



ETIPOCEAN

European Technology & Innovation Platform for Ocean Energy

Technology Theme Webinar

Developing and Implementing Optimisation tools

29 January 2018

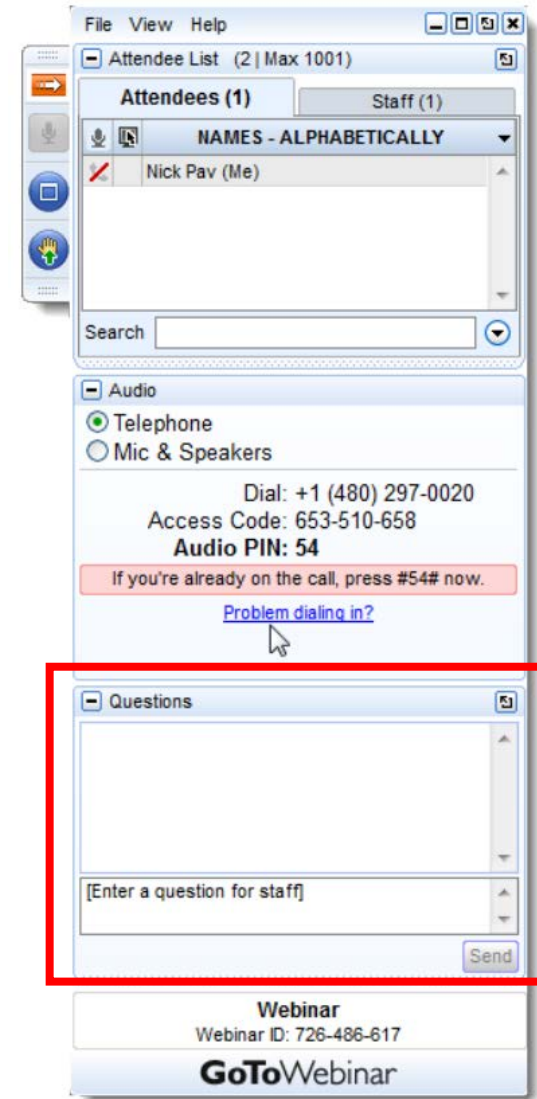
Agenda

Moderator	Speakers	
Leonore van Velzen	Dr. Raymond Alcorn	Dr. Encarni Medina-Lopez
The University of Edinburgh	Exceedence Ltd.	The University of Edinburgh

Questions and comments from the audience

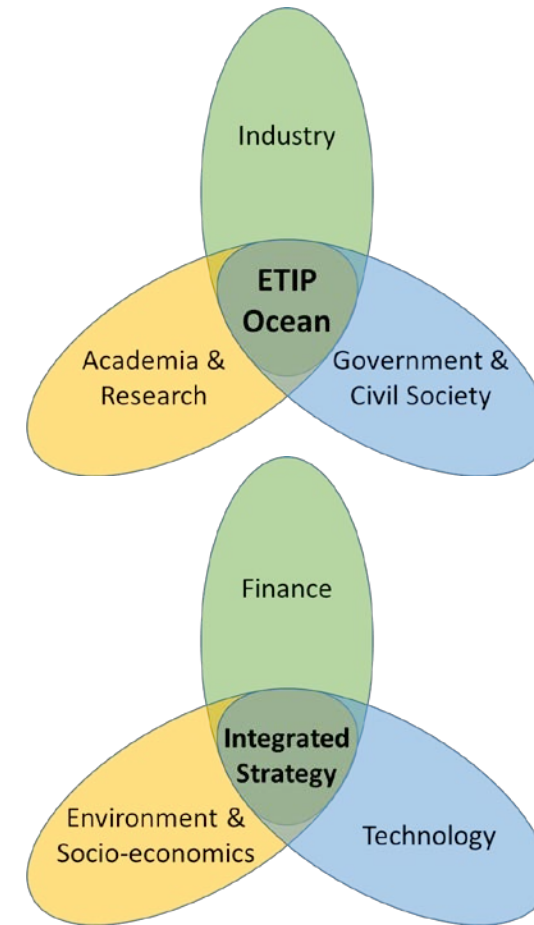
Technical details

- All attendees have microphones muted
- Feel free to send questions or comments by text at any time



The European Technology and Innovation Platform for Ocean Energy

- A hub for knowledge sharing and collaboration in the ocean energy sector
- Identify methods of overcoming barriers to sector commercialisation
- Define a common vision for the accelerated development of the sector
- Public engagement and education



Consortium



- **ETIP Ocean Coordinator**
- Europe's ocean energy trade association
- 115 member organisations
- Represents the interests of the European ocean energy sector



THE UNIVERSITY
of EDINBURGH

- **ETIP Ocean Partner**
- Policy and Innovation Group at the Institute for Energy Systems
- Leading research institution in the ocean energy sector



- **ETIP Ocean Partner**
- EERA Ocean Energy Joint Programme
- A network of the 12 foremost research institutions in the European ocean energy sector
- Coordinated by the University of Edinburgh



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wood.



OptiWave

January 2018





**\$300Bn p.a. new Renewables need
finance. \$85T will be under
management by 2050. ALL need
robust**

DECISIONS



What is OptiWave?

- Financial & engineering optimisation platform for wave energy systems
 - Exceedence Finance: Techno-financial modelling tool
 - Flexcom Wave: Offshore marine engineering simulator
- Coupling of 2 COMMERCIAL packages to provide a better end-to-end service for the industry

OptiWave



wood.  EXCEEDENCE

seai  SUSTAINABLE
ENERGY AUTHORITY
OF IRELAND



TEAM



- Domain experts in renewables
- Software team with 30 years experience
- Expertise in corporate finance including financing renewables



Annicka Wänn
Senior Projects
Engineer



Chris O'Donoghue
Principal Software
Engineer



Dr Ray Alcorn,
Founder & CEO
25 year
Domain Expert



Anthony
Sherlock
Software
Development



John Keating
Co-Founder COO
25 years Corporate
Finance



David
Sheehan
Software
Development

COMPANY OVERVIEW

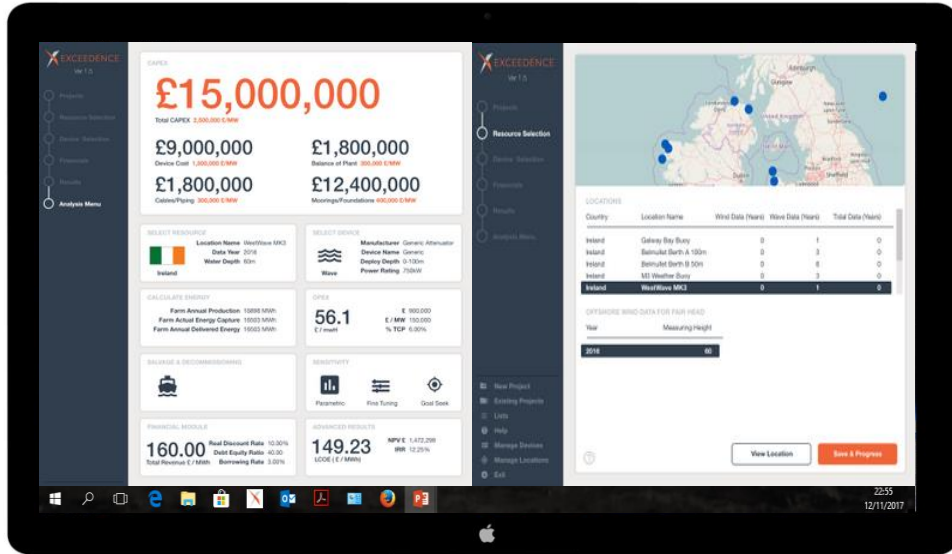


- Sell B2B financial decision support software for renewable energy
- Started in Cork, Ireland in 2015
- Spun out from a world class research centre with desktop software
- Proprietary world class knowledge & expertise
- Have developed and about to launch cloud based software and tiered subscription model



ExceedenceFINANCE

A B2B SaaS Platform



- + Focus on Analytics. 80% Use time, 20% build. This is where value derives.
- + Transparent and shareable across VALUE chain.
- + Standardised process
- + Like-for-Like Comparison
- + Identify and Reduce Risk

BETTER
Decisions FASTER

facts... Wood PLC

A new global leader in technical, engineering and project services

\$11BN

over \$11bn revenue

WG.100

FTSE 100 listed

60+

Operating in more than 60 countries

160

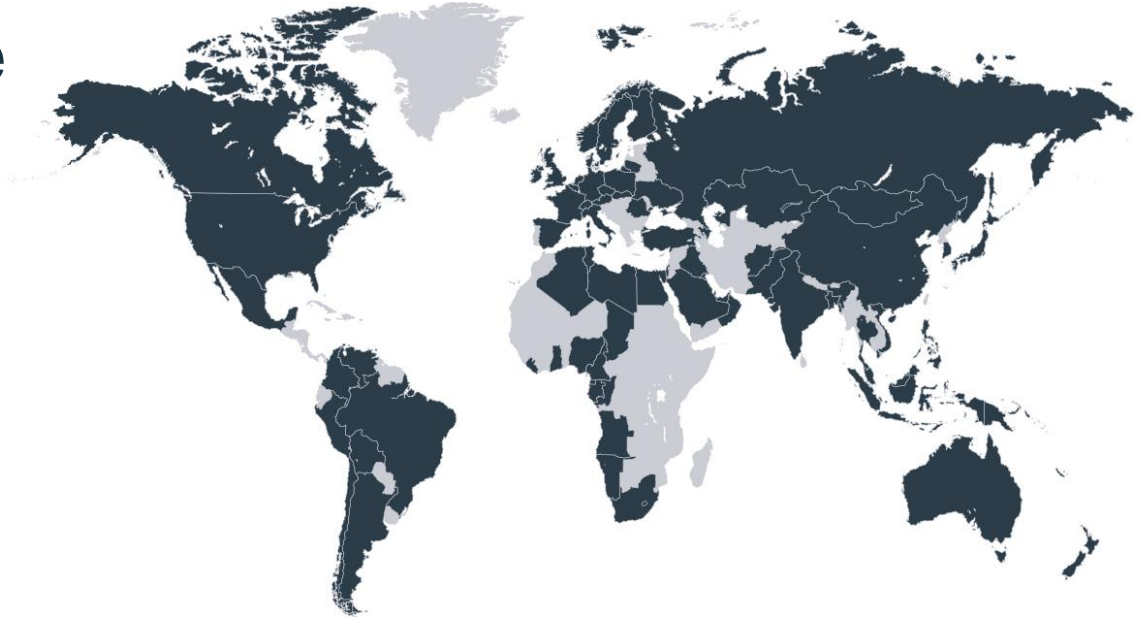
Over 160 years experience



footprint...

