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PROJECT FINAL REPORT

1. **Grant Agreement number: 262552**
2. **Project acronym: MARINET**
3. **Project title: Marine Renewables Infrastructure Network**
4. **Funding Scheme: FP7 Infrastructures**
5. **Period covered: from 01 April 2011 to 30 Sept 2015**
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[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

4.1 Final publishable summary report

4.1.1 Executive Summary (1p)

In accordance with the EU's unilateral 2020 target for its 28 Member States to reduce overall greenhouse gas emissions, the ocean energy sector is creating an entirely new industry to provide clean, green electricity where security of supply is far greater than fossil fuels, since resources are readily available within the EU's borders. Ocean derived renewable energy is still in the early stages of development but already shows huge potential for making a significant contribution to energy generation and job creation. However, if Member States conduct R&D of green technologies separately, duplication and a lack of knowledge sharing could considerably slow down progress. The Marine Renewables Infrastructure Network (MaRINET) aimed to coordinate these efforts and speed up the EU's bid to protect its economies and reduce global warming.

MaRINET is a network of (European) research infrastructures that specialise in marine renewable energy, which is defined as energy derived from ocean resources as well as offshore wind. MaRINET consists of 45 infrastructures that are operated by 30 research centres around Europe. Nine million Euro in EU funding enabled the network to offer both academic and industry groups periods of free-of-charge access to their infrastructures, to improve the infrastructures by conducting research, to standardise the testing methods and promote training and networking. The ultimate aim was to support the acceleration of the development of marine renewable energy by harnessing the full capabilities of these infrastructures.

A cornerstone of the MaRINET initiative was to provide transnational access to world-class facilities for researchers and developers of marine energy systems. Researchers and developers have been granted access to supported facilities that would not necessarily be available in their home state, or might be too expensive for SMEs to access normally.

Under WP2, a crucial step in arriving at a standardised set of best practises has been the successful in 'round robin' testing using a standardised scale model tidal device. The process enabled cross comparison between the performances of a device, irrespective of the infrastructure in which it was being tested. To achieve this, the scale tidal device developed by the French Research Institute for Exploitation of the Sea (IFREMER) was tested in two re-circulating flume tanks in France and Italy and two tow-tanks in Italy and the UK. Implementing an identical test programme at all four facilities. The round robin was the first of its kind to analyse tidal energy and quantify the effects that different simulated environments can have on test device performance. Consequently, MaRINET will be able to produce a test tank calibration factor to enable the desired cross comparison.

The programme of research carried out within MaRINET under WP4 was productive. New approaches for offshore wave climate / tidal current / wind site assessments have been investigated and documented. Technical research with direct impact for the offshore industry development has been performed (e.g. standardised PTO testing methods and advanced mooring concepts), and scientific results have been successfully introduced to the Marine Energy Research Community in various paper publications and conference presentations. The environmental impact of Marine Energy has been quantitatively evaluated and monitoring techniques have been documented in a comprehensive data base.

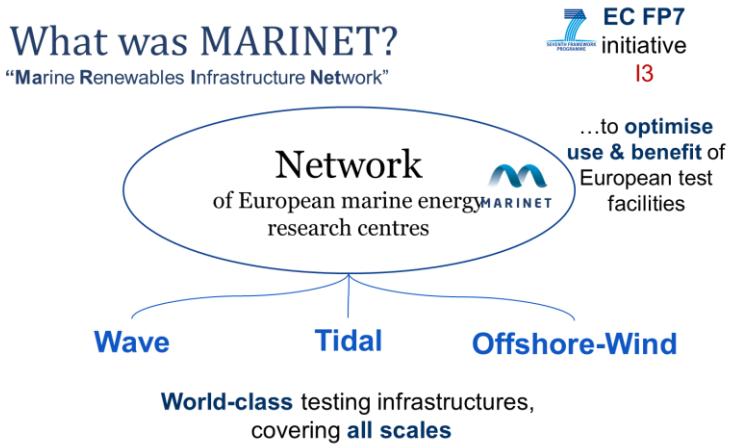
MaRINET has been present at most EU offshore renewable energy conferences and held two User Workshops; Rome in November 2013 and Nantes during Oct 2015, bringing together user groups and infrastructures managers. MaRINET related research has led to over 60 scientific papers and conference presentations, including seven key articles published in a special issue of the International Journal on Marine Energy (IJOME 12, 2015). The full content of this edition is devoted to user groups who have participated in, or who have benefited from infrastructure access through MaRINET.

4.1.2 Summary of Marinet Project and Objectives

Overview

With abundant Wind, waves, currents — the open seas are awash with untapped energy. In theory, offshore conversion systems could play a key role in the EU's shift towards a more sustainable energy mix. In practice, installed capacity remains limited, and only a fraction of the innovative concepts that could help to power more European households from renewable marine sources have matured towards deployable technologies. MaRINET integrates world-class infrastructures and expertise in a drive to bridge the R&D gap between an inspired idea and a marketable product. Progress in this technology area required a streamlined approach to R&D. access to guidelines in the shape of the project's Structured Development Plan, a blueprint for construction born from an EU Seventh Framework Programme (FP7), developed by NASA and accepted worldwide through the International Energy Agency (IEA). Though differing slightly for each type of technology, development follows the same five stages, starting with the technical analysis of a small-scale concept model through to prototype testing, technical deployment and its final implementation as a commercial unit. Each of these stages is correlated with one of the standard "TRL's" or Technology Readiness Levels which are now a universally recognised method of benchmarking the development status of devices or technologies.

The 29 partners involved in MaRINET were focused on accelerating the flow of promising ideas and providing first-rate research and development (R&D) capacity and support to facilitate their commercialisation. Europe's Marine Renewable Energy community is developing a raft of innovative technologies, which include wave energy and tidal stream converters as well as wind turbine designs for deep water deployment and combined wind- and wave-powered devices. These diverse applications are currently at different stages of development and they aim to harness renewable sources that are disparate in nature. A correspondingly wide array of test infrastructures, with diverse capability, is required to take them forward. With 48 highly specialised research facilities equipped for transnational access, the project partners set out to deliver 700 weeks of access time to support outstanding R&D efforts. Partner infrastructures ranged from the laboratory scale to large open sea test sites. The partners' transnational access (TNA) programme, underpinned by a centralised application procedure, directed prospective external users towards the installations that are best suited to their needs. Transnational Access opportunities were offered in five areas: wave energy research, tidal energy research, offshore-wind energy research, cross-cutting or common issues, and databases and environmental data. They enabled successful applicants to advance their research at first-rate facilities and, just as importantly, to benefit from the partners' outstanding expertise and know-how. They also promote a coherent, standardised approach based on tried-and-tested methodologies and protocols as a further means of boosting the impact of R&D investments.



Key Features of Marinet

- 12 countries
- 29 world-class research institutions
- 45 facilities
- 4 years, from 2011-2015
- €11.1m programme
    - of which €9m EC-funded

Who Was Involved

29 Founding Partners, coordinated by UCC, with associate partners NCKU (Taiwan), and various other intersted parties in EU, US, Canada

The main features of MaRINET TNA at a glance were:

- Unique free-of-charge access to facilities and expertise:
    - ~700 weeks, 300 projects, 800 users
    - 8 Short Courses - 200 trainees
    - 20 Staff Exchanges
    - Round Robin Testing and standardisation
    - New global network - all MRE infrastructures working *together*
- Accelerating technology & industry development?
- Facilities oversubscribed
- Training courses oversubscribed
- International reach and interest
- Positive User group feedback
- Round robin testing in both wave and tidal
- All **active** Facilities and staff better networked

4.1.3 Science and Technology Results of the Marinet Project

4.1.3.1 WP 2 Ocean Energy System Testing – Standardisation and Best Practice

Introduction

The overarching objective of this coordination activity under Marinet was to advance the standardisation and harmonisation of research methods for wave energy, tidal energy, offshore wind energy and cross cutting energy technologies. To maximise value and synergistic interactions with ongoing initiatives, the activities within this work package referred to and made use of, where possible, deliverables with other external actions in progress, such as the FP7 funded project EQUIMAR and the work of Annexe 2 of the International Energy Associations Implementing Agreement and IEC TC114. This approach has avoided duplication of effort and ensured effective engagement and uptake of outputs/ deliverables from these programmes, noting that some of the Participants in this Task were also involved in these other activities.

