# PROJECT DELIVERABLE REPORT

Grant Agreement No: 605955

## ACORN

*Advanced Coatings for Offshore Renewable Energy*

Collaborative Projects FP7-SME-2013

Type: Other

# Deliverable D7.2: Design & Decision Tool to assist the Wave & Tidal industry in resolving corrosion, cavitation and fouling issues when they arise – including when it is appropriate to use ACORN coatings

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| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services) | |
| **CO** | Confidential, only for members of the consortium (including the Commission Services) | |

# Contents

# 1 Introduction to ACORN project

The sea is a very aggressive environment that has significant adverse effects on most structures and materials exposed to it. Corrosion and biofouling are major problems for structures and materials in marine environments. For this reason, ocean energy devices and other offshore structures as platforms, buoys, docks and wind tower foundations, need to be protected because periodic dry docking is often impossible and in-situ maintenance can be difficult and costly. Conventional solutions such as paint and cathodic protection already offer a solution but with limited efficacy against corrosion and biofouling in the long term. Developing coatings that are resistant to both corrosion and biofouling with a 25+ years design lifetime can reduce maintenance costs and increase device lifetime.

The objective of Advanced Coatings for Offshore Renewable eNergy (ACORN) project is to develop a new, potentially patentable and long-lasting solution to the problem of corrosion and barnacle biofouling, offering specific advantages for offshore structures such as wind turbine towers and ocean energy generators. By developing such a coating, the Levelized Cost Of Energy (LCOE) for wave and tidal energy converters can be lowered. ACORN project will take advantage of the proven long-term corrosion protection of Thermally Sprayed Aluminium (TSA) for steel substrates. TSA provides both a barrier between seawater and steel, as well as providing sacrificial protection in damaged regions. Using the TSA as a matrix coating, the active antifouling substance will be embedded in the coating in very tiny concentrations. The antifouling mechanism prevents barnacle cyprids from settling on the surface when they come into contact with the substance. Barnacles are one of the most harmful fouling organisms and found throughout the world's oceans. Significant barnacle settlement can destroy protective paints, alter local water flow behaviour and provide an environment that promotes further biofouling.

In addition to this long-lasting solution to corrosion and biofoulilng, the project will also develop and prove a corrosion and cavitation resistant coating with a 10+ year design life, suitable for tidal energy generators. Cavitation damage is also relevant in this type of generators because it is highly likely that tidal turbines will be subjected to the effects of cavitation. The movement of the turbine blades can change pressures of the fluid and form vapour bubbles that collapse and damage the generators.

This report is part of a deliverable of the ACORN project, where a design and decision tool to assist Wave and Tidal (W&T) industry in resolving corrosion, cavitation and fouling issues has been produced. It is recommended to use this tool in combination with Deliverable D7.1: General Design Guidelines for the use of coatings in Wave/Tidal devices. Specific Assessment of possible impact of coatings on fabrication, corrosion allowances, mechanical properties, fatigue life.

# 2 Objective of this report

The aim of this report is to explain how the executable file "D7.2 Design & Decision Tool to assist the Wave & Tidal industry in resolving corrosion, cavitation and fouling issues when they arise – including when it is appropriate to use ACORN coatings" works. Although the functioning of the tool is very intuitive, this report will help the user to know all the details about it. From now on, this executable file will be named as DDT (Design & Decision Tool).