we are everywhere
you need us

- We have an unmatched global footprint
- We're accelerating and expanding in new sectors and geographies
- Unlocking our technology across an incredible sector spread

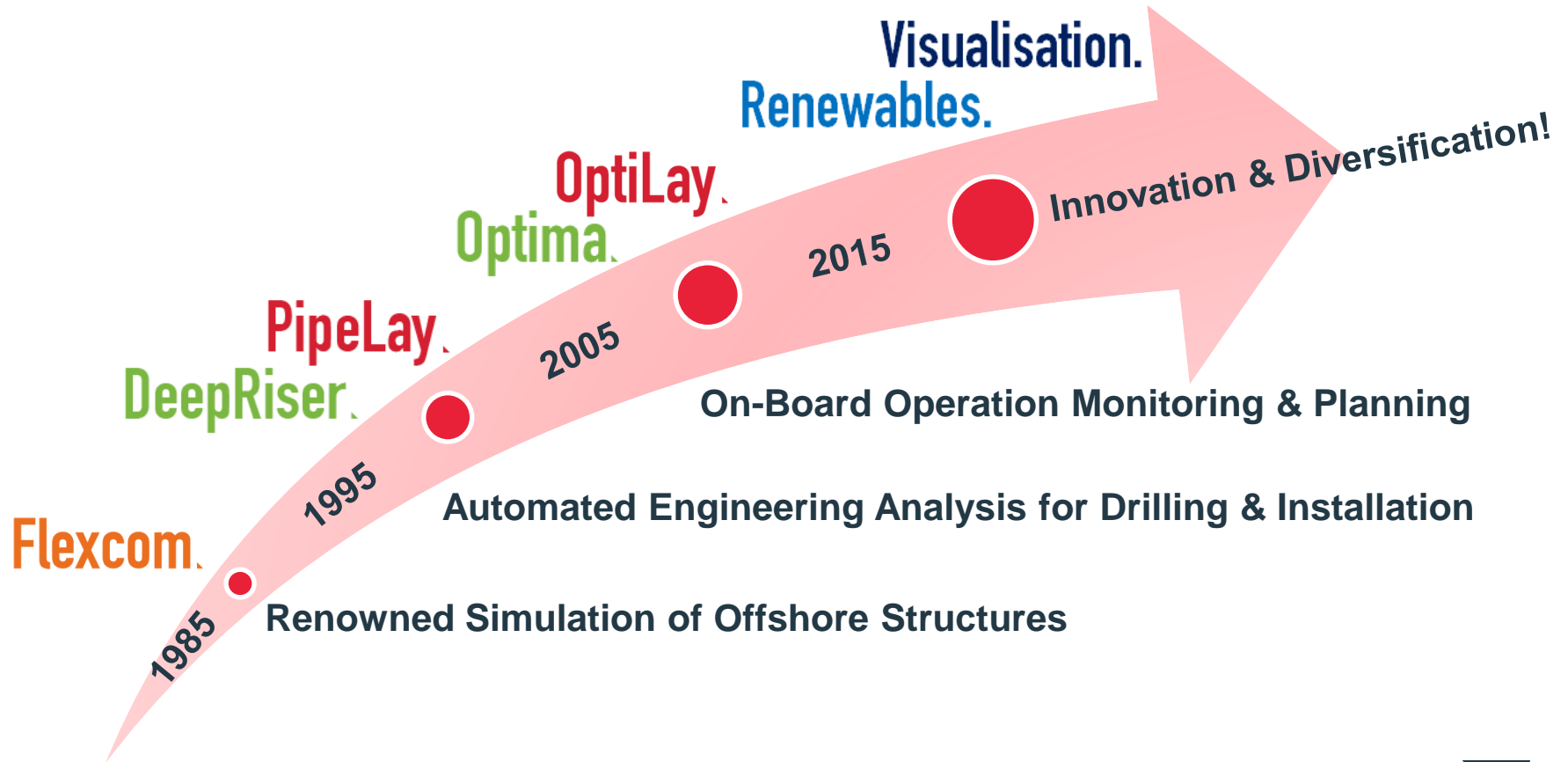


More than 600 offices worldwide



30+ years of Building Simulation Software

wood.

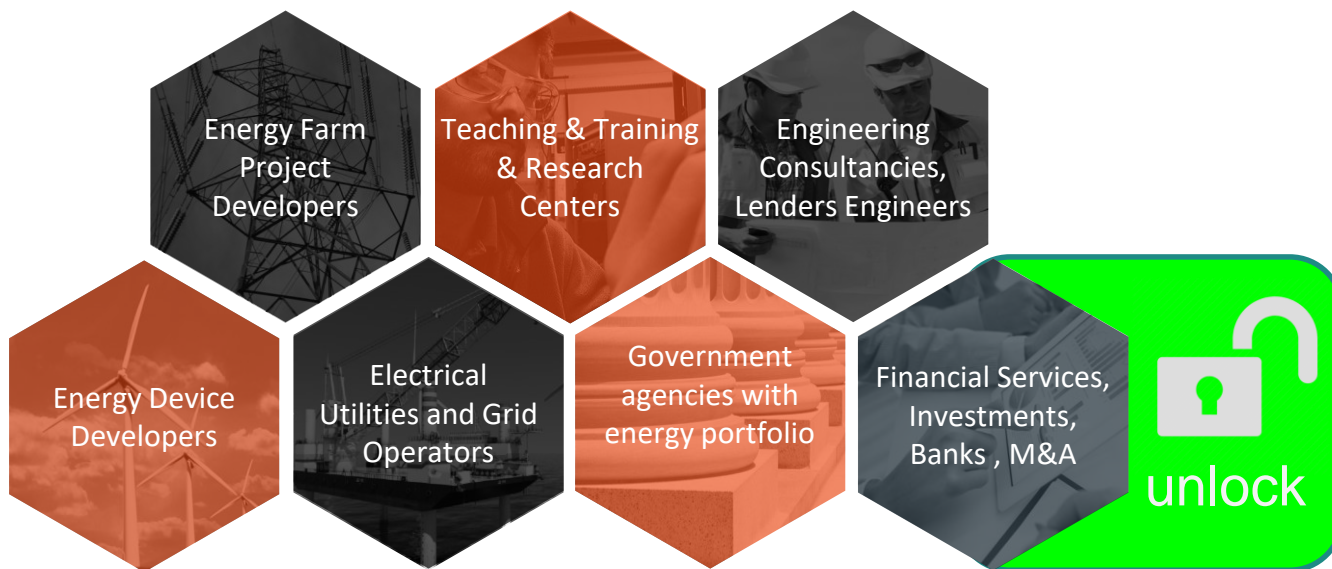


Industry Needs

- Why Techno - Financial models?
 - Convince Investors, Government and EU Funders
 - Plan for cost reduction, measure and track progress
 - Make both Corporate and Technical Development decisions
 - Supply chain credibility
 - BE COMPETITIVE
- Industry needs
 - Reference models & data
 - Own Data Import and Output with full transparency
 - Variable granularity – Input and Output
 - Indicators – Yield, Capacity Factor, LCOE, IRR, NPV, NPV/MW
 - Built in Data Sets (e.g. WES, Belmullet) and Device Models
 - STANDARDISED
 - What-IF? Analysis and Optimisation



MRE Supply Chain



Technical & Financial Marriage



Renewable Resource

- METOCEAN
- Historical
- Real
- Forecast
- Time based



Technology Performance

- Design
- Mooring
- PTO
- Constraints, Curtailment, Losses
- Availability



Costs

- CAPEX
- OPEX
- Balance of Plant
- Fees



Financial

- Revenues PPA, ROCS, Grants, CFDs
- Discount and inflation
- Debt/Equity
- Tax/Depreciation



Results & KPIs

- IRR, LCOE, NPV, ROI, Payback
- Cashflows
- What-IF Scenarios
- Analytics
- Excel & Graphical Export

wood.

 **EXCEEDENCE**



Key Benefits

- ✓ **Accurate financial metrics:** detailed engineering models and real-world wave resources
- ✓ **Accelerated development:** screen out weaker concepts earlier
- ✓ **Design optimisation:** explore advances in energy generation and opportunities for cost reduction
- ✓ **Key insights:** AEP, local power fluctuations, structural loads and fatigue life
- ✓ **Clarity:** Transparency of financial and engineering design processes
- ✓ **Consistency:** Suitable for concepts, prototypes, full scale versions
- ✓ **Unlock investment:** Increase investor confidence, de-risk projects
- ✓ **Reliable:** Validated via industry case studies



Why choose OptiWave?

- **Complete Solution**
 - Alternative products lack a techno-financial modelling capability – this is a unique selling point of OptiWave
- **Flexibility**
 - Multi-tiered pricing model which delivers cost efficiencies to smaller companies with limited budgets
- **Support & Maintenance**
 - Professionally supported product, which is often lacking in open source options



Industry Case Studies



Sea Power's Platform



Benson's ORLA



ESBI WestWave



wood.



Software demonstration

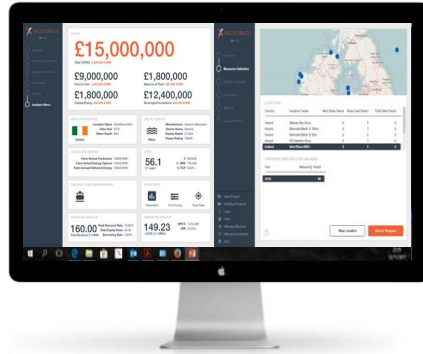


ROADMAP

DESKTOP Version



CLOUD Version



Enterprise
Standard
Lite

Future CLOUD

OptiWave
Enterprise Modules
Co Products
Data Sets
Solar PV

OPEN DATA SETS

3RD PARTY
FUNCTIONALTY
FLEXCOM WAVE

wood.

