UK Government

Accelerating Smart Power & Renewable Energy in India (ASPIRE) Programme

Grid Integration and Model Evacuation Framework for

Offshore Wind Power

Development - Business Models Implementation Structures

Contents

List of Figures

List of Tables

Abbreviations

AD	Accelerated Depreciation
ARR	Annual Revenue Requirement
ASPIRE	Accelerating Smart Power and Renewable Energy in India
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
BPC	Bid Process Coordinator
BPC	Bid Process Company
BTO	Build-Transfer-Operate
CAPEX	Capital Expenditure
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CFA	Central Finance Assistance
CfD	Contracts for Difference
ckt km	Circuit kilometre
CoD	Date of Commissioning
COP26	Conference of Parties 26
CTL	Central Transmission Licensee
CTU	Central Transmission Utility
CTUIL	Central Transmission Utility India Ltd
DBFT	Design Build Finance Transfer
DBO	Design Build Operate
DISCOM	Distribution Company
DSM	Demand Side Management
EA 2003	Electricity Act 2003
ECI	Export Cable Infrastructure
EEZ	Especial Economic Zone
EPC	Engineering, Procurement and Construction
F&S	Forecasting & Scheduling
FCDO	Foreign, Commonwealth and Development Office
FOWIND	First Offshore Wind in India
FIMOI	Financial Modelling of Offshore wind in India
FY	Financial Year
GBI	Generation Based Incentive
GEC	Green Energy Corridor
GoI	Government of India
GW	Gigawatt

GWEC	Global Wind Energy Council
HV	High Voltage
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IAC	Inter Array Cable
InSTS	Intra State Transmission System
IPT	Independent Power Transmission
IPTC-SPV	Independent Power Transmission Company by Forming SPV
ISTS	Inter State Transmission System
JV	Joint Venture
LCoE	Levelized Cost of Electricity
LDC	Load Despatch Centre
LV	Low Voltage
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MVA	Megavolt-Amperes
MW	Mega Watt
NIWE	National Institute of Wind Energy
NLDC	National Load Dispatch Centre
O&M	Operation and Maintenance
OCS	Outer Continental Self
OEM	Original Equipment Manufacturer
OFTO	Offshore Transmission Owner
OPEX	Operational Expenditure
OS	Offshore substation
OSW	Offshore Wind
OTM	Offshore Transformer Module
PGCIL	Power Grid Corporation of India Limited
POC	Point of Connection
PPA	Power Purchase Agreement
PPP	Public-Private-Partnership
PSS	Pooling Substations
RE	Renewable Energy
REC	Renewable Energy Certificate
RLDC	Regional Load Dispatch Centre
RoCE	Return on capital employee
RoE	Return of equity
RoW	Right of way
RPO	Renewable Purchase Obligations
SS	Substation
SECI	Solar Energy Corporation of India

SLDC	State Load Dispatch Centre
SP	Smart Power
SPV	Special Purpose Vehicle
STL	State Transmission Licensee
STU	State Transmission Utility
TANTRANSCO	Tamil Nadu Transmission Company Ltd.
TBCB	Tariff Based Competitive Bidding
TP	Tariff Policy
TSA	Transmission Service Agreement
TSC	Transmission Service Charge
TSL	Transmission Licensee
TSO	Transmission Service Operator
TTSC	Total Transmission System Cost
Tx	Transmission
UK	United Kingdom
VGF	Viability Gap Funding
WTG	Wind Turbine Generator
YTC	Yearly Transmission Charges

Executive Summary

The Offshore Wind (OSW) development in India is in a nascent stage. The Ministry of New and Renewable Energy (MNRE) recently published a strategy paper on "Establishment of Offshore wind energy projects" in July 2022 which has paved the way for the development of OSW in the country. It stipulates three business models under which the ministry has planned to auction 37 GW of OSW capacity by 2030. The business models proposed by the MNRE are categorised based on power sale/offtake arrangements, availability of incentives in the form of Viability Gap Funding (VGF), and the responsibility of site surveys. However, the MNRE strategy paper proposes a single power evacuation business model for all three (3) models for OSW project development. This necessitates dwelling into possible business options to develop evacuation infrastructure for India's intended OSW project development. Chapter 1 of the report forms the context for the discussion on evolving transmission system business model in India.

The OSW transmission system cost may vary significantly over the distance from the shore, technology selection, and physical topography of the site. To address the overall high cost and risk of the transmission system for the OSW projects, various innovative transmission business models have emerged in the mature OSW project market such as Europe. The different models that emerged out of various international experiences are discussed in Chapter 2. The discussion about the international experience for OSW transmission business models points to the selection of the model considering:

- Who should own the risk for the development, construction, and operation of assets?
- Visibility with clearly defined timelines for final designs and coordination facilitation for sharing key information between the OSW developer, transmission system planner, developer and operator.
- The dependency on both physical and non-physical factors including geography.
- Long-term flexibility in the development model can be useful in accelerating growth.

The discussion in this Chapter points out that most of the countries go for the centralized approach in planning, financing, and operation and India has a strong case to consider a centralised approach for the given OSW market size.

Chapter 3 provides due attention to the fact that India is already a mature market for onshore transmission system planning, development, and operation. This Chapter describes the key characteristics, structure, and applicability of already experienced onshore transmission business models for the transmission system associated with OSW. This also highlights the experiences learned in planning, development, and operationalisation of the on-shore transmission system models for other conventional and renewable energy generation. The main concerns for the planning of the onshore transmission system are to judiciously balance the factors such as long-term perspective, phase-wise/ modular development, latest technology, and optimal cost. During the implementation phase, it is important that the transmission system is available at a competitive price, so that efficiency in the financing, construction cost, and timeline is achieved. Whereas during the operation phase, it is important that OSW transmission system operates in an integrated manner through a centralized Grid operator complementing the onshore transmission system operation. This Chapter guides the approach for developing business models for OSW transmission system.

Chapter 4 of the report provides a glimpse into the prevalent statutory, policy, and regulatory framework in India and discusses the principles to evolve various transmission business model options proposed for India. This Chapter also discusses the feasibility of different business model options for OSW transmission system considering the international experiences and available expertise for working on onshore transmission system business models.

Chapter 5 of the report provides an in-depth analysis of the each of the OSW transmission system business models, their contractual arrangements, implementation aspects, and merits/ demerits of the proposed business model options for India under different market conditions. The summary of the potential risk and the suitability of each of the transmission business options from the perspective of sectoral development in alignment with MNRE process in the Indian context and its international equivalent is provided below:

Parameters	Model Option 1 [Developer driven]	Model Option 2 [Developer + TSL driven option]	Model Option 3 [TSL driven]	Model Option 4 [Hybrid option]
Potential for the socialisation of OSW Evacuation cost	Limited Potential	Average Potential	Very High Potential	Significant Potential
Design responsibility and Supply chain control for the developer	Complete control over Supply Chain with entire design responsibility	Average control over Supply Chain with partial design responsibility	Least control over Supply Chain with design guided by TSL requirement	Significant control over Supply Chain with higher design responsibility
Development and coordination Risk	Low	Moderate	High	Moderate
Financing Requirement	Significant	Medium	Low	Medium
Risk for managing approvals & compliances	Very High	Moderate	Moderate	High
Delay Risk in matching Commissioning	Low	Moderate	High	Moderate

Parameters	Model Option 1 [Developer driven]	Model Option 2 [Developer + TSL driven option]	Model Option 3 [TSL driven]	Model Option 4 [Hybrid option]
Suitability in the Indian Context	Suitable in the nascent markets with a very low OSW capacity addition or OSW projects near shore being utilised for captive consumption.	Suitable in the market, which is nascent, however, is capable of high-volume capacity addition. This model offers subsea export cable cost socialization.	Suitable for the market capable of high-volume capacity addition, like with some of the successful project installations. This model offers maximum opportunity for the socialization of transmission system cost.	Suitable in the very mature market with several OSW installations and for projects far from the shore and with established contractual arrangements.
International Equivalent	This model is also being planned in nascent markets such as Japan and the US.	Equivalent to multi-connection High Voltage Direct Current (HVDC) wind farms in Germany.	Equivalent to multi-connection High Voltage Alternating Current (HVAC) wind farms across Europe.	Similar to the UK except in the UK the offshore SS and export cable are sold to a third-party following developer construction.

The selection of a specific transmission business model option can be based on cost implications, technology selection, transmission efficiency, environmental impact, and timelines to match with the OSW project. For Indian conditions, the following is recommended:

- The most suitable model is Transmission Service Licensee (TSL) driven both in case of long distance and short distance, as this model offers the clear advantage of a centralized, coordinated approach for the development of OSW transmission system elements like pooling substation, export cables and strengthening of the onshore transmission network. In India, there is adequate policy and regulatory frameworks for planning the pooling stations and common transmission system for the onshore transmission system. With the coordinated approach, selection of the most optimal technology and phase-wise development can be achieved keeping in view the long-term perspective for the targeted OSW capacity addition.

  The TSL driven Business Model Option 3 referred in the table above, ensures the effort to cover the maximum of the OSW transmission system elements for the socialization of cost, as against the Developer driven Business Model Option 1, where it will be difficult to socialize it as there is no mechanism to ensure the competitiveness of the price.

- The Business Model Option 2 is suggested for adoption in the situation where the market is nascent for lack of installations.

  This option fits in the current Indian context, wherein the stakeholders need a certain learning opportunity to gain expertise in terms of technology, supply chain maturity, and skill set creation. Therefore, Business Model option 2 is suggested for the first set of projects in India. This will provide an opportunity to experience the nuances of project installations while considering the most balanced distribution of risks to stakeholders.

- Business Model Option 1 is not suggested for the Indian context considering the volume of capacity addition expected in the country. This will also avoid decentralized planning by each OSW developer and difficulties in operation in the sea. However, this option can be used for some of the pilot projects or the near-shore OSW projects to be utilized for captive consumption.

- Business Model Option 4 is not suggested for the Indian context at present considering the complexities in the operationalization of the model and market maturity.

This report is an integral part of the model evacuation framework for OSW – Planning and Integration for Gujarat and Tamil Nadu state which provides a qualitative comparison of the key planning aspects of three various alternatives/combinations proposed for the planning of grid evacuation infrastructure for proposed OSW plant in Gujarat and Tamil Nadu.

The suggested alternatives were also deliberated with key stakeholders during a workshop on 22 November 2022 held in Chennai, India under this ASPIRE program. This report covers the viewpoints received during the workshop.

1. Introduction

1.1. Background

At COP26, India committed to achieve net zero emissions by 2070 and has also set an ambitious target of 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030. This will require non-fossil based capacities over 500 GW to be installed in the country [1].

As of November 2022, India has an installed RE capacity of 166 GW. Of this, 62 GW is sourced from solar energy and 42 GW from wind energy [2]. The installed wind capacities are mainly within a well-settled onshore ecosystem. Further, the country has also a significant potential available for Offshore Wind (OSW) over the 7,600 km of its coastline. During the initial assessment of the National Institute of Wind Energy (NIWE) in the identified zones, a potential of almost 70 GW of OSW was identified off the coast of Tamil Nadu and Gujarat [3] which could be utilised in achieving the country's international climate change commitments.

Further, for the holistic development of OSW projects in India, in 2022, the Ministry of New and Renewable Energy (MNRE) published a 'Strategy Paper for Establishment of Offshore Wind Energy Projects'. This paper is in line with the 'National Offshore Wind Energy Policy' notified on 6 October 2015 and states that the government of India is planning to lease approximately 37 GW of OSW capacities by 2030 under three models. The Strategy Paper by MNRE majorly focuses on preliminary wind survey and demarcation of OSW sites. Further, in all three models, the responsibility for facilitating the grid connectivity for OSW projects under a single transmission business model is placed on the Central Transmission Utility (CTU). Also, the Government of India (GoI) has decided to socialise the evacuation and transmission of power from the OSW PSS to onshore transmission for all OSW capacities bid out by 2030[4].

It is observed in the matured international OSW markets of the United Kingdom (UK), Netherlands, Denmark, and Germany, that one-size-fits-all solutions for transmission infrastructure development may not be feasible, considering the cost of and risk associated with the OSW grid integration. It is noted that, as the OSW industry matures and expands, the grid connection cost forms an increasing portion of the total cost of electricity generated by the OSW projects because of the agglomeration of large and far from the shore projects.

In India, as envisaged by Central Electricity Authority (CEA) in its Draft National Electricity Plan (Generation) [5], the OSW capacity is planned with the initial 10 GW of OSW projects expected to be available by 2027-30. This sets precedence for undertaking important policy and regulatory initiatives for facilitation of OSW projects in India. Some such initiatives already in place for the RE projects such as the Renewable Purchase Obligations (RPO), Renewable Energy Certificate (REC) mechanism and Accelerated Depreciation (AD) benefits, Generation Based Incentive (GBI), Waiver of Inter State Transmission System (ISTS) charges and losses, etc. These benefits need applicability for OSW projects along with the evolution of a suitable OSW transmission business model to increase the scope to socialize the transmission asset on the country level which will help OSW development and make the OSW sector commercially viable. The transmission business model so developed also need to ensure that it allocates the various risks equitably and fairly amongst stakeholders and presents opportunities for the stakeholders to participate in each of the project's stages, namely, design, construction, commissioning, operation, and maintenance. Such a business model should also clearly define the scope, roles, and responsibilities of the stakeholders at each stage of a project along with the financial and contractual arrangements.

1.2. Context

The Foreign, Commonwealth and Development Office (FCDO) of the UK initiated the Accelerating Smart Power and Renewable energy (ASPIRE) programme in India as a part of the Forward Action Plan during the 3rd India-UK Energy Dialogue for Growth Partnership in 2021. The programme aims to support sustainable development and inclusive growth for the mutual benefit of both countries. The programme has been divided into two projects, namely, (i) the smart power (SP) project to be advanced in collaboration with the Ministry of Power (MoP) and (ii) the RE project to be advanced in collaboration with the MNRE.

Smart power and RE (offshore wind theme) are supporting OSW development in India. This multi-year technical assistance program will help the Indian government establish a project and commercial framework for offshore projects in India based on the UK's expertise and long experience in harnessing offshore wind power. ASPIRE Technical assistance is an ongoing program (since November 2021) under which the grid integration and model evacuation framework for offshore wind power development – business models and implementation structures are identified. This report is an integral part of the Model Evacuation Framework for OSW – (a) Planning and Integration for Gujarat and Tamil Nadu state which provides a qualitative comparison of the key OSW grid planning aspects for the first 5 GW of OSW projects in Gujarat (1 GW) and Tamil Nadu (4 GW).

1.3. Objective

The objective of this report is to serve as a key reference document to guide the stakeholders in the development of transmission system business models for the OSW projects in India. The business models presented in this report guide the stakeholders to select the right business model for the OSW transmission system to optimise the overall project cost and risks and to provide a sustainable business opportunity in the OSW sector in India.

1.4. Audience

In the present report, we consider the stakeholders involved in OSW development in India and attempt to provide insights into the roles of the following key stakeholders:

- Ministry of New and Renewable Energy (MNRE)
- Ministry of Power (MoP)
- Central Electricity Authority (CEA)
- Central Electricity Regulatory Commission (CERC)
- State Electricity Regulatory Commission (SERC)
- National Institute of Wind Energy (NIWE)
- Central Transmission Utility of India (CTUIL)
- Power Grid Corporation India Ltd (PGCIL)
- State Transmission Utilities (STU)
- National Load Despatch Centre (NLDC)
- Regional Load Despatch Centres (RLDCs)
- State Load Despatch Centres (SLDCs)
- RE / OSW Investors & Developers
- OEMs and Service providers active in the OSW domain

This report also presents the international experiences of the OSW transmission business models, the Transmission System Operator (TSO)-build model, the Developer-build & owned model, and Developer build and Offshore Transmission operator (OFTO) owned model. The report draws relevant parallels for the Indian context. Each of the above OSW transmission models are discussed in detail in Chapter 2.

2. OSW Transmission Business Models – International cases

The OSW market has matured and is expanding in Europe with almost 28 GW of installed generating capacity as of 2021[6]. Historically, the OSW projects developed in Europe had smaller generating capacities and were near-to-the-shore projects that required relatively simple grid reinforcement. However, in recent years, the installation of large-scale projects that are farther from the coast has made grid interconnection complex and challenging. Therefore, in Europe, to keep the overall cost and risk level in OSW projects down, innovative transmission business models have been designed.

This chapter provides the description about OSW transmission business models undertaken in Europe along with assessment of their compatibility in the Indian context.

