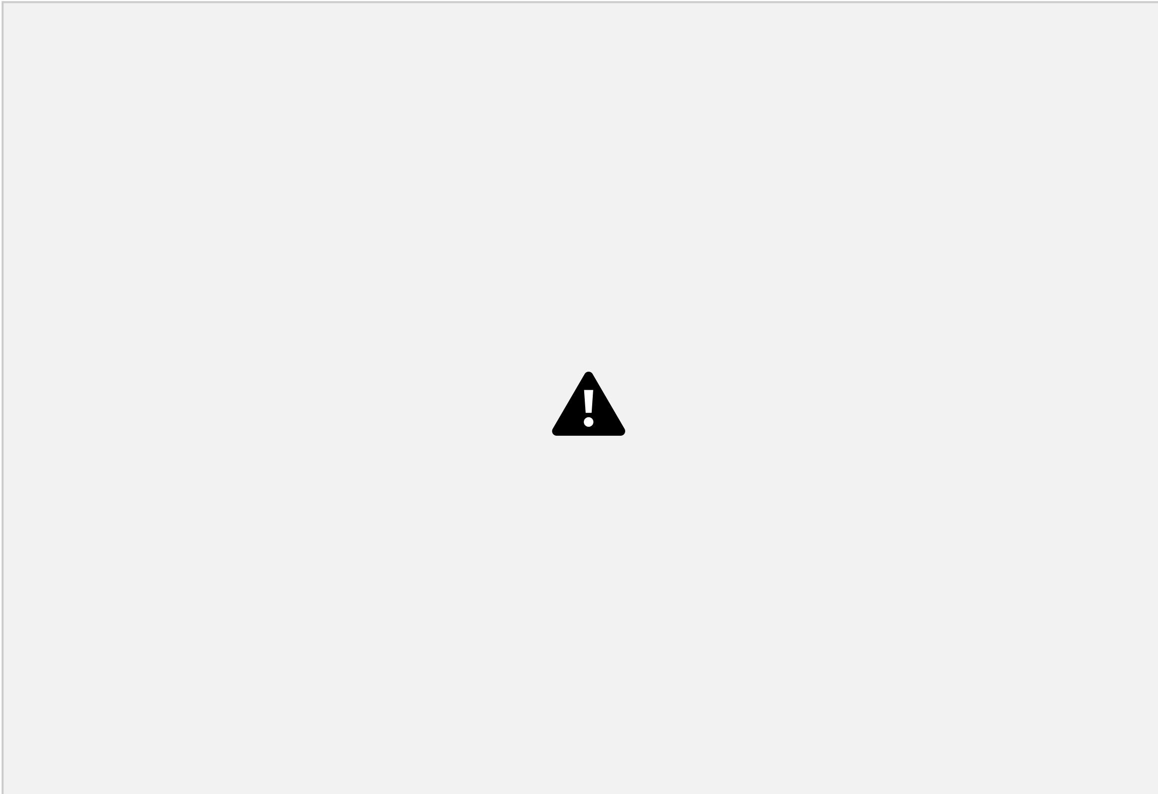

Figure D-3. Rhode Island's PPA structure

[31] The wholesale market price is defined as the "the weighted average of the Real-Time or Day Ahead Locational Marginal Price" (Rhode Island Public Utility Commission 2018).

New York–Index and Fixed OREC Approaches

New York was considering both an index offshore renewable energy certificate (OREC) and a Fixed OREC approach. Ultimately, the Index OREC approach was selected by the New York State Energy Research and Development Authority (NYSERDA), with the Fixed OREC approach also provided in the contract in case the Index OREC approach was invalidated by a court.