# 3 Working with DDT

Once the icon "D7.2_ACORN.exe" is clicked, the first screen of the DDT presents the project, names the number and title of the corresponding deliverable and has a link to the website of the ACORN project. In this website more information about the development, results, deliverables and general information of the project can be found (see Figure 1).
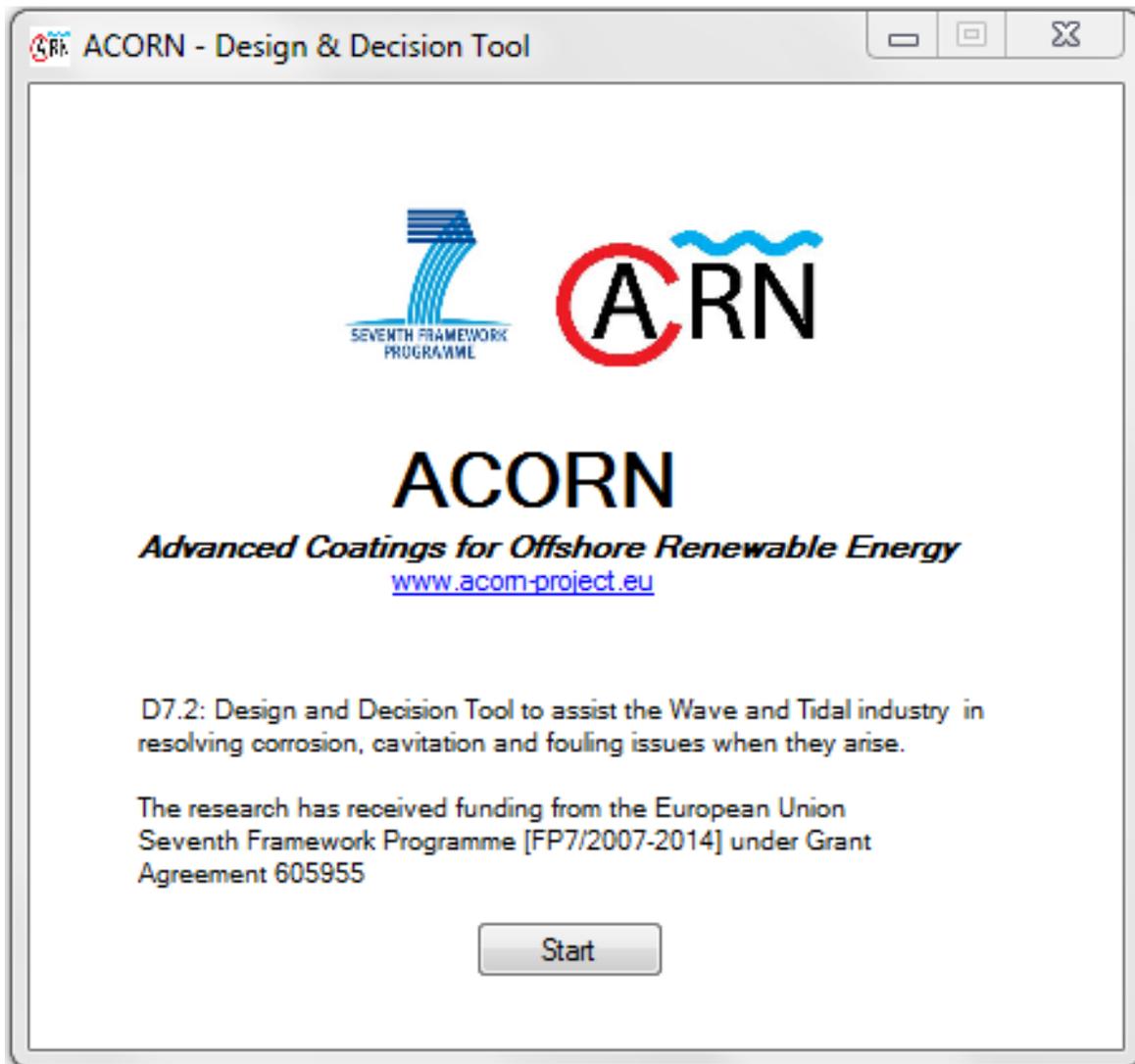


**Figure 1:** Presentation screen of the DDT

At the bottom of the screen, there is a "Start" button to run the DDT. If this button is clicked, the main screen of the DDT appears. In this screen some information has to be provided to the tool by the user in order to assess the degradation mechanisms that will take place in the seleceted device and the possible solutions to combat them. The inputs the tool needs are explained as follows:

