MHK SAM User Guide

The marine hydrokinetic (MHK) system advisory model (SAM) tool calculates the levelized cost of energy (LCOE) for MHK devices. This tool uses a wave/tidal resource matrix, a device power matrix, and cost breakdown structure (CBS) to calculate LCOE using NREL's Annual Technology Baseline methodology. This user guide lists the steps to use the MHK SAM tool.

1. Open the MHK SAM Macro

- Click 'Start a new project,'→ 'Generic system' → 'LCOE calculator (FCR method)'
- In the bottom left corner, click 'Macros'
- Click 'MHK Draft'

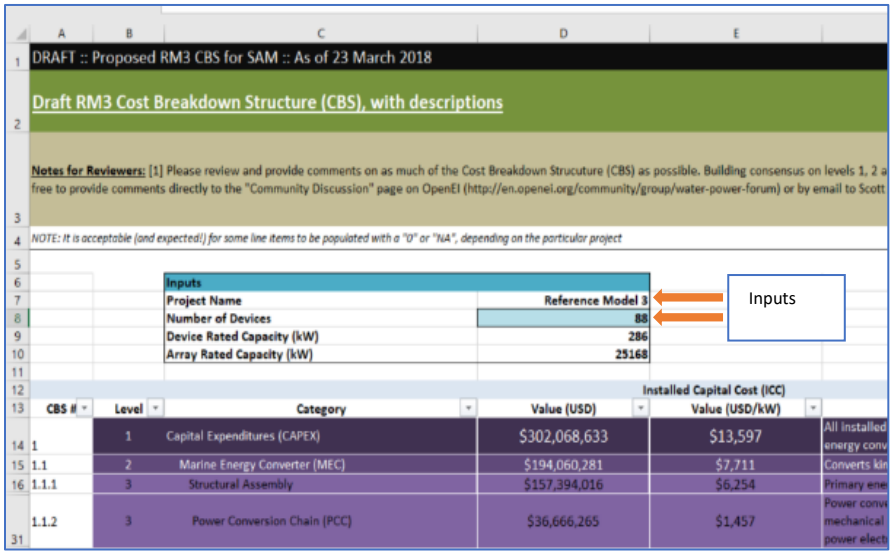
2. Download default data files

Users can download three Excel files, which provide default data for SAM LCOE calculations. The resource file, power file, and CBS are based on default data from the MHK Reference Model project, an open-source data on the technical and economic evaluation of unique MHK devices.

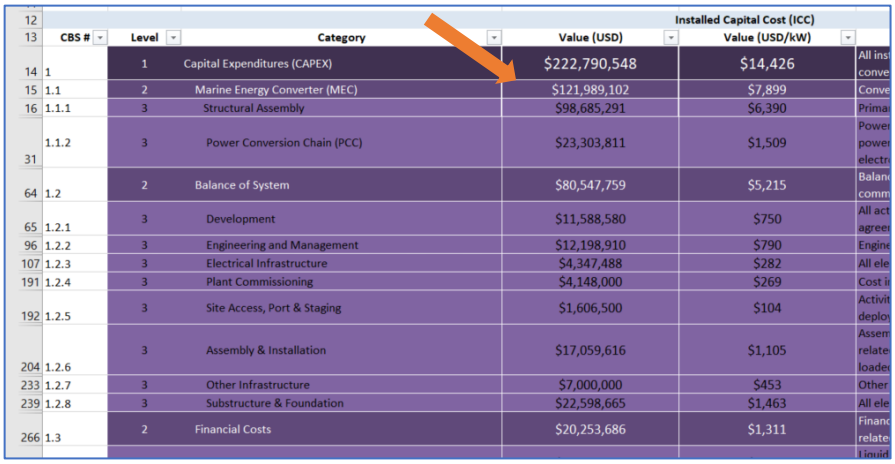
a) Resource file**:** Contains wave statistics data for the reference resource
b) Power file: Calculated electrical power matrix for the RM device (rated power)
c) CBS file: Provides capital and operational expenditures based on number of devices

3. Complete user inputs

The resource file and power file are default data that do not require user input. However, if the project has site-specific data, this data can be uploaded into the SAM tool. The CBS file requires the user to **input a project name and number of devices** for the desired array size. The CBS will calculate the capital and operational expenditures based on the number of devices.