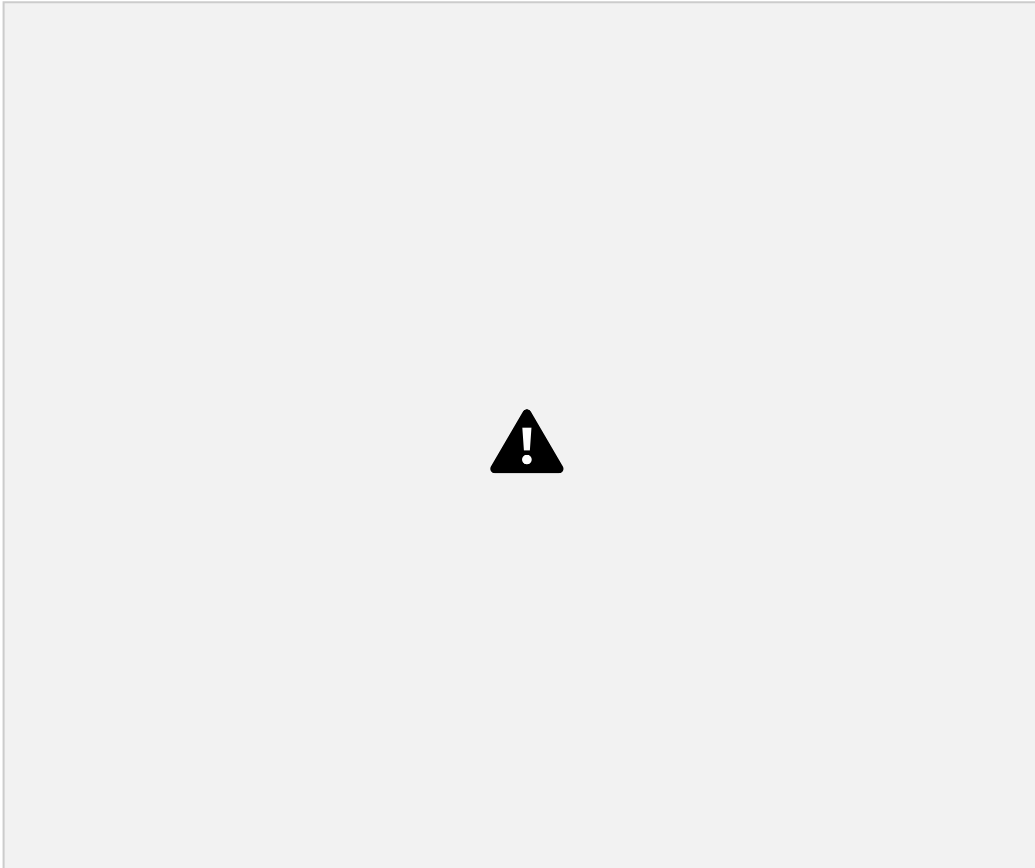

Figure D-4. New York's Index OREC structure

Under the Index OREC approach, the generator sells into the New York ISO's (NYISO's) day ahead market and may sell capacity into the forward capacity market. NYSERDA then pays the generator a price that is equal to the difference between the agreed-upon strike price and the reference monthly energy and capacity prices from NYISO. NYSERDA sells ORECs to the load serving entities (LSEs) to use for compliance.

Under the Fixed OREC approach, the generator still sells into NYSIO markets. The generator also receives a fixed price for the ORECs, which is paid by NYSERDA. This approach provides less revenue certainty to the generator but more certainty to NYSERDA. LSEs continue to purchase the ORECs they need from NYSERDA, but at a price equal to what NYSERDA pays the generator plus an administrative fee.