1) Marine energy converter selection: in this point the user must indicate if the marine energy converter to be assessed is a wave converter or a tidal converter (see Figure 2).
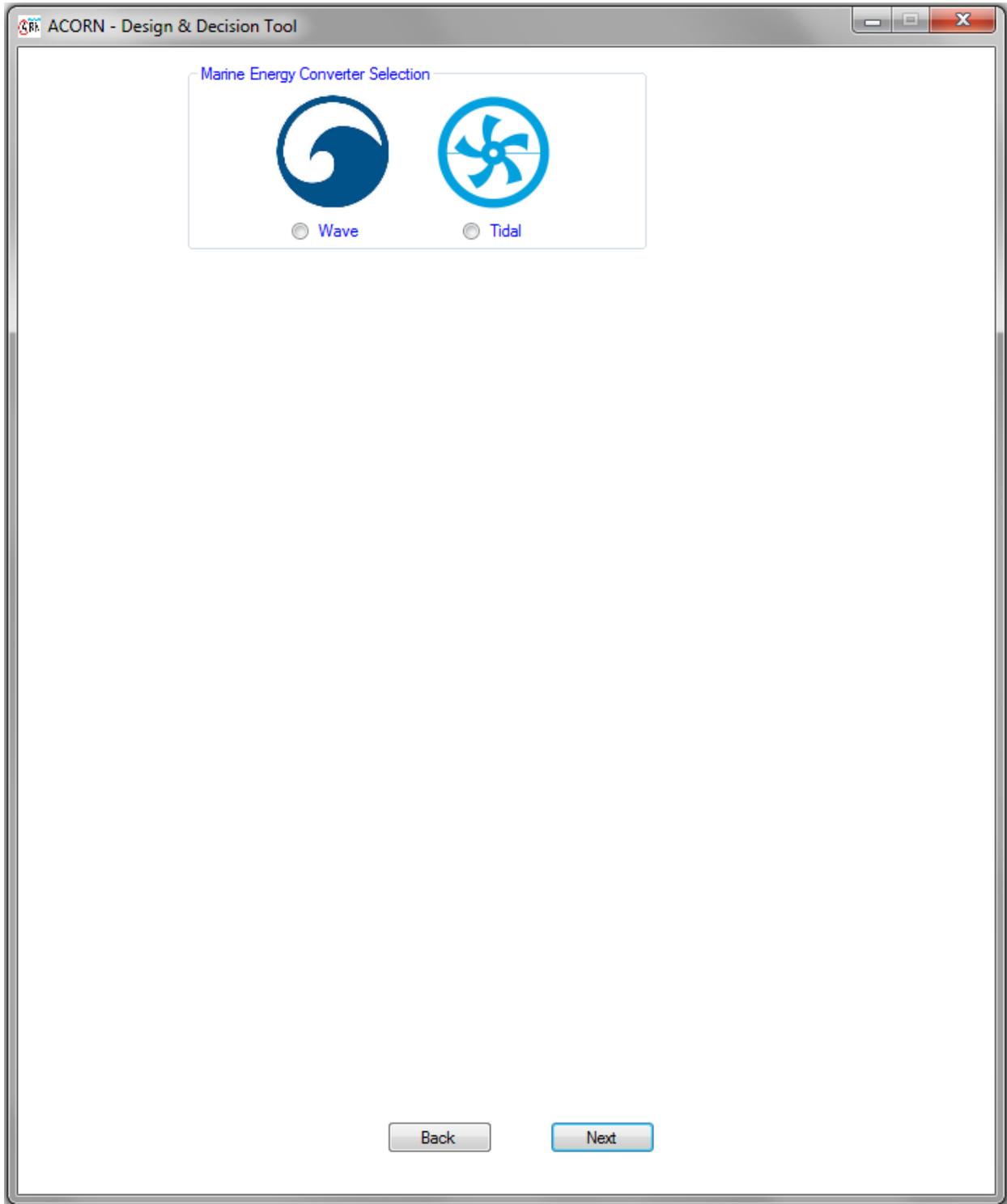


**Figure 2:** Screen to select the marine energy converter

2) Expected life time: the user must indicate if the expected life time of the assessed device is more or less than five years (Figure 3). This selection has influence on the recommendation the tool makes (e. g. the proposed solution is not the same for a device operating three years than for a device operating 10 years continuously).