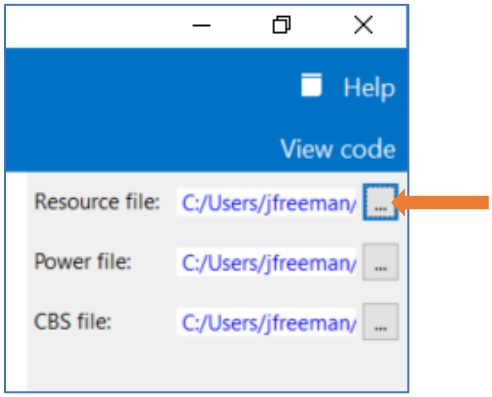
If site-specific cost data is known for the project, the user may input their own cost data into the 'Value (USD)' column in the CBS file for each known cost. This will overwrite the default data in the cell.



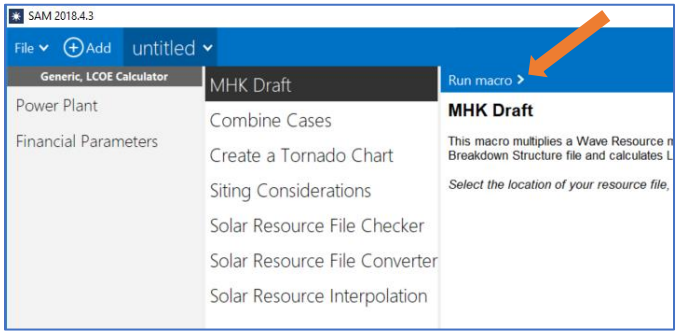
	CBS #	Level	Category	Installed Capital Cost (ICC) Value (USD)	Value (USD/kW)	
14	1	1	Capital Expenditures (CAPEX)	$222,790,548	$14,426	All inst conve
15	1.1	2	Marine Energy Converter (MEC)	$121,989,102	$7,899	Conve
16	1.1.1	3	Structural Assembly	$98,685,291	$6,390	Prima
31	1.1.2	3	Power Conversion Chain (PCC)	$23,303,811	$1,509	Power power electr
64	1.2	2	Balance of System	$80,547,759	$5,215	Balan comm
65	1.2.1	3	Development	$11,588,580	$750	All act agree
96	1.2.2	3	Engineering and Management	$12,198,910	$790	Engine
107	1.2.3	3	Electrical Infrastructure	$4,347,488	$282	All ele
191	1.2.4	3	Plant Commissioning	$4,148,000	$269	Cost i
192	1.2.5	3	Site Access, Port & Staging	$1,606,500	$104	Activit deplo
204	1.2.6	3	Assembly & Installation	$17,059,616	$1,105	Assem relate loade
233	1.2.7	3	Other Infrastructure	$7,000,000	$453	Other
239	1.2.8	3	Substructure & Foundation	$22,598,665	$1,463	All ele
266	1.3	2	Financial Costs	$20,253,686	$1,311	Financ relate
						Liquid

4. Upload files into SAM LCOE tool

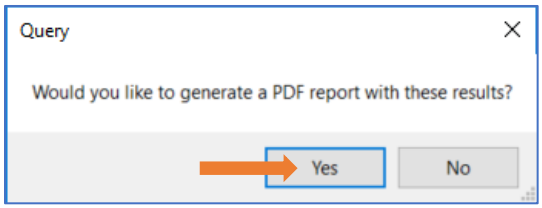
To upload the resource, power, and CBS files into the SAM, **click on the square box with three dots**, located in the upper right corner of SAM. SAM will upload resource and power files that are saved as CSV files. The CBS file should be saved as XLS file.