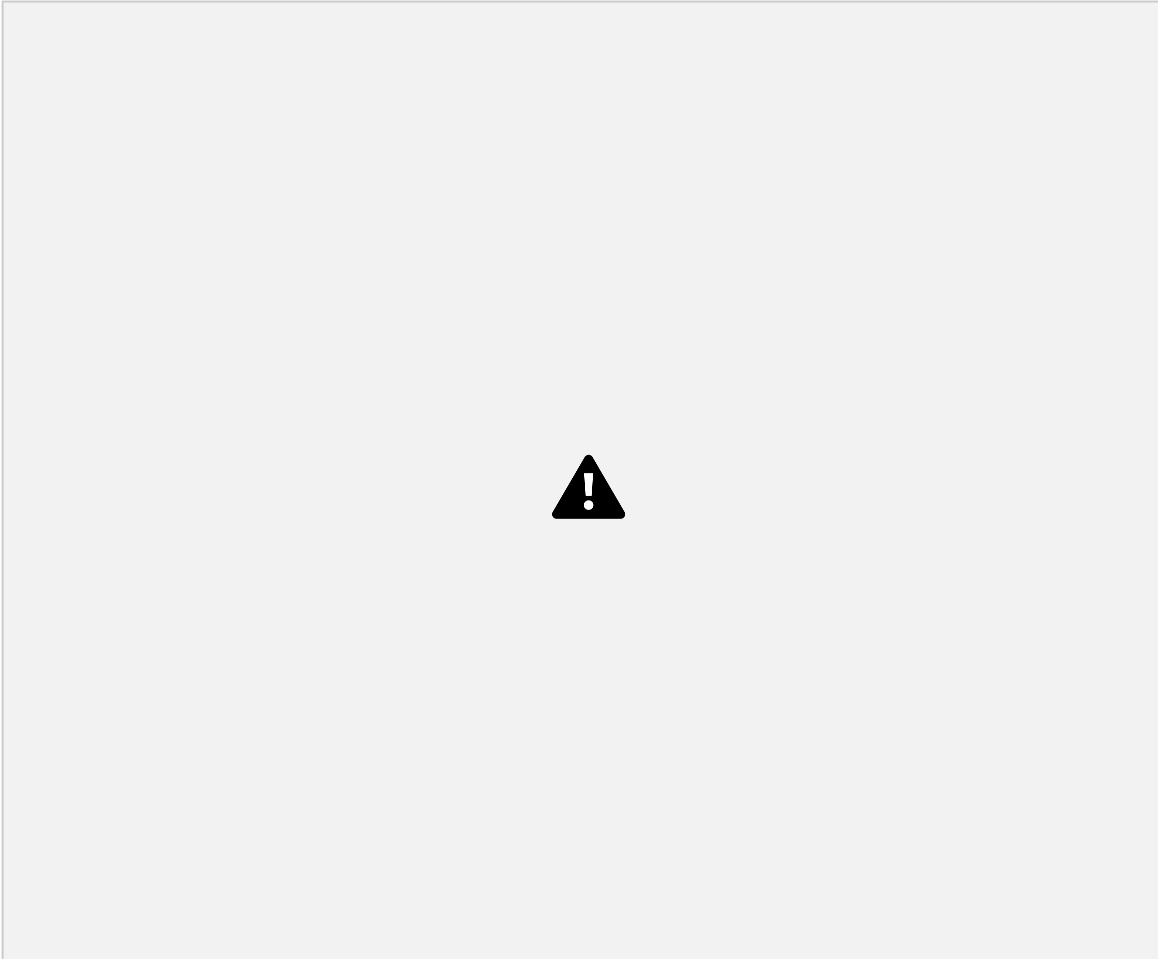

Figure D-5. New York's Fixed(-Premium) OREC structure

Maryland's OREC Mechanism

Maryland's OREC structure uses an escrow account as an intermediary between wholesale market revenues and the distribution utility. The generator sells energy capacity and ancillary services into PJM. The associated revenues are then routed to an escrow account and ultimately to the distribution utility and ratepayers. The state's electricity suppliers purchase ORECs via the escrow account, and those funds are then transferred to the generator.

