



*Advanced Design Tools for Ocean Energy Systems Innovation,  
Development and Deployment*

# Ocean Energy Europe Workshop

## Stage Gate design tool

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 785921



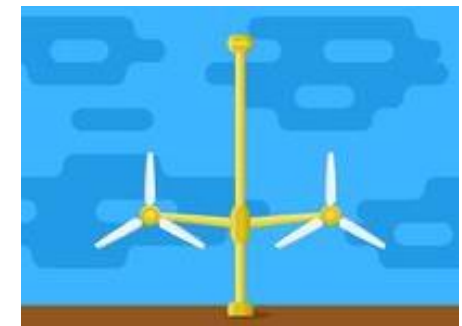
# Stage Gate design tool

## Why it's needed

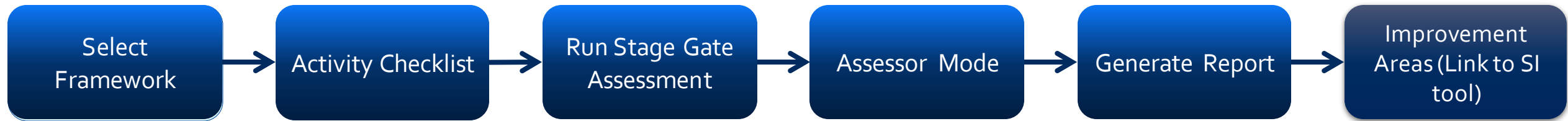
- No consensus on technologies in ocean energy sector
- Difficult to compare different concepts
- Urgently need consistency in assessment processes
- Pathway to demonstrate progress to investors

## The Stage Gate design tool aims to

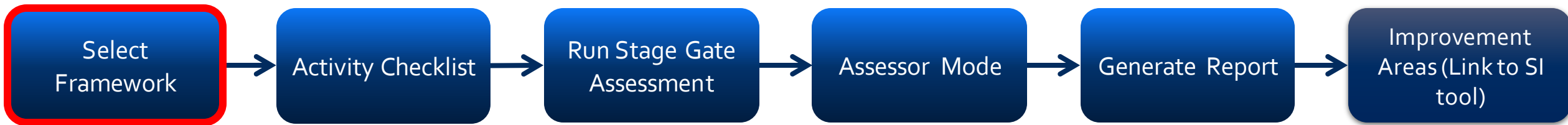
- Provide a framework to assess ocean energy technology
- Facilitate clear consistent assessment
- Enable technology developers to demonstrate success
- Enhance the DTO+ suite by bringing all assessment processes together



# Overview of the Stage Gate tool



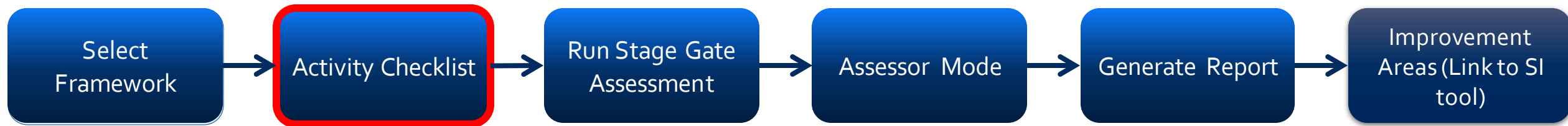
# Overview of the Stage Gate tool



## Selecting the framework

- Review and select pre-defined frameworks
- Edit thresholds to metrics

# Overview of the Stage Gate tool



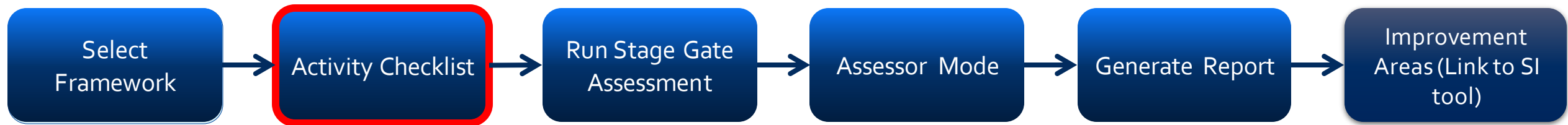
User checks off what technology development activities have been completed, in each of the following categories:



For example:

- Tank testing at 1/25th - 1/10th scale
- Development of basic FMEA based on tank-test & modelling data
- Development of basic O&M schedule for planned maintenance
- Identification of main failure modes and associated estimates of MTTR (hours) for each mode

# Overview of the Stage Gate tool



Based on Activities complete, the user selects which stage gate they would like to select:

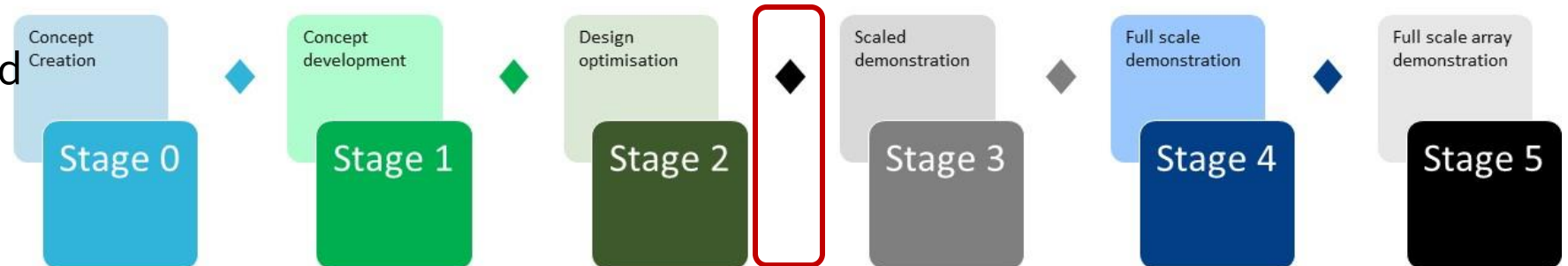
Stage Gate 0 – 1

1 – 2

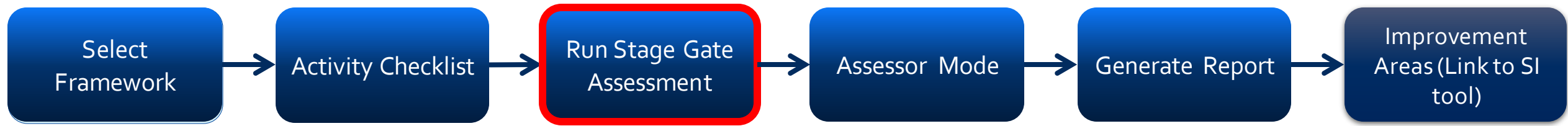
2 – 3

3 – 4

4 – 5



# Overview of the Stage Gate tool



The user will be asked to fill out **questions** about their technology

Qualitative questions

User inputs narrative

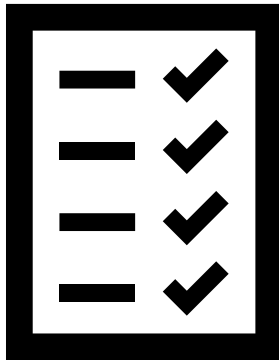
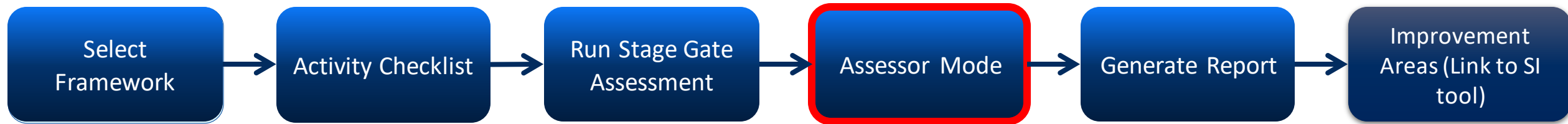
Quantitative questions

User inputs metrics

Run Deployment and Assessment tools



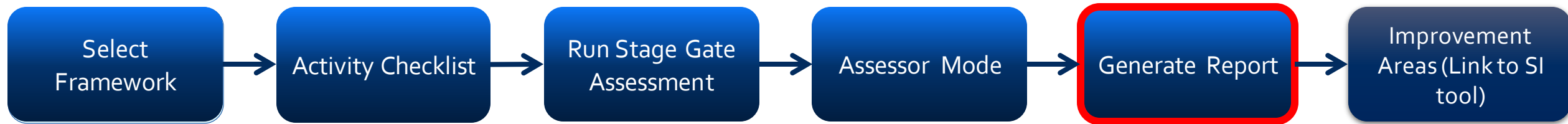
# Overview of the Stage Gate tool



- The applicant scores can be reviewed – both qualitative answers, metric results and justification text
- Scoring criteria used
- There is space for assessor comments