VALIDATION

EY Building a better working world

Proof of Concept

- Sales & consultancy Revenues

Tiered Offering

- Across value chain

New Products, Channels & Markets

How did we do it

- Originally both desktop packages
- Exceedence ground-up rebuild as Cloud Package
 - Many advantages for customer & company
- Linked a Desktop Package to web services
- Now providing an accessible TIERED offering to the industry on a subscription basis



OptiWave

Financial and engineering optimization platform for wave energy systems

Start
Flexcom
Wave

Start
Exceedence
Finance

Watch
Tutorial

Open
Website

Sample Project – RM3

- Dual-body floating point absorber
 - Designed by US DoE
 - Publicly available information
- Real-world design environment
 - Eureka site, California
- **GOAL – optimise LCOE for the given Resource**



U.S. DEPARTMENT OF
ENERGY

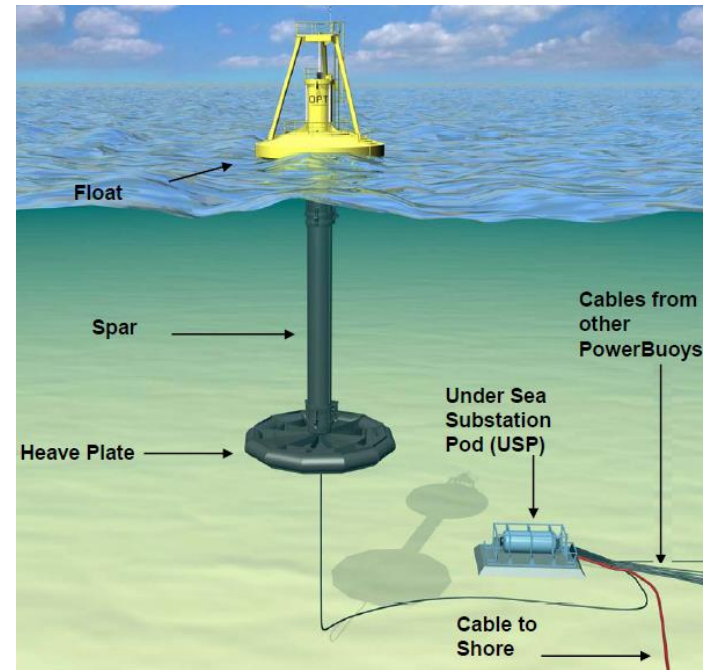


Image courtesy Ocean Power Technologies



SANDIA REPORT

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Methodology for Design and Economic Analysis of Marine Energy Conversion (MEC) Technologies

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 Sandia National Laboratories

5 Reference Model 3 (RM3): Wave Point Absorber

5.1 RM3 Description

The RM3 wave point absorber, also referred to as a wave power buoy, was designed for a reference site located off the shore of Eureka in Humboldt County, California. The concept design for this device was inspired by the Ocean Power Technology's PowerBuoy (<http://www.oceanpowertechnologies.com>), which is a two-body floating point absorber (FPA) designed to convert ocean wave energy into electrical power. The design of the device consists of a surface float that translates (oscillates) with wave motion relative to a vertical column spar buoy, which connects to a subsurface reaction plate (Figure 5-1 and Figure 5-2). This two-body point absorber converts wave energy into electrical power predominately from the device's heave oscillation induced by incident waves; the float is designed to oscillate up and down the vertical shaft up to 4 m. The bottom of the reaction plate is about 35 m below the water surface. The device is targeted for deployment in water depths of 40 m to 100 m. The point absorber is also connected to a mooring system to keep the floating device in position. Our RM3 design assumed a hydraulic PCC system, which is placed inside the vertical column. The optimum energy capture of a wave point absorber occurs when the system is at resonance, in other words, when the oscillating body velocity is in-phase with the hydrodynamic wave excitation force.

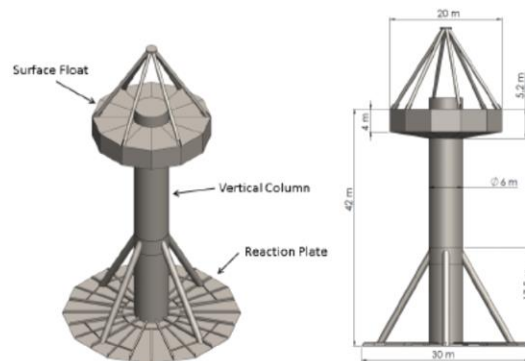


Figure 5-1. RM3 device design and dimensions.

Getting Started

The screenshot shows a web browser window with the URL `exfindemowave.azurewebsites.net`. The page title is "Exceedence Finance". The main content area is titled "Welcome to Exceedence Cloud" and features four primary sections:

- NEW PROJECTS:** Includes a plus icon and the text "Create a new project that is either wind, wave, or tidal." with a "Create Project" button.
- RECENT PROJECTS:** Includes a refresh icon and a list of project links: [EMEC 2003](#), [Shannon Estuary 1999](#), [Belmullet 2010](#), and [Inverness 2016](#).
- COMPARE MULTIPLE PROJECTS:** Includes a folder icon and a list of comparison links: [EMEC 2003 >> Belmullet 2010](#), [Shannon 1999 >> Inverness 2016](#), and [Belmullet 2010 >> Shannon 1999](#).
- HELP - COMMONLY SEARCHED TOPICS:** Includes a question mark icon and a list of help links: [CAPEX Details](#), [OPEX Entry](#), [Fine Tuning Results](#), and [Analytics](#).

A dark sidebar on the left contains the "EXCEEDENCE" logo and a navigation menu with the following items:

- Project
- Resource Selection
- Device Selection
- Energy Settings
- Capex
- Opex
- Financials
- Results
- Analysis Menu
- Import Flexcom File
- Home
- New Project
- Existing Projects
- Help
- Manage Devices
- Manage Locations
- Exit



Define a Project

The screenshot shows a web browser window with two tabs labeled 'Exceedence Finance'. The address bar shows the URL 'exfindemowave2.azurewebsites.net/DemoProject/DemoProject'. The page title is 'Create a Project'. On the left is a dark sidebar with the 'EXCEEDENCE' logo and a menu with items: Project, Resource Selection, Device Selection, Energy Settings, Capex, Opex, Financials, Results, Analysis Menu, and Import Flexcom File. At the bottom of the sidebar are icons for Home, New Project, Existing Projects, Help, Manage Devices, Manage Locations, and Exit. The main content area contains a form with the following fields:

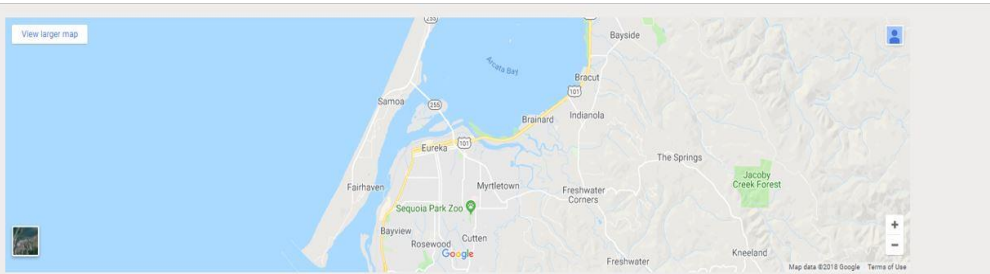
- Project Name:** Text input with value 'Eureka RM3'
- Farm Technology:** Dropdown menu with value 'Wave'
- Currency:** Dropdown menu with value 'US Dollar'
- Preferred Farm Size (MW):** Text input with value '10'
- Operating Years:** Text input with value '25'
- Pre-Development Years:** Text input with value '0'
- Decommissioning Years:** Text input with value '0'
- Comments:** Text area with value 'case study calibrated to USDQE Reference Model 3 in engineering and LCOE terms'
- ID:** Text input with value '0'

At the bottom of the form is an orange 'Continue' button.



Resource Selection

- Project
- Resource Selection
- Device Selection
- Energy Settings
- Capex
- Opex
- Financials
- Results
- Analysis Menu
- Import Flexcom File

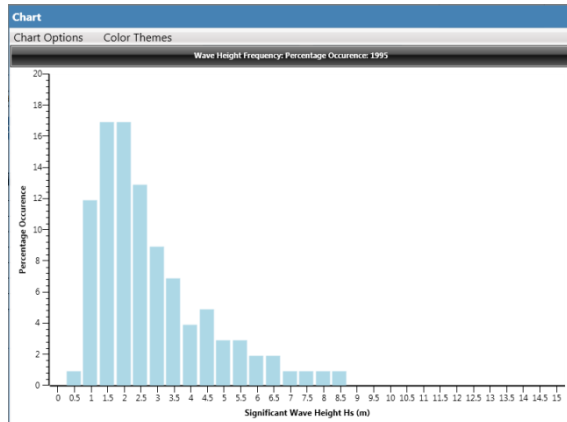
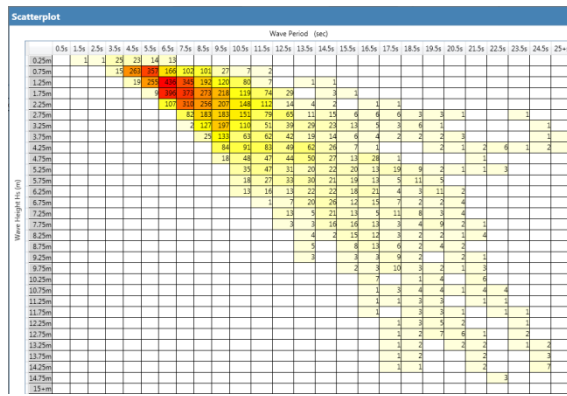


Locations

Country	Location Name	Wind Data (Years)	Wave Data (Years)	Tidal Data (Years)	Resource Details
France	SEM-REV	3	1	0	View Location
USA	Eureka	0	1	0	View Location
Ireland	Belmullet Berth A	3	0	0	View Location
Netherlands	Nordzee Wind	1	0	0	View Location
United Kingdom	Widemouth Pier	3	3	3	View Location

Date

[Continue](#)



Choose a Device

Exceedence Finance | Exceedence Finance | exfirstdev.azurewebsites.net/DeviceManagement/ViewDevice?id=13