**Figure 3:** Screen to select the expected life time

3) Device selection: according to the type of marine converter selected previously (wave or tidal), the user must indicate in this point the device to be assessed. There are eight options for wave converters (see Figure 4) and six options for tidal converters (see Figure 5). When an option is selected, a brief explanation of how this device works appears below the names and pictures of the devices (in Figure 6 the explanation of how an overtopping terminator works is noted).
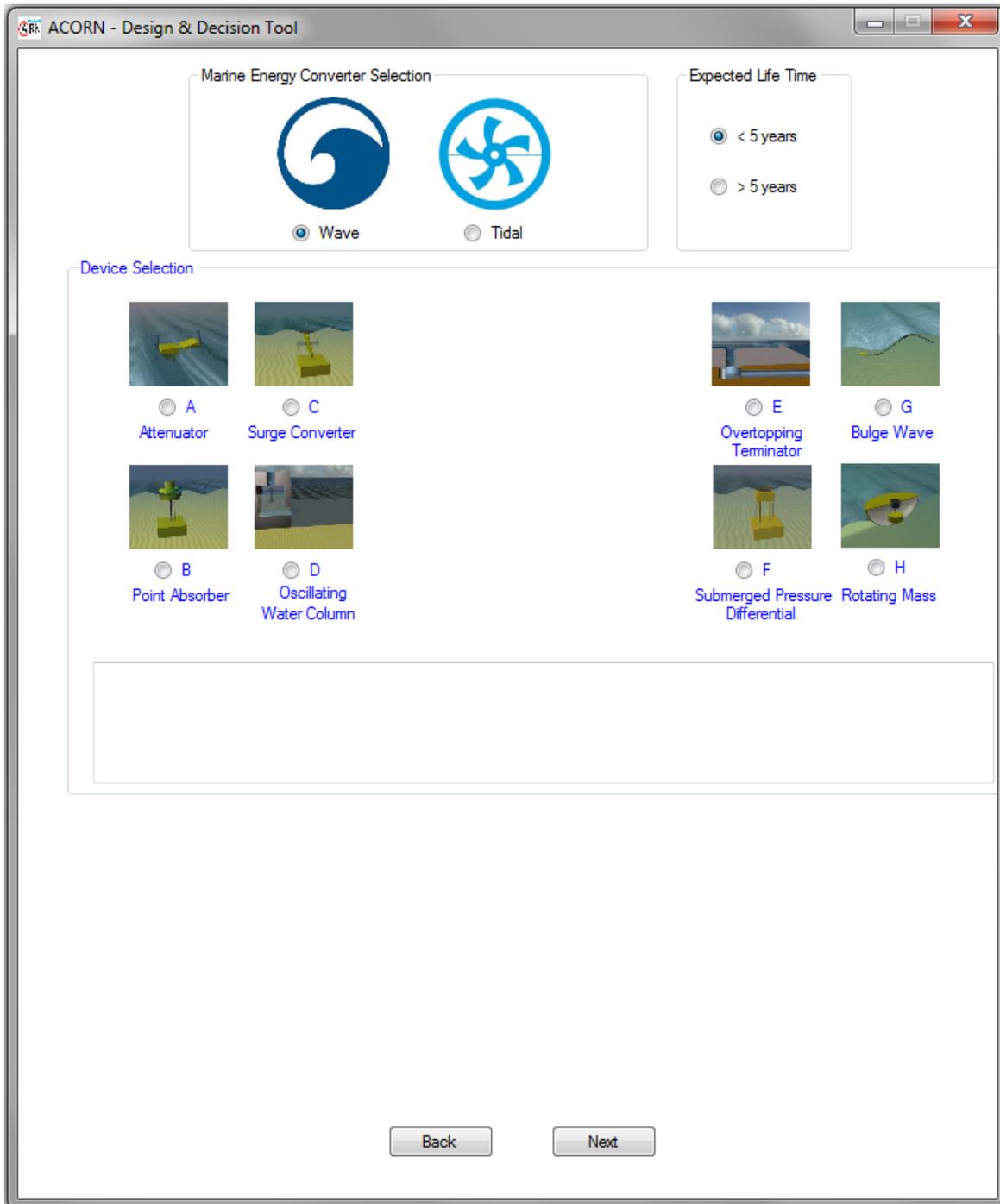