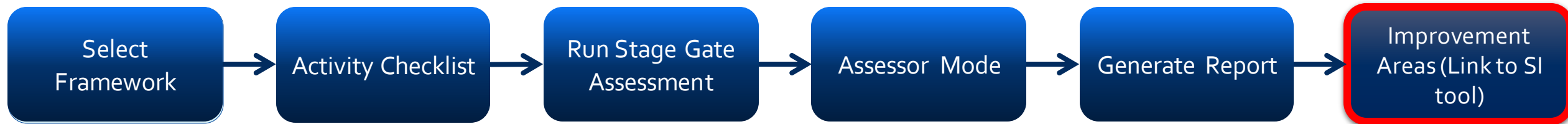
# Overview of the Stage Gate tool



Standardised PDF report generated summarising all inputs, results and scores



# Overview of the Stage Gate tool



*Examples of improvement areas:*

- If running a stage gate assessment identifies a missing Evaluation area
- If the metric results deviate significantly from the thresholds set by the user



# Demo – Outline

- 3 use cases to demonstrate the key features of the tool
- Consider the following scenario:

*A wave energy technology developer is working on a novel wave energy device, at an early stage ~ TRL 3*



# Demo – Use Cases

Activity Checklist

Run Stage Gate  
Assessment

Improvement  
Areas (Link to SI  
tool)

- 1) The technology developer wants to identify the stage of development that they have reached
- 2) After completing the outstanding tasks for a Stage, they want to simulate running a Stage Gate assessment to see if they are ready to progress to the next stage
- 3) A technology developer wants to understand which areas of their technology need to be improved upon. This is one of the key integration points with the Structured Innovation tool. Can be used for concept improvement


# Back-up slides


OEE demo






This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 785921



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 Stage Gate Studies

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# Welcome to DTOceanPlus

Stage Gate tool v0.3.0

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Frameworks

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Create Stage Gate study

Compare Stage Gate studies

Name	Description	Framework	Operations
OEE demo	An example for OEE 2020	Framework with thresholds	<p>Select Edit</p> <p>Delete</p>



**Name of Study:** OEE demo

**Description:** An example for OEE 2020

**Framework:** Framework with thresholds

- Activity Checklist
  - [Perform](#)
  - [View Results](#)
- Stage Gate Assessment
  - [Applicant Mode](#)
  - [Assessor Mode](#)
- Improvement Areas
  - [View improvement areas](#)
- Generate and export summary report
  - [Generate PDF report](#)



## Stage 0

Activity Category  Evaluation Area

Concept creation and description

Device concept definition

Materials identification

- **Description:** Identification of key materials and structure types through concept description

Complete?

Sizing estimates for structure

- **Description:** Identification of rough commercial-scale size of key structural components and comparison to the existing industry capability

Complete?

Impact of control systems on installability

Hydrodynamic performance assessment

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Frameworks

Stage Gate Studies

Links

- **Description:** Identification of rough commercial-scale size of key structural components and comparison to the existing industry capability

Complete?

Impact of control systems on installability



Hydrodynamic performance assessment



Power take off (PTO) considerations



Design and analysis of control systems



Preliminary economic assessment



Environmental and social impacts



Comparable technology evaluation



Novel technology evaluation



Target selection



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Save

Submit

Next Stage >



< Go Back

**Name of Study:** OEE demo

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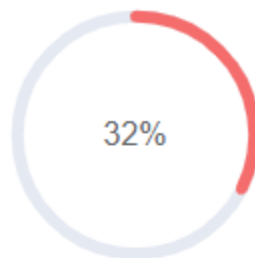
Stage 0



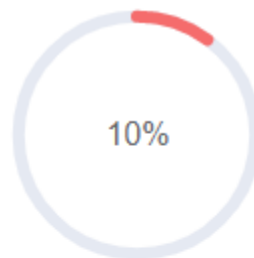
Stage 1



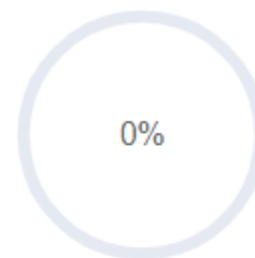
Stage 2



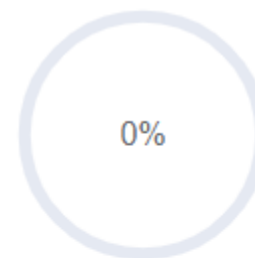
Stage 3



Stage 4



Stage 5



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### Activity Categories

Manufacturing processes	50%	3 out of 6 activities complete
Tank testing	0%	0 out of 1 activities complete
Rig testing	0%	0 out of 3 activities complete
Survival tank testing	75%	3 out of 4 activities complete
Device and PTO integration	0%	0 out of 1 activities complete
Numerical modelling	0%	0 out of 6 activities complete
Load and safety factor assessment	0%	0 out of 2 activities complete
Design solution optimisation	0%	0 out of 2 activities complete
Installation plan	0%	0 out of 1 activities complete
FMEA, O&M model and plan	50%	2 out of 4 activities complete
LCOE model	100%	2 out of 2 activities complete
Greenhouse gas emissions	100%	1 out of 1 activities complete
Environmental and social impacts	0%	0 out of 1 activities complete