Device Details

Renewable Technology	Wave	Maximum Power Rating (kW)	285	Comments	Original version
Device Classification	Other (Wave)	Period Type	Te		
Manufacturer	ustcwa	Device Life Time (Years)	25		
Device Name	ALBESHA 888	Deployment Depth (m)	40		
			10		
			100		

Device Power Matrix

Wave Height (m)	Wave Period (sec)																											
	0.5s	1.5s	2.5s	3.5s	4.5s	5.5s	6.5s	7.5s	8.5s	9.5s	10.5s	11.5s	12.5s	13.5s	14.5s	15.5s	16.5s	17.5s	18.5s	19.5s	20.5s	21.5s	22.5s	23.5s	24.5s	25+s		
0.25m					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
0.75m					3	5	7	9	10	10	9	7	6	5	4	3	3	2	2	2								
1.25m					9	15	20	25	27	26	23	20	17	14	11	9	8	6	5	4								
1.75m					18	29	40	48	52	50	45	38	32	27	22	18	15	12	10	8								
2.25m					29	48	65	79	84	81	72	62	52	43	35	29	24	20	16	14								
2.75m					43	71	97	116	123	118	106	91	77	63	52	43	35	29	24	20								
3.25m					60	98	134	161	169	162	145	123	105	87	71	59	48	40	33	28								
3.75m					80	130	178	211	222	212	190	164	138	114	94	77	63	52	44	37								
4.25m					102	167	227	284	291	286	261	227	174	144	119	97	80	67	55	47								
4.75m					130	207	281	336	338	328	298	255	214	178	146	120	99	82	69	58								
5.25m					165	262	349	395	394	389	360	326	285	239	198	165	139	116	99	83	70							
5.75m					198	308	398	435	430	428	398	365	325	285	244	209	172	142	118	99	83							
6.25m					219	336	428	457	450	450	420	387	347	306	264	221	182	150	124	103	87							
6.75m					251	368	461	481	470	470	438	405	364	322	280	237	195	162	134	112								
7.25m					285	394	488	507	494	494	462	429	388	346	304	261	219	185	154	129								
7.75m					320	429	524	542	528	528	496	463	422	380	338	295	252	210	176	148								
8.25m					356	460	556	573	558	558	526	493	452	410	368	325	282	239	204	176								
8.75m					393	494	590	606	590	590	558	525	484	442	400	357	314	271	228	192								
9.25m					431	529	625	640	624	624	592	559	518	476	434	391	348	305	262	220								
9.75m					470	566	662	676	660	660	628	595	554	512	470	427	384	341	298	256								
10.25m																												
10.75m																												
11.25m																												
11.75m																												



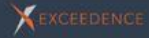
Yield Calculation BEFORE

The screenshot displays the Exceedence Finance web application interface. The browser address bar shows the URL: `exfindemowave.azurewebsites.net/DemoProject/DemoEnergyModule`. The application has a dark sidebar on the left with the 'EXCEEDENCE' logo and a navigation menu including: Project, Resource Selection, Device Selection, Energy Settings, Capex, Opex, Financials, Results, Analysis Menu, and Import Flexcom File. At the bottom of the sidebar are icons for Home, New Project, Existing Projects, Help, Manage Devices, Manage Locations, and Exit.

The main content area is divided into several sections:

- Farm Size:** Shows a 'Preferred Farm Size (MW)' of 3 and a 'Final Farm Size (MW)' of 2.9. Below this is a table with columns: Technology, Manufacturer, Device Name, Max Power Rating, Modify Unit Number, Modify %, and Device MW Contribution. The table contains one row for 'Wave' with manufacturer 'USDoE', device 'FLEXCOM RM3', max power '286kW', unit number '10', modify percentage '95', and contribution '2.9'. A 'Calculate' button is located at the bottom right of this section.
- Loss Factors:** Contains two sub-sections. The first, 'Loss Factors', has input fields for Curtailment Loss Factors % (100), Constraint Loss Factors % (100), and Transmission Loss Factors % (98), with a note '*100% implies no losses'. The second, 'Device Factors', has input fields for Array Loss Factor (100%) and Availability Loss Factor (99%).
- Detailed Results:** Shows a 'Capacity Factor' of 28.42%. Below this are three energy production metrics: 'Farm Annual Energy Production' (7191 MWh), 'Farm Actual Energy Capture' (7120 MWh), and 'Farm Annual Delivered Energy' (6977 MWh). A 'Continue' button is at the bottom right.

CapEx & OpEx



- Project
- Resource Selection
- Device Selection
- Energy Settings
- Capex
- Opex
- Financials
- Results
- Analysis Menu
- Import Flexcom File

- Home
- New Project
- Existing Projects
- Help
- Manage Devices
- Manage Locations
- Exit

CAPEX Complexity Selection

Total CAPEX per Farm	Simple Breakdown CAPEX per Farm	Detailed CAPEX per Device
	Device Cost: <input type="text" value="11,085,286"/>	⊙\$ ⊙\$/MW
	Balance of Plant: <input type="text" value="6,947,065"/>	⊙\$ ⊙\$/MW
	Cabling / Piping: <input type="text" value="1,651,000"/>	⊙\$ ⊙\$/MW
	Moorings/Foundations: <input type="text" value="1,736,766"/>	⊙\$ ⊙\$/MW

Continue



Financial Parameters

The screenshot displays the 'Exceedence Finance' application interface, showing various financial parameter settings for a project. The interface is divided into two main panes.

Left Pane: Revenue - Basic Inputs

- Revenue - Basic Inputs:** Includes a checkbox for 'Include Revenue Inputs' (checked), 'Feed in Tariff' set to 'Fixed', and a value of '\$/MWh' set to 580.
- Revenue - Extra Inputs:** Includes checkboxes for 'RE Certificate', 'ROC Equivalent', and 'Additional Grid Sales', each with 'Fixed' and 'Variable' radio options. Below these, there are three input fields for '\$/MWh', all set to 0.
- Total Sales Revenue/MWh:** A single input field set to 580.
- Input Per Annum:** A table with columns for Year Number, Grant Amount \$, FIT Rate \$/MWh, Revenue Cert Rate \$/MWh, ROC Equivalent \$/MWh, and Additional Grid Sales Revenue \$/MWh. The table shows data for years 0, 1, 2, and 3.

Right Pane: Discounting and Inflation Options

- Discounting and Inflation Options:** Includes radio buttons for 'Do not apply discount or inflation to Cash Flow Sheet', 'Undiscounted Cash Flows with Inflation Included', 'Cash Flows (no Inflation) to Cash Flow Sheet', and 'Cash Flows in Nominal Terms to Cash Flow Sheet'. Below these are input fields for 'Inflation Rate %' (0.00%), 'Nominal Discount Rate %' (0.00%), and 'Real Discount Rate %' (10.18%).
- Indexation and Escalation Factors:** Includes checkboxes for 'Apply Revenue Indexation Factor', 'Apply Opex Escalation Factor', and 'Apply Revenue Escalation Factor', each with an input field for the rate (all set to 0.00%).
- Debt / Equity:** A slider for '100% implies no debt' is set to 100%. Below it are input fields for 'Equity' (100%), 'Debt' (0%), 'Debt Term' (0), 'Borrowing Rate' (0.00%), and 'Debt Amount' (0).
- Taxation:** An input field for 'Tax Rate %' is set to 0.00%.

Bottom Panel: A navigation bar with buttons for Home, New Project, Existing Projects, Help, Manage Devices, Manage Locations, and Exit.



Results Before

Excedence Finance

x

← → ↻ exfindemowave.azurewebsites.net/DemoProject/DemoResultsModule

EXCEEDENCE

- Project
- Resource Selection
- Device Selection
- Energy Settings
- Capex
- Opex
- Financials
- Results
- Analysis Items
- Import Flexcom File

Project Results

\$610,118

Net Present Value (\$)

\$68,148

Equivalent Annual Charge

11.44%

Internal Rate of Return

\$213,328

Net Present Value per MW (\$)

19

Discounted Payback Period (Years)

\$1,450.66

Levelised Cost of Electricity (\$/MWh)

Cash Flow

Cashflow Chart
Cashflow Spreadsheet

Discount Factor	Savings Income	Discounting Factor	Discounting Cost	Annual Revenue	Interest Payments	Profit	Taxable Profit	Taxable Profit After Losses	After Tax Profit	Net Cash Flow	Cumulative Net Cash Flow	Discounted Net Cash Flow	Cumulative Discounted Net Cash Flow
1.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.01	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.02	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.03	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.04	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.05	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.06	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.07	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.08	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.09	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.10	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.11	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.12	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.13	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.14	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.15	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.16	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.17	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.18	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.19	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.21	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.22	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.23	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.24	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.26	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.27	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.28	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.29	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.30	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.32	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.33	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.34	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.35	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.36	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.37	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.38	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.39	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.40	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.41	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.42	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.43	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.44	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.45	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.46	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.47	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.48	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.49	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.50	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.52	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.53	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.54	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.55	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.57	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.58	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.59	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.60	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Continue

29

Results Before CF

Excedence Finance

x

← → ↻
exfindemowave.azurewebsites.net/DemoProject/DemoResultsModule
🔍 ☆

EXCEEDENCE

Project

Resource Selection

Device Selection

Energy Settings

Capex

Opex

Financials

Results

Analysis Items

Import Flexcom File

Project Results

\$610,118

Net Present Value (\$)

\$213,328

Net Present Value per MW (\$)

\$68,148

Equivalent Annual Charge

9

Simple Payback Period (Years)

19

Discounted Payback Period (Years)

11.44%

Internal Rate of Return

\$1,450.66

Levelised Cost of Electricity (\$/MWh)

Cash Flow

Cashflow Chart
Cashflow Spreadsheet

Discount Factor	Savings Income	Discounting Cost	Annual Revenue	Interest Payments	Profit	Yearly Profit	Yearly Profit After Taxes	After Tax Profit	Net Cash Flow	Cumulative Net Cash Flow	Discounted Net Cash Flow	Cumulative Discounted Net Cash Flow
1.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.01	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.02	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.03	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.04	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.05	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.06	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.07	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.08	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.09	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.10	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.11	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.12	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.13	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.14	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.15	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.16	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.17	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.18	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.19	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.21	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.22	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.23	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.24	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.26	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.27	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.28	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.29	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.30	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.32	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.33	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.34	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.35	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.36	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.37	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.38	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.39	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.40	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.41	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.42	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.43	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.44	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.45	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.46	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.47	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.48	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.49	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
1.50	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Continue



