INTERPLAN
INTEgrated opeRation PLAnning tool towards the Pan-European Network

Work Package 1

Coordination and project management

Deliverable D1.5

Project Handbook (DoW)

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Abbreviations

AB	Advisory Board
CA	Consortium Agreement
DoA	Description of Action
DSL	DIgSILENT Simulation Environment
DSO	Distribution System Operator
EAC	Electricity Authority of Cyprus
EB	Executive Board
EC	European Commission
EERA JP SG	European Energy Research Alliance Joint Programme on Smart Grids
EU	European Union
GA	Grant Agreement
LoS	Letter of Support
M	Month
MS	Milestone
OPF	Optimal Power Flow
PC	Project Coordinator
PM	Person-Months
RES	Renewable Energy Sources
RIA	Research and Innovation Action
SC	Steering Committee
TPC	Technical Project Coordinator
TSO	Transmission System Operator
UPB	University Politehnica of Bucharest
WP	Work Package
WPL	Work Package Leader
ENEA	AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE
AIT	AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH
DERlab	European Distributed Energy Resources Laboratories e.V.
UCY	UNIVERSITY OF CYPRUS
FRAUNHOFER IEE	Fraunhofer-Institut für Energiewirtschaft und Energiesystemtechnik
IEn	INSTYTUT ENERGETYKI

Executive Summary

The purpose of this document is to provide a detailed description of the work to be done in INTERPLAN project with the aim to promote an effective trans-disciplinary work in the consortium and ensure an adequate communication among partners. The document describes the project's goal and relation to the Work Programme, by presenting the specific and measurable objectives, which will be attained within the project duration. The concept underpinning INTERPLAN, the innovative methodology proposed, as well as the expected impacts together with the measures to maximize the impact of the project's results are presented.

The work plan is structured to allow a logical progression of the needed activities, and closely follows the objectives and methodology proposed. In detail, INTERPLAN project consists of seven work packages which are strongly interdependent. This strong correlation reflects both the GANTT and PERT charts. A detailed description of Work Packages, including definition of partners' roles, tasks, deliverables, milestones and risks with the corresponding mitigation measures is presented.

To guarantee the flexible coordination of the activities to be carried out in the INTERPLAN project, a smooth decision process, a prompt management of risks and unforeseen events, and in general a proper management structure is needed. Therefore, the management structure is presented by including a brief description of each body involved.

Moreover, the deliverable defines the key aspects of internal communication among partners, through the description of the channels to be used by the consortium, such as INTERPLAN portal, web-meetings and physical meetings.

Finally, the essential issue of communication with external stakeholders is addressed. In this respect it is the objective of the consortium to work closely with the industry, operators, policy entities and standardisation bodies for responding effectively to their needs and at the same time creating the right bi-directional communication and response for validating the identified solutions and developments.

1 Introduction

The goal of INTERPLAN project is to provide an INTEgrated opeRation PLANning tool towards the pan-European network, to support the European Union in reaching the expected low-carbon targets, while maintaining the network security. A methodology for proper representation of a “clustered” model of the pan-European network will be provided, with the aim to generate grid equivalents as a growing library able to cover all relevant system connectivity possibilities occurring in the real grid, by addressing operational issues at all network levels (transmission, distribution and TSOs-DSOs interfaces). In this perspective, the chosen top-down approach will actually lead to an "integrated" tool, both in terms of voltage levels, going from high voltage down to low voltage up to end user, and in terms of building a bridge between static, long-term planning and considering operational issues by introducing controllers in the operation planning. Proper cluster and interface controllers will be developed to intervene in presence of criticalities, by exploiting the flexibility potentials throughout the grid.

The project is in line with the Horizon 2020 Work Programme challenge on “Secure, Clean and Efficient Energy”, by ensuring more flexibility and active involvement of all stakeholders in the electricity system, and a close coordination of transmission system operators (TSOs) and distribution system operators (DSOs).
Moreover, its versatility in the concept of grid equivalents, will allow an accurate analysis of the complex network, by considering local active elements in the grid.

The achievement of the project's goal will be ensured by the subdivision of the needed steps in seven work packages, each of them, with a specific measurable objective.

1.1 Purpose and scope of the document

The main objectives of Deliverable D1.5 are described in the following:

- Describing the Project's goal and relation to the H2020 Work Programme;
- Presenting the specific and measurable objectives through a direct relation to the Work Packages;
- Describing the concept underpinning INTERPLAN and the methodology proposed;
- Presenting the expected impacts and the measures to maximize the impact of the project's results;
- Describing in detail the work plan through a presentation of the Work Packages, partners' roles, involved Tasks, deliverables, milestones and critical risks with the corresponding mitigation measures;
- Describing the project as a whole, by presenting the PERT and GANTT Charts to show the strong correlations among the various Work Packages;
- Describing the channels for internal communication among partners;
- Describing the key aspects of communication with external stakeholders.