2.1. OSW Transmission Business Models across Europe

In Europe, several transmission business models are used for OSW evacuation. A schematic representation of these is shown in Figure 1 below [7]:

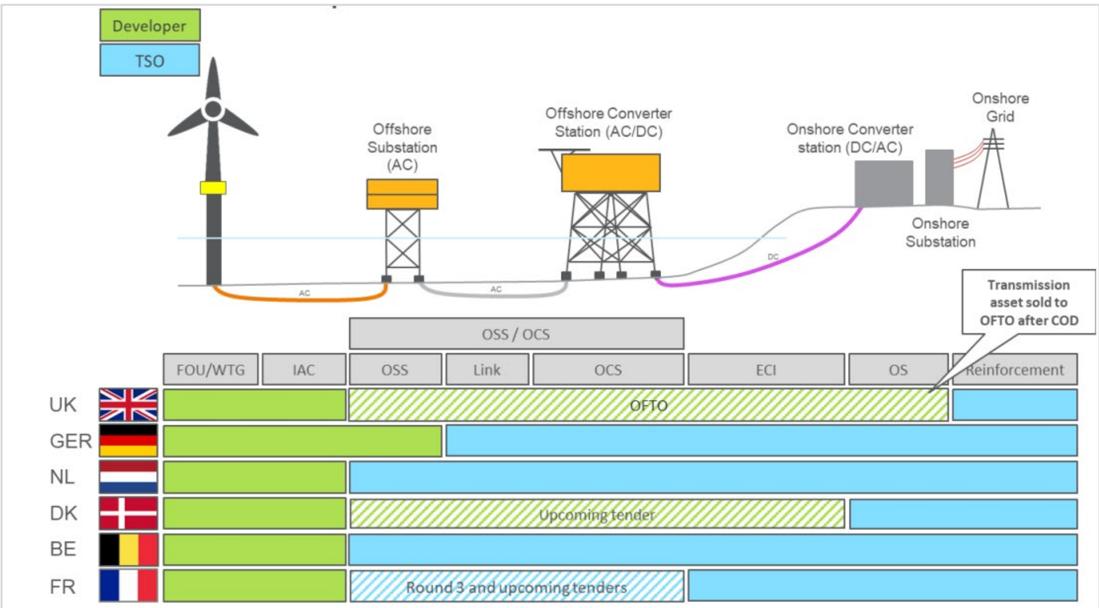


Figure 1: Transmission development models used internationally

Acronyms used: FOU/WTG – foundation/wind turbine generator; IAC – inter-array cable; OSS – offshore substation; OCS – offshore converter station; ECI – export cable; OS – onshore substation; OFTO – offshore transmission owner; COD – commercial operations date.

It may be noted from the above figure that, in Europe, a developer-led model is used only in the UK market. In Denmark, various transmission business models are used depending on the project size and site. Recently, in the Danish Thor and Hesselø tenders, the grid connection from the OSW to the onshore point of connection was included in the scope of the tender. Previously, the Danish TSO was responsible for constructing and operating the offshore SS, and the export cables, and financing the cost over the tariffs. However, now these tasks are assigned to the developer.

2.1.1 Approach

Generally, the OSW transmission infrastructure is developed and operated using two approaches as detailed below:

2.1.1.1 Decentralised Approach

A decentralised approach with regard to transmission models is one in which the developer is responsible for planning, site selection, and installation & construction of the transmission assets. In these transmission business models; the developer has more control over and certainty about the project. The developer has greater control over the construction and operation of their assets. This enables the developer to make decisions regarding design, innovation, construction, and operation. However, this could impact the overall capital cost of the project and entail raising a larger quantum of finance. Further, this expands the scope of developers' responsibility. Arguably, a decentralised approach does result in lowering the cost of point-to-point transmission assets because the developer has an incentive and the means to reduce costs across the lifecycle of the OSW.

In the UK, the current point-to-point uncoordinated approach was designed when OSW market was at a nascent stage. Leaving the developers in control of the design and build of the transmission reduced for the consumer the risks of underwriting investment to connect new projects and left developers in control of the delivery. The approach has been effective at delivering high capacities in an immature industry, and enabling developers to manage risk, simplifying construction timings and allowing developers to time export system construction with the rest of the wind farm assets.

However, in the UK, the scale of expected deployment in coming years has changed and there is consensus that constructing individual transmission links will not deliver the best outcomes for consumers, the environment, and local communities. It has been suggested that this uncoordinated approach could pose a major barrier to achieving the ambitious targets set for the future deployment of OSW. For this reason, the UK is undertaking an Offshore Transmission Network Review that has undertaken stakeholder consultation and analysis to determine the benefits of a more coordinated approach. Such benefits may include:

- Reduced cost;
- Reduced environmental impact through reduction in required offshore cable lengths; and
- Job support and creation in planning and constructing offshore transmission infrastructure[1].

2.1.1.2 Centralised Approach

A centralised approach regarding transmission models is one in which the developer is less responsible for planning, site selection, and installation & construction of the transmission assets, and the government/transmission system operator (TSO) plays a more active role in these stages. Centralised transmission business models may bring benefits through greater central coordination of onshore and offshore grid networks. From a whole systems perspective, this may lower the costs and risks, but can require up-front investment in transmission infrastructure.

Potential benefits of a centralised approach may be particularly important for countries that desire a rapid increase in the proportion of RE generation in their total power output. However, difficulties may arise as the developer has less control of the design and construction of the transmission system, which increases the risk that design is not optimised for the wind farm itself, or that construction timelines are misaligned, delaying wind farm commissioning.

An additional potential benefit of a centralised approach is that it may can also result in lower net societal costs if the integration of offshore hubs and interconnection can be achieved, e.g., through multi-purpose interconnectors. Offshore hubs that connect multiple wind farms from multiple developers are expected to be simpler to manage in a centralised system, as there may be difficult legal implications should one developer be operating a transmission asset that directly affects the ability of a separate generator to transmit power to shore.

Central coordination is particularly important for countries that face onshore grid constraints. For example, Germany suffers from transmission constraints because their power generation is in the North and load centres in the South, which creates bottlenecks and requires transmission planning. In response, Germany has worked to strategically coordinate its grid expansion plans suitably with the locations of future offshore wind farms, thereby enabling coordination of onshore grid planning with offshore grid planning.

To mitigate potential supply chain bottlenecks and provide greater visibility to facilitate the coordination of necessary onshore upgrades with the installation of the OSWs, a phased development of both the facilities with clearly defined schedules will be necessary in the Indian context.

2.1.2 OSW Transmission Business Models

The transmission business models used internationally can typically be placed under one of the three categories:

1. Developer-led, where the OSW developer develops and operates the transmission assets.
2. TSO-led, where the Transmission system licensee designated by the national government develops and operates the transmission assets.

[1] UK Offshore Transmission Network Review, Holistic Network Design - link

3. OFTO, (Offshore Transmission Owner) where the OSW developer develops the transmission assets and transfers the assets to the TSO to operate.

2.1.2.1 Developer led

In the developer-led transmission business model, the developer constructs and operates the offshore transmission assets. The developer carries out site surveys, acquires grid permits and consent, and designs and constructs the transmission infrastructure. This approach lowers the risk and cost for governments in these phases, as the developer will bear these initial costs and risks. However, this approach often results in higher electricity costs once contracts are awarded as the costs for design, development, and construction of the offshore transmission assets will be recovered. These additional costs are then passed onto the consumer.

Developers find this route attractive as it gives them a high level of control over the projects and opportunities to demonstrate competitive advantage. However, it may introduce a significantly higher up-front risk of incurring sunk costs. This approach is followed in the UK and Denmark in its recent projects.

2.1.2.2 TSO led

In the TSO-led transmission business model, the offshore transmission development and operation is given to the TSO by the national government, and the TSO then bears most of the upfront financial and administrative risk to undertake site identification, investigation, surveying, consenting, grid permitting and connection, before tendering the site.

In the TSO-led approach, whilst this may be attractive to developers from a de-risking perspective, the reduction in developer scope will reduce the ability to obtain competitive advantage, and therefore may reduce the incentive for innovation. Indeed, in the recent Denmark Hesselø tender, the transmission system was included in the developer scope with a note that this may encourage inclusion of Power to X (PtX) transmission opportunities[2].

A TSO-led approach has been followed in Germany, Denmark, and the Netherlands.

2.1.2.3 OFTO

In the UK, post-completion of construction, the offshore SS, and export cable assets are auctioned to an OFTO. This is often done for asset monetisation. Also, the developer may not be willing to foray into the transmission business and focus on power generation.

In the UK there is also provision for an 'OFTO build model' whereby an OFTO is appointed before the construction of the assets. However, currently, the decision on whether to undertake the construction themselves or appoint an OFTO for this purpose lies with the developer, and yet none of the developers has chosen the OFTO build model.

2.1.3 Evaluation of Merits/De-merits of different transmission model options

S. No.	TSO led	Developer led
Planning and design	• An inter-connected approach facilitates better system-wide planning and long-term planning. • The development stage is accelerated. • Standardisation leads to cost reduction through economies of scale.	• A single entity is responsible for all the decisions at the planning and design stage. • Designing smaller offshore assets take less time. • Since the developers are not reliant on TSO construction risks for developers are minimized.

[2] Invitation to dialogue, the Hesseloe offshore wind farm tender, November 2020

S. No.	TSO led	Developer led
	• Shared assets can limit environmental footprint.	• Encourages competition and innovation in the transmission system.
	• The challenges of coordination between TSO and multiple developers may lead to oversizing assets at additional costs. • Difficult to implement unique innovation in the design and procurement processes initiated by developers. • Larger and more complex standardised transmission systems become possible. However, further standardisation may discourage developers from introducing innovations in the system and the supply chain. • The developer faces the risk of idle OSW if TSO fails to deploy offshore transmission assets promptly. • If the receipt of the final engineering designs of the surroundings of the OSW site, inter-inter-array cable voltages, power outputs, etc., from the developer are delayed, TSO may not have enough time for proper planning, which could lead to severe delays	• Incremental development with a short horizon. • Developers use different designs, which limits standardisation, asset sharing, and cross-sector cost reduction. • As grid development is conducted on a project-by-project basis, transmission system development is not a core business activity. • The developer risks stranded assets if TSO's onshore work of grid reinforcement is delayed. • Developers may not have full visibility of long-term system planning and be unable to design effectively. • The potentially increased consenting risk with point-to-point connections may have greater environmental impacts.
Commercial and Finance	• A TSO has more projects in the pipeline than a developer and gets better financial terms and conditions. • The benefit of better financial terms and conditions as above minimise CAPEX costs for developers in transmission construction	• Developers and other third parties can have higher debt shares that can result in lower weightage on the average cost of capital.
	• In constructing and operating large transmission assets to which many OSWs are attached, a TSO must make a heavy investment and run a greater risk. • Required pre-investment capital high. • The developer runs the risk of higher costs because, unlike the developer, the TSO is not driven by the cost pressure that the competitive tendering system exerts on the developer.	• If the developer sells the assets to a third party, the developer may incur a higher cost of capital due to the higher equity return rates, higher interest rates on debt, and increased transaction costs. • In case the developer is not provided subsidy support or revenue certainty and if additional costs are incurred on designing, constructing, operating, and decommissioning offshore transmission assets, they may

S. No.	TSO led	Developer led
		make a project financially infeasible.
Construction risk	• A coordinated approach to construction. Larger shared assets can capture the benefits of economies of scale. • TSO can coordinate construction schedules with other onshore assets for efficiency opportunities. • TSO, not the developer, owns the construction risk and, therefore, in case of delays, can minimise the developer's overall risk with suitable compensatory mechanisms.	• When a single entity, the developer, develops the project, there are fewer interfaces between the various stakeholders. This lowers the risk of construction delays. • The developer owns the construction risk and, therefore, is better able to manage the risk. • Developers may have greater experience with the logistics of managing an offshore construction project in an emerging market.
	• Highly complex and commercial relations between stakeholders. Higher risk of stranded assets. • The stranded assets risk to TSO, in the case of delay in OSW construction, does not materialise. • If TSO's construction is delayed, the developer runs the risk of stranded turbine assets. • If there are several developers, the construction arrangements between the developers and the TSO are complicated.	• High-impact landfall through multiple point-point connections. • Increased project management costs to address developing transmission assets which are not a key business activity. • The developer must coordinate the offshore work with the TSO's onshore works and grid reinforcement to avoid the risk of time overrun
Operations	• Sharing of assets results in larger assets that have lower OPEX than several smaller individual assets. • High redundancy. • More coordinated control of ancillary services and power curtailment are possible. • Centralised control of grid services reduces the risk of dynamic instability. • A simple arrangement for procuring grid-stabilising services is possible.	• Shareholders are most affected by the risk of transmission system failure and, therefore, have the greatest motivation for action repairs. • Developers may have the advantage of more experience than TSOs in operating offshore wind transmission assets in an emerging market. • Higher efficiencies may be achieved by sharing maintenance services for transmission assets if they are located in close vicinity than if the responsibility for maintenance is shared between the developer and TSO.

S. No.	TSO led	Developer led
	• Unavailability penalties might be less effective as, ultimately, costs could be (partially) socialised. • Unavailability penalties may be ineffective with TSO as costs could be in part socialised. • There may be liability complications in case there are failures of TSO-operated assets, which would reduce the ability to transmit the OSW-generated power to the shore	• Transmission assets may have a longer design lifetime than an OSW, which would prevent full transmission asset utilisation. • High OPEX, lower redundancy, and high risk of an outage. Difficult to coordinate services and curtailment at the system level. • A single interface between TSO and the developer may increase response times to grid emergencies. • High risk of revenue loss from transmission asset failure.

2.2. Regulatory Framework

2.2.1 Transmission Charges

The recovery of the transmission charges as applied across the OSW farms is a fundamental consideration for the transmission business model. The transmission charge model is often called the 'charging model'. The term refers to the method of applying the transmission charges. The operational models above are described in terms of who is responsible for the design, build, and operation. Although the responsibilities of these entities often overlap (e.g., a TSO-led methodology often intertwines with super-shallow charging) the overlapping need not necessarily happen. Hence, it should not be assumed that the charging model and operational models are always applied together. Figure 2 highlights how transmission charges are applied across markets internationally.

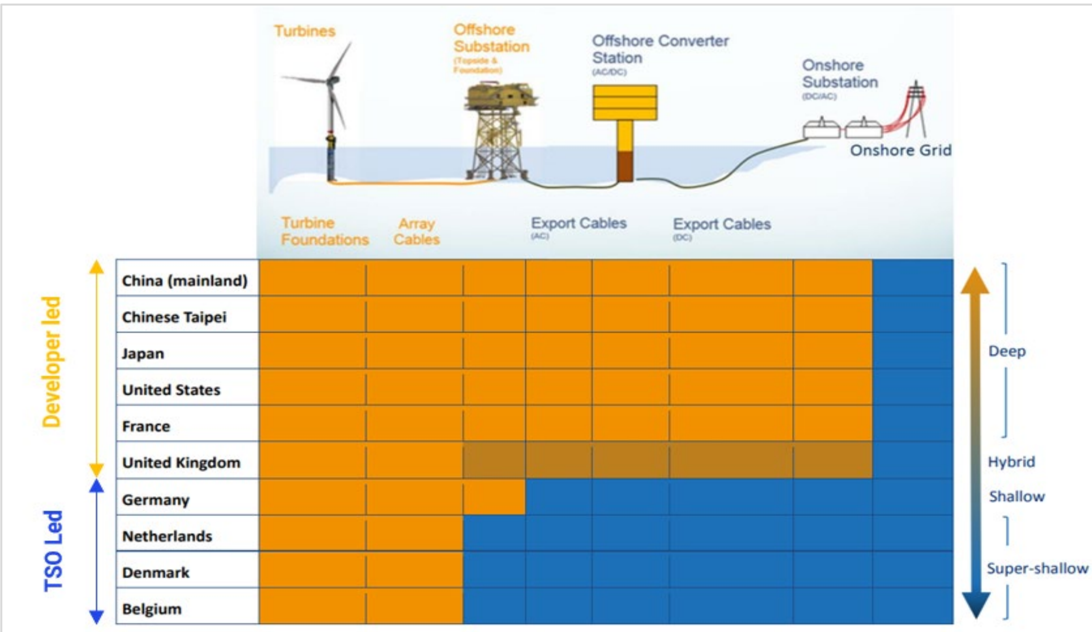


Figure 2: Comparison of charging methodologies in existing offshore wind markets

{Orange represents developer responsibility Blue represents TSO/third party responsibility. Note: in all these markets, the party responsible for the cost is also the owner}

The entities that bear the technical and commercial risks are highlighted in the above four charging models as follows:

1. **Developer-led deep charging model.** The developer bears the cost of all offshore transmission assets including construction and operation, and any onshore reinforcement and recovers it through transmission charges. This model has been adopted in the USA for developing its offshore wind market.
2. **Developer-led hybrid deep-shallow model.** This approach varies from the models above but can entail a developer constructing the offshore assets and then transferring ownership and operation to a TSO or third party. This model is implemented in the UK's OFTO regime.
3. **TSO-led shallow charging model.** The developer bears the cost of intra-array cabling and the offshore substation and recovers it through transmission charges while the TSO provides transmission infrastructure to export electricity to the shore.
4. **TSO-led super-shallow charging model.** The developer bears the cost of intra-array cabling and connection into a substation only and recovers it through transmission charges The TSO provides substations, export cabling, and onshore reinforcements.

2.2.2 Incentives

In the UK, timely project delivery of transmission and generating assets is incentivised through the Contracts for Difference (CfD) subsidy policy. The policy uses key milestone dates and a 'Non-Delivery Disincentive'. The penalty for being offered a subsidy for a project and then refusing it or signing a contract and then failing to deliver the project in terms of the capacity build is an exclusion for 13 months from the refusal date from future auctions at the same location.

Unlike other European markets, the CfD does not include a non-delivery/delay penalty, and this could be viewed as a disincentive for generators to reveal the true costs.

2.2.3 Penalties

Delay penalties, or non-delivery disincentives, are necessary to encourage developers, TSOs, and third parties (OFTOs) to meet the prescribed timeframe. In the case of OSW development, this is very critical, as stranded assets, either offshore or onshore, can create significant costs, besides depreciation of asset value and integrity. Further, when the transmission asset is operated by an organisation other than the developer, e.g., a TSO or OFTO, then appropriate incentives and disincentives should be included in the agreement to encourage the high availability of the assets.