**Figure 4:** Screen to select the device for a wave converter
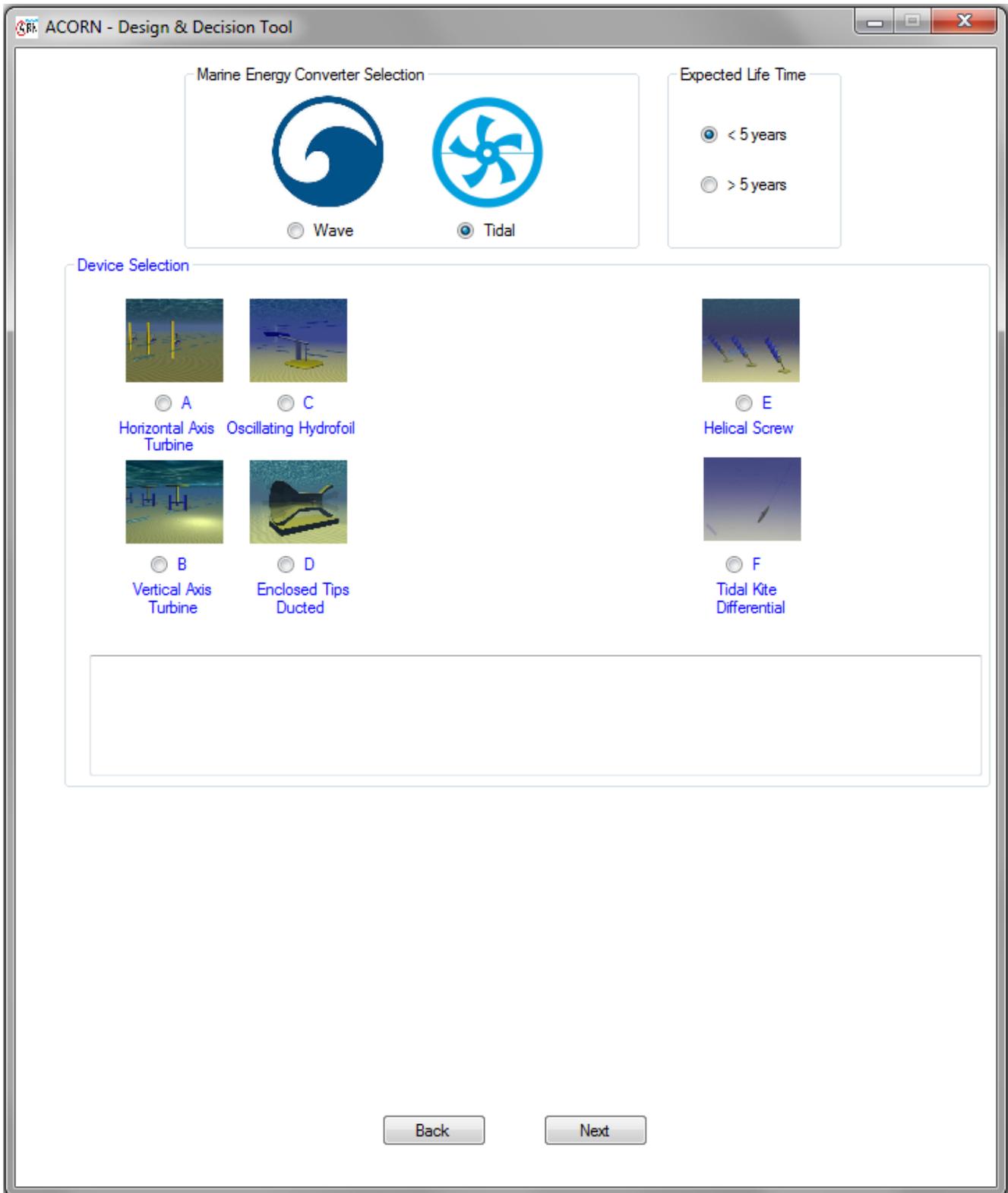
**Figure 5:** Screen to select the device for a tidal converter