Marine renewables testing centres are not uniformly configured or constructed, so the deliverables from WP2 were designed to complement deliverables from other projects by:

- developing an understanding of the impact the specific test centre geometrical layout and configuration has had on the testing results;
- quantification of the range of errors introduced and the sensitivity of the individual components making up the testing procedure;
- development of specific corrective algorithms to be applied to the results from different test centre configurations in order to facilitate benchmarking;
- delivery of Quality Management practices to be adopted in the processing and presentation of data when corrective algorithms have been applied

The work was broken down under 4 main tasks with 29 deliverables, consisting of 11 EC and 18 internal reports undertaken by project partners as follows:

- Task 2.1 Wave Energy – Standardization (Lead: HMRC; Participants: AAU, ECN, UNEXE, EMEC, EVE, UEDIN, SEAI, WavEC, UoP, IPT)
- Task 2.2 Tidal Energy – Standardization (Lead: Uni_Strath, UEDIN; Participants: EMEC, QUB, TTC, IFREMER, INSEAN)
- Task 2.3 Off-Shore Wind Energy – Standardization (Lead: RISOE, LUH; Participants: ECNeth, UNIFI-CRIACIV, Uni_Stutt, NTNU)
- Task 2.4 Power Take-off, Electrical Power Conversion Systems and other cross cutting issues (Lead: Fh-IWES; Participants: NAREC, Technalia_RBTK, SINTEF, UNI-TUS)

The listed deliverable outputs from the various subtasks per reporting period under the above were as follows (together with lead Authors) where it can be noted that many of the EC contracted deliverables take the form of good practice/guidance manuals and databases:

Period 1 Deliverables (4 EC & 8 Internal)

- D2.12 Collation of Wave Simulation Methods ECN
- D2.13 Collation of Model construction Methods SEI
- **D2.1 EC Wave instrumentation database EMEC**
- D2.14 Wave data Presentation and Storage Review UoP
- D2.15 Tidal flow characterisation parameter review UEdin
- **D2.2 EC Collation of Tidal Test Options TTC**
- D2.16 Tidal Test Parameter Draft Overview IFREMER
- D2.17 Tidal Measurement Best Practice QUB
- D2.18 Tidal Data Analysis Best Practice UoS
- **D2.3 EC Review of Relevant PTO Systems Fh-IWES**
- **D2.4 EC Collation of Off-shore Wind-Wave dynamics RISOE**
- D2.19 Collation of Dynamic loads SINTEF

Period 2 Deliverables (3 EC & 7 Internal)

- D2.20 Draft Standardisation Report Wave Simulation incorporating
  - wind/wave joint simulations HMRC (draft)
- D2.21 Review of Mooring Testing Systems EXE
- **D2.5 EC Report on Instrumentation Best Practice AaU**
- **D2.6 EC Report on Off-shore Wind Systems Monitoring Practice and Normalisation Procedures LUH**
- D2.22 Data Presentation Draft Standards WAVEC
- D2.23 Review of Tow Tanks limitations CNRINSEAN
- **D2.7 EC Tidal Measurement Best Practice Manual QUB**
- D2.24 Planning Completed for Comparative Model Tests UEdin
- D2.25 Review Best Practice for electrical PTO systems NAREC
- D2.26 Collation European Grid Codes for Testing TECNALIA

Period 3 Deliverables (4 EC & 3 Int)

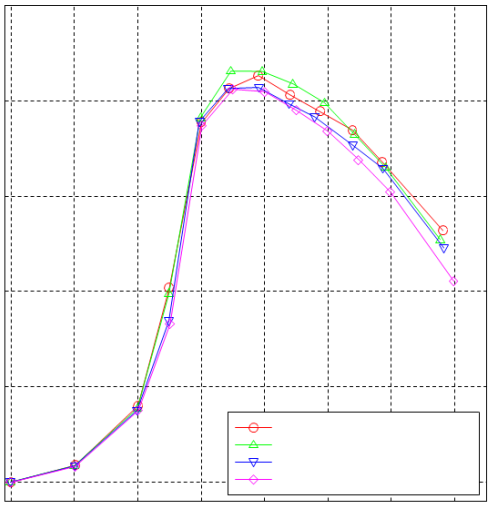
- **D2.8 EC Best Practice Manual and Protocol for Wave Simulations HMRC**
- D2.27 Manual of Wave Instrumentation AaU
- **D2.9 EC Standards for Wave Data Analysis Archival and presentation,** WAVEC
- D2.28 Protocol for Model Construction HMRC
- **D2.10 EC Best Practice Protocol for Off-shore Wind System Fluid-Structure Interaction Testing** ECNeth
- D2.29 Report on Comparative Testing of Tidal Devices UoS
- **D2.11 EC Best Practice Manual for PTO Testing TECNALIA**

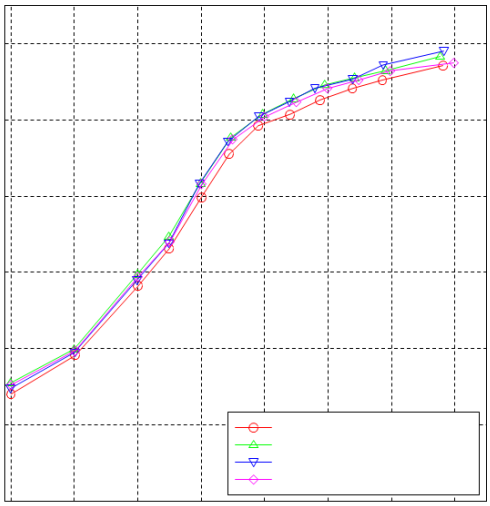
Some of the main highlights of these activities are presented (with Task and associated Deliverables) in the following section in graphic format with explanatory notes.

Task 2.2: Tidal energy Infrastructure comparative testing.

Laboratory name	IFREMER	UoS	CNR-INSEAN 1	CNR-INSEAN 2
Type of tank	flume	Towing	Flume	Towing
Length [*m*]	18	76	10	220
Width × depth [*m*]	4 × 2	4.6 × 2.5	3.6 × 2.25	9 × 3.5
Speed range [*m/s*]	0.1 to 2.2	0.1 to 5	0.3 to 5	0.1 to 10
Turbulence int. [%]	3 to 15	NA	2.5 to 12	NA
Blockage ratio [%]	4.8	3.3	4.8	1.2

The graphs below show close agreement between the key parameters ascertained at each of the test tanks





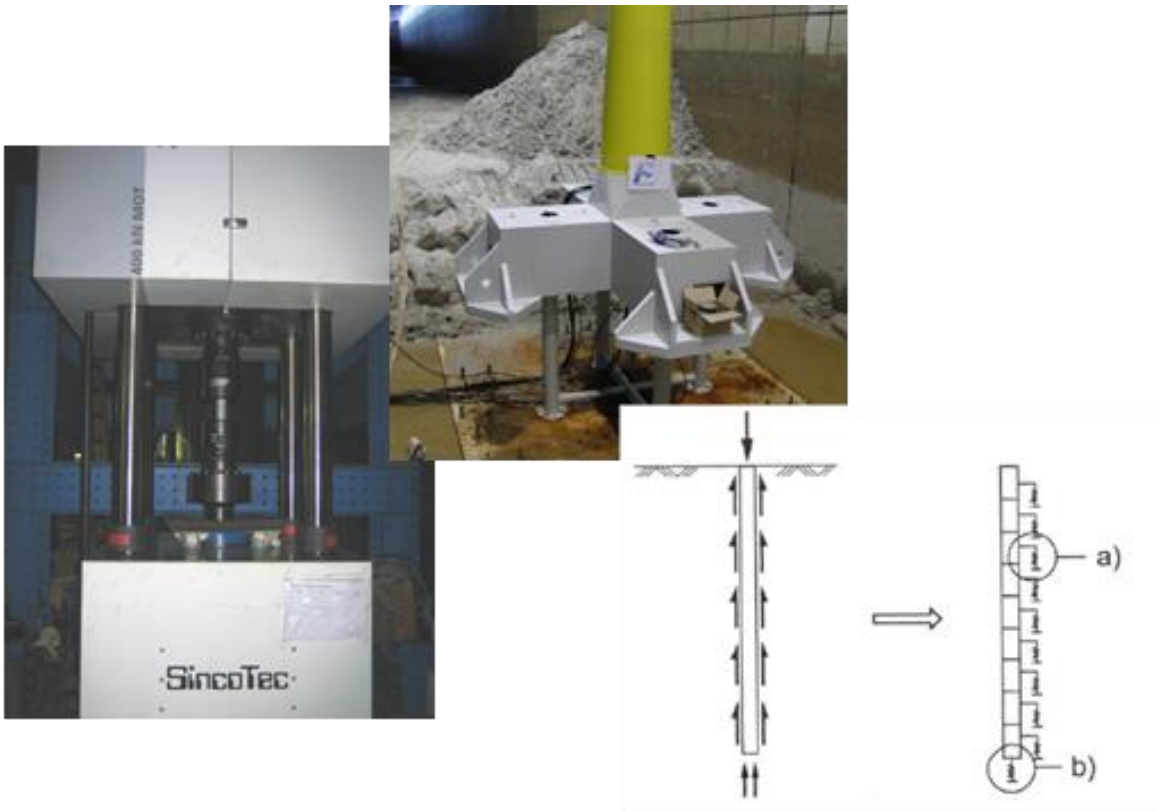
CP/ λ and CT/ λ for IFREMER flume, UoS tow, INSEAN flume and INSEAN tow

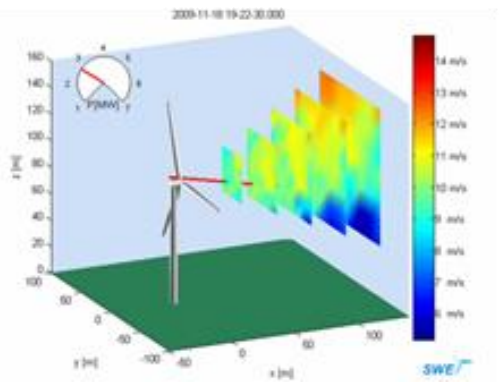
D2.29 Report on Comparative Testing of Tidal Devices. Key features are:

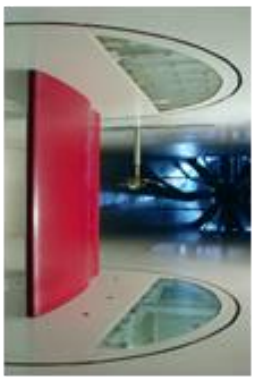
- *Informing infrastructure testing programs to enable comparative evaluation*: test environment, instrumentation, test set-up and execution, processing and production of data and evaluation and interpretation of performance parameters
- Builds on Equimar protocol for tidal device testing
- Robustness checking against Round Robin tidal turbine testing program & TNA activity (INSEAN June 2015)

Task 2.3 Off-Shore Wind Energy Standardisation, D2.6 – Report on Offshore Wind System Monitoring Practice and Normalisation Procedures

- Practices for experimental testing and measurement campaigns elaborated as references for harmonized testing standards in international facilities
- Detailed assessment practice recommendations elaborated for:
  - Fatigue of steel components and structures
  - Pile foundations under cyclic loading
  - Scour development and protection
- Further practical references given for:
  - Wind field analysis
  - Airfoil design
  - Full scale model testing and measurements
  - Wind tunnel model tests
- Involved partners: LUH, USTUTT, ECNeth, CRIACIV, DTU, NTNU

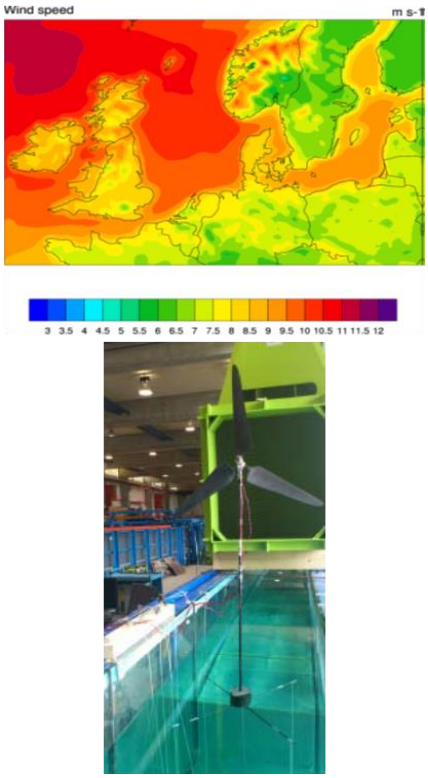






D2.4 - Collation of Offshore Wind-Wave Dynamics

- Protocol manual for representative offshore climates ensuring harmonization of environmental conditions in offshore simulations
  - Wind and wave climates for five offshore sites (North and Baltic Sea)
  - Full description of unidirectional wind-wave climate can be constructed
  - Extension to directional distribution is possible
- Scaling model for wind and wave conditions in physical model tests
  - Existing scaling methods are reviewed
  - Proposed dynamic-elastic scaling model
  - Application example presented for scaled experiment of a floating wind turbine
- Involved partners: DTU, USTUTT, CRIACIV, NTNU



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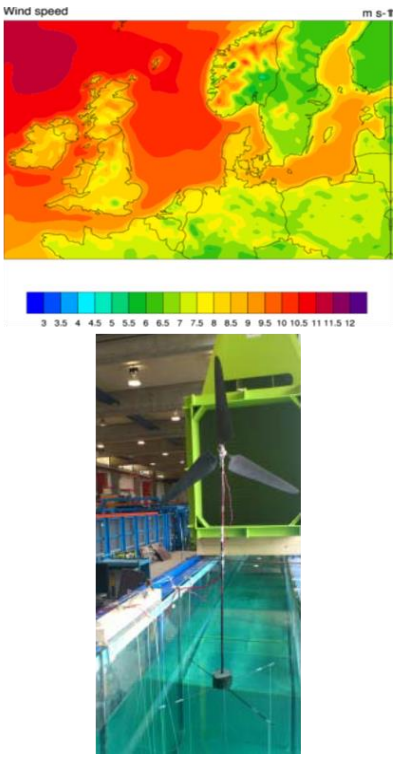
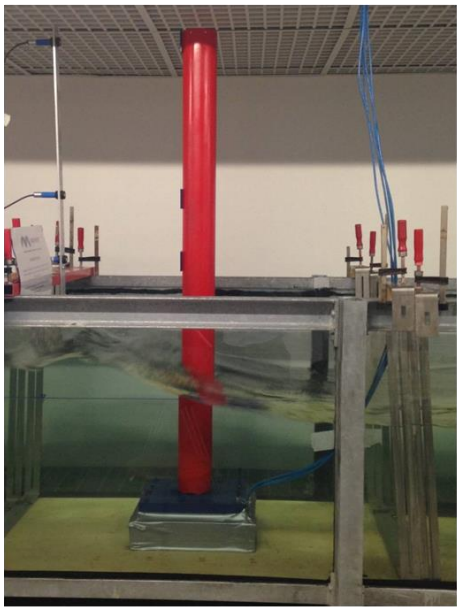


D2.10 - Best practice Protocol of Offshore Wind System Fluid-Structure Interaction Testing

- The best way to prepare the model tests is by writing a test specification. This model test specification should contain the following:
  - Model test purpose
  - Offshore turbine description
  - Scale model
  - Environmental conditions
  - Test scope
  - Test execution
  - Reporting and data analysis
- Institutes involved in D2.10:
  - ECNETH - J.M. Peeringa and A. Brand
  - UNIFI-CRIACIV - E. Marino, L. Cappietti and M.L. Pecora

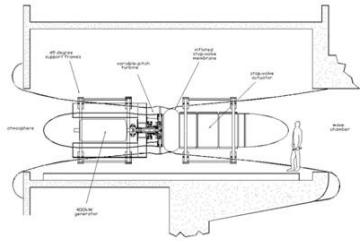


Task 2.4 - Power Take-off, Electrical Power Conversion Systems and other cross cutting issues. The approach was to undertake a global review of existing PTO concepts in renewable energy generation industry (wind, tidal, wave) to identify requirements for PRO testing and standardisation. This was designed in order:

- To support dynamic tests required for the Power take-off (PTO) components to be used in Marine Renewable Energy (MRE) converters
- To establish and dedicate standard PTO testing procedures

PTO Components, Part 1
Transmission of mechanical energy

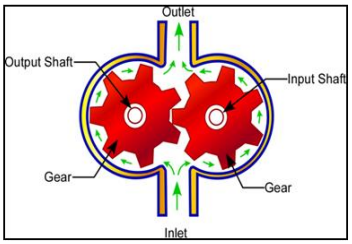
- Air Turbines (Wells, Impulse, etc.):



Left: Principle of an Air Turbine

Right: Pico OWC Plant

- Hydraulic Converters

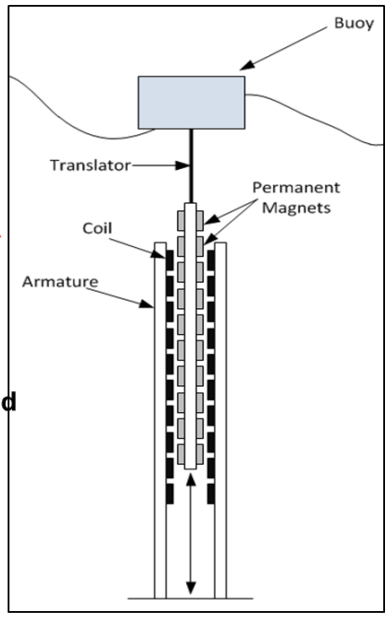


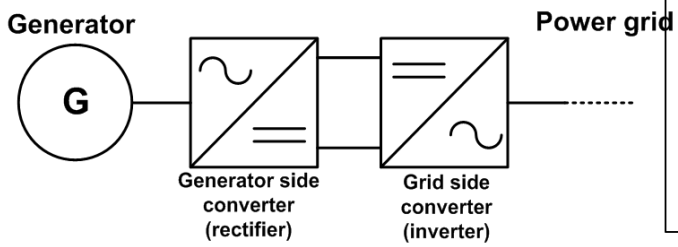
Left: Hydraulic to Mechanic Energy (gear motor)

Right: Pelamis Hydraulic Wave Energy Converter

PTO Components, Part 2
Conversion to grid-compatible electrical energy

- Electrical Generators:
  - Rotating Generators
  - Linear Generators (example)
- Frequency Converters (variable speed PTO operation)





4.1.3.2 WP3 Networking and Transnational Access to World Class Ocean Energy Test Infrastructures

Introduction

The group of partners who came together under MaRINET to provide access to their testing infrastructures all have a long track record in performing research related to the ocean energy sector. They all have suitable facilities and appropriately trained expert staff on hand the expertise to manage and enable a wide variety of devices, testing scenarios and database access across each of the key sectors for a range of technology readiness levels (TRLs). In this way WP3 is effectively where the main operational elements of the project were undertaken, and it was very effectively led by IFREMER. WP 3 was also the focal point for coordinating networking and interchange of staff between infrastructures in order to promote knowledge exchange and transfer of good practice.