A robust regime must be created to encourage the TSO so that the completion of the construction and connection of transmission assets coincides with operationalisation of the developer's generation and transmission assets. There should not be any significant delay on either side and the assets must operate to give high availability. Different penalties are applied during construction and operation phases and on TSOs, developers, and third parties as discussed below: Penalties for Developers

Construction Penalties: Penalties for the construction phase are typically embedded in subsidy mechanisms and are summarised in Table 1.

Table 1: Penalties for the developer in the Construction phase

Particulars	UK	Denmark	Germany	Netherlands
Relevant to	Wind farm and transmission assets	Wind farm	Wind farm	Wind farm
Delay Penalty	Contract term erosion/Contract cancellation	Financial penalty (auction specific)	Financial Penalty and license revoked	Financial Penalty
Non-delivery penalty	Exclusion for auction for up to 24 months	Financial penalty (auction specific)	Financial Penalty and license revoked	Financial Penalty
Targeted Technology (RE agnostic / Offshore Wind)	RE agnostic	Both	Offshore Wind	Offshore Wind

Operation Penalties: For developers, loss of revenue because of failure to supply power is considered a sufficient penalty to motivate them to make quick repairs when required.

2.2.3.1 Penalties for TSOs

Construction delay penalties: The delay in constructing transmission assets by TSO creates the risk of stranded WTGs and transmission assets. This may require diesel generation for auxiliary power. Moreover, during such periods, though the developer is capable of generating power to be transmitted to the shore but is unable to do so, would be losing revenue. Hence, such delays are a very significant risk for the developers. Therefore, a regime that clearly spells out the compensation requirements must be implemented.

Germany is the prime example of a market that experienced grid connection delays. In early projects, the TSO TenneT was unable to provide grid connection for installed OSWs on time. The resulting damage claims amounted to €1 billion. German regulation places a maximum penalty of 20% of such damages on the TSO, with the remainder to be borne by consumers as an additional levy on electricity.[8]

Compensation payable to the developer may be linked to estimates of the expected revenue from generation based on WTG and wind data to be provided as evidence by the developer. Germany, Denmark, and the Netherlands, each have detailed compensation requirements for such delays.

The UK rules provide that, for an 'OFTO build model' the OFTO is appointed before the construction of the assets. However, currently, a developer can decide whether to undertake the construction themselves or opt for the OFTO build model. Yet not many developers have chosen the OFTO build model. A key reason for this situation is that the developers view the penalties imposed on OFTO for the perceived risk of delay in the construction of assets by OFTO as insufficient to cover their potential losses. The OFTOs also carry only a small portion of the outage risk penalty for transmission delays.

Operation Penalties: In case TSO, or another organisation, is responsible for operating a transmission asset that is critical for an OSW's grid connection, the developer faces the risk of failure of the transmission asset, or the unavailability of grid connection for any reason. Typically, a compensatory mechanism is put in place to ensure that the developer is compensated for lost revenue in the case of such incidents.

2.2.3.2 Penalties for OFTO

In the UK, operational penalties are applied to the OFTO up to a maximum of 10% of the base revenue if availability drops by up to 4 percentage points below the target (e.g., if the target is 98% and availability falls to 94% or lower). If availability drops by more than 4 percentage points below the target, the penalties are accrued up to a maximum of 50% of the base revenue. These penalties are imposed for up to five years: the maximum revenue reduction in any given year is 10% of base revenue.

2.2.4 Auction for allocating OSWs.

In the TSO-led models, auctions are not held for construction and ownership of transmission assets as these are constructed by the TSO. On the other hand, in the developer-led models, auctions are first held for the allocation of both generating and transmission assets. In the UK, following the completion of construction of offshore SS and laying of export cable assets, an auction is held to sell these assets to OFTO

2.3. Financing of OSW Transmission Infrastructure

OSW transmission infrastructure being costly, requires substantial initial capital outlay. The costs are incurred at various stages of development. Most of the risks and the major part of the cost occur during the development and construction phase. The cost incurred is low once the asset becomes operational. Internationally, several alternative models have been introduced to manage high cost of OSW transmission infrastructure. Some of them are discussed below:

2.3.1 Repayment of construction costs through consumer levies

In cases where the transmission infrastructure is built by the TSO, the cost for construction and operation may be borne by the TSO, but ultimately recovered as a levy on electricity prices that the consumers pay. Germany operates such a model.[9]

2.3.2 UK's OFTO regime – third-party finance

Pre-2010, early projects in the UK were mostly balance sheet financed. However, as the OSW market has matured, and debt and equity financers have become familiar with the technological and construction risks involved in these projects. Further there has been an increase in the availability of project finance.

The UK's grid design and construction approach are unique in Europe. In 2009, the UK developed a regime that requires the OSW developer to build the OSW transmission assets and then transfer the assets to a third party (OFTO) through competitive tendering administered by the UK Energy regulator, Ofgem. This approach aims at bringing new sources of finance into the OSW sector by portioning off highly valuable assets (around 25%-30% of the OSW costs) that were less risky than the turbines. The new sources would step in to finance the less risky part of the project, and thus, reduces the financial burden on the developer. Further, the revenue from the investment would solely base on asset availability, i.e., whether the transmission assets were available to transmit energy to shore, rather than any exposure to generation risk. In addition, the competitive element has been introduced to ensure the selection of the bidder with the lowest overall cost to minimise the price of electricity that consumers pay.

Under the OFTO regime, the developer designs and constructs the transmission assets. Once complete, Ofgem will determine the cost of construction of the asset to determine the 'transfer value' and run a tender for prospective OFTO' s to bid for the asset based on the revenue stream over the 20 years (the term of the license) required to operate the assets profitably. The winning OFTO then pays the transfer value to the developer and the ownership of the asset is transferred to the OFTO through an agreement with the National Grid. The National Grid pays a revenue stream (partly funded by the developer, for which reason the UK's regime is considered shallow, not a super shallow, charging regime) to the OFTO for the duration of the 20-year license period.

According to Ofgem, the OFTO regime's unique competitive design has saved consumers over £700m in the UK alone. Creating this competitive pressure plus increasing the confidence of financers and reducing financing costs, the regime has reduced the revenue stream from around 10%-12% of asset value in the early stage of the regime to around 5% today.
In addition, the first bond issued for OSW investment in the UK was by an OFTO, which demonstrated the regime's ability to unlock novel sources of finance.

2.4. CAPEX implications

The cost of the inter-inter-array cables, offshore SS, export cables, and onshore SS for a 1 GW OSW may be placed at around £315m and installation costs a further £285m[10]. Therefore, the division of responsibility for constructing, and thereafter, operating such costly assets have a significant impact on the developer's expected costs for the project.

If the developer receives a subsidy, the additional costs for the transmission system can be expected to be borne in the bid price for the subsidy, and therefore ultimately by the consumer. In the case that there is no subsidy support, the costs will impact the commercial feasibility of the project and the power sale price that a developer can reach for a feasible project.

2.5. Transitioning to a different development model

Transmission development models in European markets have generally evolved towards a TSO-built grid development model because of the direct connections established and operated by commercial parties. In this model, the TSO has a legal obligation or a government mandate to design, build and operate the offshore grid.

Many European OSW markets, most recently the Danish OSW market, have transitioned from a 'Developer Build' to a 'TSO Build' model. This transition is largely caused by the TSO's recent willingness to accept a larger share of the development risk and costs. Further, despite utilising the decentralised approach with great effect to accelerate market growth, even the UK is now contemplating how it can best transition to a more TSO-led model. This has been stated in the country's 'Offshore Transmission Network Review'.

The current decentralised point-to-point approach to designing and building offshore transmission in the UK was developed when OSW sector was at a nascent stage and the expectations from the industry were as low as 10GW generation by 2030. It was designed to de-risk the delivery of offshore wind by leaving the project developers in control of building the associated transmission assets to bring the energy onshore. This approach contributed to the maturing of the sector. However, the UK government is now seeking a strategy to coordinate interconnectors and offshore networks for OSWs and their connections to the onshore network and pass the necessary legislation to enable that coordination. This is likely to result in the electricity system operator taking the central role in the coordination of offshore energy infrastructure and reducing the role of the developers in the construction of transmission assets.

In the UK's case, one of the key reasons for seeking a transition to a different development model is to minimise the number of connections required on the shore. In the current point-to-point model, most OSWs have their own onshore connection point. Given the issues with permitting the establishment of onshore connections due to their environmental impacts and land requirements, it is believed that a more coordinated approach will be advantageous for future OSWs. In a TSO-led approach, a coordinated approach could open the opportunity to have just one offshore substation that acts as a pooling station for several OSWs and has a single export system to the shore. This is attractive also because it minimises the necessary infrastructure.

In the case of Denmark, there has been a recent transition in the grid connection approach from a TSO-led model to a developer-led model. Whereas previously the TSO was responsible for constructing the offshore transmission system, this is now in the scope of the developers. The Danish Energy Agency offered the current increased competition in the market as the reason for the transition. The competition and the inclusion of the offshore transmission system in the developer's scope open greater opportunities for innovation and cost reduction. Denmark is also explicitly exploring opportunities for 'Power-to-X', e.g., hydrogen production by utilising offshore energy wherever they may offer improvement opportunities.[11]

Changing market circumstances may make either a developer-led or TSO-led model more appealing, depending on the market objectives. If there is limited competition and a need for innovation, then a TSO-led approach may offer benefits through closer coordination between projects of different developers. With significant competition in a mature market, encouraging developers to innovate transmission systems may provide additional benefits. It is important to consider where the expertise sits between the developer and TSO.

2.6. Key learnings from International Experiences

- **Consider who should own the risk for development, construction, and operation of assets –** Deciding the ownership of risk and the cost of building transmission assets is a significant decision and can have significant implications for the cost and feasibility of the project and competition. Serious consideration should be given to where this risk lies and how it should be managed.

- **Visibility with clearly defined timelines for final designs and sharing key information between the developer and the TSO would improve coordination and lower the costs -** A robust process should be developed to define the responsibilities of the developer and TSO, timelines, and penalties for delay.

- **The transmission model used across Europe is dependent on both physical and non-physical factors including geography-** Local geography should play a key role in deciding the type of offshore transmission network. In large coastal regions, it may be possible for each OSW to have an independent connection to the shore. In areas of less available space, a networked option that has a lower impact on the shoreline may be preferred.

- **Long-term flexibility in the development model can be useful in accelerating growth-** Changing market circumstances may make either a developer-led or TSO-led model more appealing, depending on the market objectives. If there is limited competition and a need for innovation, then a TSO-led approach may offer benefits through closer coordination between projects of different developers. With significant competition in a mature market, encouraging developers to innovate transmission systems could bring additional benefits.

3. Independent Power Transmission Business Models in India

The Independent Power Transmission (IPT) business model offers rights and obligations associated with a single transmission element or a package of a few transmission elements. The government, in most cases bids out the IPT through Tariff Based Competitive Bidding (TBCB) mechanism. Once the contract is awarded, the IPT (the winning bidder) is responsible for building and operating the single transmission element or a package of a few transmission elements defined in the contract. The IPT has no rights or responsibilities for the existing network or to new transmission investment other than those defined in the contract.

The present chapter provides insights onto the key features and the contractual arrangements of the IPT models in India. Further, the responsibility and risk assessment are carried out with respect to the OSW during key stages of a project from the developer's perspective to identify the relevance of the IPT models for the OSW projects.

3.1. Background

IPT concept can be exploited for the development, ownership, and operation of OSW evacuation infrastructure under any of the above models wherever the role of Transmission Licensee (TSL) is envisaged. The TSL in the Indian context is similar to that of TSO in the international context with a difference that may arise due the terms of license granted by the respective authorities in the Indian and international context respectively. IPT structures can effectively bring in innovation and best practices in execution, financial structures/leverages, access to state of art technologies, and project management practices. It can also bring transparency in cost discovery and fair allocation of risks amongst parties and facilitate de-risking of OSW projects from the developer's perspective. Several variants' structures of IPT have been tried out in India and other markets. In the recent past, private participation in transmission development through a competitive bidding framework has been tested through various business models for increasing competitiveness and privately financed transmission in India, mainly for the following reasons:

1. Various variants of IPT can be used to meet India's investment needs. JV route could be implemented for specific project cases. The SPV route has been extensively exploited for private-sector participation in the transmission business in India.
2. IPT models, such as EPC contracting with deferred financing option can create more competitive pressure than other business models by running a tender for each line or package of lines.
3. It is consistent with policies being developed by the Central and State Governments.

4. JV Model and SPV Model have been successfully demonstrated models in many countries. Therefore, these are more likely to be applied than other business models.

3.2. Key Characteristics of IPTs

3.2.1 Term

The term ranges from 25 years to 35 years. Some contracts include the option for extending the term for a further period.

3.2.2 Coverage

The IPT may include a single element of the transmission system or a package of a few transmission elements. IPT has no other obligations in the concerned region or country.

3.2.3 Revenues

The annual payment is a bid parameter. The winning bid largely establishes the payments to be received over the contract term. The payment can start on the date of the beginning of commercial operation or the date of commissioning (CoD), even if this occurs before the due date in the contract. The TSA with the IPT will need to set out the requirements for commissioning and the parameters of performance after commissioning. If the performance parameters are not met, the contract should provide for penalties to be imposed, and prolonged failure to achieve commissioning should lead to termination of the contract.

3.2.4 Incentives

The contract establishes incentives for the IPT to achieve timely commissioning of the transmission line and minimising the whole-of-life costs. The main performance incentive is to ensure high availability of the transmission line over the contract term. IPT is not responsible for how the integrated transmission grid performs. IPT's responsibility is limited to ensuring that the transmission line or lines that it owns are available.

3.2.5 Access

All users of the transmission networks must get consistent access to the transmission network in a non-discriminatory manner.

3.3. Structuring of IPTs

The alternatives for structuring the IPT can be classified depending based on the source of CAPEX. IPT can be a private company that will own the transmission assets independently or in partnership or project finance through tender opportunities or a third party. The IPT structures through which the alternatives can be configured are briefly explained below:

3.3.1 Joint Venture (JV)

A JV is a common way of combining the resources and expertise of two otherwise unrelated companies. In this case, a government entity and a private entity join in a JV. There are many benefits to this type of partnership, but it is not without risks—such arrangements can be very complex.

3.3.2 Independent Power Transmission Company by Forming SPV (IPTC-SPV):

In this model, the private company forms SPV which holds the transmission assets. Here, the project is funded through a project finance route for which the lender considers cash flows from the transmission assets as the primary source for the repayment of the loan and the assets of the SPV are the collateral for the loan.

3.3.3 EPC Contracts

EPC contracts are project finance documents that establish a contractual framework between owner and contractor that transfers all design and construction risks to the contractor. Since EPC contracts have been found effective for managing risk, they are the most preferred type of construction contracts for raising project finance.

3.3.4 EPC Developer and Operator

Under this method, the government grants the project (with a mutually agreed value) to the EPC contractor who provides the expertise, technology, materials, and equipment, and oversight and builds the project. The funds are provided by the government.

On its completion, the O&M of the project is undertaken by the EPC contractor on negotiated terms and the project is transferred to the government at the end of the contract. In this option, the EPC contractor bears the operation risk. There are efficiency gains in this approach because the developer bears the performance risk.

3.3.5 EPC + Finance

In this method, the government grants the project (a mutually agreed) to the EPC contractor who provides the expertise, technology, materials, and equipment, and oversight and builds the project. The project is funded by the EPC contractor. The payment is guaranteed by the government. The repayment terms are negotiated with the government directly.

On its completion, the project is transferred to the government. In this EPC + Finance option, the public sector bears operation risk. There are no efficiency gains from the EPC + Finance approach, as the developer does not bear performance risk during the operation stage except for the timely delivery of the project.

3.4. IPT Contractual Schemes

There are three types of contractual schemes implemented for transmission investment. These schemes are Build-Own-Operate-Transfer (BOOT), Build-Own-Operate (BOO), and Build-Transfer-Operate (BTO). The Public-Private-Partnership (PPP) structures for all three schemes are presented in Table 2.

Table 2: PPP Structures for IPT Contracts

Particulars	BOOT	BOO	BTO
Who funds the Capital Investment?	Developer/ Equity Shareholder/Lenders	Developer/Equity Shareholder/Lenders	Developer/Lenders
Who bears Construction Risk?	Developer/EPC	Developer/EPC	Developer/EPC
Who bears Operation Risk?	Developer/ O&M contractor	Developer/ O&M contractor	Government Co.
Who owns the Transmission Assets?	SPV/JV	SPV/JV	Government Co.

3.5. IPT Business Models and relevance to OSW Evacuation

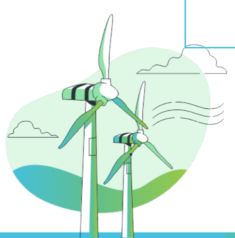
This section provides details of four IPT-based models to discuss their relevance for OSW evacuation infrastructure in India.

1. IPT Model-1 (BOOT-TBCB)
2. IPT Model-2 (BOOM/BOOT – JV)
3. IPT Model-3 (DBFT, EPC + Financing)
4. IPT Model-4 (DBO, EPC + O&M)

The details of IPT models, such as salient features, contractual agreements, governing framework, and a schematic representation of the key entities and their inter-relationships in the model are presented in Annexure 1.

Different IPT models, based on their typical configurations, offer various advantages for devising evacuation infrastructure in the OSW context in India. The IPTs 1 and 2, having been tested in India for onshore evacuation infrastructure, and the valuable insights gained from the experience were useful while selecting the suitable business model for OSW evacuation. Each model is discussed in detail to present the responsibility and risk during key stages of a project from the developer's perspective.