Analytics

Project Analysis

CAPEX

\$61,261,529

Total CAPEX: \$1,421,155/MW
\$31,703,915
 Device Cost: \$1,085,285 \$/MW
\$4,967,151
 Cable/Piling: \$176,765/MW

\$19,868,603
 Balance of Plant: \$,547,045/MW
\$4,721,860
 Moorings/Foundation: \$,651,000/MW

SELECTED RESOURCES

Location Name: Eureka
 Date Year: 2017
 Water Depth: 30m

SELECTED DEVICES

Manufacturer: USDOE
 Device Name: FUSION-DM-002
 Deploy Depth: 60m - 100m
 Power Rating: 35GW

CALCULATE ENERGY

Annual Production: 7191 MWh
 Actual Energy Capture: 7120 MWh
 Annual Delivered Energy: 6377 MWh

OPEX

\$ 3,275,476
 \$/MW: 1,146,070
 % TCF: 5.35%

SAVILAGE & DECOMMISSIONING

SENSITIVITY

Parameter Sensitivity Fine Tuning Sensitivity Goal Seek Sensitivity

FINANCIALS

Real Discount Rate: 10.15%
 Total Revenue \$/MWh: 500.00

ADVANCED RESULTS

NPV: \$110,118
 LCOE: \$1,450.66
 IRR: 11.44%

Resource Curves/Matrices

Power Curves/Matrices

CAPEX Graphical Results

OPEX Graphical Results

Final Report

Fine Tune Sensitivity

Energy	Device	CAPEX
OPEX	S&D	Finance

Value Scaling

60%

Max
0.00
Min
0.00

Results

Levelised Cost of Electricity

Net Present Value

Net Present Value/MW

Internal Rate of Return



Revise the Device

Exceedence Finance x Exceedence Finance x

exfirstddev.azurewebsites.net/DeviceManagement/ViewDevice?id=13

Project

Renewable Technology
Wave

Device Classification
Other (Wave)

Manufacturer
usdout

Device Name
FLEXCOM RMS

Maximum Power Rating (kW)
286

Device Life Time (Years)
25

Deployment Depth (m)
40

Comments
Original Version

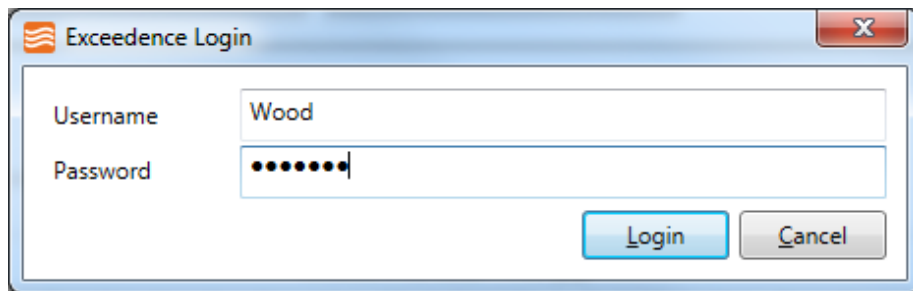
Device Power Matrix

Wave Period (sec)

Wave Height (m)	0.5s	1.5s	2.5s	3.5s	4.5s	5.5s	6.5s	7.5s	8.5s	9.5s	10.5s	11.5s	12.5s	13.5s	14.5s	15.5s	16.5s	17.5s	18.5s	19.5s	20.5s	21.5s	22.5s	23.5s	24.5s	25+s		
0.25m					1	1	1	1	1	1	1	1	1															
0.75m					3	5	7	9	10	10	9	7	6	5	4	3	3	2	2	2								
1.25m					9	15	20	25	27	26	23	20	17	14	11	9	8	6	5	4								
1.75m					18	29	40	48	52	50	45	38	32	27	22	18	15	12	10	8								
2.25m					29	48	65	79	84	81	72	62	52	43	35	29	24	20	16	14								
2.75m					43	71	97	116	123	118	106	91	77	63	52	43	35	29	24	20								
3.25m					60	98	134	161	169	162	145	125	105	87	71	59	48	40	33	28								
3.75m					80	130	178	211	222	212	190	164	138	114	94	77	63	52	44	37								
4.25m					102	167	227	269	281	268	241	207	174	144	119	97	80	67	55	47								
4.75m					128	207	281	336	354	336	296	253	214	178	146	120	99	82	69	58								
5.25m					155	252	336	406	428	406	356	306	258	214	176	145	120	99	83	70								
5.75m					186	298	396	486	508	486	426	366	306	254	209	172	142	118	99	83								
6.25m					219	356	486	596	624	596	526	456	386	324	261	215	168	138	115	97								
6.75m					255	406	546	676	708	676	596	516	436	366	303	239	192	160	134	112								
7.25m					294	468	624	776	808	776	686	596	506	426	356	292	220	183	153	129								
7.75m					336	528	708	886	918	886	786	686	586	506	426	356	292	237	173	146								
8.25m					380	596	808	1008	1040	1008	896	786	686	586	506	426	356	293	233	195	164							
8.75m					426	676	918	1148	1180	1148	1026	906	796	686	586	506	426	356	290	218	184							
9.25m					474	776	1056	1328	1360	1328	1196	1066	936	816	706	596	506	426	356	282	204							
9.75m					524	886	1184	1488	1520	1488	1346	1206	1066	936	816	706	596	506	426	351	226							
10.25m																												
10.75m																												
11.25m																												
11.75m																												



Import Data into Flexcom Wave

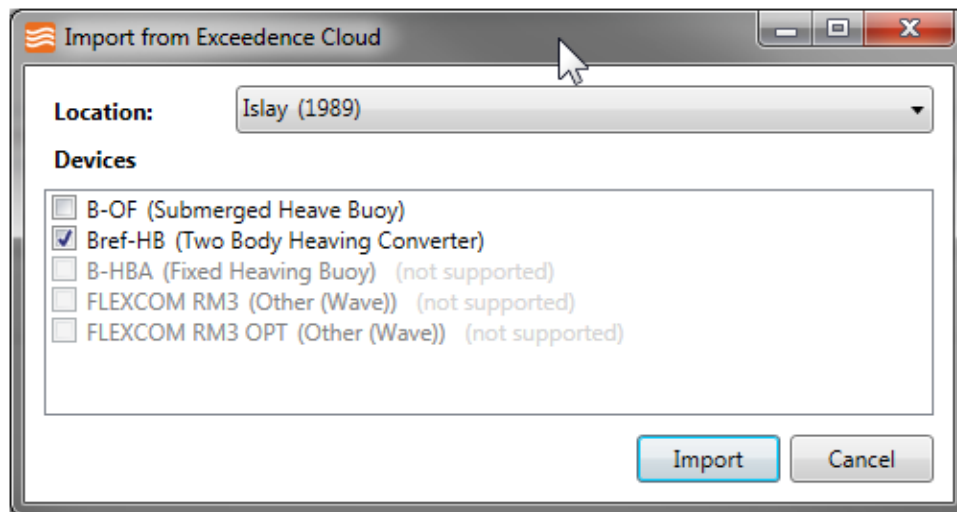
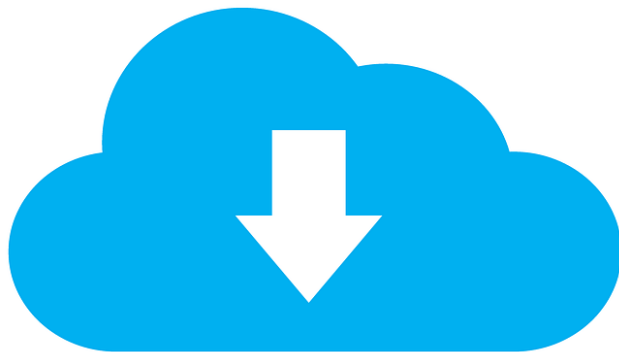


Exceedence Login

Username: Wood

Password: ●●●●●●

Login Cancel



Import from Exceedence Cloud

Location: Islay (1989)

Devices

- B-OF (Submerged Heave Buoy)
- B-ref-HB (Two Body Heaving Converter)
- B-HBA (Fixed Heaving Buoy) (not supported)
- FLEXCOM RM3 (Other (Wave)) (not supported)
- FLEXCOM RM3 OPT (Other (Wave)) (not supported)

Import Cancel

Engineering Model

The screenshot displays the Flexcom Wave software interface, version 8.9.1 (Beta). The main window shows a 3D model of a floating dual-body point absorber, consisting of a yellow cylindrical float and a grey cylindrical spar, connected by a mooring line. The model is shown in a perspective view, with a smaller inset view showing a top-down view of the float and spar. The software interface includes a Project View pane on the left, a Properties pane for the selected Mooring Line, and an Output View pane at the bottom.

Project View

- Devices
 - Float
 - Floating Dual-Body P...
 - P10 Linear Motion PTO
 - Mooring Line
 - Spar
- Environments
 - Eureka California
- Simulations
 - Simulation

Mooring Line Properties

Geometric Properties

Unstretched Length	(m)	267
Min Mesh Density	(m)	1
Max Mesh Density	(m)	2
Diameter	(mm)	76.6

Structural Properties

Axial Stiffness	(MN)	753.6
Mass per unit Length	(kg/m)	113.35
Stiffness Damping Coefficient		0.05
Mass Damping Coefficient		0.05
Bending Stiffness	(N*m ²)	276362.08
Torsional Stiffness	(N*m ² /rad)	212586.21