4) Subsystem selection: there are four subsystems defined for all the devices, independently of being wave or tidal converter: Prime Mover; Structure, Foundations and Mooring; Power Take Off; and Control. The user must select the subsystem to be assessed by the tool. When a subsystem is seleceted, a brief explanation of it appears below the selection.
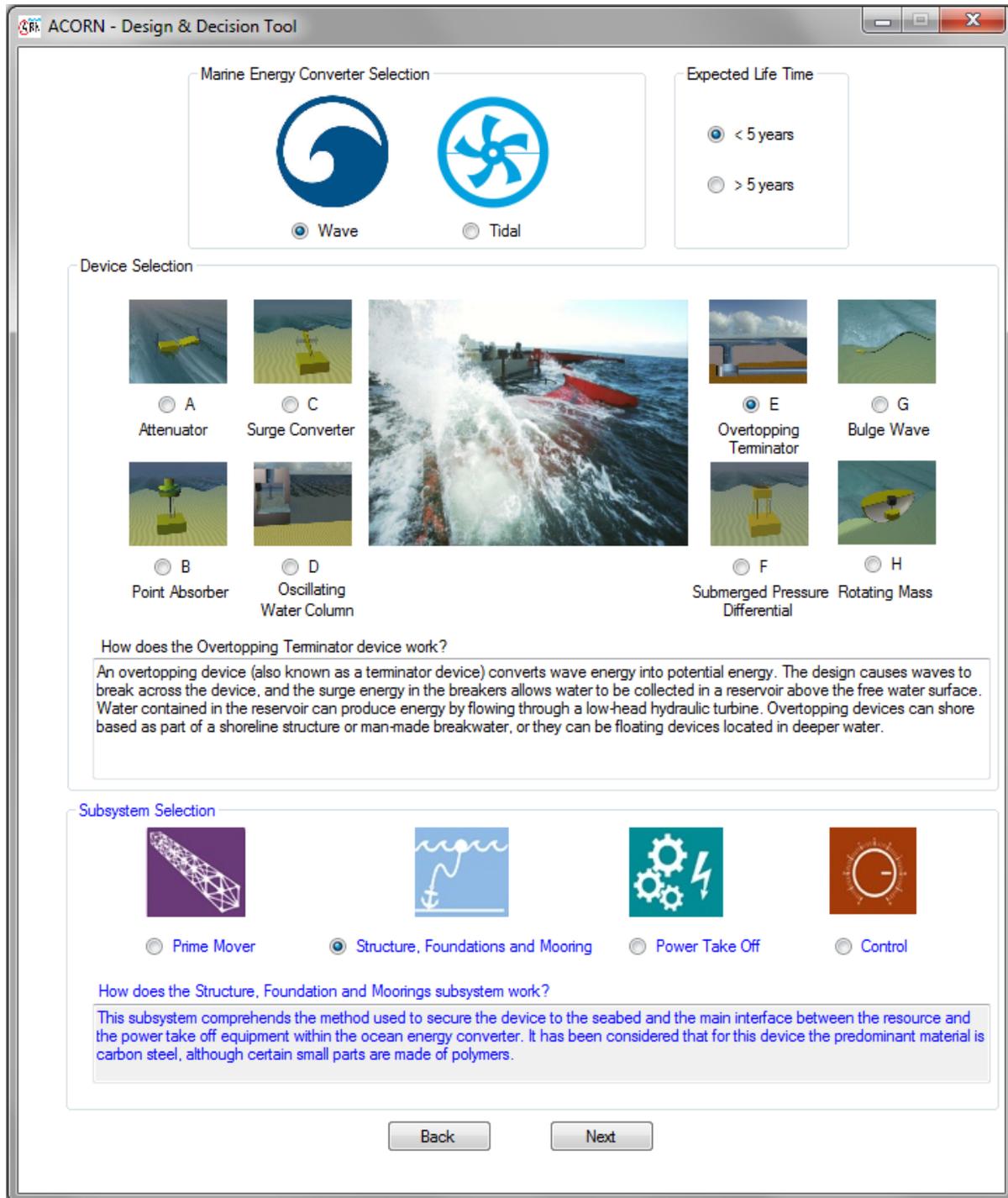


**Figure 6:** Screen to select the subsystem

After the Subsystem selection is done, clicking the "Next" button, the following screen is shown. In this screen, the recommendations to combat the identied surface degradation mechanisms for the selected subsystem, device and expected life time are shown (see Figure 7).

In the upper part of the screen, there is a part called "Your Selection" where there is a reminder of the selections made in the previous screen. Below this part, there is another section called "Recommendations" where the recommendations that the DDT provides the user are shown.



**Figure 7:** Screen that shows an example of the recommendations to combat the different surface degradation mechanisms identified

If the "Back" button is clicked, the DDT redirects to the previous screen where the converter type, the expected life time, the device type and the subsystem are selected. If the "Next" button is clicked, the last screen is showed where the logos of all the partners of ACORN Project are set (see Figure 8). It any of these logos is clicked, the tool redirects the user to the website of this company.