	IPT 1 (BOOM/BOOT-TBCB)	IPT 2 (BOOM/BOOT-JV)
Planning and design	**Developer Responsibility: Low** • Bid Process Coordinator (BPC) – CTU/STU or nominated govt. company to initiate the process for competitive bidding. • SPV to select the EPC and O&M contractor.	**Developer Responsibility: High** • Private Developer to create a JV with a nominated govt. company. • Nominated govt. company could also initiate the process to select a JV partner. • JV to select the EPC and O&M contractor.
	Developer Risk: Low • Minimum technical specifications are available. This results in higher efforts in technical detailing and also an opportunity for cost optimisation.	**Developer Risk: High** • The JV creation process can be complex. Efforts are required to match the level of expertise and investment. • The govt entity may have a greater say in the finalisation of technical specifications because of the expertise that the govt. entity possesses.
Commercial and Finance	**Developer Responsibility: High** • SPV to approach SERC/CERC for grant of a license, cost recovery by SPV– transmission service charge. • SPV to approach lenders to raise finance. • BPC ensures transmission service agreement with the beneficiaries is in place.	**Developer Responsibility: Low** • JV to approach SERC/CERC for pre-approval of revenue streams. • JV to approach lenders for arranging finance • JV ensures transmission service agreement with beneficiaries is in place.
	Developer Risk: High • SPV bears risks of cost of finance and impact on revenue.	**Developer Risk: Low** • JV bears risks of cost of finance and impact on revenue, bringing in finance may be easier with govt company as part of JV.
Construction	**Developer Responsibility: High** • SPV to seek timely approvals to avoid cost overruns. • SPV is responsible for construction quality to minimise expenses during the O&M phase. • SPV to coordinate with TSL, generators, CTUIL, or STU for commissioning interconnection points.	**Developer Responsibility: Low** • JV to seek timely approvals to avoid cost overruns. • JV is responsible for the quality of construction to minimise expenses during the O&M phase. • JV to coordinate with other licensees/ generators/CTUIL/STU for the commissioning of interconnection points. • Differences in process environment are to be handled carefully during the construction stage.



	IPT 1 (BOOM/BOOT-TBCB)	IPT 2 (BOOM/BOOT-JV)
	Developer Risk: High • Procuring right-of-way clearances is usually a challenge for the private sector due to various layers of interactions with local/state government agencies. • Difficult terrain may pose the risk of unavailability of expertise for the SPV.	**Developer Risk: Low** • Availing right-of-way clearances may not pose a significant challenge because of the set processes available with a govt partner company. • 2. Difficult terrain may pose the risk of unavailability of expertise for the JV.
Operations	**Developer Responsibility: Low** • SPV is responsible for maintaining system availability. • SPV is responsible for coordination with the developer/interconnecting TSL during the O&M stage.	**Developer Responsibility: High** • JV is responsible for maintaining system availability. • JV is responsible for coordination with the developer/ interconnecting TSL during the O&M stage. • JV to ensure availability of skilled manpower and spare availability.
	Developer Risk: High • Maintaining availability during difficult weather conditions, and system disturbances. • SPV to ensure availability of skilled manpower and spares, tools, and tackles.	**Developer Risk: Low** • Maintaining availability during difficult weather conditions and system disturbances can be better managed with skilled manpower already available with govt. partner company. • Differences in work culture are to be handled carefully during the O&M stage.
Relevance for OSW	This model is amenable to ISTS-connected OSW evacuation infrastructure with the least interventions in the existing policy, regulatory, and governing frameworks. It offers scalability and comes with the advantage of having been experimented with in India for InSTS-connected large-scale, onshore evacuation projects.	This model is amenable to ISTS-connected OSW evacuation infrastructure, with STU having a controlling stake in the JV. It enables STU to bring in private sector investments and properly allocate project risks among the parties. Further, it comes with the advantage of having been experimented with in India for some of the InSTS-connected onshore evacuation projects when private sector participation was less mature.

The other IPT models such as IPT 3 (DBFT – EPC & Financing) or IPT 4 (DBO, EPC + O&M) have strong applicability for OSW evacuation in a mature market. However, in the Indian context, considering the complicated structure of these models and lack of previous experience in implementing these models for onshore transmission projects, these are not parts of the present discussions.

Overall, considering the advantages that the IPT model brings, it can be gainfully utilised for OSW evacuation to achieve:

1. Faster Execution- Private sector participation in transmission projects through TBCB has resulted in faster execution of onshore transmission projects with the use of advanced technologies and reduction of the project burden on Central/State agencies.
2. Lower Tariff- Competitive bidding has helped reduce transmission tariffs by almost 30-35% in many cases for onshore transmission projects. Private players bring in innovative financing options, design and contractual frameworks, and implementation mechanisms to reduce overall project costs and tariffs.
3. Innovative Technology- TBCB enables the micro-management of specifications and gives the developers free hand to use innovative technology solutions for constructing transmission projects. The OSW evacuation technology being at a nascent stage in India, these business models can play a key role in the development of the sector.
4. Investment Mobilisation- OSW evacuation infrastructure being cost intensive, with TBCB, the private sector can bring in significant investment in the sector and achieve rapid growth.

The IPT 1 & 2 business models are successfully deployed while addressing the main concerns of long term perspective, phase-wise/ modular development, latest technology, and optimal cost at the time of planning. During the implementation phase, the transmission system is available at a competitive price. This has led development of IPT business models offered to a developer through Tariff Based Competitive Bidding (TBCB) so that efficiency in the financing, construction cost, and timeline is achieved along with the operation in an integrated manner through a centralized Grid operator.

This builds a strong case for OSW transmission business models to adopt experiences of centralised planning where a centralized agency can look into immediate requirement as well as long term perspective along with phase wise development. This is more important when we are developing any transmission infrastructure particularly inside the sea where the physical footprint of the infrastructure needs to be kept minimal. The Chapter 4 dwells into the OSW transmission specific aspects and provide insights on feasibility of transmission business model options for India.

4. OSW Transmission Business Model Options for India

In the previous chapters, various transmission business models for the OSW across Europe have been examined along with the existing onshore IPT models. It is observed that the overall OSW project development would largely be influenced by the distance of OSW sites (typically in the range of 10 km to 60 km in case of India) from the coastline and the maturity of the OSW market. Further, given the present expertise of the TSL for the development and operations of transmission infrastructure, the IPT model 1 and IPT model 2 could be compatible with the initial OSW projects. However, based on the market maturity other IPT models could also be tried for the OSW power evacuation.

The present chapter provides an in-depth review of the present policy and regulatory framework for the transmission system in India and proposes several transmission business model options based on the guiding principles set for the OSW development and the international learnings from the Chapter 2. Further, it assesses the relevance of the multiple IPT models for the OSW power evacuation.

4.1. Policy and Regulatory Framework for OSW Evacuation

In India, the generation, transmission, distribution, and trading of electricity are governed by a single, consolidated statute, the Electricity Act 2003 (EA 2003). Section 14 of EA 2003 defines transmission as a licensed activity, and the appropriate commission may grant the license to carry out this activity to a person on an application made under Section 15 of EA 2003. Further, under Section 2 (73), the term 'transmission licensee' means a licensee authorised to establish or operate transmission lines. Hence, when the above clauses are read together, one can infer that the OSW evacuation infrastructure may be developed and operated together as a single or can be carried out as separate activity by the OSW developer or the transmission licensee respectively. Further, Section 40 of the EA 2003, specifies the duty of the transmission licensee to build, maintain, and operate the transmission system.

The cost of the transmission infrastructure is recovered through the regulatory framework applicable for determining transmission system charges and losses based on the following regulations:

1. **Transmission system developed under Section 62 of the EA 2003:**
    a) Transmission charges and losses are determined by CERC/ SERCs as per the tariff regulations notified by CERC for ISTS projects and tariff regulations notified by the respective State.
    b) CERC (Sharing of transmission charges and losses), Regulations, 2020 as amended from time to time.
2. **Transmission system developed under Section 63 of the EA 2003:**
    a) Tariff-based competitive bidding framework.

Apart from the applicable regulations for recovery of cost, other regulations that are mandatory for the development of transmission systems in India are as follows:

1. CERC (Indian Electricity Grid Code) Regulations, 2010 and amendment thereof [12].
2. CERC (Connectivity and General Network Access to the inter-State Transmission System) Regulations, 2022 and amendment thereof.
3. CERC (Deviation Settlement Mechanism and Related Matters) Regulations, 2022 and amendment thereof.

The National Offshore Wind Policy was notified in 2015. The policy defines the roles and responsibilities of the developer and TSL for the development of the transmission infrastructure. The Section 10 of the EA 2003, provides the responsibility of generator "*to establish, operate and maintain generating stations, tie-lines, sub-stations and dedicated transmission lines connected therewith in accordance with the provisions of this Act or the rules or regulations made thereunder.*" Further, the Section 2 (16) of the EA 2003 defines dedicated transmission lines as "*any electric supply line for point-to-point transmission which is required to connect electric lines or electric plants of a generating station under Section 10 of EA 2003 to any transmission lines or sub-stations or generating stations, or the load centre.*". Therefore, in the OSW policy the OSW developer was responsible for the development of the OSW farm along with the transmission lines up to the onshore PSS.

However, since then the roles and responsibilities of the OSW developer and TSL have evolved. In the recent MNRE strategy paper published in 2022, the CTU/transmission licensee has been made responsible for the development and establishment of the connection of the offshore PSS with the onshore grid infrastructure via a submarine export cable.

The MNRE strategy paper stipulates that the OSW developer shall be responsible for the development of the OSW farm and the offshore PSS. Further, in each of the three-business models proposed under the strategy paper as outlined in Table 3 below:

Table 3: Salient features of models proposed under MNRE Strategy Paper

Model 1	Model 2	Model 3
1. Applicable to demarcated OSW zones studied/ surveyed in detail by MNRE/NIWE. 2. Zone B3 (365 Sq.km) off the coast of Gujarat	1. Applicable for OSW sites identified by NIWE but not studied/surveyed in detail. 2. Developers to select wind sites in the	1. Those large OSW zones that NIWE shall identify within the EEZ from time to time and not covered under Model 1 and Model 2.

Model 1	Model 2	Model 3
shall be considered in Phase 1 of this model. 3. VGF will be available under this model.	identified zones and conduct necessary studies/surveys with MNRE's approval. 3. The model has two types: ➢ Model 2(A) with VGF ➢ Model 2(B) Without VGF. Power can be sold in open access/open door mode	2. Zones are to be leased out for a fixed period through single-stage two-envelope bidding. 3. The generated power shall be used either for captive consumption through open access mechanism or sold to an entity under a bilateral power purchase agreement or sold through power exchanges.

It may be noted that the models recommended by the MNRE Strategy Paper outlined above are differentiated based on the responsibility of site surveys, availability of the VGF, and the power sale/offtake arrangements. Further, for the three business models above, MNRE has proposed a single transmission business model.

However, given the country's OSW objective and its transmission infrastructure cost, which contributes almost 15-20% of the total OSW project cost[13], it is necessary to develop several transmission business models to introduce innovative modes of allocation of risk, the responsibility of development, ownership, and operations to various parties in OSW transmission infrastructure to reduce the overall LCoE. Therefore, the key guiding principles for the development of the transmission business models are detailed in the following section.

4.2. Guiding Principles for developing OSW Business Models Options

The proposed OSW transmission business model should:

- Recognise different types of OSW evacuation arrangements within the statutory framework.
- Enable multiple participation models for OSW evacuation.
- Facilitate the creation of suitable ownership structures and innovative contracting arrangements for OSW Evacuation.
- Encourage long-term OSW development through market mode.
- Encourage Innovations in OSW evacuation with a technology-agnostic approach.
- Provide simplified and integrated interconnections, energy accounting, and settlement framework.
- Encourage LCOE reduction and cost optimisation.
- Encourage high reliability of transmission assets.
- Be cognisant of different expertise levels of stakeholders.
- Distribute risk appropriately according to ability to bear risk.
- Attract investments in India's nascent OSW market

4.3. Proposed OSW Transmission Business Model Options for India

Given the prevalent statutory, policy, and regulatory framework in India and the principles sets for the OSW evacuation, various transmission business model options are developed. The schematic representation of these model options is shown in Figure 3 under which the overall evacuation system from the OSW plant upto the grid interconnection point is divided into four Blocks as follows:

1. Block A: Offshore generation Blocks and the inter-array cables to the offshore pooling substation
2. Block B: Offshore Pooling Substation (PSS)
3. Block C: Submarine cables from the offshore PSS to the onshore pooling substation
4. Block D: Onshore PSS and the connection to the grid

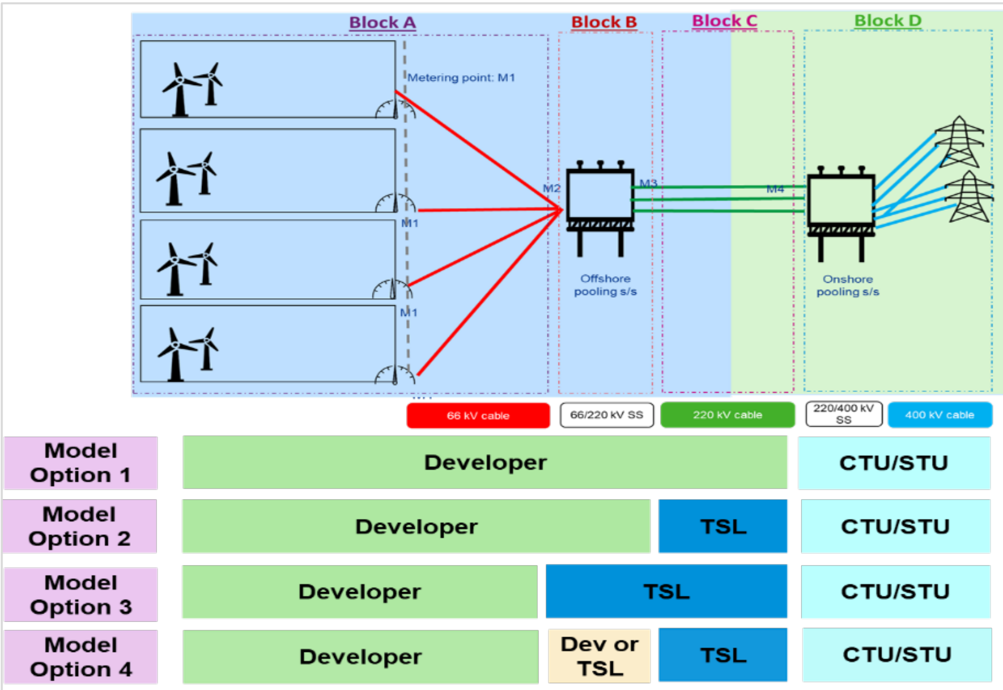


Figure 3: Schematic representation of OSW transmission system Business Model Options

In all the proposed OSW transmission system Business Model Options, the developer is responsible for Block A i.e., OSW farm up to the LV side of the OSW PSS, throughout the different stages of the project lifecycle, namely, planning, design, development, construction, commissioning and operations. In a similar manner, under all of the proposed OSW Business Model Options, the TSL would be responsible for Block D, i.e., the planning, design, development, construction, commissioning and operations of the onshore PSS and the requisite upstream transmission infrastructure. The innovations in the Business Model Options stem from various possibilities of development, asset ownership, and O&M of Blocks B and C, which, in turn, will depend on the project size and site-specific condition as detailed in Table 4.

Table 4: Proposed Business model options for OSW transmission system development

	Block	Development	Asset Ownership and O&M responsibility	Transmission Business proposed for OSW in India	Compatibility with international cases
Model Option 1	A	Developer	Developer	More suitable for near-shore sites with a lower investment in transmission system. This option is similar to the conditions stipulated under MNRE OSW Policy, 2015 and offers only onshore transmission system for socialisation of costs.	Implemented in nascent markets such as Japan and the US.
	B	Developer	Developer		
	C	Developer	Developer		
	D	CTU/STU	CTU/STU		
Model Option 2	A	Developer	Developer	Evacuation arrangement aligned with Models 1, 2 & 3 outlined under the MNRE Strategy paper. This option offers export cable portion and onshore transmission system for socialisation of costs.	Implemented in Germany for multi-connection HVDC OSW farms where developer-owned OSW AC SS connect to a large, TSO-owned HVDC converter station.
	B	Developer	Developer		
	C	Transmission licensee	Transmission licensee		
	D	CTU/STU	CTU/STU		
Model Option 3	A	Developer	Developer	More suitable for deep water and long-distance sites where OSW PSS generally form a significant portion of OSW evacuation cost. Aligns with the centralised planning approach to keep the environmental footprint of transmission system at a minimum level. The OSW PSS shall form part of the ISTS network and hence its cost recovery could be socialised.	Generally, implemented in the mature OSW markets across Europe where developer-owned offshore AC SSs (Multi connection HVAC) connect to a large TSO-owned HVDC converter station.
	B	Transmission licensee	Transmission licensee		
	C	Transmission licensee	Transmission licensee		
	D	CTU/STU	CTU/STU		
Model Option 4	A	Developer	Developer	This option is similar to Option 3, except that the design, engineering, and implementation of the OSW PSS are to be carried out by the developer and aligned with the array design of Block A. Further. the PSS Block B is to be handed over through bidding/auctions to Transmission Licensee once commissioned.	Like the UK-OFTO Model, except that, in the UK, the OSW SS and export cable are sold to OFTO after their construction by the developer.
	B	Developer	Transmission licensee		
	C	Transmission licensee	Transmission licensee		
	D	CTU/STU	CTU/STU		

Note Box: Compatibility of IPT Model for OSW Project

- **IPT Model 1:**
  - This Model is suitable for all the proposed OSW transmission business model options because it has a well-settled ecosystem in the onshore power evacuation.
  - Several successful examples can be referred to the Ministry of Power, Govt of Indian portal: Tarang). Some of the successful examples include Jabalpur Transmission Company Ltd. by Sterlite, Vikhroli Transmission Pvt Ltd (KVTPL) by Adani Transmission Limited
- **IPT Model 2:**
  - This Model is suitable for the OSW projects which are connected to the InSTS network. At present, the initial 37 GW of OSW projects are to be connected to the ISTS network as envisaged in the MNRE strategy paper. However, based on the maturity of OSW market, the near shore /individual small capacity OSW farms under the business model option 1, 2 and 3 are most likely to adopt this IPT model.
  - Some of the successful onshore examples include, Jaigad Power Transmission Ltd (JV between M/s. JSW and Maharashtra State Electricity Transmission Company Ltd., Powerlink (JV between Tata Power & Power Grid Corporation of India Ltd.), PrKTCL (JV between Indigrid & Power Grid Corporation of India Ltd.) for evacuation of power from Parbati -Koldam hydro projects, Torrent Power Grid Limited, a Joint venture with Power Grid Corporation of India Ltd. and Torrent.
- **IPT Model 3 and 4:**
  - This Model can be suitable for the OSW projects after the maturity of the OSW market in India because these are yet to be implemented in India for the onshore power evacuation.

