

Capital Expenditures (CapEX)

All installed costs incurred prior to commercial operations date (COD). CAPEX components include marine energy converters, balance of systems and financing costs.

CapEX Classification:

1. **Marine Energy Converter (MEC):** Converts kinetic energy from water into three phase alternating current (AC) electrical energy.
 - a. **Structural Assembly:** Primary energy capture and supporting structural components.
 - i. **Prime Mover:** Primary energy capture.
 1. Primary Structural Assembly
 2. Buoyancy Chambers
 3. External Ballast Chambers
 4. Active Structure
 - a. Drive Mechanisms
 - b. Hydrodynamic Bodies
 - ii. **Additional Structural Components:** Any additional supporting structural components not included in the Structure category.
 - iii. **Marine Systems:** Ancillary systems on the marine energy converter (MEC) device.
 1. **Personnel Access System (Device Access):** Additional components on marine energy converter (MEC) device to support personnel access.
 2. **Ballast System:** Ballast to control draft/stability of floating systems, ballast can be fixed or variable (active or passive).
 3. **Navigation Lighting:** Navigation lighting placed on the structure of the marine energy converter (MEC).
 - iv. **Coatings:** Coatings to protect from corrosion in marine environment.
 - v. **Transportation of Structure:** Costs of transporting the marine energy converter (MEC) structure components from the manufacturing facility to the staging area.
 - b. **Power Takeoff Systems:** It is comprised of a drivetrain, a generator, short term storage and power electronics.
 - i. **Hydraulic Drivetrain:** Hydraulic system to transfer mechanical energy from marine energy converter to electrical energy.
 - ii. **Gearbox or Speed Increaser/Reducer:** Mechanical system used to increase or decrease the speed of the shaft work going into the generator. This may include mechanical motion rectifiers.
 - iii. **Turbine:** Any turbine that is used to convert kinetic energy in the air, due to wave oscillations, into shaft work.
 - iv. **Electrical Generator:** Any Generator that is used to convert rotational shaft work, or translational motion into electrical power.
 - v. **Short-Term Energy Storage:** Temporary storage of electrical energy.

- vi. **Power Electronics:** Electrical system used to transfer power, convert voltages or frequencies, as well as any active power controllers.
- vii. **Power Take-Off Enclosure:** Any enclosure used to house or isolate the Power Take-Off system.
- viii. **Coatings:** Coatings to protect from corrosion in marine environment.
- ix. **Transportation of Power Conversion Chain:** Costs of transporting the marine energy converter (MEC) power conversion chain (PCC) components from the manufacturing facility to the staging area.
- c. **Mooring Foundation, and Substructures:** All elements of the marine energy converter mooring system and/or foundation.
 - i. **Mooring Lines:** Chain, wire, or synthetic fiber ropes to connect marine energy converter with anchors on the seabed.
 - ii. **Anchors and Piles:** Anchors and Piles installed on the seabed to either maintain station keeping or to react against the seabed. This can include gravity-based anchor systems.
 - iii. **Connecting Hardware:** Connectors required to attach the mooring lines to anchors and marine energy converter.
 - iv. **Sub-Foundation or Bedding:** Layers of gravel and stone to provide a stable and level surface on which to place anchors.
 - v. **Messenger Lines and Buoys:** Ancillary equipment used during the installation of the mooring system.
 - vi. **Scour Protection:** Rock fill or concrete mattresses to protect substructures from scouring (caused by currents or waves).
 - vii. **Outfitting structure (steel or other):** Additional non-structural elements attached to substructure elements.
 - viii. **Ancillary Marine Systems:** Ancillary systems required for marine operations.
 - ix. **Integration, Assembly, Testing, and Checkout:** Activities performed by manufacturer to integrate, assemble, test, and checkout for the mooring and foundation system before delivery to customer. Does not include commissioning activities.
 - x. **Transportation:** Costs of transporting the mooring system components from the manufacturing facility to the staging area.

2. Balance of System (BOS)

- a. **Development:** All activities from project inception to financial close, where financial close is the date when project and financing agreements have been signed and all the required conditions have been met.
 - i. **Site Selection (Siting and scoping):** Initial desktop-level studies to select project location, develop a conceptual design, identify regulatory requirements, and create preliminary business case.
 - ii. **Permitting and Leasing:** Acquisition of permits and leases required for site assessment, construction, and operation at the project site.
 - iii. **Advisory Services:** Legal support, external consultants, accounting, etc., during development.