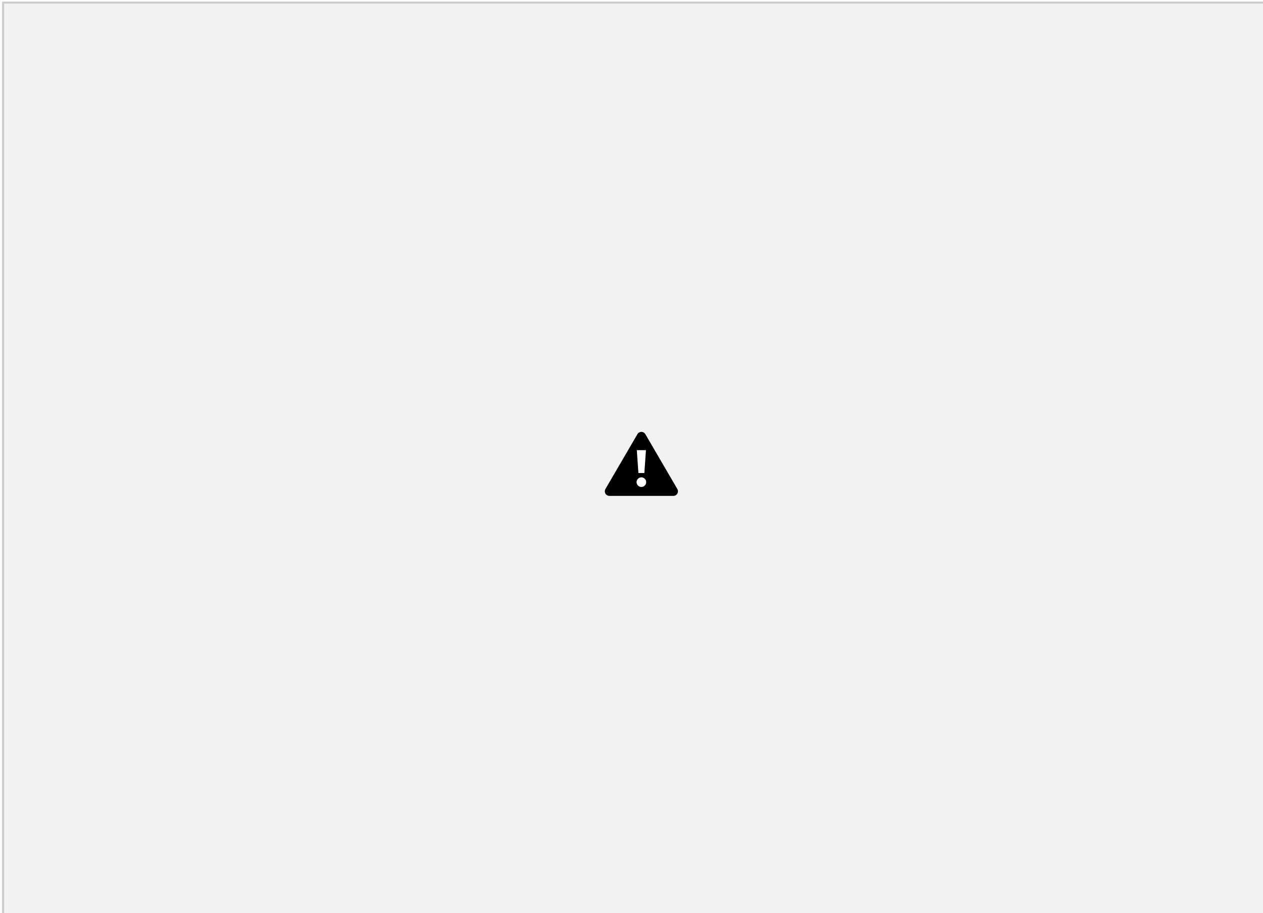

Figure D-6. Maryland's OREC structure

New Jersey's OREC Mechanism

New Jersey's OREC approach is similar to Maryland's. The generator sells electricity into PJM, receiving the revenues from the electricity. The generator returns all revenues earned to ratepayers via the distribution utility. Electricity suppliers are mandated to procure ORECs, which are transferred to them from the generator upon payment.

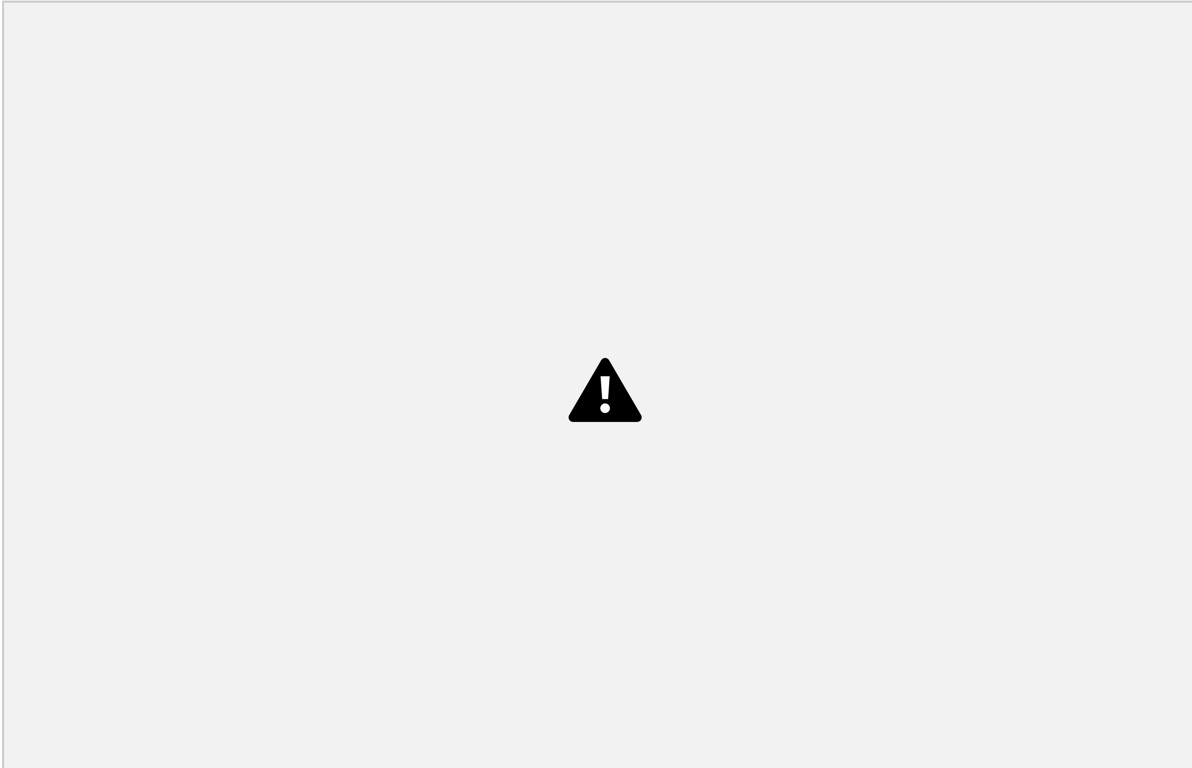

Figure D-7. New Jersey's OREC structure