The listed objectives of WP3 were to:

- Provide access to shared relevant Research Infrastructure related to marine renewable energy research. to Promote focused research activity in order to speed up development within the Ocean Energy Sector which is growing rapidly in Europe.
- Foster Networking between researchers in Europe through trans-national access to the Infrastructures.
- Promote Networking between the Infrastructures for training to improve capabilities of individual staff members.
- Encourage interchange of research results through the User Workshop meetings

The key features of the MaRINET Transnational Access Programme were:

- Facilitating and encouraging access to infrastructures **located outside the users home country**
- Providing free-of-charge access to 45 facilities
    - Wave Energy
    - Tidal Energy
    - Offshore-Wind Energy & Environmental Data
    - Cross-Cutting Areas (electrical, moorings, materials etc.)
- Facility costs are paid by the EC:
    - ranging from €1,500-€30,000/week
- **Open to all –companies any size, research groups etc. (Uptake was predominantly SME).**
- **Visiting group must be majority-based in EU**

Over the lifetime of the project MaRINET TNA delivered:

• **6 calls for access**	• **178 selected projects**
• **315 Applications for access**	• ~696 weeks of access
• **308 Eligible projects**	• ~€3.5M costs granted

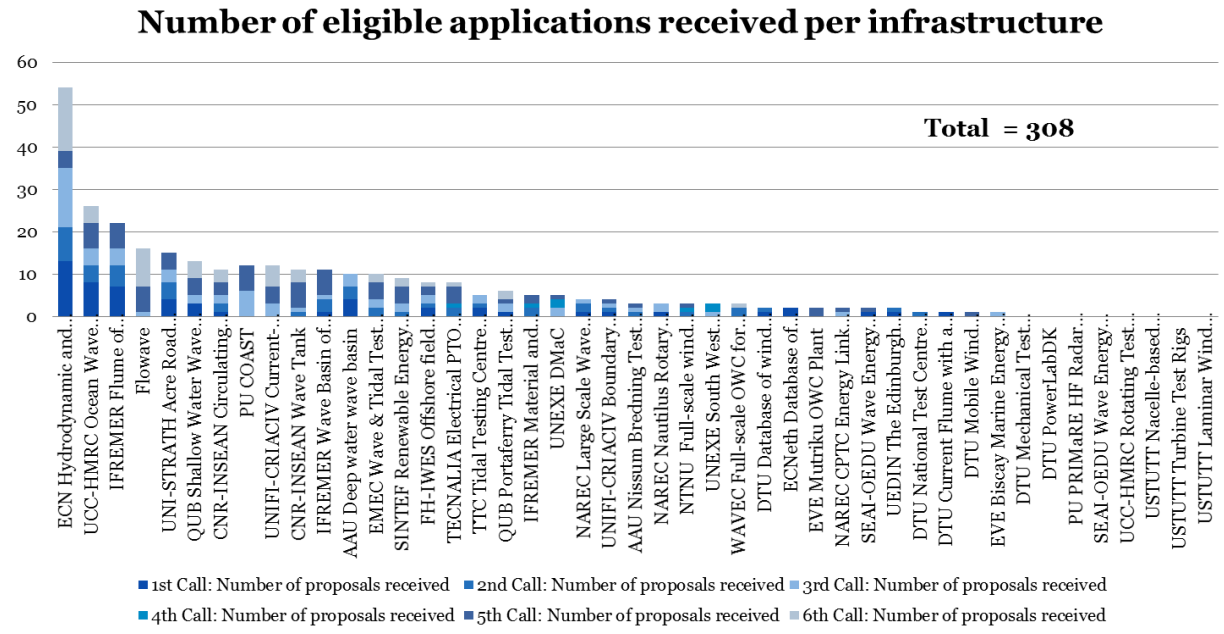
Call number	Call 1	Call 2	Call 3	Call 4	Call 5	Call 6
Opening of Call	1st December 2011	16th July 2012	15th February 2013	28th June 2013	16th September 2013	30th January 2015
Closing of Call	29th February 2012	30th September 2012	22nd March 2013	13th August 2013	21st November 2013	2nd March 2015
Announcement	30th May 2012	20th December 2012	21st June 2013	3rd October 2013	21st January 2014	27th March 2015
Access period	01 June 2012 – 31 January 2013	1st February 2013 – 31st July 2013	1st August 2013 – 31 July 2014	4th November 2013 – 30th April 2014	31st January 2014 – 31st December 2014	30th March – 31 st July 2015

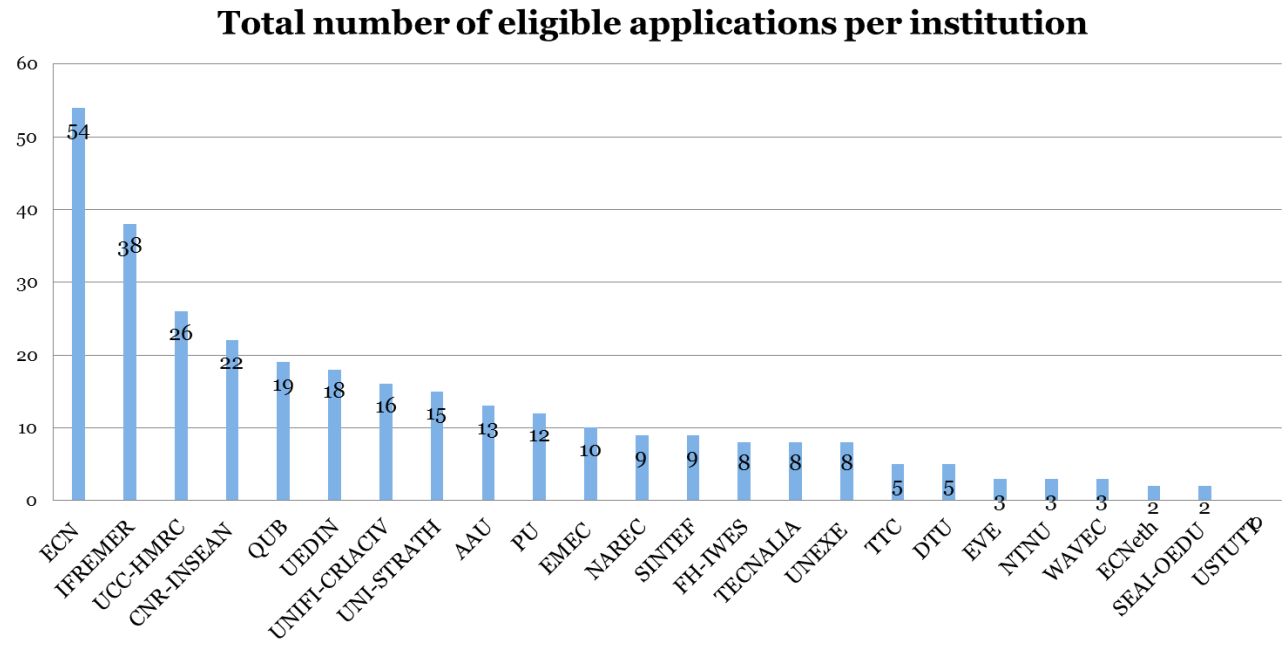
The entire process from initial dissemination of an access call through submission of the final access report by a User in respect of the findings generated was handled via the Marinet website with a specialised User Portal section. This was set up at the start of the project with advanced functionality to manage the detailed requirements associated with operating the access programme and enabled different levels of access depending on role (user, facility manager, coordinator, User Selection Board etc.).