Hydrodynamic Properties

Normal Drag Coefficient		2
-------------------------	--	---

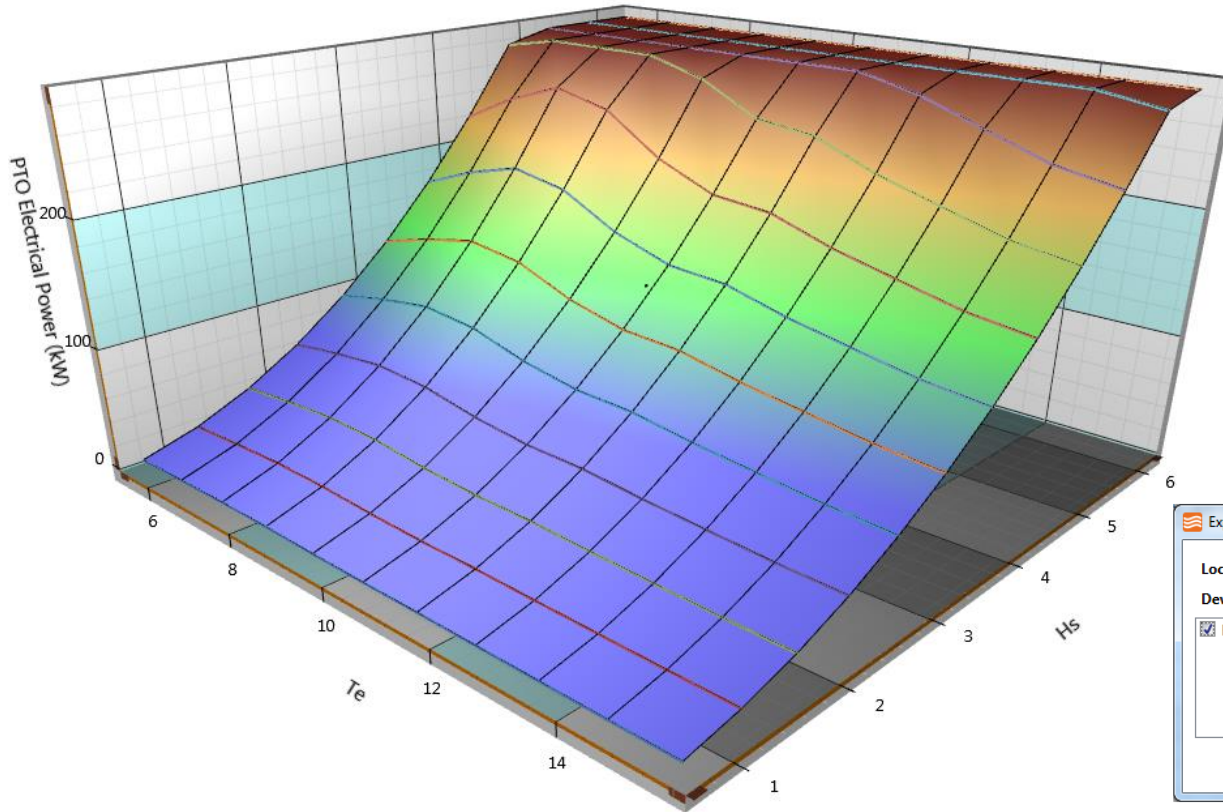
Output View

Message Text Line

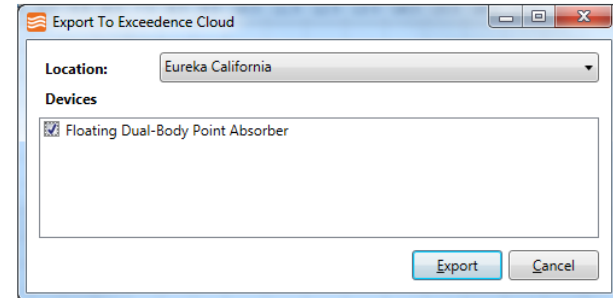


Power Output

Average Electrical Power



*Export to
Exceedence*



Yield After

The screenshot displays the Exceedence Finance web application interface. The browser address bar shows the URL: `exfindemowave2.azurewebsites.net/DemoProject/DemoEnergyModule`. The interface includes a dark sidebar with navigation options: Project, Resource Selection, Device Selection, Energy Settings, Capex, Opex, Financials, Results, Analysis Menu, and Import Flexcom File. At the bottom of the sidebar are icons for Home, New Project, Existing Projects, Help, Manage Devices, Manage Locations, and Exit.

The main content area features two large green numbers at the top: **3** Preferred Farm Size (MW) and **2.9** Final Farm Size (MW). Below these is a **Device Summary** table:

Technology	Manufacturer	Device Name	Max Power Rating	Modify Unit Number	Modify %	Device MW Contribution
Wave	USDoE	FLEXCOM RM3	286kW	<input type="text" value="10"/>	<input type="text" value="95"/>	2.9

A **Calculate** button is located below the table. Further down are **Loss Factors** sections:

Curtailment Loss Factors %: **Constraint Loss Factors %:** **Transmission Loss Factors %:** *100% implies no losses

Device Factors:

Manufacturer	Device Name	Array Loss Factor	Availability Loss Factor
USDoE	FLEXCOM RM3	<input type="text" value="100%"/>	<input type="text" value="99%"/>

The **Detailed Results** section shows **Farm Results** for Technology: Wave, Manufacturer: USDoE, Device Name: FLEXCOM RM3. A large green number **32.47%** represents the **Capacity Factor**. Below this are three green numbers representing energy metrics:

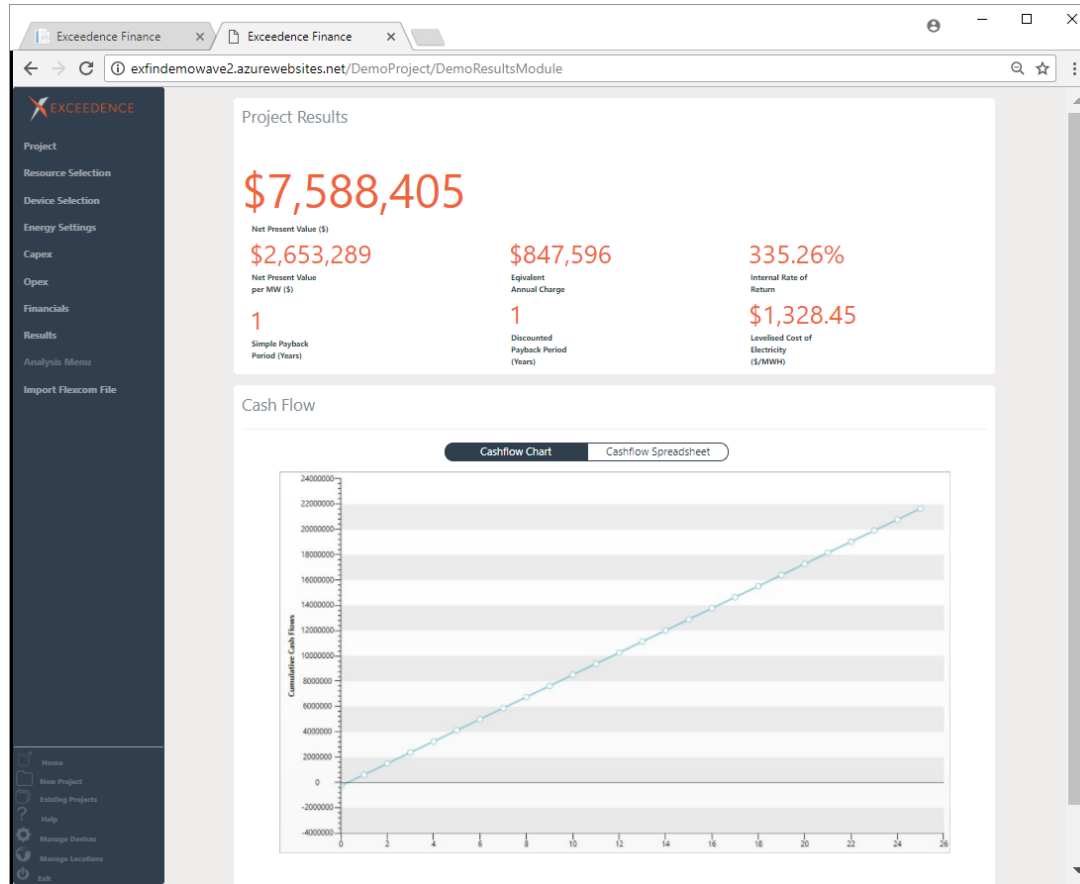
- 8215 (MWh)** Farm Annual Energy Production
- 8133 (MWh)** Farm Actual Energy Capture
- 7970 (MWh)** Farm Annual Delivered Energy

A **Continue** button is located at the bottom right of the results section.

- 14% Increase in Yield



Results After



- 9% reduction in LCOE



OptiWave

Financial and engineering optimization platform for wave energy systems

- Greater understanding for wave energy developers
- Better confidence for funders and investors
- Validated against real world case studies
- Fully supported commercial package
- Tiered subscription offering
- 1st in a line of products

Start
Flexcom
Wave

Start
Exceedence
Finance

Watch
Tutorial

Open
Website

Further Information

OptiWave

- OptiWave@woodgroup.com
- <https://www.woodgroup.com/optiwave>
(coming soon)

Exceedence

- <http://exceedence.com>

Flexcom

- <https://www.woodgroup.com/flexcom>



wood.



Thank you



DTOcean

Optimisation design tools applied to the EnFAIT project

Dr Encarni Medina-Lopez



THE UNIVERSITY
of EDINBURGH

**POLICY AND
INNOVATION
GROUP**



DTOcean (Optimal Design Tools for Ocean Energy Arrays). ENERGY 2013-1, EC.

Objectives:

1. Full suite of whole-system software design tools.
2. Identification of enabling technologies to reduce deployment costs and increase the performance of ocean energy arrays.
3. Guidelines for accelerating decisions by reducing risks and uncertainties.