- iv. **Engineering:** Engineering studies to specify the design of the project (e.g., technology, layout) and understand economics and risks associated with the design.
 - v. **Site Characterization:** Equipment, material and labor costs required for collecting / analysis of wind resource, ocean conditions, and geological data at project site. Defines parameters for engineering assessments as data becomes available.
 - vi. **Interconnection and Power Marketing:** Activities to gain access to the transmission grid and negotiate contracts to sell or otherwise market power.
 - vii. **Project Management During Development:** Project Management from the start of the development phase through financial close.
 - viii. **Financing and Incentives:** Fees, closing costs, and staff and consultant efforts to arrange and secure equity, debt financing, and government incentives.
- b. **Engineering and Management:** Engineering and management activities from financial close through commercial operation date (COD).
- i. **Detailed Design and Construction Engineering:** Detailed design and construction engineering costs.
 - ii. **Procurement Management:** Bid management, purchasing, negotiations, contract management.
 - iii. **Construction Management:** Quality control and assurance.
 - iv. **Project Certification:** Review by a 3rd party independent verification agent to assure that project follows design basis as well as technical standards and regulatory requirements. Results in project certificate.
 - v. **Health, Safety, and Environmental Monitoring:** Coordination and monitoring to ensure compliance with health, safety, and environmental monitoring requirements during construction.
- c. **Electrical Infrastructure:** All electrical infrastructure to collect power from generators and deliver to the grid.
- i. **Array Cable System:** Collects power generated by the marine energy converter(s) and transports to the offshore substation(s).
 - ii. **Export Cable Systems:** Export cables and associated infrastructure to connect marine energy converter(s) or offshore substation(s) with onshore electric infrastructure or offshore converter station(s) if using direct current (DC).
 - iii. **Cable Protection:** Equipment and materials used to protect cable from damage (strikes, over-bending, etc.)
 - iv. **Offshore Substation(s):** Electric conversion equipment required to step-up or convert power for export to the onshore grid and support structure, also onboard work platforms, accommodation, equipment storage, helicopter access, etc.
 - v. **Onshore Transmission Infrastructure:** Any onshore transmission or conversion equipment required to connect project to onshore grid.
- d. **Plant Commissioning:** Cost incurred by owner or prime contractor to test and commission the integrated power plant.

- e. **Site Access, Port and Staging:** Activities and physical aspects of a staging port. Elements needed to support the delivery, storage, handling, and deployment of marine energy converter (MEC) components.
 - i. **Staging Port:** Port facilities or space leased to support the installation of the project.
 - ii. **Cranage:** Cranage fees to use and operate crawler cranes, tower cranes, harbor cranes, self-propelled modular transporters (SPMTs) used for land-based assembly of components and load out onto installation vessels.
 - iii. **Port Improvements:** Any improvement to existing port infrastructure paid for by project owner (e.g., quayside reinforcement).
 - iv. **Port Fees:** Fees for vessel access, docking and loading/unloading.
- f. **Assembly and Installation:** Assembly and installation activities conducted at the staging port and at the project site. Assume financial costs related to warranties, contractor insurance, Selling, General and Administrative (SG and A), profit margin, etc., are loaded in day rates for vessels, labor, and equipment.
 - i. **Substructures and Foundations:** Vessel, labor, and equipment costs to complete installation of foundations and substructures.
 - ii. **Marine Energy Converter Device:** Vessel, labor, and equipment costs to complete marine energy converter installation procedures for the entire project.
 - iii. **Offshore Electrical Infrastructure:** Vessel, labor, and equipment costs to install electrical infrastructure.
 - iv. **Offshore Logistical Infrastructure:** Labor and Equipment cost to install offshore logistical infrastructure.
- g. **Other Infrastructure:** Other capital investments made by the project company prior to commercial operation date (COD).
 - i. **Offshore Accommodations:** Hotel Vessels or permanent platform(s) at the project site to house project personnel during operations.
 - ii. **Dedicated O and M Vessel(s):** New build vessels owned by the project company that will be used exclusively to support operations at project.
 - iii. **Onshore O and M Facilities:** Facilities on land, owned by the project company, to support the operation of the project.
 - iv. **O and M Equipment Purchases:** Other purchases necessary for the operation of the marine energy converter project after commercial operation date (COD). Examples include safety equipment (e.g., harnesses, floatation devices), equipment to store replacement parts (e.g., climate control for spare electric cables), vehicles to support operations (e.g., fork trucks).
 - v. **Offshore Logistical Infrastructure:** Systems to support marine coordination, weather forecasting, and met ocean data collection. May include marine management software, wave buoy, current meter.
 - vi. **Other Infrastructure Transportation:** Cost of transporting other infrastructure components from the manufacturing facility to the staging area.

3. Financial Costs

- a. **Project Contingency Budget:** Liquid financial instrument set up to respond to "known unknown" costs that arise during construction, does not include contingences set by manufactures and contractors as part of supply contract pricing.
- b. **Insurance During Construction:** Insurance policies held by owner during construction period, can include construction all risk, marine cargo, commercial general liability, workers compensation, environmental site liability, pollution liability, etc. Does not include insurance held by contractors.
- c. **Carrying Costs During Construction (Construction Financing Costs):** Carrying charges of expenditures on equipment and services incurred before commercial operation date (COD).
- d. **Reserve Accounts:** Payments (before commissioning) into reserve accounts. Generally required by either financiers or regulators.
 - i. **Maintenance Reserve Account:** Payments (before commissioning) into reserve accounts set up to cover major maintenance expenditures (MRAs), often required by debt service providers.
 - ii. **Debt Service Reserve Account:** Payments (before commissioning) into reserve accounts set up to cover debt service expenditures (DSRAs), often required by debt service providers.
 - iii. **Decommissioning Reserve Account:** Payments (before commissioning) into reserve accounts to fund project decommissioning obligations (e.g. security bonds).