The main elements of the selection procedure used to filter applications received was as follows:

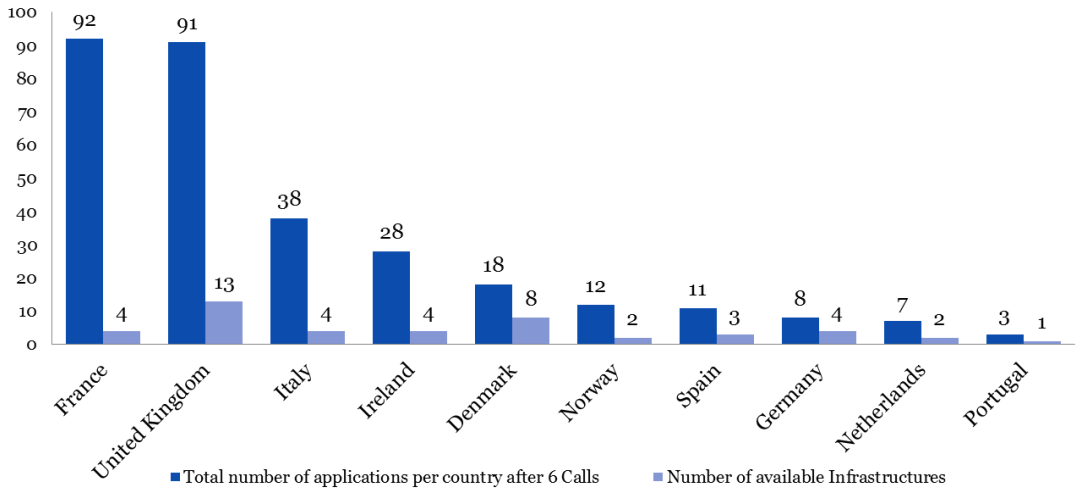
- Technical assessment (Infrastructure Managers) : Technical feasibility – Level of preparedness – Schedule and planning
- Scientific assessment (Internal & External Experts): Quality of Scientific content – Relevance of outcome
- Selection Committee
    - Eligibility criteria
    - Technical feasibility according to Infrastructure managers assessment
    - Experts ranking and comments
    - Management of the requested time in regard of the total allocated time per infrastructure

Summary of outcomes of the TNA Programme



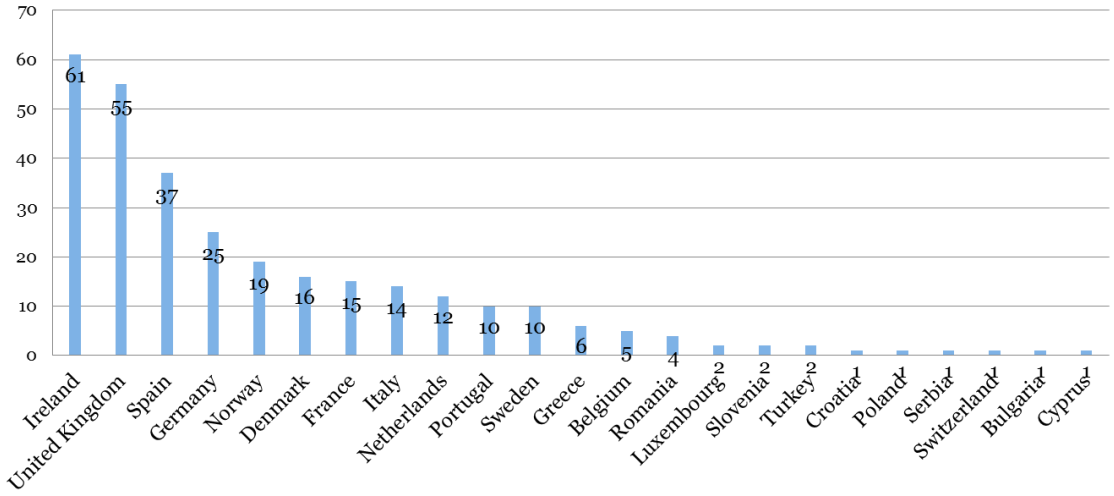


Total number of eligible applications received per country

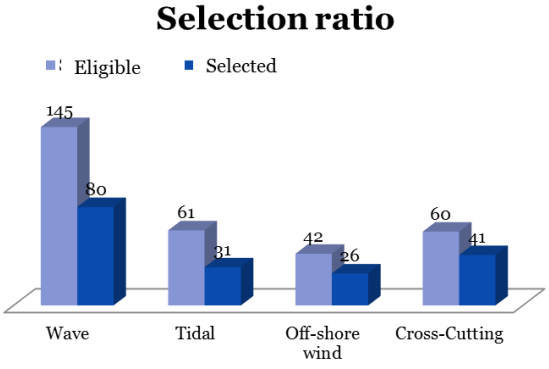


Applications received from 23 Countries across Europe

Total number of applications "from" country



Distribution as a function of Focus Groups



Focus group	% of all eligible projects	% of all selected projects
Wave	47,08	44,94
Tidal	19,81	17,42
Off-shore wind	13,64	14,61
Cross-Cutting	19,48	23,03

Average success Rate : 178/308=57.8%

Summary of Networking activities

Staff Exchange programme:

- Transnational exchange programme for personnel working within existing research infrastructures is offered to share knowledge and experience, train new people for the sector and achieve harmonization of procedures/practices.
- This exchange programme involves training at another Infrastructure for a minimum of one week and is for both experienced and new staff at the individual locations.

~7 Exchanges were organised , including WP2 Round Robin activity

Infrastructure benefiting from the staff exchange programme	Hosting Infrastructure	Objectives
AAU	PU COaST	large-scale setups in Large Lab
AAU	UCC-Beaufort	Management of TA access cost reporting
UCC-Beaufort	Strathclyde	Round Robin WP2
Ifremer wave-current flume	Strathclyde	Round Robin WP2
Ifremer wave-current flume	CNR-INSEAN Circulating water channel	Round Robin WP2
Tecnalia PTO Lab	UCC-Beaufort	Learning about Tank Testing facilities
Tecnalia PTO Lab	UNEXE SWMTF	Moorings testing and procedures

4.1.3.3 WP4 Research to innovate and improve infrastructures technologies and techniques

The work programme conducted under WP4 involved 23 partners and was designed to address a number of unsolved issues that are specific to ocean energy technologies and required further research. The transition of wind energy offshore required specific infrastructure capabilities which were different from techniques onshore. The relevant Infrastructures also identified some key issues related to improvement of capabilities in this area. Advantages gained from the joint research approach were:

- a whole range of methods and techniques was available to bring together best available instrumentation and data analysis methods for comparative studies for and validation of different new methods
- feedback during development process from simulation and modelling, through model testing to the final full scale field test
- the different highly interdisciplinary skills from the leading research teams throughout Europe were brought together to maximise synergies in complex generic topics such as wave current interaction and others
- techniques and methods which have in the past been used independently and were combined for testing e.g. in hardware in the loop test combining controlled operation and real numerical modelling, water to wire test of complete models instead of individual component tests
- joint activity enabled the harmonisation of different methods in order to make results comparable e.g. by introducing common instrumentation and data processing methods
- joint activity enabled the identification of the differences and limitations of methods and techniques and to combine the best available ones for the benefit of the whole research community.
- The different activities described under this work package are consequently a combination of the optimisation of existing instrumentation, the development of new instrumentation and the required data processing, the development of new test methods and the introduction and validation of new theoretical approaches from numerical modelling through tank tests to full scale field tests.

The research work was broken down into six tasks as follows:

Task 4.1: Wave Energy Infrastructure Related Research

This task investigated new methods related to remote underwater motion measurement, non-intrusive wave field measurement, and real time estimation of incident waves. It is led by ECN (Ecole Centrale de Nantes, France).

Task 4.2: Tidal Energy Infrastructure Related Research

This task investigated improvements in the determination of the current velocity field over a Tidal Energy Converter's swept area, focusing on dynamic effects from turbulence and waves and the resulting dynamic forces in the rotor blades by improving the use of existing (as well as designing new) instrumentation, and was led by QUB (Queen's University Belfast, UK).

Task 4.3: Offshore-Wind Energy Infrastructure Related Research

Offshore wind turbine technology today is based on upgraded turbine concepts from onshore technologies. This task investigated the two main areas of uncertainty remaining in this process. First was the

characterisation of offshore wind at rotor scale in order to determine the dynamic performance of the converter and the 2nd was the foundation performance analysis under different geological conditions.

Task 4.4: Cross-Cutting – Electrical Related Research
This task dealt with engineering aspects related to dynamic testing of electrical components and systems and new analysis tools for the integration in the electrical grid. It is led by Tecnalia, Spain.

Task 4.5: Cross-Cutting – Environmental Monitoring Related Research
This task supported the understanding of the environmental effects of ocean energy devices and offshore wind turbines on the marine environment by expanding the knowledge of environmental effects and monitoring methods. It was led by EMEC (European Marine Energy Research Center).

Task 4.6: Cross-Cutting – Station-Keeping Related Research
This task addressed the considerable engineering challenges of finding economical mooring solutions for marine energy converters, vital for the successful development of the sector. This requires a strong investigation on introduced mooring dynamics, especially concerning closely packed devices in array formations. It was led by UNEXE (University of Exeter).

The following deliverables were produced in association with the tasks listed above.

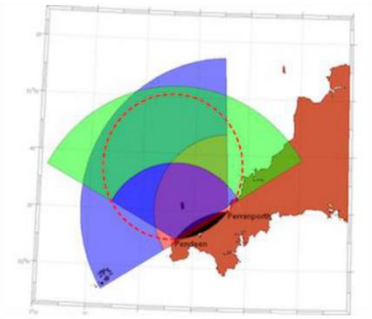
Deliverable No. (related Task)	Deliverable Title
D4.1 EC (T4.1)	Report on tank test related instrumentation and best practice
D4.2 EC (T4.4)	Report on dynamic test procedures
D4.3 EC (T4.4)	Report on grid integration and power quality testing
D4.4 EC (T4.6)	Report on low frequency response and moorings
D4.5 (T4.1)	Report on “Non-intrusive wave field measurement
D4.6 EC (T4.3)	Data Reports and Data Bases on coastal and offshore wind measurements
D4.7 EC (T4.5)	Best practice report on environmental monitoring and new study techniques
D4.8 EC (T4.5)	Database for environmental monitoring techniques and equipment
D4.9 EC (T4.1)	Report on “Remote underwater motion measurement”
D4.10 EC (T4.1)	Report on “Real Time Estimation of Incident Waves”
D4.11 EC (T4.2)	Report new instrumentation and field measuring technology for tidal currents
D4.12 EC (T4.3)	Report on design and accuracy of the sensor and SHM-system
D4.13 EC (T4.6)	Report on field test buoy research
D4.14 (T4.4)	Report on demand-side grid compatibility
D4.15 (T4.4)	Report on numerical methods for PTO systems
D4.16 (T4.3)	Report on options for full scale wind resource surveying
D4.17 (T4.5)	Report on environmental monitoring protocols

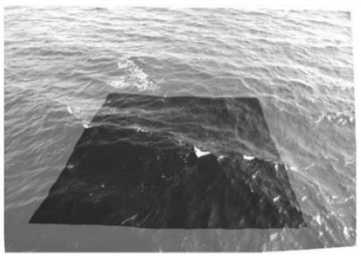
Some of these key results and findings are illustrated graphically to expand and explain their relevance in the following section.