18 partners from 11 countries under the coordination of the University of Edinburgh



THE UNIVERSITY of EDINBURGH



Fraunhofer



tecnalia



UNIVERSITY OF EXETER



MARINTEK



Prysmian Group



VATTENFALL



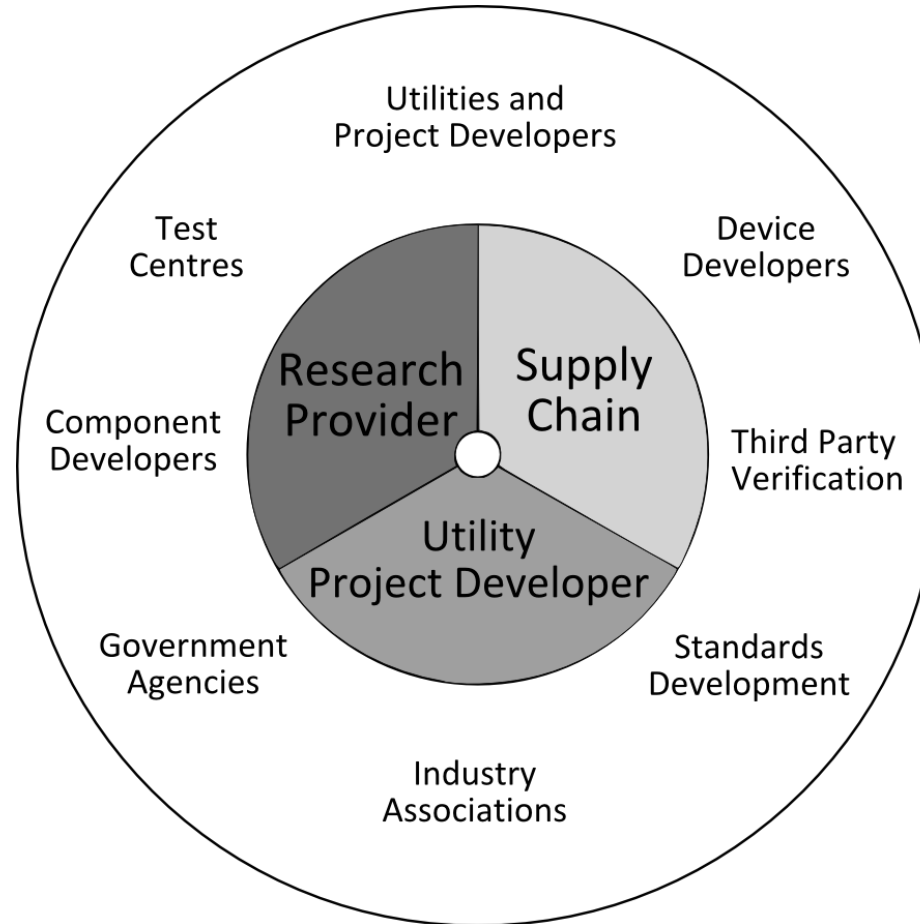
JRC
EUROPEAN COMMISSION



European Ocean Energy



Structure of the consortium



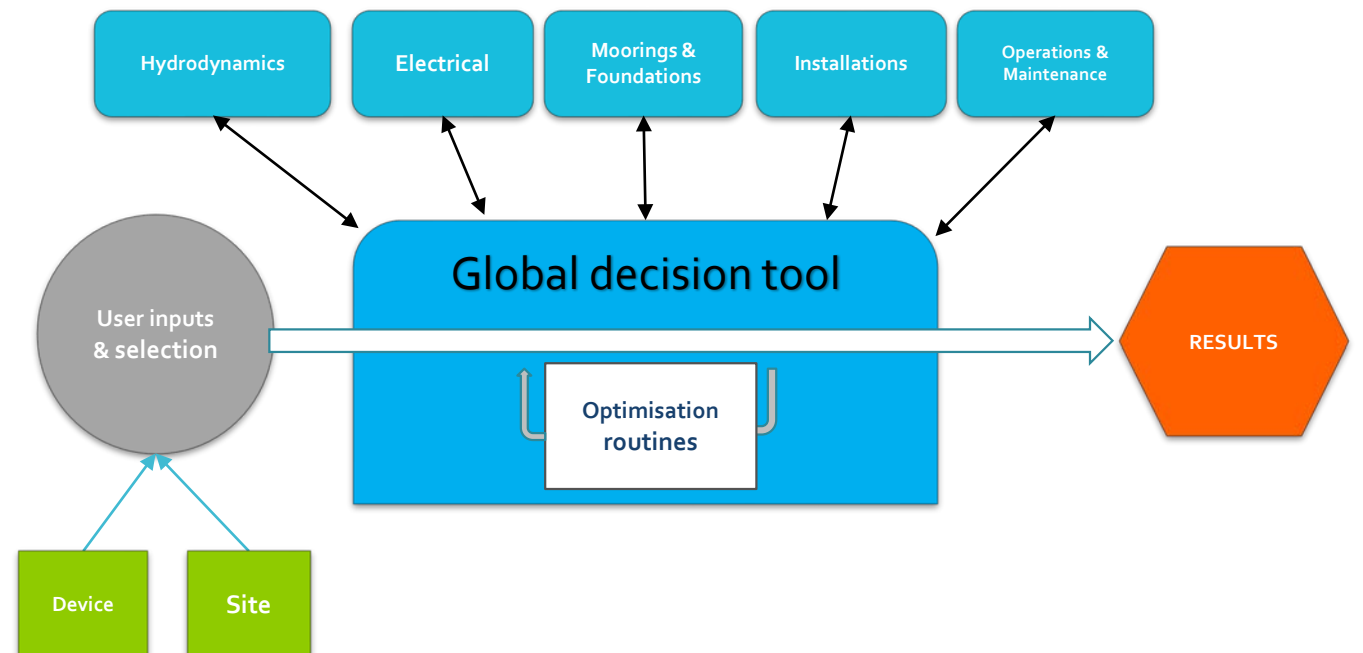
- Advisory Board
- Research Providers (Universities and Applied Research Centres)
- Utilities and Project Developers
- Supply Chain

DTOcean structure

- Modules
 - Hydrodynamics
 - Electrical systems
 - Moorings & Foundations
 - Installation
 - Operations & Maintenance



- Assessments
 - Economics
 - Environmental
 - Reliability



Software

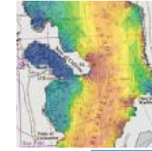
- Python 2.7: the programming language of the software
- PostgreSQL 9.4: Database manager
- Qt4: graphical interface

Typical mid-range Windows system



Device data

- Geometry
- Performance
- Maintenance
- Installation
- ...



Site data

- Bathymetry
- Metocean
- Soil features
- ...



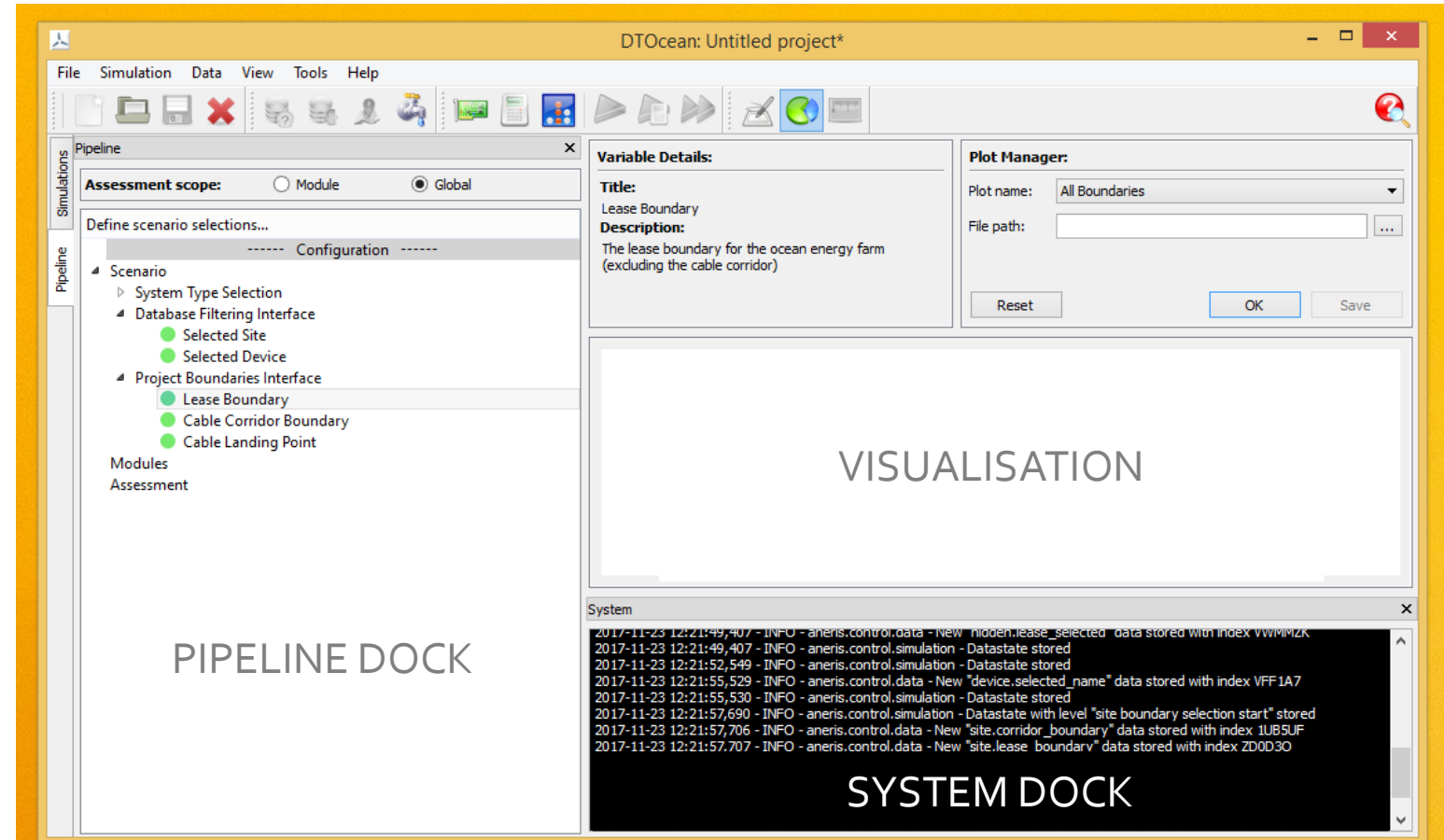
Project data

- Array power
- Ports nearby
- Vessels
- Installation rates
- Basic costs
- ...