Operating Expenses (OpEX)

Expenditures required to operate the project and maintain availability. These expenditures are generally annualized.

OpEX Classification:

- 1. **Operations:** Operations is defined as non-equipment costs of operations for the project.
 - a. **Environmental, Health and Safety Monitoring:** Coordination and monitoring to ensure compliance with health, safety, and environmental (HSE) requirements during construction.
 - i. **Health, Safety Monitoring:** Coordination and monitoring to ensure compliance with health and safety requirements during operations.
 - ii. **Environmental Monitoring:** Coordination and monitoring to ensure compliance with environmental requirement during operations. Includes post-construction survey activities.
 - b. **Annual Leases/Fees/Costs of Doing Business:** Ongoing payments after COD, including but not limited to: payments to regulatory body for permission to operate at project site (terms defined within lease); payments to Transmissions Systems Operators or Transmission Asset Owners for rights to transport generated power.
 - i. **Submerged land-lease:** Payments after COD to the state or federal regulatory authorities for rights to operate marine energy converter project on publicly owned seabed or lakebed.

- ii. **Land-lease:** Payments after COD to land owners for rights to operate transmission lines, onshore substation, or other facilities.
 - iii. **Transmission Charges/Rights:** Any payments to Transmissions Systems Operators or Transmission Asset Owners for rights to transport generated power.
 - iv. **Federal Energy Regulatory Commission (FERC) Fees:** Fees paid to FERC during operations.
- 2. **Insurance:** Insurance policies held by project company or operations manager during operational period.
- 3. **Operations, Management, and General Administration:** Activities necessary to forecast, dispatch, sell, and manage the production of power from the plant. Includes both on-site and off-site personnel salaries, software, and equipment to coordinate high voltage equipment, switching, port activities, marine activities, weather forecasting.
 - a. **Generation Planning and Integration:** Efforts to forecast, sell, and dispatch power generated by the facility.
 - b. **Operating Facilities:** Co-located offices, parts store and quayside facility, helicopter facilities, etc.
 - c. **Operating Equipment:** Lease payments for operating equipment held by the project to support operations (e.g., cranes, fork trucks).
 - d. **Sales, General, and Administrative:** Includes financial reporting, public relations, procurement, parts and stock management, Health, Safety, and Environment (HS and E) management, training, subcontracts and general administration. Includes financial reporting, public relations, procurement, parts and stock management, Health, Safety, and Environment (HS and E) management, training, subcontracts and general administration.
 - e. **Marine Energy Converter Power Consumption:** Charges for power drawn from the grid by the marine hydrokinetic project (e.g., marine energy converter, substation) during operation.
 - f. **Weather Forecasting:** Daily 96 hour forecast of met ocean conditions used to plan maintenance visits and project power production.
 - g. **Marine Management:** Coordination of port equipment, vessels, and personnel to carry out maintenance and inspections of generation and transmission equipment.
 - h. **Condition Monitoring:** Monitoring of SCADA data from marine energy converter components to optimize performance and identify component faults.
 - i. **Operating Margin:** Any margin earned by an independent operations management company.
 - j. **Professional Advisory Services:** Legal support, external consultants, accounting, etc., during operation.
- 4. **Maintenance:** Vessel, labor, and equipment costs of operations for the project.
 - a. **Long Term Service Agreement:** Annualized cost of a contract, generally between the owner and marine energy converter OEM or Third Party, to maintain the water power project at a guaranteed level of availability for a defined period, will likely replace scheduled and unscheduled maintenance categories below for duration of contract.

- b. **Scheduled Maintenance:** Planned and routine activities to ensure that marine energy converters, substructures, and all related systems are operating correctly, at optimal efficiency, and to minimize unscheduled breakdowns/downtime, includes cost of vessels, labor, equipment, spare parts and consumables. Sometimes referred to as preventative maintenance.
 - i. **Marine Energy Converter Scheduled Maintenance:** Planned maintenance activities for marine energy converter systems.
 - ii. **Balance of System (BOS) Scheduled Maintenance:** Planned maintenance activities for balance of system.
- c. **Unscheduled Maintenance:** Interventions and other activities to respond to random failures. Costs include equipment and vessels, labor, replacement parts, and consumables. Also known as corrective maintenance.
 - i. **Marine Energy Converter Unscheduled Maintenance:** Unplanned maintenance activities for marine energy converter systems.
 - ii. **Balance of System (BOS) Unscheduled Maintenance:** Unplanned maintenance activities for balance of system.
 - iii. **Unscheduled Maintenance Contingency:** Liquid financial instrument set up to respond to "known unknown" costs that arise during maintenance.

References:

1. MHK CBS 2019, OpenEI, <https://openei.org/datasets/dataset/72859dbb-cbbf-4ef2-9771-d077d3b52de5/resource/061b81dc-5dc0-4366-a11c-0096d9ab6b9d/download/meccbsoct2019.xlsx>