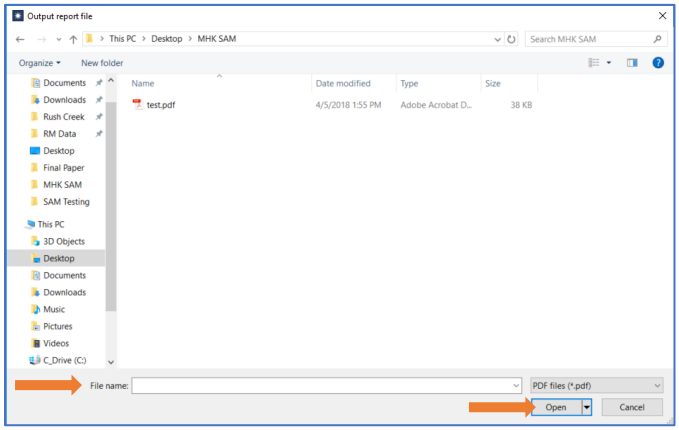
After uploading each file, click **'Run macro'** in the upper left corner of SAM.



A popup will display. Click **yes** to generate a PDF with results.

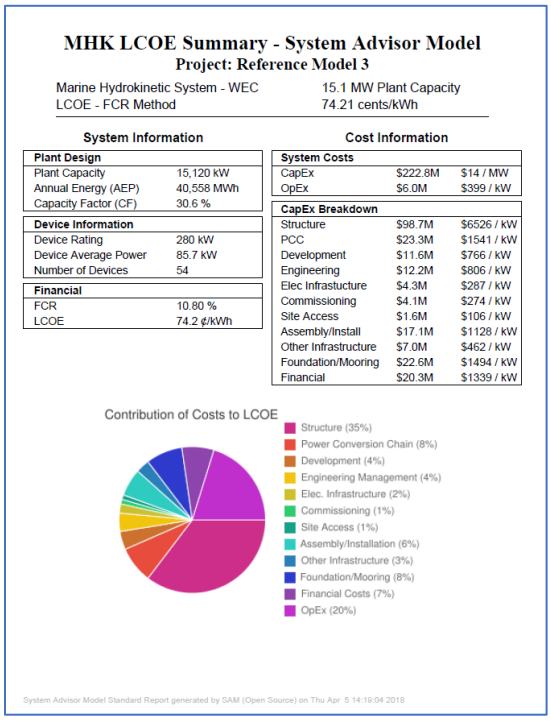


Next, **type in a file name** in the popup box and **click 'Open.'**



5. SAM calculates LCOE, summarizes the system, and generates a report

SAM multiples the resource matrix, device power matrix, and number of devices to calculate the annual energy production. Cost information for the MHK system is summarized. LCOE is calculated by SAM using user data inputs and a fixed charge rate (FCR) method.



MHK LCOE Summary - System Advisor Model
Project: Reference Model 3

Marine Hydrokinetic System - WEC — 15.1 MW Plant Capacity
LCOE - FCR Method — 74.21 cents/kWh

System Information

Plant Design	
Plant Capacity	15,120 kW
Annual Energy (AEP)	40,558 MWh
Capacity Factor (CF)	30.6 %

Device Information	
Device Rating	280 kW
Device Average Power	85.7 kW
Number of Devices	54

Financial	
FCR	10.80 %
LCOE	74.2 ¢/kWh

Cost Information

System Costs		
CapEx	$222.8M	$14 / MW
OpEx	$6.0M	$399 / kW

CapEx Breakdown		
Structure	$98.7M	$6526 / kW
PCC	$23.3M	$1541 / kW
Development	$11.6M	$766 / kW
Engineering	$12.2M	$806 / kW
Elec Infrastucture	$4.3M	$287 / kW
Commissioning	$4.1M	$274 / kW
Site Access	$1.6M	$106 / kW
Assembly/Install	$17.1M	$1128 / kW
Other Infrastructure	$7.0M	$462 / kW
Foundation/Mooring	$22.6M	$1494 / kW
Financial	$20.3M	$1339 / kW

Contribution of Costs to LCOE

System Advisor Model Standard Report generated by SAM (Open Source) on Thu Apr 5 14:19:04 2018