The above discussion on OSW transmission system business model formulation based on the suitability of the onshore transmission business models in India along with the international experience of implementing the models needs a qualitative analysis during development, asset ownership and O&M stage of the project lifecycle considering the maturity of the countries' OSW markets, topographic conditions, project sizes, etc. This analysis is carried out in Chapter 5 while considering the implementation of these models in India and assess their relevance for implementation more comprehensively.

5. Operationalisation of Transmission Business Models

The present chapter provides deeper insights into roles and responsibilities, challenges and opportunities associated with the OSW projects at each stage of project development, namely, design & development, finance & construction, and ownership & operation stages. Further, an in-depth analysis of the contractual arrangements and pros and cons of each of the proposed transmission business model options for India has been performed for gaining insights on suitability of operationalisation of the transmission business model options.

5.1. Stages of OSW Transmission Business

The assessment of roles and responsibilities, challenges and opportunities for developers, investors, and TSLs, for effective implementation/development of the OSW transmission system over the project stages are elaborated below:

5.1.1 Design and Development stage

During the design and development stage of the OSW transmission system, the OSW developer/TSL's scope of work for the OSW project shall comprise, but not necessarily be limited to the following:

a) Activities regarding the site survey and necessary measurements in the marine environment, formulation of detailed project report, financing arrangements, project management, necessary consents, clearances and permits (EIA & CRZ, civil aviation, port etc.).

b) Due diligence for selection of the point of connectivity under the GNA Regulations and its amendment thereof by selecting the existing substations having available margin as indicated by the respective substation owner or existing substations where augmentation is under process or plans for augmentation have been announced.

c) Seeking the approvals from CTUIL on grid interconnection parameters.

d) Seeking approvals for technical designs, drawings, specifications, perform the type testing as may be needed.

e) Arrangement of all equipment, facilities, components, and systems of the project to ensure that it shall be in accordance with Transmission Service Agreement and applicable Rules/ Regulations, Orders and Guidelines issued by the appropriate government.

f) Project planning to ensure timely completion of entire scope of project in all respects as shall be specified in the Request for proposal documents.

Seeking for the transmission license from the appropriate Commission, as per the provisions of the EA 2003 and regulations made thereunder, applicable if the transmission system is being constructed through Tariff Based Competitive Bidding guidelines under Section 63 of the EA 2003.

At this stage, the key challenges, and opportunities are:

a) Defining a generalised scope of work package/field investigations and surveys for the OSW developer/TSL is a challenge. The MNRE strategy paper has stipulated three business models in which the principles for the site surveys and sea leasing are mentioned. The submarine cable route survey and the OSW PSS survey essentially need to be a separate activity to facilitate transmission infrastructure and agnostic of OSW transmission business model.

b) Defining technical specification, approved vendors, type testing parameters for the OSW projects as per Indian condition. It provides opportunities for the international OSW developers to work in Indian conditions bringing their expertise.

c) Selection of the suitable configuration for the inter inter-array cables, OSW PSS foundation and structure design and the subsea export cable is a challenge because the configuration of these equipment generally varies with respect to transmission business models.

d) Computation of the project cost consideration the India-specific conditions and a tax friendly regimes maybe required to attract developers

e) There is an opportunity to develop a single window clearance for the approvals/consents to avoid situation of stranding of assets. Longer timelines for approvals/consents, and delays during the concept-to-commissioning interval could be deterrents for OSW developer given manpower, material, and work time availability constraints.

5.1.2 Finance and Construction stage

During the Finance and Construction stage, the OSW developer/TSL's scope of work for the OSW project shall comprise, but not necessarily be limited to the following:

a) Explore low-cost financing arrangements for the CAPEX of the OSW project. Generally, in India the debt: equity is 70:30 for public sector transmission projects and ranges to approx. 75:25 for private sector transmission projects. The project developing entity must have invested directly or indirectly at least twenty six percent (26%) of the shareholding in the project company till the time of commissioning/completion of the project.

b) Arrangement of debt refinancing to lower down the investment requirement for the project.

c) Performing the construction and testing of all equipment, facilities, components and systems in accordance with latest version of relevant standards and codes issued by Bureau of Indian Standards or reputed international standards viz. *International Electrotechnical Commission Standards/ American Society of Mechanical Engineers Standards/ Deutsches Institut für Normung Standards or equivalent and codes.*

d) Coordination between the OSW developer and TSL to avoid delays and penalties due to delay in CoD from both parties.

At this stage, the key challenges, and opportunities are:

a) Defining a generalised financing arrangements for CAPEX related to grid interconnection [14] for the OSW developer/TSL. As the CAPEX would vary based on the transmission business model options as shown Figure 4.

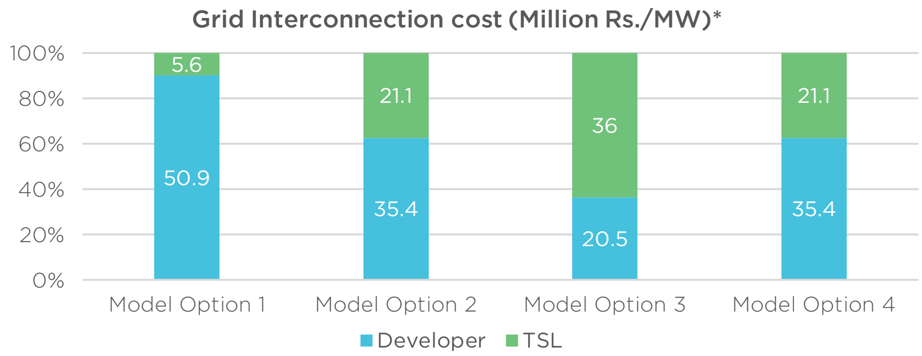


Figure 4: Grid Interconnection cost by 2025

**Grid interconnection cost includes cost of inter-array cable, offshore PSS, subsea export cable, onshore PSS.*

b) Risk of significant capital outlay with foreign currency exposure/risks for equipment finance.

c) Lack of technical standards for construction and testing of the OSW power plant and the electrical line is a challenge. This provides an opportunity for developers/TSL to consult with CEA or appropriate agency to develop grid codes and standards specific for OSW projects.

d) Limited expertise of the TSL to carry out construction in a marine environment provides a risk of stranded assets due to mismatch of the development timelines from the OSW project side to the transmission system side. This provides opportunity for the private sector developers/TSL to plan for expertise enhancement /skill development.

e) Offshore port and logistic facility are a major challenge in transportation of raw material and labours at the project site. However, development of OSW project would provide employment opportunities at port as well as at the offshore project site.

5.1.3 Ownership and operation stage

During the Ownership and operation stage, the OSW developer/TSL's scope of work for the OSW project shall comprise, but not necessarily be limited to the following:

a) Performing the O&M of all equipment, facilities, components, and systems in accordance with relevant standards and codes.

b) Ensuring arrangement of necessary spares and facilities such as submarine vessels, choppers, etc. at the project site. Further, all costs involved in procuring the inputs (including statutory taxes, duties, levies thereof) at the project site must be included in the transmission system charges.

c) Forecasting & scheduling, energy accounting and deviation settlement at grid interconnection point.

At this stage, the key challenges and opportunities are:

- Coordination between the developer and TSL with the OEMs throughout the project life would be complex under the nascent market. However, it would provide opportunity for TSL to work in marine environment through learnings/knowledge exchange amongst stakeholders.
- Paucity of the regulatory frameworks for energy accounting, forecasting, and scheduling, Grid code, sharing of transmission charges and losses, etc. for the OSW

projects creates an opportunity for developers/TSL to consult with the regulators for developing OSW specific provisions.

5.2. Transmission Charges, Waivers, and Incentives

5.2.1 Transmission charges

The CEA report on "Transmission System for Integration of over 500 GW RE Capacity by 2030," 2022, estimates the expected cost of transmission system for the first 10 GW OSW to be Rs. 2.81 Cr./MW against the onshore RE transmission infrastructure which is referred as ~Rs. 1 Cr/MW. Costs for India are to a large extent based on supply chain stakeholder feedback. The FIMOI study expects a drop in investment cost in OSW project in India by 40% over the next 10 years, which is contingent on building a substantial pipeline of offshore wind projects starting today. A predictable and substantial pipeline will allow developers, manufacturers, and service providers to establish a local supply chain, thus greatly reducing the costs. This expected reduction on cost in OSW projects can greatly influence the reduction in OSW transmission sytem cost in India over the next 10 years.

With respect to transmission charges, at present, the ISTS asset pool consists of several ISTS transmission system commissioned, with a major portion of ISTS assets owned by Power Grid Corporation of India Ltd. (PGCIL). In the ISTS pool, PGCIL owns gross fixed assets of Rs. 2,41,498 Crs. [15] as of March 2022. The corresponding yearly transmission charges paid during the same period was Rs. 32, 589 Crs [16].

This information can be useful to infer, if the transmission system assets for 1 GW of OSW project added to the RE portfolio of India, there would be corresponding increase in OSW transmission assets of Rs. 2810 Crs. [17] in the total onshore ISTS transmission asset. This increase corresponds to 1.16% in assets cost of ISTS pool. This may lead to corresponding impact for increase in Yearly Transmission Charges (YTC) to be recovered through the CERC Sharing of Inter-State Transmission Charges and Losses, 2020 and its amendment thereof.

This increase in YTC charges also needs to be viewed from the beneficial aspects of OSW projects and its ecosystem with increased energy security, prowess in technology & supply chain and social inclusion by way of creation of sustainable jobs in the entire value chain.

5.2.2 Waivers

In case of Onshore RE, under the CERC Sharing of Inter-State Transmission Charges and Losses Regulations, 2020 (Principal Regulations) and its draft amendment, 2022, no transmission charges is applicable for the use of ISTS shall be levied for GNA quantum for scheduling power from RE generating stations or RE hybrid generating station based on wind or solar sources which have declared commercial operation upto 30.6.2025.

In case of the OSW, case for extending the benefit of ISTS waiver needs a push to avoid exposing the OSW project developers to regulatory risk and cost implications in operationalising various Models envisaged to be deployed as per MNRE strategy paper for OSW development in India.

Considering OSW project development cycle longer in nature, it is important to provide this abundant regulatory clarity and certainty to cover not only the OSW projects planned to be commissioned prior to 2030 but also for the OSW projects that would be tendered out prior to specified date (say, 31-Mar-2030) based on targets envisaged under MNRE Strategy Paper for OSW. This can be achieved through issuance of an amendment of the Sharing of Inter-State Transmission Charges and Losses Regulations, 2020 to cover the waiver of ISTS charges for the RE generating Stations based on OSW sources.

5.2.3 Incentive

In India, incentive is provided to the TSL during the operation's phase. The TSL is entitled to the incentive on achieving annual availability beyond the target availability, in accordance with the following formula:

Incentive = Annual Transmission Charges x (Annual availability achieved – Target Availability) / Target Availability.

Where,
Annual transmission Charges shall correspond to Aggregate Revenue Requirement for each year of the Control Period for the Transmission Licensee.

The target availability is defined under the Muti Year Tariff Regulations [18]. However, at present, the target availability is defined only for the onshore AC systems and the HVDC bi pole links. For the OSW project, CEA or appropriate agency may need to benchmark the target availability based on actual operating performance after the operating parameters for the initial projects in Gujarat and Tamil Nadu are available.

5.3. Contractual arrangements of Transmission Business Model Options

5.3.1 OSW Transmission Business Model Option 1 [Developer driven]

Under Model Option 1, the Nodal Agency, SECI or NIWE, as the case may be, would invite bids under Section 62/63 of the EA 2003, for establishing the OSW power project under Section 10 of the EA 2003, in which the developer would be responsible for the development, construction and commissioning of OSW farm and inter-array cable in block A along with the dedicated transmission lines, which include the OSW PSS and the subsea export cable under Blocks B and C. In-house O&M after the commissioning of the project would be carried out either by the developers themselves or through O&M contractor for these blocks.

Further, the bid process (BPC)/government agency would invite transmission bids under Section 62/63 for establishing the onshore PSS under Section 40 of the EA 2003. Upon award of the contract, the CTUIL/TSL would develop, construct, and commission Block D. O&M activities for Block D after the commissioning of the project would be conducted by the CTUIL/TSL themselves or through the O&M contractor engaged for the purpose.

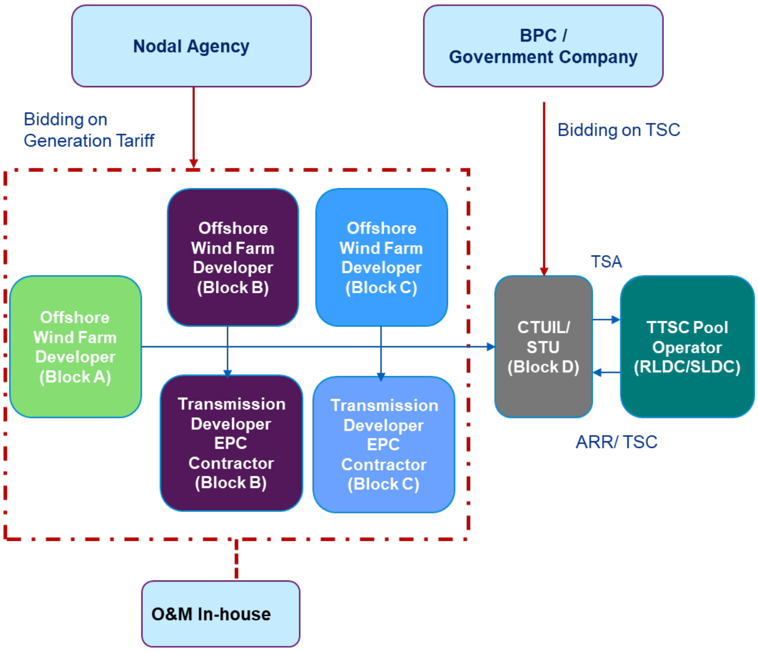


Figure 5: Schematic of Contractual arrangement under Model Option 1

Particulars	Contractual arrangement and Implementation aspects under Model Option-1 [Developer Driven]
Salient Features	• CAPEX requirement will be higher for the OSW developer given the Blocks A, B, and C are under the developer's scope. However, there will be cost optimisation opportunities available with them because of the larger portion of the ownership in the OSW transmission infrastructure. • The OSW developer would also have a better control over the supply chain, given their expertise in the OSW ecosystem. • Fewer chances of mismatches occurring during the construction of connected blocks and delays. • The Grid Interconnection point will be on the LV side of the onshore PSS (Block D) at which energy accounting, DSM settlement, and F&S would occur during the O&M phase. • However, the generation costs would be higher under this model option.
Governing Framework	• Under Section 10 of the EA 2003, the developer would be responsible for the development, construction, commissioning, and O&M of the OSW farm and inter-array cable in Block A along with the dedicated transmission lines including the OSW PSS and the subsea export cable under Blocks B and C. • The TSL would be responsible for the development, construction, commissioning, and O&M of the onshore PSS under Section 40 of the EA 2003.
Transmission Infrastructure cost recovery	• Generation tariff is determined under Sections 62/63 of the EA 2003, which would include the cost of the OSW farm and the dedicated transmission infrastructure under Blocks B and C. Generation tariff is recovered through PPA with the consumers or DISCOMs, as the case may be.