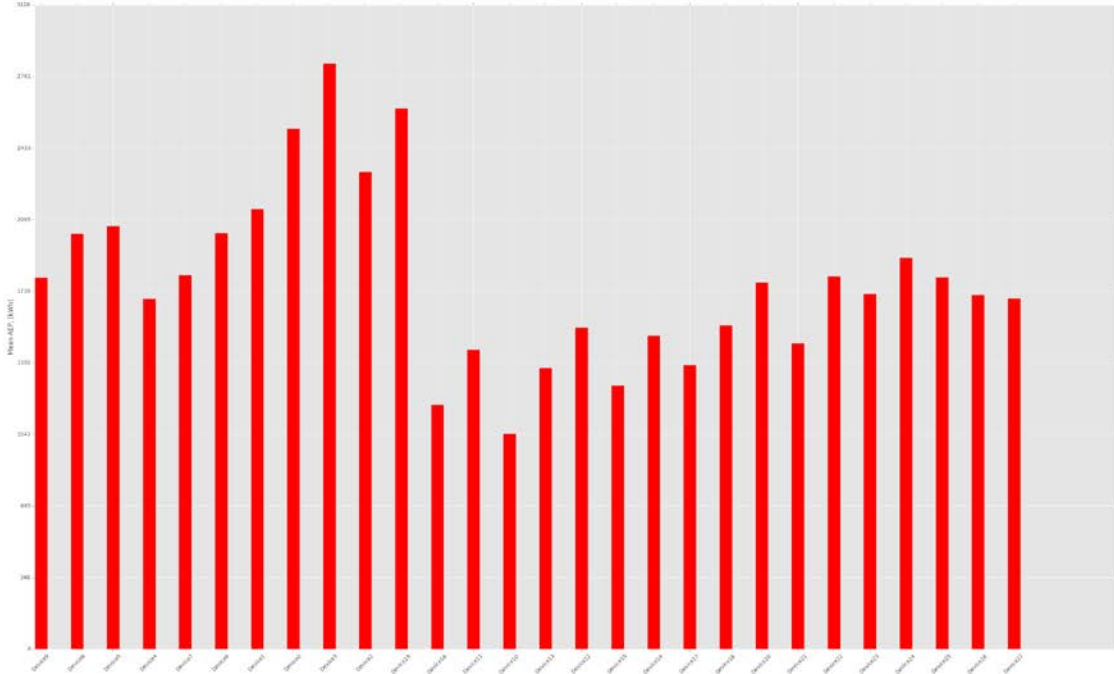
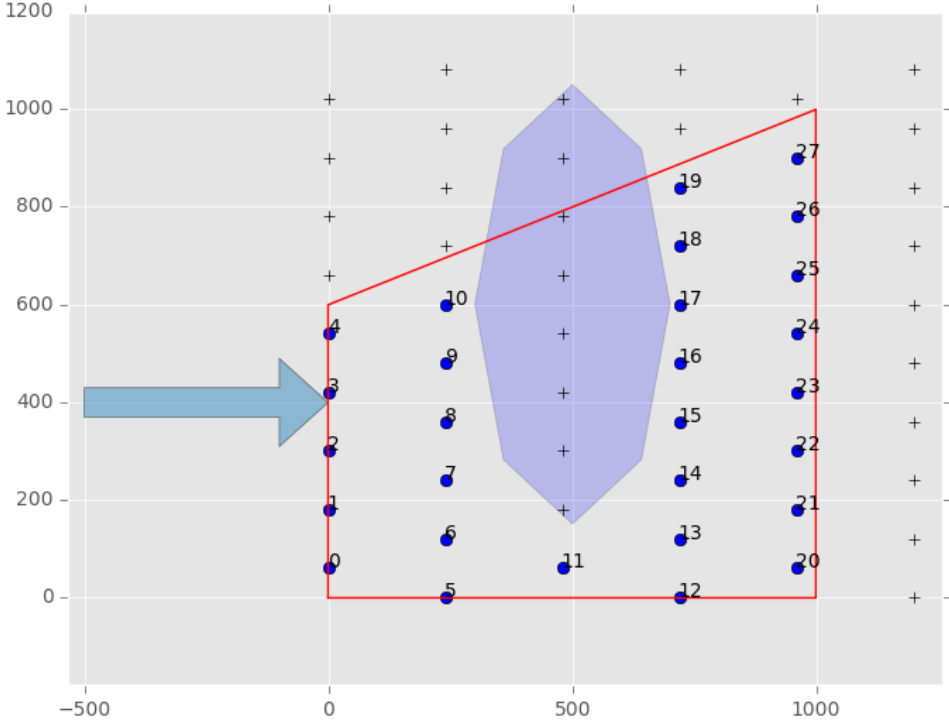
Data requirements

- Tidal
- Wave
- Fixed or floating device?

DTOcean interface



Expected outputs



The EnFAIT project



- Enabling Future Arrays in Tidal
- 5 years project (start July 2017).
- 9 partners around Europe.

<https://youtu.be/jLuOueRuIEk>



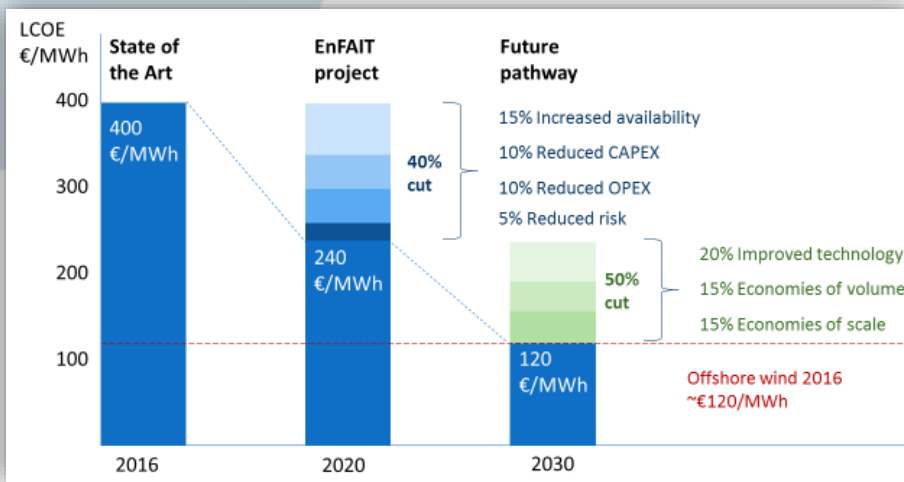
THE UNIVERSITY
of EDINBURGH



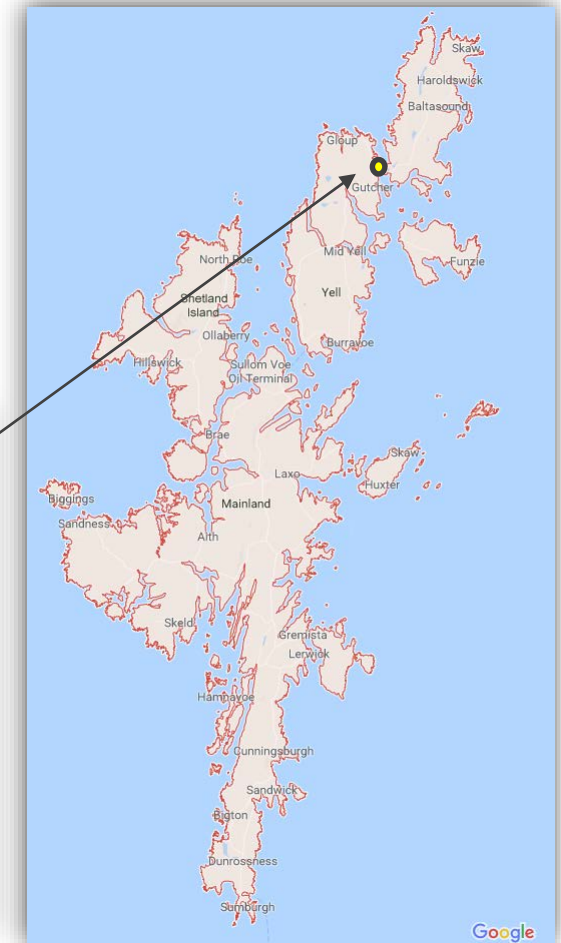
- Present: 0.3 MW array. Upgrade to 0.6MW (100kW turbines).

GOALS

- Reduce LCOE
- Prove high reliability and availability
- Disseminate learning in ocean energy
- Step towards bankability of tidal arrays



Buemull Sound
Shetland Islands
Scotland



DTOcean – EnFAIT: goals

- Validate tool
- Validate 3-turbines array
- Optimal placing of 6-turbine array
- Estimation of metrics to be used

Thank you

Dr Encarni Medina-Lopez
emedina@ed.ac.uk

www.policyandinnovationedinburgh.org



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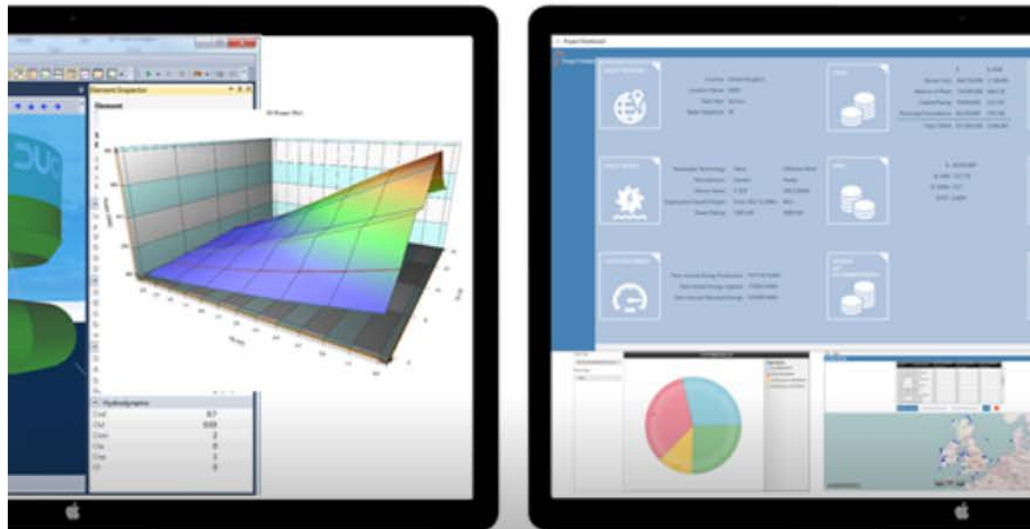
ETIPOCEAN

European Technology & Innovation Platform for Ocean Energy

Technology Theme Webinar

Developing and Implementing Optimisation tools


29 January 2018



Webinar: Developing and implementing optimisation tools



Webinar: Adaptive Management Systems – Don't make the same mistakes twice!



**Seminar at OEE2017
Conference: Wave Power Take Off - Have we cracked it?**



ETIP Ocean workshop at OEE2017



Webinar: Funding Ocean Energy Technology Development Using Pre-Commercial Procurement and Stage-Gate Development Processes

Staying in Touch



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<https://vimeo.com/channels/1210250>



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