WP4 Results: Non-intrusive wave field measurement (D4.05)

Available technologies:

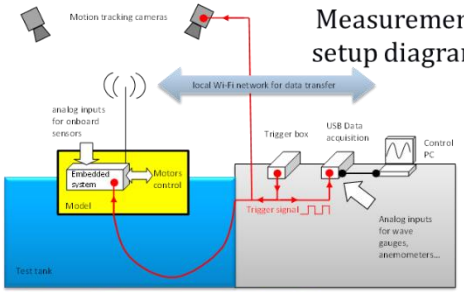
- Acoustic systems (Acoustic Doppler Current Profiler "AquaDops")
- Radar Remote sensing
- Image methods



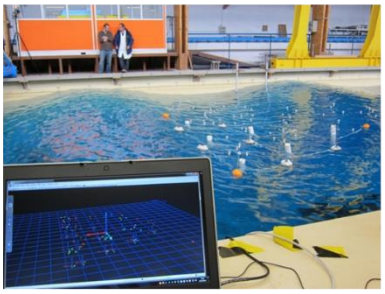


WP4 Results: tank test related instrumentation and best practice(D4.01)

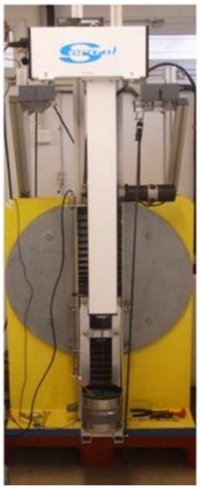
- Choose & set up the appropriate sensor
- From the sensor signal to the data file
- Know your measuring systems



Measurement setup diagram



15 floating bodies motion tracking – Albatern project



Calibration bench

WP4 Results: Remote underwater motion measurement (D4.09)

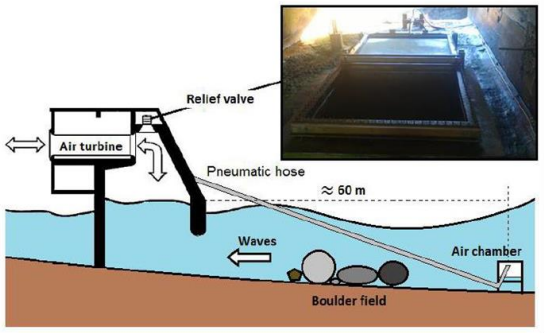
Available technologies:

- Optical systems (stereo vision principle, "Qualisys")
- Acoustic systems (signal transit time between emitter and receiver, "Tritec USBL system")
- Inertial systems (6dof position by motion integration, "SBG")

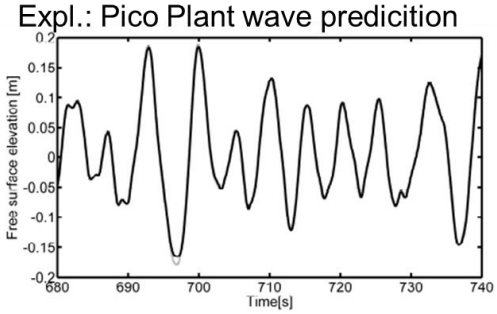
Picture of the Inertial Navigation System Ellipse-E developed by SBG

WP4 Results: Real Time estimation of incident waves (D4.10)

- Very relevant topic for the enhancement of power production from WEC
- Mathematically complex problem due to frequency and directional spectra of the waves
- Research performed included theoretical, laboratory and real scale tests



Expl.: Pico Plant wave predicition



The following presents some of the key outputs from work conducted during the production of D4.11 "New instrumentation and field measuring technology for tidal currents" which was led by Pal Schmitt at QUB.

Review of ADV/ADP Technology (Acoustic Doppler Velocimetry/Profiling) which is a fast evolving field with new methods and equipment coming available frequently.

- Industry standard to measure flow velocity and turbulence

- Different methods proposed to differentiate turbulence from Doppler/instrument noise, (still issues remaining)
- Wave affected flows challenging to assess. Currently the requirements are:
    - Wave orbital phase should be constant along the water column,
    - Kinematics decay with depth is based on the linear theory
    - Kinematics decay should be similar for the 2 opposing beams

Review of Radar Use in Tidal Measurements

- European Marine Energy Centre (EMEC) has installed two OceanWaves GmbH WaMoS®II Wave Monitoring systems
- The X-band radar signal is reflected by Bragg scattering from surface capillary roughness
- FFT analysis provides wavelength/period pairs of estimates.
- When these pairs are fitted at multiple frequencies to the dispersion relationship $(\sigma + k)2 = g.\ k.\ \tanh(k.\ h)$ current speed in the water can be estimated.
- The HRC software package has the potential for retrieval of more detailed temporal and spatial current measurements from the X-band radar images on a fine grid of 150m x 150m at Billia Croo and a coarser 600m x 600m grid at the Fall of Warness and is being evaluated.
- Satisfactory large scale validation with numerical models, but ongoing improvements

Review of procedures/expertise in field tests of marine energy technologies-impact for field testing of tidal energy devices.

- Potential of Remotely Operated Vehicle:
    - The maximum speed of the vehicle (usually up to 2 knots), makes it time consuming to collect a series of data over a survey site
    - These types of devices commonly have difficulties with station keeping in strong currents which is a major challenge for the successful application of the technology to sites identified for tidal energy developments
    - Many systems use video cameras as feedback sensors making them ill-suited to sites with low visibility
    - Vehicles often need a dedicated deployment craft which increases the operation costs
- Optical techniques such as LDV and PIV, and large-scale particle image velocimetry (LSPIV)

Application of real /field conditions to tank /model scale testing produced a listing of facilities and operational limits in respect of:

- flow turbulence
- interaction between current and surface waves
- bathymetry-induced flow deviations
- periodicity between ebb and flood phases in case of tidal (bi-directional) streams

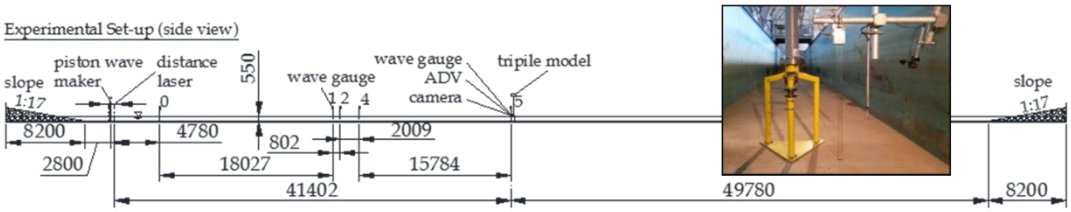
Measuring turbulence upstream of a floating tidal energy converter and wake measurement of full scale tidal turbines

- Current and Turbulence Measurement with Co-located ADP and Turbulence Profiler Data (2015 IEEE/OES Eleventh Current, Waves and Turbulence Measurement Workshop (CWTM))
- Measurement technology developed and tested on the Schottel STG turbine, Strangford Lough during MaRINET campaign. Initial flow characterisation ustilising turbine and seabed installed acoustic sensor arrays.

WP4 Results: Report on design and accuracy of the sensor and SHM-system (D4.12)

Conclusion

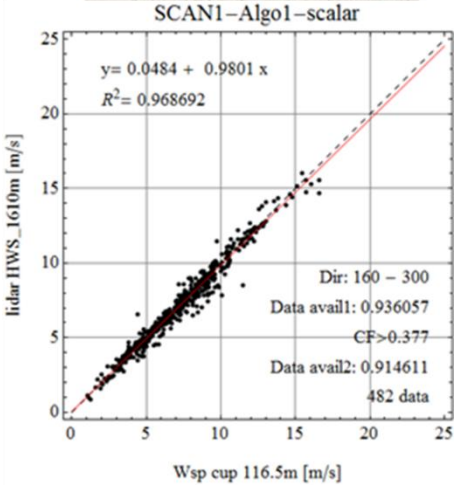
- global SHM is able to detect damage existence
- local measurement is able to detect damage existent at hot spots and can contribute to damage localization
- correct choice of damage dependent eigenmodes is essential due to their damage sensitivity



WP4 Results: coastal and offshore wind measurements (D4.6 & D4.16)

Testing coastal lidars on-shore:

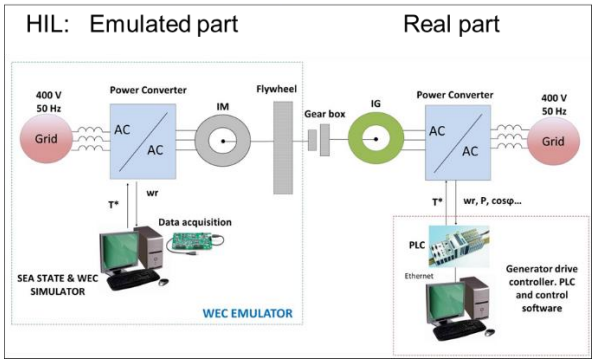
- Lidar can perform satisfactorily over several kilometers of range.
- Large coastal field experiment using Lidar measuring technique to demonstrate that it can be used for measuring the wind ressource for near-coastal wind farms (project RUNE).