There are also two email addresses to contact in the case there is any doubt in the way the ACORN coating is applied (surfacing@twi.co.uk) or the DDT works (info@ctcomponentes.com).
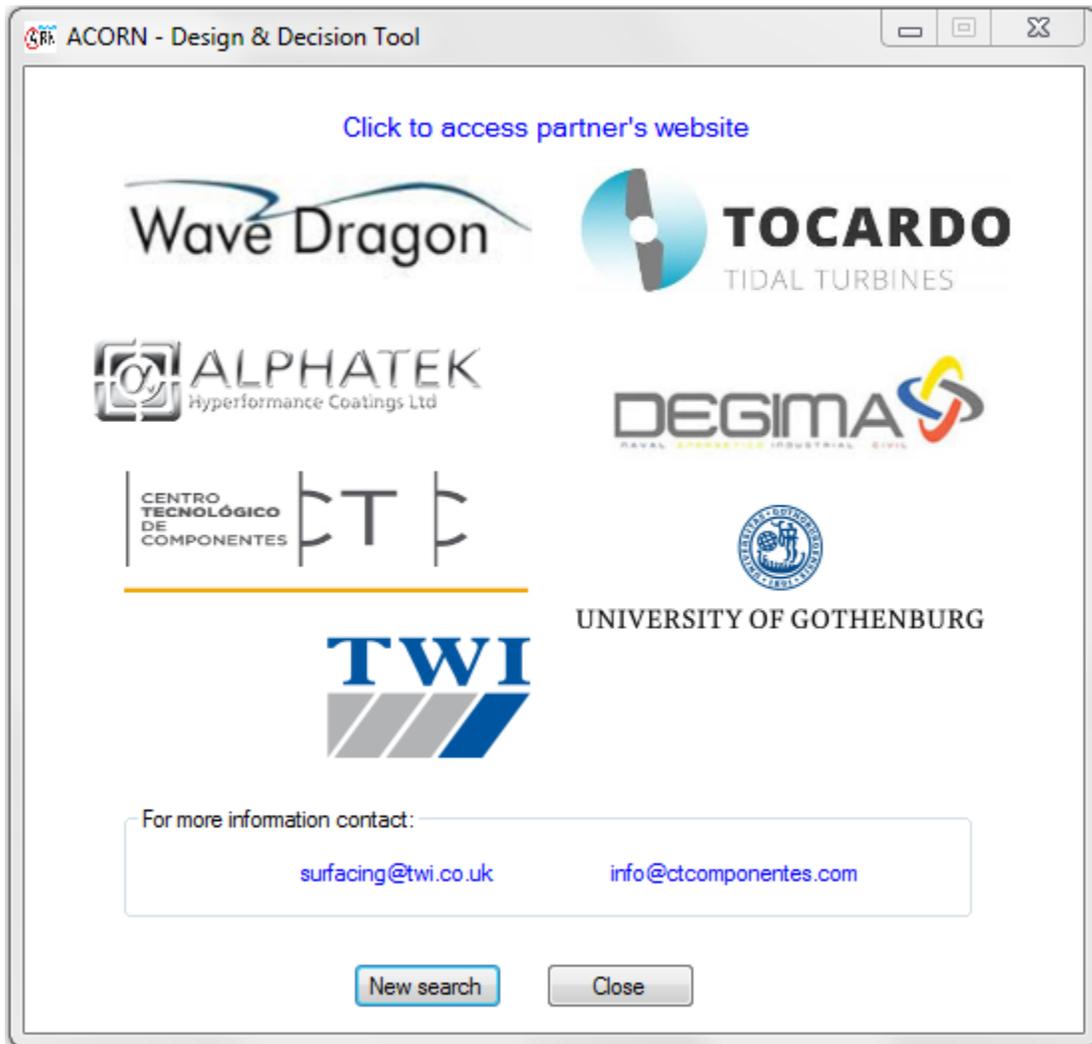


**Figure 8:** Schematic diagram of TSA application

There are two buttons in the lower part of the screen: "New search" button and "Close" button. If "New search" button is clicked, DDT shows the main screen (Figure 2) to start the process again. If "Close" button is clicked, the DDT is closed.