### Evaluation Areas

Acceptability	50%	1 out of 2 activities complete
Installability	0%	0 out of 2 activities complete
Availability	100%	1 out of 1 activities complete
Maintainability	33%	1 out of 3 activities complete
Reliability	0%	0 out of 4 activities complete
Survivability	43%	3 out of 7 activities complete
Affordability	100%	2 out of 2 activities complete
Manufacturability	50%	3 out of 6 activities complete
Power Capture	0%	0 out of 4 activities complete
Power Conversion	0%	0 out of 4 activities complete



**Name of Study:** OEE demo

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## Stage Gate 1 - 2

### Technology

In this section, Applicants shall address the following:

- What is the current baseline layout of the WEC/TEC?
- What challenges and technical risks exist prior to commercial adoption?
- What mitigations are required in order to overcome these challenges?
- What activities have already been completed to reduce the technical risks?

### Engineering description of technology

### Degree of novelty and innovation (I)

- **Description:** Describe the technological innovation being implemented, how it will improve best-in-class.
- **Weighting:** 6
- **Scoring criteria:**
  - The novelty and innovation of the technology is based on sound scientific, technical and engineering principles and remains likely to improve best-in-class performance.
  - Identification of any dependencies on wider technical breakthroughs, and the likelihood of this being successful.

### Response

Here, the user will describe the technological innovation being implemented, and how it will improve the current state-of-the-art.

Metrics - Installation

In this section, Applicants will provide key metric results for the 'Installability' evaluation area. They will also provide a narrative around the assumptions, inputs and calculation methods used to generate these values as well as outlining the justification for the decisions that were made.

Installation duration

- **Description:** Please enter the value for the average installation duration.

Please also describe any assumptions, input parameters and calculation methods that were used and provide a justification for these decisions in the corresponding text box.

The Deployment and Assessment tools of DTOceanPlus can be used to calculate this key metric.

- **Weighting:** 2
- **Scoring criteria:**
- **Metric:**
  - **Name:** Average installation duration
  - **Evaluation area:** Installability
  - **Unit:** hours per kW

**Result**

-	0.35	+
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**Justification**

An example justification. Providing background of how this metric was calculated, the assumptions used etc.



## Summary

Response rate (%) 71%

Threshold success rate (%) 50%

## Metric results

Metric	Unit	Result	Threshold type	Threshold	Pass/fail	Absolute distance (units)
Average installation duration	hours per kW	0.35	upper			
Cost of installation	€	9999	upper			
Probability of failure of system	%	9999	upper			
Probability that a maintenance activity can be carried out	%	9999	lower			
Average maintenance duration	hours per kW per year	9999	upper			
Probability of structural irreparable failure	%	9999	upper			
Average time-based availability of array	%	43	lower	50	FAIL	7



## Improvement areas

Please select the Stage to use as the basis for the Improvement Area analysis. Any applicant answers or assessor scores provided in the Stage Gate immediately preceding the selected Stage are also used in this analysis (where applicable). By default, the analysis uses the Activity Checklist results to identify the earliest Stage that has not been fully completed and selects this Stage as the basis of the analysis.

The list of improvement areas that have been identified for this Stage Gate study will be shown below. Improvement areas are those evaluation areas that have been highlighted as weaknesses of the technology or device. The list is sorted in descending order by the total number of causes for each evaluation area. The causes for each evaluation area are also listed.

Stage 2

- Power Conversion
  - Less than 50% of activities for the evaluation area were completed
  - The result for a metric tagged to the evaluation area failed to meet the specified threshold
  - Average or weighted average assessor score for an evaluation area was less than 3
- Maintainability
  - Less than 50% of activities for the evaluation area were completed
  - Average or weighted average assessor score for an evaluation area was less than 3
- Reliability
  - Less than 50% of activities for the evaluation area were completed
  - Average or weighted average assessor score for an evaluation area was less than 3
- Installability
  - Less than 50% of activities for the evaluation area were completed
- Survivability
  - Less than 50% of activities for the evaluation area were completed
- Power Capture
  - Less than 50% of activities for the evaluation area were completed
- Availability
  - The result for a metric tagged to the evaluation area failed to meet the specified threshold
- Affordability
  - Average or weighted average assessor score for an evaluation area was less than 3