WP4 Results: Dynamic test procedures (D4.2)

Electrical testing :

- Allows Validation of electr. Concept
- Shows Instability, inefficiency and under-performance
- Hardware in the Loop approach can be used

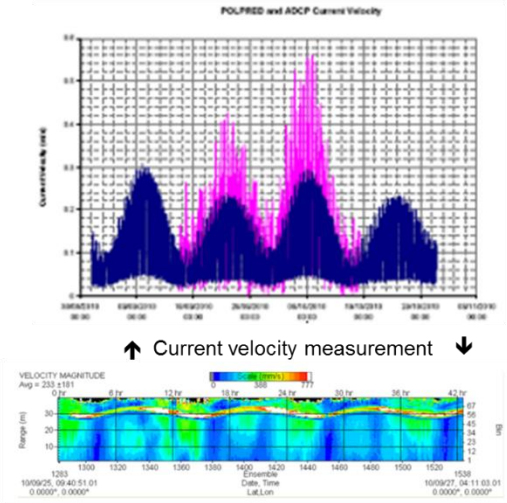


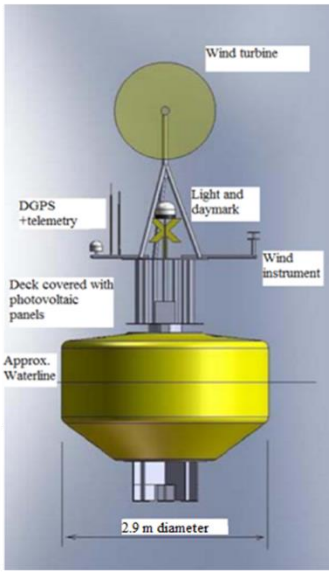
WP 4 Results: Best practice report on environmental monitoring and new study techniques(D4.07, D4.8 and D4.17).

- Database for environmental monitoring techniques and equipment: http://wiki.fp7-marinet.eu/index.php/D4.8:_Instrumentation_Database
- D4.17 Report on Environmental Monitoring Protocols
- D4.7 EC Best Practice report on environmental monitoring and new study techniques (based on the above achieved results)

WP4 Results: Station keeping related research (D4.04, D4.13)

- Field buoy research
- Resource character-isation
- Response and Load character-istics





SWMTF buoy instruments

4.1.4 Impact, Dissemination and Exploitation of Results (10p)

4.1.4.1 Scientific Impact

Some of the most notable scientific outcomes from the Marinet project can be appreciated with reference to Special issue of International Journal of Marine Energy Volume 12 (2015). This journal issue contains 7 articles which cover a wide range of topics in marine energy. The articles span wave & tidal energy and cover particular approaches to the experimental modelling of tidal turbines as well as wave energy covering a wide domain from instrumentation reliability for wave measurements to characterisation of power take-off systems efficiency.

Quote from IJOME editor in chief AbuBakr S. Bahaj University of Southampton, United Kingdom

> *"The articles in this special issue of IJOME contain valuable experimental data that has assisted in the development of the marine energy technologies and in some case provided validation datasets for further numerical model development, pushing these industries ever closer to commercialisation. It is clear that MaRINET has been successful in fulfilling its goal to promote the R&D of marine renewable energy through offering free-of-charge access to world class research facilities throughout Europe. The articles published here contain a snapshot of some of the high quality research that has been undertaken through the MaRINET programme with other work supported under the programme were submitted to IJOME as contributed articles."*

- Jeffcoate et al. presented field testing results of a full-scale commercial tidal turbine in timeaveraged flows up to 2.1 m/s. A vessel-mounted testing method for field studies of medium and full-scale tidal devices has been used to investigate the performance of a full-scale device in tidal flows under the IEC standards of data processing.
- Nielsen et al. concerns experiments on a ship shaped wave energy converter in order to investigate the power attenuation efficiency of the system in a range of regular and irregular wave conditions.
- Rolland et al. addressed the need of experimental validation for numerical model developments. Both performance and flow measurements have been used to validate the design process of a vertical axis turbine.
- Armstrong et al. presented a methodology of integrating a Wave Energy Converter (WEC) into an electrical test infrastructure incorporating Hardware-In-the-Loop (HIL). The work was aimed at demonstrating the efficiency of the use of electrical research test infrastructures incorporating HIL simulation instead of the use of real electrical equipment and measured signals, in combination with the simulated numerical model.
- Liu et al. investigated whether the wave characteristics can be accurately measured using the wave buoys. Wave measurements using three wave buoy models were compared to the measured waves using reference wave gauges.
- Maisondieu et al. presented the MaRINET Transnational Access program and provided a good overview of the current research activity, as well as evidence of the requirement for specialised research facilities, in marine energy field. Statistics on the MaRINET applications and completed projects were also presented which gave a further overview of the development progress of different offshore renewable energy conversion technologies at a European level.
- Gaurier et al. proposed an evaluation of the efficiency of different kind of experimental infrastructures for classical tidal turbines performance characterisation. Based on the use of a generic tribladed horizontal axis turbine in four experimental basins, the wok presented the level of confidence on performance assessment carried out in towing as well as in circulating tanks.

Standarisation and Best Practice

Key outputs were sets of guidelines and manuals of good practice most of which were contractual deliverables as described in the precious section.

A crucial step in arriving at a standardised set of best practises has been the success in 'round robin' testing using a standardised scale model tidal device. The process enabled cross comparison between the performances of a device, irrespective of the environment in which it was being tested. To achieve this, the scale tidal device developed by the French Research Institute for Exploitation of the Sea (Ifremer) was tested in two recirculating flume tanks in France and Italy and two tow-tanks in Italy and the UK. Implementing an identical test programme at all four facilities, the round robin was the first of its kind to analyse tidal energy and quantify the effects that different environments can have on test device performance. Consequently, MaRINET will be able to produce a test tank calibration factor to enable the desired cross comparison.

A broad variety of research fields have been highlighted in the Research WP of Marinet, and new approaches for offshore wave climate / tidal current / wind site assessments have been investigated and documented. Technical research with direct impact to the offshore industry development has been performed (standardised PTO testing methods and advanced mooring concepts), and scientific results have been successfully introduced to the Marine Energy research Community in various paper publications and conference presentations. The environmental impact of Marine Energy has been quantitatively evaluated and monitoring techniques have been documented in a comprehensive data base.

The following reports (specific deliverables) are noted in terms of their potential for use and applicability beyond the duration of the project.

- List of measuring techniques frequently used; List of working sensor implementation;
- Electrical/PTO test facility improvements
- Database of constituent material properties determined; direct impact on commercial development of tether; Project D-TET, Durability testing of the Exeter Tether (a novel mooring tether designed to reduce peak loads and fatigue damage)
- Database for environmental monitoring techniques and equipment

4.1.4.2 Socio-economic and wider societal implications

Conspicuous societal imperatives and the associated policy landscape concerning energy autonomy and reduction of carbon will continue to drive rapid development of renewables for the foreseeable future, and in this context there are strong expectations of major developments in the marine renewables area. As progress is made towards higher TRLs, cost and scale increase accordingly meaning that international collaboration becomes increasingly more important to maintain competitiveness. MaRINET has been at the forefront in ensuring that Europe continues to maintain a leading position, and has developed sufficient reach and critical mass to ensure that Europe has not missed opportunities for the establishment of radical new technologies.

Owing to it's diverse range of facility types and scale, MaRINET has fostered R&D across a broad range of TRL levels which is recognised as being highly relevant in the context of an overarching aim to supply society with new practically and economically viable large-scale renewable energy supply solutions in coming years. Spanning many technologies and TRL levels is also a potent attractant for a broad range of researchers and Institutions, which in turn provides enhanced scope for return on the very significant infrastructural investments that have been made at Member State level.

MaRINET has also provided a cohesive coordination role which is an important enabler in the context of the broad range of scientific and technical disciplines involved across multiple TRLs. The project's broad perspective in terms of geographical coverage, TRL and technologies has also provided an important platform for highly relevant trans-disciplinary training, and international staff exchange with formal courses and more hands-on activities being developed and delivered at key facilities. It is noteworthy that demand far outstripped supply in these areas, a factor that will be taken into account in future initiatives.