Particulars	Contractual arrangement and Implementation aspects under Model Option-1 [Developer Driven]
	• Transmission tariff is determined under Sections 62/63 of the EA 2003 and includes the onshore PSS under Block D. Further, the transmission tariff is recovered through yearly transmission charges (YTC) through the total transmission system cost (TTSC) pool as per CERC's Transmission Sharing of Charges/Losses Regulations and its amendment thereof.
Risk Assessment	• The potential for the socialisation of OSW Evacuation cost is low, given that Blocks A, B, and C are in the developer's scope and only Block D is in the scope of TSL. • With Blocks A, B, and C under the developer's scope, the developer bears heavy responsibilities for design and supply chain control. This would motivate the developer to encourage competition and innovation in the transmission system to reduce the LCoE. • Since Blocks A, B, and C are all developed by the developer, there are few interfaces between various stakeholders, which lowers the development and coordination risk. • Financing risk is high because the developer finances three blocks, namely A, B, and C. In the cases where subsidy support is not available or revenue certainty is not provided to the developer, any additional costs incurred on design, construction, operation, and decommissioning of the offshore transmission assets may make the project financially infeasible. • Risk for managing approvals and compliances is a heavy financial burden because a single entity is responsible for three blocks. • Delay risk in matching CoD is low because of a single entity and fewer interfaces between various stakeholders in the construction of the project. Also, the developers have greater experience with the logistics of managing the construction of offshore projects in an emerging OSW market.
Suitability in India	• Model Option 1 is suitable for the nascent market with a very low OSW capacity addition or captive power projects considering the high investment outlay requirements for constructing both, the OSW project and the associated transmission infrastructure. • Under this model option, near to the shore projects should be developed to reduce the financial risk over the developer as it would lower the dedicated transmission infrastructure cost and further reduces the generation tariff.

5.3.2 OSW Transmission Business Model Option 2 [Developer + TSL driven option]

Under Model Option 2, the Nodal Agency, SECI, or NIWE, as may be the case, invite bids under Sections 62/63 for establishing the OSW power project under Section 10 of the EA 2003. In this, the developer would be responsible for the development, construction, and commissioning of the OSW farm and inter-array cables in Block A along with the dedicated transmission lines which include the OSW PSS under Block B. In-house O&M of these Blocks after the commissioning of the project would be conducted by the developer themselves or through EPCs.

Further, the BPC/Government agency would invite transmission bids under Sections 62/63 for laying the subsea export cable and building the onshore PSS as provided under Section 40 of the EA 2003. Upon award of the contract, the CTUIL/TSL would develop, construct, and commission Blocks C and D. Further, in-house O&M after the commissioning of the project would be carried out by the CTUIL/TSL themselves or through EPCs.

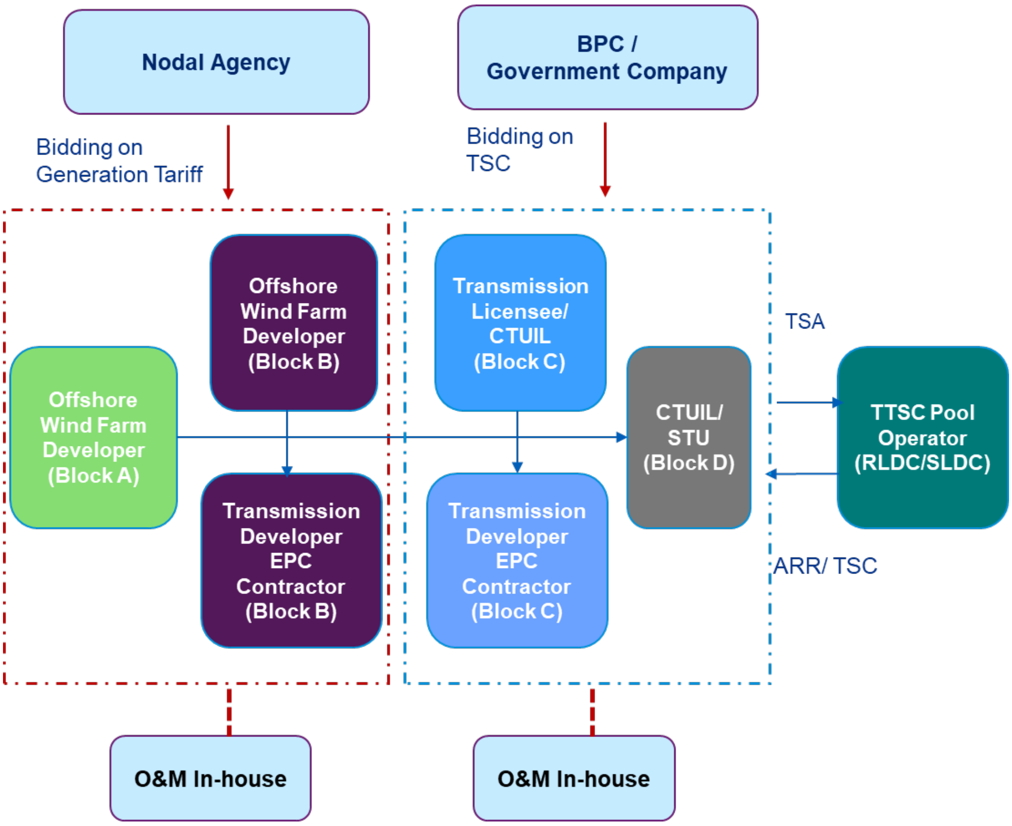


Figure 6: Schematic of Contractual arrangement under Model Option 2

Particulars	Contractual arrangement and Implementation aspects under Model *Option-2 [Developer + TSL driven]*
Salient Features	• There will be higher cost optimisation opportunities available for the OSW developers than the TSL because of the larger portion (i.e., the OSW farm and the OSW PSS) of the ownership are with the OSW developers. • The OSW developer would also have a better control over the supply chain, given their expertise in the OSW ecosystem. • CTU/TSL shall be responsible for the development of Block C, i.e., laying the subsea export cable. • The Grid Interconnection point will be on the HV side of the OSW PSS (Block B) at which energy accounting, DSM settlement, and F&S would occur during the O&M phase. However, the generation costs would be lower than the Model Option 1. • There are possibilities of delay due to a mismatch in the construction of the connecting blocks between Blocks A and B developed by the OSW developer and Block C and D developed by CTU or TSL.

Particulars	Contractual arrangement and Implementation aspects under Model *Option-2 [Developer + TSL driven]*
Governing Framework	• Under Section 10 of EA 2003, the developer would be responsible for the development, construction, commissioning, and O&M of the OSW farm and inter-array cable in Block A, and the dedicated transmission lines, including the OSW PSS under Block B. • Under Section 40 of the EA 2003, the TSL would be responsible for the development, construction, commissioning, and O&M of the subsea export cable and the onshore PSS.
Transmission Infrastructure cost recovery	• Generation tariff is determined under Section 62/63 of the EA 2003. It includes the cost of the OSW farm and the dedicated transmission infrastructure under Block B. The generation tariff is recovered through PPA with the consumers or DISCOMs, as the case may be. • Transmission tariff is determined under Section 62/63 of the EA 2003, which would include the subsea export cable and the onshore PSS under Blocks C and D respectively. Further, the YTC is to be recovered through the TTSC pool as per CERC's Transmission Sharing of Charges/Losses Regulations and its amendment thereof.
Risk assessment	• Given that Blocks A and B are under the developer scope and Block C and D are under TSL, the potential for the socialisation of OSW evacuation cost is moderate. • Design responsibility and supply chain control for the developer are high because Blocks A and B are within the developer's scope and the developer encourages competition and innovation in the transmission system up to OSW PSS. However, the use of varied designs by the developers limits standardisation, asset sharing, and cross-sector cost reduction. • Development and coordination risks are moderate because of the complicated construction arrangements between the TSL and multiple developers who may use various designs of OSW PSS. Further, there is also an increased consenting risk because point-to-point connections may have greater coordination risk at each interface. • Financing risk is moderate because financing by the developer is limited only to Blocks A and B. However, the cost of capital for the developer could be high because of increased equity return rates and debt rates. • The effort and cost of obtaining approvals and complying with regulations is moderated as it is shared between the developer and the TSL if both need approvals construct in in the marine environment and comply with relevant rules. • There is a moderate delay risk involved in matching CoD. Such delay may be caused if the developer is compelled to wait for the TSL to make subsea export cable and onshore grid reinforcements available before the developer can connect the OSW to the network. The

Particulars	Contractual arrangement and Implementation aspects under Model *Option-2 [Developer + TSL driven]*
	developer faces the risk of having stranded assets if TSL's work is delayed.
Suitability in India	• Model Option 2 is suitable for the market, which is nascent, however, is capable of high volume capacity addition, like the Indian context. This brings possibility of long term market creation cautiously while providing an opportunity to the TSL to gain expertise in working in the marine environment. • Model Option 2 offers the off loadable component of the subsea export cable for cost socialisation within the cost of transmission system and at the same time does not compromise with the innovations in the OSW pooling substations that developer may bring.

5.3.3 OSW Transmission Business Model Option 3 [TSL driven]

Under Model option 3, the Nodal Agency, SECI or NIWE as may be, would invite bids under Section 62/63 of the EA 2003, for establishing the OSW power project under Section 10 of the EA 2003, in which the developer would be responsible for the development, construction and commissioning of a wind farm along with the inter inter-array cables in Block A. In-house O&M after the commissioning of the project would be done by the developer either by themselves or through EPCs.

Further, the bid process company (BPC)/Government agency would invite transmission bids under Section 62/63 of the EA 2003, for establishing the OSW PSS, subsea export cable, and the onshore PSS under Section 40 of the EA 2003. Upon award of the contract, the CTUIL/TSL would develop, construct, and commission Block B, C, and D. Further, in-house O&M after the commissioning of the project would be done by the CTUIL/TSL either by themselves or through EPCs.

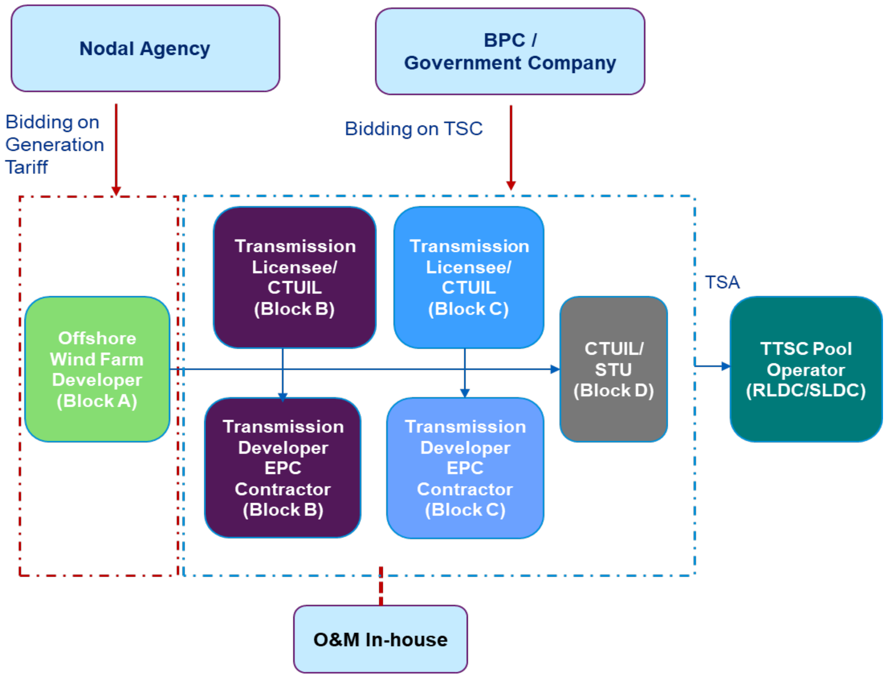


Figure 7: Schematic of Contractual arrangement under Model Option 3

Particulars	Contractual arrangement and Implementation aspects under Model *Option-3 [TSL Driven]*
Salient Features	• CAPEX requirement will be higher for Blocks B, C & D. However, there will be higher cost optimisation opportunities available for the TSL than the OSW developer because the larger portion of the ownership are with the TSL i.e., the OSW PSS, subsea export cables and the onshore PSS. • The Grid Interconnection point will be on the LV side of the OSW PSS (Block B) at which energy accounting, DSM settlement, and F&S would occur during the O&M phase. • Transmission charges will be higher than in other model options, given the majority ownership are with the TSL.
Governing Framework	• The OSW developer would be responsible for the development, construction, commissioning, and O&M of the OSW farm along with the dedicated transmission lines which include the inter-array cables in Block A, under Section 10 of the EA 2003. • The TSL would be responsible for the development, construction, commissioning, and O&M of the OSW PSS, subsea export cable, and the onshore PSS under Section 40 of the EA 2003.
Transmission Infrastructure cost recovery	• Generation tariff is determined by the provisions of Sections 62/63 of the EA 2003 and includes the cost of the OSW and the export cables in Block A. The generation tariff is recovered through PPA with the consumers or DISCOMs, as the case may be. • Transmission tariff is determined as set out in Sections 62/63 of the EA 2003 and includes OSW PSS, subsea export cable, and the onshore PSS in Blocks B, C, and D. Further, the YTC is to be

Particulars	Contractual arrangement and Implementation aspects under Model *Option*-3 *[TSL Driven]*
	recovered through the TTSC pool as per CERC's Transmission Sharing of Charges/Losses Regulations and its amendment thereof.
Risk assessment	• As Blocks A, B and C are within the scope of TSL, there is a strong possibility for socialisation of OSW evacuation cost. • The developer does not bear the responsibility for the design and does not control the supply chain because the developer's scope covers only Block A. The developer can encourage competition and innovation within their scope. However, an interconnected approach for Blocks B, C, and D by TSL would make long-term planning and standardisation of assets possible. The resultant economies of scale would lead to saving costs. At the same time, standardisation may prove to be a disincentive for innovation by developers and in the supply chain. • Development and coordination risks are high because it is difficult for the developers to implement innovation in the design and procurement process. The coordination between TSL and multiple developers can be challenging and may lead to the oversizing of assets at additional costs. Further, the complicated construction arrangements between the TSL and multiple developers add to the possibility of TSL's assets becoming stranded if power generation is delayed. • Financing risk is low because it minimises CAPEX costs for developers in transmission construction and most of the financing is to be provided by the TSL. Further, in matured a market, the TSLs, usually, have a fuller order book of projects than individual developers. Therefore, TSLs would be better placed for raising finance, that too at a lower interest rate, than the developers. • Risk for managing approvals & compliances is moderate, provided that the developer and TSL both need approvals in the marine environment. Further, in the matured market, the TSL is expert enough to comply with the existing regulations. • Delay risk in matching CoD is high because if the TSL receives final engineering designs at a late stage from the developer around OSW farm site locations, inter-inter-array cable voltages, power outputs, etc., then only at this point can the TSL plan properly for its assets which could lead to severe delays. At the same time, the developer must wait for the TSL to make onshore grid reinforcements before it can connect to the network which results in a risk of stranded assets for the developer.
Suitability in India	Model option 3 is suitable for the market capable of high-volume capacity addition, like the Indian context with some of the successful project installations. This will allow to assess the risks from both Government's and Developer's perspective in realistic manner and prepare for mitigations to cover maximum part of transmission asset for socialisation.

Particulars	Contractual arrangement and Implementation aspects under Model *Option*-3 *[TSL Driven]*
	This model option of the centralised and inter-connected approach enables better system-wide and long-term planning resulting in the economics of scale, cost savings and limiting environmental footprint through the standardised shared assets among multiple developers.

5.3.4 OSW Transmission Business Model Option 4 [Hybrid Option]

Under Model option 4, the Nodal Agency, SECI or NIWE as may be, would invite bids under Section 62/63 of the EA 2003, for establishing the OSW power project under Section 10 of the EA 2003, in which the developer would be responsible for the development, construction and commissioning of the OSW farm and inter-array cable in Block A along with the dedicated transmission lines which include the OSW PSS under Block B. Further, the OSW PSS under Block B is to be transferred to the CTU/TSL for in-house O&M after the commissioning of the project either by themselves or through EPCs.

The bid process company (BPC)/government agency would invite transmission bids for establishing the subsea export cable and the onshore PSS under Section 62/63 of the EA 2003. Upon award of the contract, the CTUIL/TSL would develop, construct, and commission Block C and D. Further, in-house O&M after the commissioning of the project would be done by the CTUIL/TSL either by themselves or through EPCs.