MARiNET has also acted as a focal point for broader international collaboration, and the "brand" is now well established internationally with very satisfactory levels of visibility and recognition among relevant stakeholders and actors on the global stage.

The success of the MaRINET's transnational access programme (TNA) can be regarded in the light of the key statistics as outlined below:

- Over 300 applications received from industrial and academic research groups right across the EU.
- From these, 178 high quality projects were selected and granted a more than 700 weeks of access across the range of testing facilities
- +/- 1.9m Euro in costs granted

These numbers provide a solid indication of the size of the direct interface that exists between individuals that are part of the MaRINET operational community and members of external user groups drawn mainly from SME's and academia. It also illustrates the scale of funds involved which create economic benefits not only to the facilities themselves, but in most cases have provided a critical opportunity for the individual research teams to address otherwise insurmountable technological issues and development obstacles. This was a factor repeatedly borne out in acknowledgments given in testimonies and accounts presented by facility Users during various workshop sessions in Rome and Nantes, and can also be appreciated by reference to the post access reports returned by users after each access period.

The great majority of testing facilities involved in MaRINET are medium to large operations in their own right, which owe their existence to significant and investment programmes from national governments. These facilities can have considerable fixed operational costs (staff, services etc) meaning that access to users

applying through MaRINET is an important way to help ensure that spare capacity is not wasted. This underlines the importance and value of MaRINET tank time in terms of economic contribution to the ongoing operational feasibility of testing infrastructures. The direct and indirect socio-economic impact of research infrastructures in their local and regional geographical context has been poorly studied to date and hence sources of quantitative data are few. One such study is available for Orkney which identified a very significant positive contribution to the Islands ecomomy with 10,s to 100's of FTE equivalent jobs being directly and indirect associated with the extensive European Marine Energy Centre testing facilitates located there.

It is clear that offshore and related research can be logistically complex and expensive, and all the more so at the higher TRLs, in this context the pooling effect of MaRINET on European resources for renewable energy research has positive socio-economic consequences, particularly in cases where some facilities may not have been operating at their full capacity.

MaRINET has also provided the first opportunity to build up a strategic overview of the key features, operational practices and other defining characteristics of the principal EU infrastructures currently operating in the marine renewables space. In this light, the potential for adoption onto the European Strategic Forum for Research Infrastructures (ESFRI) roadmap was identified by several of the key players in the later stages of the project. With the name Marinerg-I, this concept was adopted and developed under the leadership of the coordinating partner UCC, by MaRINET partners in five countries; Ireland, UK, France, Spain and Portugal into a bid for inclusion on the 2016 ESFRI roadmap as a distributed infrastructure.

Following a stringent review process the ESFRI evaluation committee issued their final set of recommendations on 10th November 2015 in which Marinerg-I was given "medium" as an overall score of maturity, and designation of "emerging" as the recommended status, with the following final comment:

> *"Marinerg-I is evaluated `high` for the scientific case and `medium` for its maturity. The development and provision of practical and cost-effective renewable energy is of outmost strategic importance and Marinerg-I building upon Marinet concerns a very promising initiative. In particular, the project would profit a lot from an immediate Design Study. Marinerg-i is highly recommended as `emerging` project for the 2016 ESFRI Roadmap."*

In general this can be interpreted as an extremely positive outcome from a highly respected and objective source, which clearly recognises the value of MaRINET in terms of the preparatory work that has been carried out. In this regard it should be noted that nearly all other ESFRI candidates would have completed bespoke design studies in preparation for their bid based on specific multi-million Euro investments e.g. under INFRADEV, whereas MaRINET was able to build a credible case purely on the basis of what has been attained under the I3 programme.

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4.2 4d

4.2.1 . Initial Marinet Plan for Use and Dissemination of Foreground

An important aspect of the marine renewable energy industry is the sensitivity in relation to knowledge of device designs, data, technology etc. Ultimately, only a small number of successful designs will prevail and reap the associated rewards, and for this reason, current technology developers are extremely sensitive about protecting their intellectual property (IP). This industry, and the academic research associated with it, is therefore unlike most traditional scientific endeavours whereby knowledge is shared and advanced for the common good and advancement of science. In this industry, knowledge and designs are generally very closely protected, similar for example to the pharmaceutical industry which develops proprietary drug formulations.

The MaRINET Transnational Access programme operates in this context, and therefore must honour competing EC obligations in terms of ensuring that generated foreground is publishable, while at the same time protecting the IP of that generated foreground. In order to do this, the Project Manager continued to operate in keeping with the previously produced MaRINET-specific rules incorporating the EC obligations which each User-Group accepts upon making an application. This includes a user-access report template which outlines how foreground and the testing experience should be reported, and a suggested Access Provider/User-Group agreement which can be modified by the Access Provider as desired.

Figure 4.2.1: Publishing foreground and protecting IP: (1) Access report template, (2) Transnational Access rules & conditions document and (3) suggested Access Provider/User-Group Agreement

Section A

Publications Uploaded directly into ECAS

Section A (public)

This section includes two templates

- Template A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.

- Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

Section B (Confidential[2] or public: confidential information to be marked clearly)
N/A for Marinet
Part B1

The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The list should, specify at least one unique identifier e.g. European Patent application reference. For patent applications, only if applicable, contributions to standards should be specified. This table is cumulative, which means that it should always show all applications from the beginning until after the end of the project.

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights[3]:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)

[2] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.

[3] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2

Please complete the table hereafter:

N/A for MARINET

Type of Exploitable Foreground[4]	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application[5]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
	Ex: New supercond uctive Nb-Ti alloy			*MRI equipment*	*1. Medical 2. Industrial inspection*	*2008 2010*	*A materials patent is planned for 2006*	*Beneficiary X (owner) Beneficiary Y, Beneficiary Z, Poss. licensing to equipment manuf. ABC*

In addition to the table, please provide a text to explain the exploitable foreground, in particular:

- Its purpose
- How the foreground might be exploited, when and by whom
- IPR exploitable measures taken or intended
- Further research necessary, if any
- Potential/expected impact (quantify where possible)

[19] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[5] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

4.3 Report on societal implications

Data Uploaded directly to ECAS

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	
Title of Project:	
Name and Title of Coordinator:	

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***0Yes 0No***
2. Please indicate whether your project involved any of the following issues (tick box) :	***YES***
RESEARCH ON HUMANS	
• Did the project involve children?	
• Did the project involve patients?	
• Did the project involve persons not able to give consent?	
• Did the project involve adult healthy volunteers?	
• Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	
• Did the project involve Human Foetal Tissue / Cells?	
• Did the project involve Human Embryonic Stem Cells (hESCs)?	
• Did the project on human Embryonic Stem Cells involve cells in culture?	
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	

• Were those animals transgenic small laboratory animals?	
• Were those animals transgenic farm animals?	
• Were those animals cloned farm animals?	
• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	0 Yes 0 No
• Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator		
Work package leaders		
Experienced researchers (i.e. PhD holders)		
PhD Students		
Other		

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	
Of which, indicate the number of men:	

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?

○ Yes
○ No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
❑	Design and implement an equal opportunity policy	○	○	○	○	○
❑	Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
❑	Actions to improve work-life balance	○	○	○	○	○
○	Other:					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

○ No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

○ Yes- please specify

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify

○ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[6]:

○ Associated discipline[6]:

○ Associated discipline[6]:

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*

○ Yes
○ No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No
○ Yes- in determining what research should be performed
○ Yes - in implementing the research
○ Yes, in communicating /disseminating / using the results of the project

[6] Insert number from list below (Frascati Manual).

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ ○	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- ○ Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- ○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

Agriculture		Energy		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	
Competition		Environment		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		Food Safety		Research and Innovation	
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs		Humanitarian aid		Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ○ European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	
To how many of these is open access[7] provided?	
How many of these are published in open access journals?	
How many of these are published in open repositories?	
To how many of these is open access not provided?	
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[8]: ……	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	
	Registered design	
	Other	
17. How many spin-off companies were created / are planned as a direct result of the project?		
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑ Increase in employment, or	❑ In small & medium-sized enterprises
❑ Safeguard employment, or	❑ In large companies
❑ Decrease in employment,	❑ None of the above / not relevant to the project
❑ Difficult to estimate / not possible to quantify	

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*
Difficult to estimate / not possible to quantify	❑

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes ○ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes ○ No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

❑	Press Release	❑	Coverage in specialist press
❑	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
❑	Brochures /posters / flyers	❑	Website for the general public / internet
❑	DVD /Film /Multimedia	❑	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	❑	English
❑	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised

[7] Open Access is defined as free of charge access for anyone via Internet.

[8] For instance: classification for security project.

technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]

11. FINAL REPORT ON THE DISTRIBUTION OF THE EUROPEAN UNION FINANCIAL CONTRIBUTION

This report shall be submitted to the Commission within 30 days after receipt of the final payment of the European Union financial contribution.

Report on the distribution of the European Union financial contribution between beneficiaries

Name of beneficiary	Final amount of EU contribution per beneficiary in Euros
1.	
2.	
n	
Total	