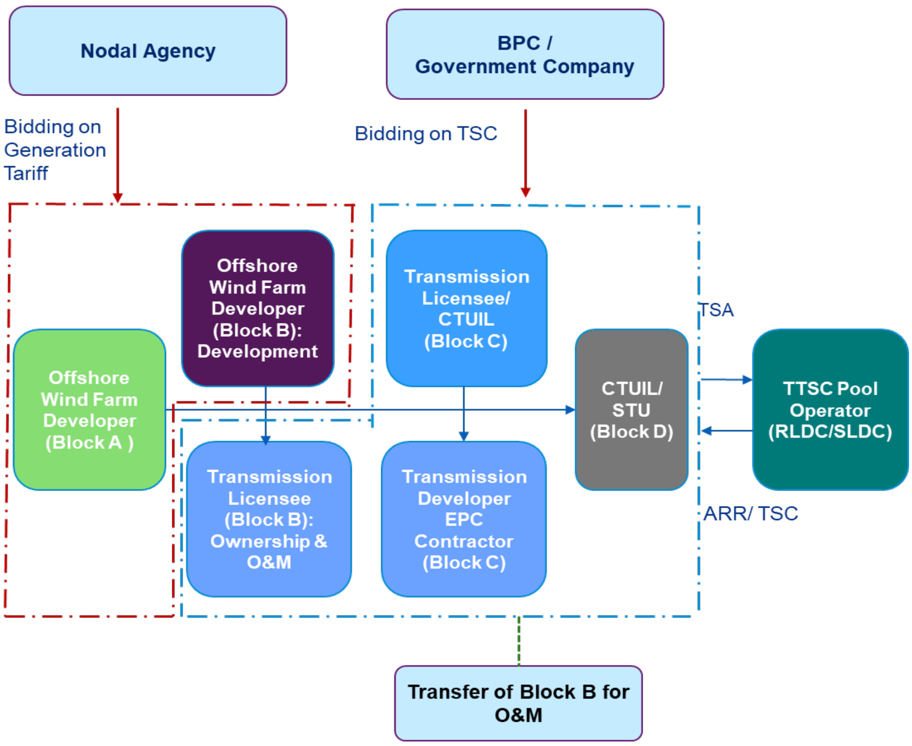


Figure 8: Schematic of Contractual arrangement under Model Option 4

Particulars	Contractual arrangement and Implementation aspects under Model *Option*-4 *[Hybrid Option]*
Salient Features	• There will be higher cost optimisation opportunities would be available through innovations in the OSW components by the developer, given their expertise in the OSW ecosystem. • CTU/TSL shall be responsible for ownership and O&M of Block B, C and D. • The Grid Interconnection point will be on the at LV side of the OSW PSS (Block B) at which energy accounting, DSM settlement, and F&S would occur during the O&M phase.
Governing Framework	• The developer would be responsible for the development, construction, and commissioning of the OSW farm along with the dedicated transmission lines which include the inter-array cables and OSW PSS in Block A and B respectively, under Section 10 of the EA 2003. Further, the OSW PSS would be transferred to the TSL for O&M. • The TSL would be responsible for the development, construction, commissioning, and O&M of the OSW PSS, subsea export cable, and the onshore PSS under Section 40 of the EA 2003. Also, TSL would be responsible for O&M of the OSW PSS as transferred by the developer after commissioning.
Transmission Infrastructure cost recovery	• Generation Tariff is determined under Section 62/63 of the EA 2003, which would include the cost of the OSW farm and the inter-array cables under Block A. The Generation tariff is recovered through PPA with the consumers such as DISCOMs. • Transmission Tariff is determined under Section 62/63 of the EA 2003, which would include OSW PSS, subsea export cable, and the onshore PSS under Block B, C, and D. Further, the YTC are to be recovered through the TTSC pool as per CERC's Transmission Sharing of Charges/Losses Regulations and its amendment thereof.
Risk assessment	• The potential for the socialisation of OSW Evacuation cost is high, given that Blocks, B, C, and D are under the TSL scope after the commissioning of the project. • Design responsibility and supply chain control for the developer are high because Block A and B would be developed and constructed by the developer, which could encourage competition and innovation. However, the developer's use of different designs may limit assets standardisation in the mature market further reducing the O&M flexibility. • Development and coordination risk is moderate because the developers have greater experience with the logistics of managing an offshore construction campaign. Further, the TSL would also be enough expertise to coordinate construction schedules with other onshore assets for efficiency opportunities and can minimise the

	developer's overall risk with suitable compensatory mechanisms in case of delays. However, the use of different designs may increase the OPEX for TSL and also, makes it difficult to coordinate services and curtailment at the system level. • Financing Risk is moderate because it minimises OPEX costs for developers by transferring the OSW PSS to the TSL upon commissioning. However, the transaction costs would be included in the CAPEX for the developer because the developer sells the OSW PSS to a third party/ TSL. • Risk for managing approvals and compliances is high, because the effort and cost of obtaining approvals and complying with regulations could be high if the development of transmission system is not among the core businesses of the developer. However, in the mature market, TSL possesses the expertise in managing grid compliances. • Delay risk in matching CoD is moderate because the developer is responsible for the OSW and the OSW PSS. However, if the TSL receives the final engineering designs of these at a late stage, then only at this point can the TSL plan properly for its assets which could lead to severe delays. Further, there is a risk for developers if TSL does not deploy subsea export cable promptly, which is unlikely to happen in the matured OSW market.
Suitability in India	The projects where there is a need for innovation, such as HVDC connections or if it involves working in the deep sea, then Model option 4 can facilitate the integration of technological innovations that would minimise the overall CAPEX of the OSW project. Simultaneously, the developers would be relieved from the OPEX of the transmission infrastructure to reduce the financial risk to the developer for such critical projects. Model option 4 however being different from Model option 3 in terms of contractual arrangements, is not suitable for Indian context at present.


company and subdivisions
d prognosis of activity
200
280
400
410
360
470
600
619
440
526
apr.
may
june
july
aug.
sep.
nov.
dec.
jan.
feb.
2014
2015
2016
2017
2018
2019

6. Key Takeaways and Recommendations

Given the prevalent statutory, policy, and regulatory framework in India and the principles sets for the OSW evacuation, there is a requirement to evaluate multiple transmission business model options according to the OSW market size, maturity, technical competence, and opportunities for socialisation of transmission system cost. This can fairly and equitably allocate the risks and cost associated with the OSW project with the stakeholders and facilitate selection of suitable business model option in the Indian context.

This report enumerates four (4) transmission business model options are proposed for the OSW development in India along with the analysis of their contractual arrangements and implementation aspects. The summary of the potential risk and the suitability of each of the transmission business options in the Indian context is provided in the table below:

Table 5: Summary of the potential risk analysis under the proposed Transmission Business Model Options

Parameters	Model Option 1 [Developer driven]	Model Option 2 [Developer + TSL driven option]	Model Option 3 [TSL driven]	Model Option 4 [Hybrid option]
Potential for the socialisation of OSW Evacuation cost	Limited Potential	Average Potential	Very High Potential	Significant Potential
Design responsibility and Supply chain control for the developer	Complete control over Supply Chain with entire design responsibility	Average control over Supply Chain with partial design responsibility	Least control over Supply Chain with design guided by TSL requirement	Significant control over Supply Chain with higher design responsibility
Development and coordination Risk	Low	Moderate	High	Moderate
Financing Requirement	Significant	Medium	Low	Medium
Risk for managing approvals & compliances	Very High	Moderate	Moderate	High
Delay Risk in matching Commissioning	Low	Moderate	High	Moderate

Parameters	Model Option 1 [Developer driven]	Model Option 2 [Developer + TSL driven option]	Model Option 3 [TSL driven]	Model Option 4 [Hybrid option]
Suitability in the Indian Context	Suitable in the nascent markets with a very low OSW capacity addition or OSW projects near shore to be utilised for captive consumption.	Suitable in the market, which is nascent, however, is capable of high-volume capacity addition. This model offers subsea export cable cost socialization.	Suitable for the market capable of high-volume capacity addition, like with some of the successful project installations. This model offers maximum opportunity for the socialization of transmission system cost.	Suitable in the very mature market with several OSW installations and for projects far from the shore and with established contractual arrangements.
International equivalent	This model is also being planned in nascent markets such as Japan and the US	Equivalent to multi-connection HVDC wind farms in Germany	Equivalent to multi-connection HVAC wind farms across Europe	Similar to the UK except in the UK the offshore SS and export cable are sold to a third-party following developer construction

Selection of a specific transmission business model option can have implications for cost, technology selection, operation efficiency, environmental impact, and timelines. Hence, an appropriate business model option for transmission evacuation is to be selected to meet specific requirements of the stakeholder at the project design/inception stage itself.

This report provides much-needed guidance to stakeholders to select an appropriate business model option as below:

- If the socialisation of the capital cost for the transmission infrastructure is a priority for the government, then Business Model option 3 is preferred.
- If technology selection is a priority, then Business Model option 1, 2 and 4 is to be selected as it provides higher supply chain control to the OSW developers who can be quick to implement innovation in the transmission system to reduce the LCoE.
- If operation efficiency is a priority, then the Business Model option 4 is preferred considering opportunities to reduce the operational risk.
- If environmental impact minimisation is a priority for the government, then Business Model option 3 is to be selected as this option provides an inter-connected approach with shared assets among the multiple OSW developers which can limit environmental footprint, unlike the case of point-to-point connections under Business Model option 1.
- If reduction of risk of the delay in completion of the transmission infrastructure is a priority for the government, then Business Model option 1 is to be chosen because under this option a single entity and fewer interfaces between various stakeholders. Also, the developers have greater experience with the logistics of managing the construction of offshore projects which would reduce the risk of construction delays.

For Indian condition, with the stakeholders already having experienced privatization in development of onshore transmission system under IPT 1 & IPT 2 models, following is recommended:

- The most suitable model is Business Model option 3 both in case of long distance and short distance as this model offers the clear advantage of a centralized, coordinated approach for the development of offshore PSS, be it an AC substation or HVDC station in case of long distance. There are adequate regulations and policy frameworks for planning the pooling stations and common transmission system as part of the ISTS system. With the coordinated approach, the most optimal technology, phase-wise development keeping in view the long-term perspective of development can be adopted for a market like India having a very high potential for OSW capacity addition.

  This Business Model option 3 ensures the effort to cover the maximum of the transmission system parts B, C, and D for the socialization of cost, as against the Business Model option 1, where it will be difficult to socialize it as there is no mechanism to ensure the competitiveness of the price.

- The Business Model option 2 is suggested for adoption in the situation where the market is nascent for lack of installations.
  This option fits in the current Indian context, wherein the stakeholders need a certain learning opportunity to gain expertise in terms of technology, supply chain maturity, and skill set creation. Therefore, Business Model option 2 is suggested for the first set of projects in India. This will provide an opportunity to experience the nuances of project installations while considering the most balanced distribution of risks to stakeholders.

- Business Model option 1 is not suggested for the Indian context considering the volume of capacity addition expected in the country. This will also avoid decentralized planning by each OSW developer and difficulties in operation in the sea. However, this option can be used for some of the pilot projects or the captive generation near-shore projects.

- Business Model option 4 is not suggested for the Indian context at present considering the complexities in the operationalization of the model and market maturity.

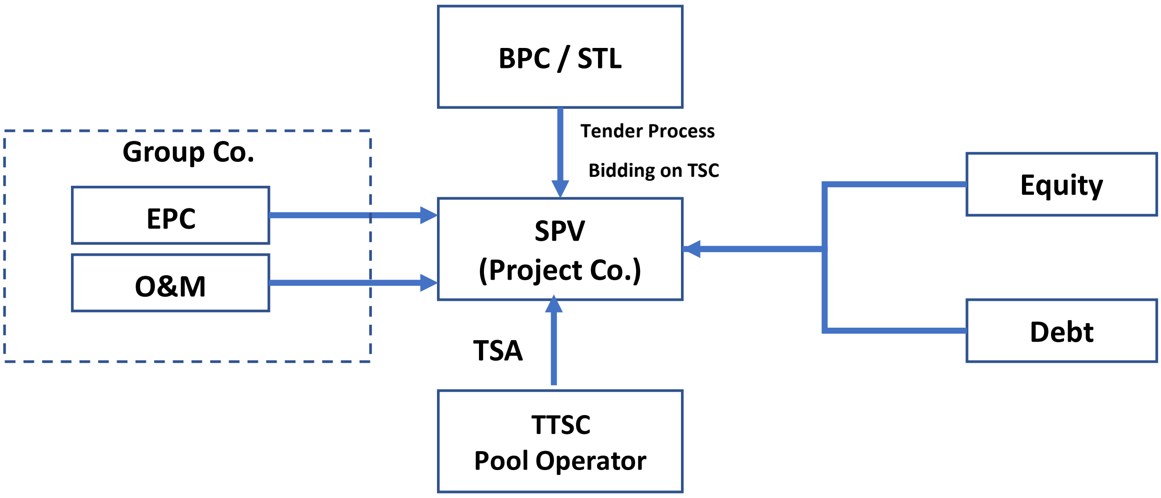
This report is an integral part of the model evacuation framework for OSW – Planning and Integration for Gujarat and Tamil Nadu state which provides a qualitative comparison of the key planning aspects of three various alternatives/combinations proposed for the planning of grid evacuation infrastructure for proposed OSW plant in Gujarat and Tamil Nadu.

The suggested alternatives were also deliberated with key stakeholders during a workshop on 22 November 2022 held in Chennai, India under this ASPIRE program. This report covers the viewpoints received during the workshop.

Annexures

Annexure 1: Details of IPT Models

1. IPT Model-1 (BOOT-TBCB)

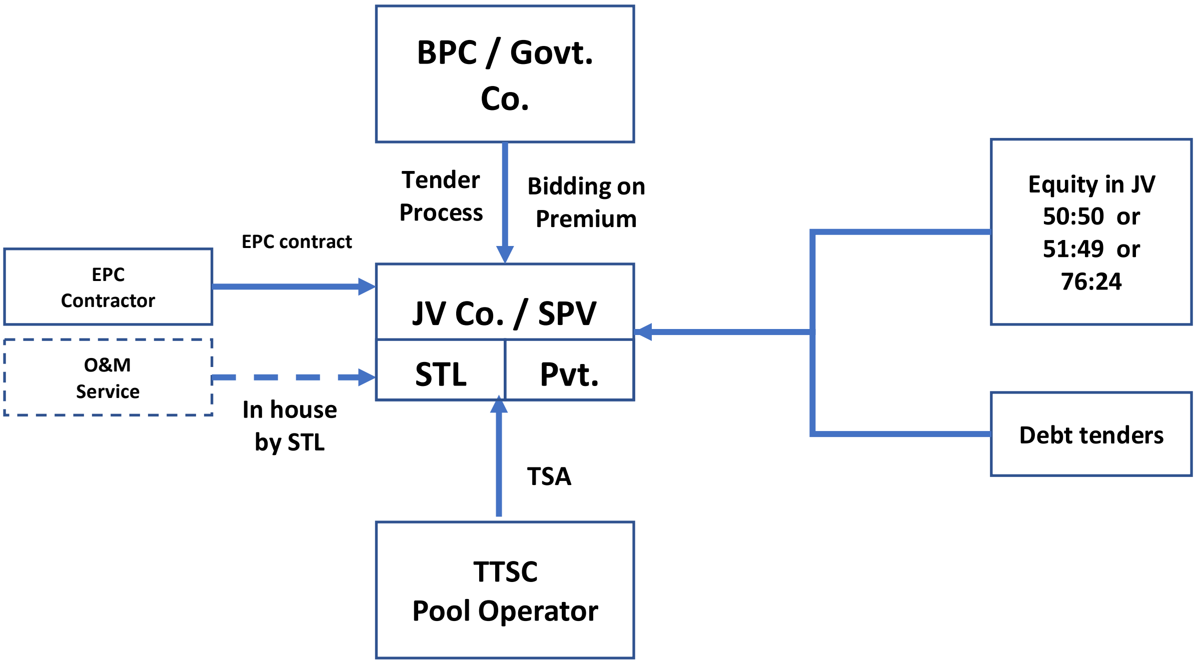


Key Features of proposed IPT Model-1 (BOOT/SPV through TBCB):

Important parameters	Model Description (Build-Own-Operate-Transfer)
Key objective	• Cost of development of transmission scheme to be competitively discovered by way of lowest transmission service charge /transmission tariff. • Funding to be brought in by Private sector players
Salient features	• Bid Process Coordinator could be Central Transmission Licensee/State Transmission Licensee or a nominated Government Company • BPC could form a SPV/Project company which can be transferred to a successful bidder or private sector player. • Successful bidder to arrange finances for transmission project through own equity & debt through a lender. • SPV/Project Company would decide on award/selection of EPC contractor & O&M contractor, • SPV to approach SERC/CERC for grant of transmission licensee & for the adoption of Transmission Tariff/Transmission service charge. • SPV to recover its costs by way of Transmission service charge (TSC).

	• Important contractual agreements include – Concession/Implementation Agreement, Transmission service agreement.
Governing framework for model	• Governing framework for IPT Model-1 shall be Competitive Bidding Guidelines for transmission notified by the Central Government along with Standard Bidding Documents, relevant Regulations for granting of transmission licence, and sharing of transmission charges/losses.
Relevance of Model for application in cases	• Model suitable for all Inter-State transmission Projects and for those intra-State Projects above the threshold level (where the threshold level is prescribed by SERC)
Contractual framework documents	• Transmission Service Agreement • Concession or Implementation Agreement
Relevant Examples	Several TBCB projects can be referred to the Ministry of Power, Govt of Indian portal: Tarang). Some of the successful examples include Jabalpur Transmission Company Ltd. by Sterlite, Vikhroli Transmission Pvt Ltd (KVTPL) by Adani Transmission Limited

2. IPT Model-2 (BOOM-JV or BOOT-JV)

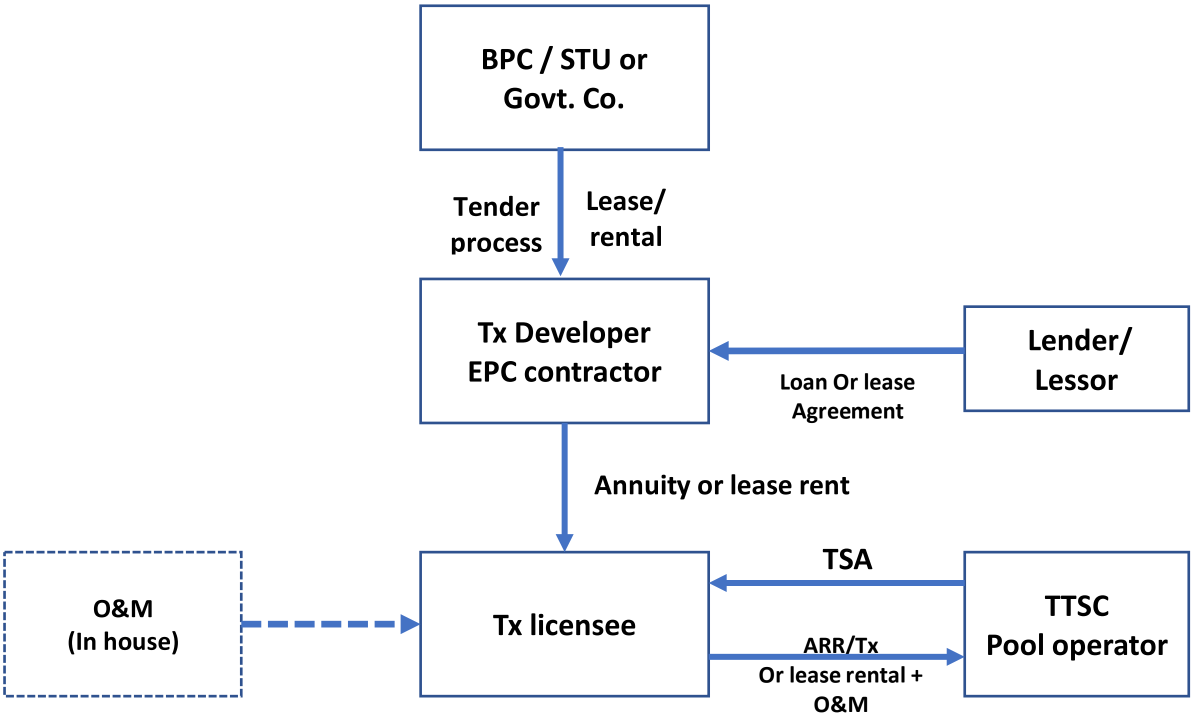


Key Features of proposed IPT Model-2 (BOOM/BOOT through JV):

Important parameters	Model Description (Build-Own-Operate-Maintain)
Key objective	• To maximise premium/revenue for the Government / Govt. Company for selecting JV partner • Alternately, the model can be structured to minimise VGF requirement for a given transmission tariff stream • Funding (in whole or part) to be brought in by Private sector players
Salient features	• Bid Process Coordinator could be Central Transmission Licensee/State Transmission Licensee or a nominated Government Company • BPC could form a JV company with a successful bidder. Part of the investment is to be brought by a private investor and part by STL/CTL at 50:50 or 51:49 or 74:26 • JV Agreement/Shareholder Agreement to prescribe role/ responsibility for the successful bidder to arrange/mobilise finances for transmission project through debt through lender and equity to be funded in a pre-agreed proportion. • There could be a structured exit or rule for change in inter-se shareholding patterns between JV partners. • Selection Criteria: A bidder who seeks the lowest grant/VGF or offers the highest premium, as the case may be, would be selected as a successful bidder. • Govt. Company or STU/CTUIL could avail clearances/permits/ RoW for the JV Co and claim a premium for its efforts or preparatory activities or its sweat equity. • Alternately, VGF or Grant based bidding can be structured as selection criteria, if Govt. is willing to consider grant/VGF for special transmission project schemes. • Transmission Tariff: Revenue stream or transmission tariff to be pre-approved by SERC/CERC (on cost plus basis) before bidding. • JV Company would decide on the award/selection of the EPC contractor and O&M contractor (if required). It is envisaged that JV Co. would prefer to undertake O&M in-

Important parameters	Model Description (Build-Own-Operate-Maintain)
	house considering the capabilities of JV partners (incl. State Tx Licensee as one of the JV partners) • JV Co. to approach SERC/CERC for grant of transmission licensee & for determination of Transmission Tariff/Transmission service charge. • JV Co. to recover its costs by way of a pre-determined Transmission Tariff (revenue stream) or Regulated Tariff (cost plus approach) • Important contractual agreements include – Concession/Implementation Agreement, Transmission service agreement
Governing framework for model	• Governing framework for IPT Model-2 shall be Amended Competitive Bidding Guidelines for transmission to be notified by Central Government along with Model JV Agreements to enable such a model. • Relevant Regulations for grant of transmission licence, sharing of transmission charges/losses (POC mechanism), and Amendment to MYT Regulations for determining Project Specific revenue stream under cost plus regime (with lower RoE/ composite RoCE).
Relevance of Model for application in cases	• Model suitable for Special Tx project schemes such as HVDC, 765 kV, National Tx scheme, Inter-regional corridor schemes, etc., and Special Tx Project schemes at the intra-State level)
Contractual framework documents	• Transmission Service Agreement • Model JV Agreement
Relevant Examples	• Jaigad Power Transmission Ltd (JV between M/s. JSW and Maharashtra State Electricity Transmission Company Ltd., Powerlink (JV between Tata Power & Power Grid Corporation of India Ltd.), PrKTCL (JV between Indigrid & Power Grid Corporation of India Ltd.) for evacuation of power from Parbati -Koldam hydro projects, Torrent Power Grid Limited, a Joint venture with Power Grid Corporation of India Ltd. and Torrent.

3. IPT Model-3 (DBFT, EPC + Financing)



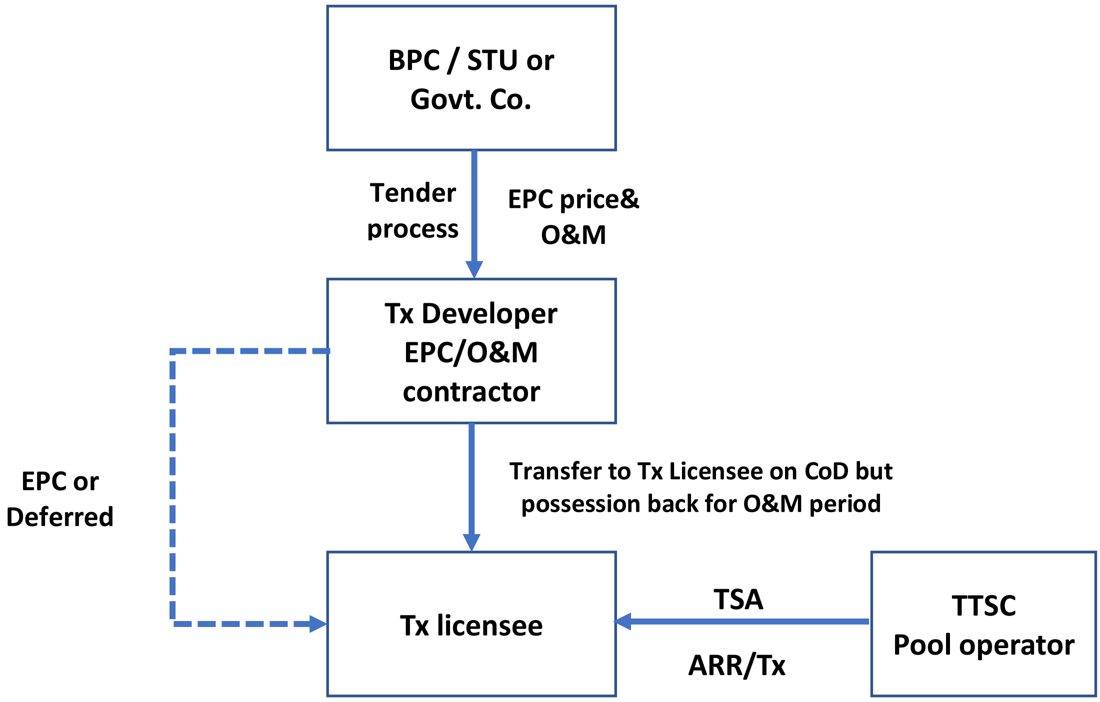
<u>Key Features of proposed IPT Model-3 (DBFT – EPC & Financing):</u>

Important parameters	Model Description (Design-Build-Finance-Transfer)
Key objective	• To minimise Annualised Financing Cost of the transmission project scheme • To encourage the Transmission Developer/Financier model • To access Long Term Funding and encourage Innovative financing options by Private sector players
Salient features	• Bid Process Coordinator could be Central Transmission Licensee/State Transmission Licensee or a nominated Government Company • BPC could invite bids for Annuity/Rental based TSC charges from Tx Developers / EPC contractors on a long-term basis • Model could encourage EPC contractors, and Tx Developers to participate in Transmission bids, who otherwise are not interested to own or engage in the Transmission Licence business. • It could also encourage innovative structures of funding/lending/leasing and tie-up /access to

Important parameters	Model Description (Design-Build-Finance-Transfer)
	long-term loan sources, deferred capital expenditure/long-term suppliers credit scheme, Insurance/Pension funds, etc. • Transmission Asset would get transferred to the incumbent Transmission Licensee or State Transmission Licensee upon commissioning and CTL/STL would be responsible for operations & maintenance of the Tx scheme. • **Selection Criteria**: A bidder who quotes the lowest Annuity/Lease Rentals for Transmission Scheme would be selected as a successful bidder. • **Transmission Tariff**: Revenue stream or transmission tariff for Tx licensee could comprise two components viz. (a) Annuity/Rental discovered through the bidding process and (b) O&M component at a regulated rate as per O&M norms under MYT Regulations • Tx Licensee (CTUIL/STU) to approach CERC/SERC for determination of Transmission Tariff comprising adoption of Annuity/Tx Rental plus the determination of Transmission O&M charge • Important contractual agreements include – Transmission Development and Financing agreement
Governing framework for model	• Governing framework for IPT Model-3 shall be Amended with Competitive Bidding Guidelines for transmission to be notified by Central Government along with Model Transmission Development & Financing Agreements to enable such a model. • Relevant Regulations for sharing of transmission charges/losses (POC mechanism) and Amendment to MYT Regulations for the adoption of Annuity/Tx Rental and determining Tx O&M charge.
Relevance of Model for application in cases	• Such models could be deployed for Transmission Evacuation Schemes for Renewable Energy Projects or Evacuation of Conventional power or Dedicated Transmission Schemes forming part of Green Energy Corridors • This model could also be considered for Tx project schemes that are of strategic importance or nature, wherein CTL/STL need to continue as Tx licensee but innovations of funding and technological interventions thru Pvt sector EPC players need to be harnessed.

Important parameters	Model Description (Design-Build-Finance-Transfer)
Contractual framework documents	• Transmission Development & Financing Agreement
Relevant Examples	• Not implemented in India, however, has applicability for RE Evacuation, Green Energy corridors, Schemes of Strategic importance, etc.

4. IPT Model-4 (DBO, EPC + O&M)



<u>Key Features of proposed IPT Model-4 (DBO – EPC + O&M):</u>

Important parameters	Model Description (Design-Build-Operate)
Key objective	• To minimise EPC cost and O&M cost over useful life for the transmission project scheme • To encourage Transmission Developer/Operator or Tx Franchisee model
Salient features	• Bid Process Coordinator could be Central Transmission Licensee/State Transmission Licensee or a nominated Government Company • BPC could invite bids for composite bids for EPC cost and O&M charges from Tx Developers / EPC contractors for the useful life of Tx Asset/scheme

Important parameters	Model Description (Design-Build-Operate)
	• Model could encourage EPC contractors, Tx Developers to participate in Transmission bids, who otherwise are not interested to own but operating in association with OEMs. • It could also encourage to optimise the long term cost of acquisition for the Tx Licensee and ensure the reliability of supplies and spares availability and performance of Tx assets. • Transmission Asset would get transferred to the incumbent Transmission Licensee or State Transmission Licensee upon commissioning and the possession would be handed over to Tx Developer/successful bidder for operations & maintenance of the Tx scheme. • Selection Criteria: The bidder who quotes the lowest composite EPC cost and O&M cost for the Transmission Asset/scheme would be selected as the successful bidder. • Transmission Tariff: Revenue stream or transmission tariff for Tx licensee could comprise two components viz. (a) Regulated Capacity Charge as per Financing Norms under MYT Regulations based on discovered EPC cost + normative Financing cost and (b) discovered O&M charge component • Tx Licensee (CTL/STL) to approach CERC/SERC for determination of Transmission Tariff comprising adoption of O&M charge plus the determination of Transmission Capacity Charge based on discovered EPC cost and normative financing cost • Important contractual agreements include – Transmission Development and O&M agreement
Governing framework for model	• Governing framework for IPT Model-4 shall be Amended Competitive Bidding Guidelines for transmission to be notified by Central Government along with Model Transmission Development and O&M Agreements to enable such a model. • Relevant Regulations for sharing of transmission charges/losses (POC mechanism) and Amendment to MYT Regulations for the adoption of Tx O&M charge and determining Tx capacity charge based on discovered EPC.
Relevance of Model for application in cases	• Such models could be deployed for Intra-State Transmission Schemes (such as Tx scheme for augmentation or Tx schemes below a stipulated threshold value)
Contractual framework documents	• Transmission Development and O&M Agreement
Relevant Examples	• Not implemented in India, however, has applicability for Intra-State Transmission Schemes (such as schemes for augmentation or below a stipulated threshold value)

Bibliography

[1] CEA, "Report on Optimal Generation Capacity Mix for Government of India Ministry of Power Central Electricity Authority," 2020.

[2] CEA, "All India Installed Capacity (in MW) of Power Stations," Nov. 2022. https://cea.nic.in/wp-content/uploads/installed/2022/11/IC_Nov_2022.pdf (accessed Dec. 23, 2022).

[3] MNRE, "Offshore Wind | Ministry of New and Renewable Energy, Government of India." https://mnre.gov.in/wind/offshore-wind/ (accessed Jan. 22, 2023).

[4] PIB, "Offshore Wind Energy in India." https://pib.gov.in/PressReleasePage.aspx?PRID=1832708 (accessed Jan. 22, 2023).

[5] CEA, "NATIONAL ELECTRICITY PLAN (Draft) Generation Vol. I." https://cea.nic.in/wp-content/uploads/irp/2022/09/DRAFT_NATIONAL_ELECTRICITY_PLAN_9_SEP_2022_2-1.pdf (accessed Jan. 22, 2023).

[6] F. Z. Joyce Lee, B. B. Alastair Dutton, W. L. Liming Qiao, A. L. Emerson Clarke, M. S. Martand Shardul, and T. W. H. Younger, "GLOBAL OFFSHORE WIND REPORT 2021", Accessed: Dec. 23, 2022. [Online]. Available: https://gwec.net/wp-content/uploads/2021/09/GWEC-offshore-wind-2021-updated-1.pdf

[7] Navigant Netherlands B.V., "Connecting Offshore Wind Farms A Comparison of Offshore Electricity Grid Development Models in Northwest Europe ," 2019. Accessed: Dec. 23, 2022. [Online]. Available: https://guidehouse.com/-/media/www/site/downloads/energy/2019/2019-navigant-comparison-offshore-grid-development.pdf

[8] "Wind power ." https://www.windpowermonthly.com/article/1152087/consumers-may-pay-cable-delays (accessed Dec. 23, 2022).

[9] Dr Christian Knütel, "Offshore Wind Worldwide Regulatory Framework in Selected Countries." Accessed: Dec. 23, 2022. [Online]. Available: https://www.hoganlovells.com/~/media/germany_folder-for-german-team/artikel/2020_offshorewindworldwide.pdf

[10] The Crown Estate and the Offshore Renewable Energy Catapult, "Guide to an offshore wind farm," 2019. Accessed: Dec. 23, 2022. [Online]. Available: https://www.thecrownestate.co.uk/media/2860/guide-to-offshore-wind-farm-2019.pdf

[11] DEA, "OFFSHORE WIND DEVELOPMENT." Accessed: Dec. 23, 2022. [Online]. Available: https://ens.dk/sites/ens.dk/files/Vindenergi/offshore_wind_development_final_june_2022.pdf

[12] CERC, "Draft Indian Electricity Grid Code 2022." https://cercind.gov.in/2022/draft_reg/Draft-IEGC-07062022.pdf (accessed Dec. 23, 2022).

[13] J. Forman, S. Hetebrügge, and K. Hansen, “FIMOI Version2: Cost estimates for the first offshore wind farms in India,” 2022. Accessed: Dec. 23, 2022. [Online]. Available: https://coe-osw.org/wp-content/uploads/2022/04/FIMOI-final2.pdf

[14] DEA and COWI, “FIMOI Version 2: Cost estimates for the first offshore wind farms in India,” 2022. https://coe-osw.org/the-fimoi-report/

[15] Screener.in, “Power Grid Corporation of India Ltd financial results and price chart.” https://www.screener.in/company/POWERGRID/consolidated/#balance-sheet (accessed Jan. 22, 2023).

[16] POSOCO, “NOTIFICATION OF TRANSMISSION CHARGES PAYABLE BY DICS FOR THE BILLING MONTH OF MAY’22.”

[17] CEA, “Transmission System for Integration of over 500 GW RE Capacity by 2030,” 2022.

[18] CERC, “ Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019.” https://cercind.gov.in/2019/regulation/Tariff Regulations-2019.pdf (accessed Jan. 22, 2023).

For more information please contact:

Nishant Singh
Senior Advisor
Foreign, Commonwealth and Development Office (FCDO)
Nishant.Singh@fcdo.gov.uk

Vikas Gaba
Partner and National Lead Power & Utilities
KPMG India
vikasgaba@kpmg.com

Abhishek Shah
Director
KPMG India
abhishekshah@kpmg.com

Mr. Ajit Pandit
Founding Director & CEO
Idam Infrastructure Advisory Pvt. Ltd.
ajit.pandit@idaminfra.com

This report has been prepared by KPMG India and Idam Infrastructure Private Limited, under the Accelerating Smart Power and Renewable Energy (ASPIRE) programme being implemented by Foreign Commonwealth and Development Office (FCDO), Government of UK in association with the Ministry of Power and Ministry of New and Renewable Energy, Government of India. KPMG is the lead implementing partner of ASPIRE programme.