1.2 Structure of the document

In the following, the INTERPLAN project summary is discussed in Section 2. The work plan including the detailed description of Work Packages is described in Section 3. The project as a whole including the PERT and GANTT Charts is discussed in Section 4. The channels for internal

communication among partners are described in Section 5. The key aspects of communication with external stakeholders are discussed in Section 6.

2 INTERPLAN project summary

The general information of INTERPLAN project are provided below:

- **Project title**: INTEgrated opeRation PLAnning tool towards the Pan-European Network
- **Grant Agreement Number:** 773708
- **Starting date**: 01/11/2017
- **Duration in months**: 36
- **Call (part) identifier**: H2020-LCE-2017-SGS
- **Topic**: LCE-05-2017 - Tools and technologies for coordination and integration of the European energy system
- **Type of Action**: Research and Innovation Action (RIA)
- **Total Budget**: € 2,964,362.50

2.1 List of Beneficiaries

The list of Beneficiaries is shown in Table 1 below.

Table 1: List of Beneficiaries

No	***Name***	***Short name***	***Country***	***Project entry month***	***Project exit month***
1	AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTWNIBILE	ENEA	Italy	1	36
2	AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH	AIT	Austria	1	36
3	European Distributed Energy Resources Laboratories e.V.	DERlab	Germany	1	36
4	UNIVERSITY OF CYPRUS	UCY	Cyprus	1	36
5	Fraunhofer-Institut für Energiewirtschaft und Energiesystemtechnik IEE	FRAUNHOFER IEE	Germany	1	36
6	INSTYTUT ENERGETYKI	IEn	Poland	1	36

2.2 Objectives and relation to the work programme

The European Union (EU) has set ambitious goals for designing its whole energy system from 2020 up to the middle of the 21st century. In view of the fundamental transformation needed to deliver a sustainable Europe by 2050, crucial changes are required. Several regulations and European Directives[1] have encouraged such changes, emphasizing electricity as a crucial enabler for the economic growth.

[1] *These Directives refer to four different energy packages addressing the unbundling of the electrical sector (first package), the promotion of renewables and the network access conditions for cross boundary electricity exchanges (second package), common rules for a single electricity market in Europe (third package), and a redesign of the European electricity market, the updating of the energy efficiency labelling, and the revising of the EU Emissions Trading System (energy summer package).*

These Directives support the three European energy policy pillars, which are the security of supply, sustainability, and market efficiency, and the related short-term energy policy targets by 2020.

These targets expect both a significant integration of renewable energy sources (RES) into the current electricity system[2] and energy efficiency measures [1]. The traditional flexibility measures used over the past hundred years were based on the assumption that power generation must instantaneously meet the load, and therefore they are no longer sufficient to face the growing share of non-dispatchable distributed generation.

The ongoing deployment of the pan-European electricity system strongly depends on different potential scenarios for items such as renewable energy share (primarily in terms of technologies, performance, and geographical siting), and penetration of distributed energy resources. Although these factors constitute preferential patterns to meet EU energy policy targets, they induce new challenges for the networks, which will outline the critical structural and operational needs of the European power grid of the future. For example, renewable energy technologies deliver electricity where and when resources are available, but energy may not be needed at the same time and in the same location, thereby leading to congestions. Transmission System Operators (TSOs) in Europe will have to evolve progressively from a "business as usual approach" to a proactive approach in order to avoid a bottleneck effect in the future European electricity system, and this may be achieved through a proper system operation planning.

As regards the distribution networks, traditionally, they were designed to transport electricity in one direction: from the generation connected to the transmission system to customers at the end point of the network based on worst case scenarios (maximum generation and minimum load as well as vice versa). This type of system did not require extensive management and control tools, since enough reserves are available in the system. With the growing share of non-dispatchable distributed generation, customers are increasingly generating electricity themselves. Therefore, by becoming "prosumers", they are moving from the end point to the centre of the new value chain.
Hence, Distribution System Operators (DSOs) will need to actively manage and operate a smarter grid through appropriate system control logics, by using the grid's and consumers' flexibility potential to solve constraints and to maximize the utilization of the existing infrastructure, thereby optimizing the network performance.

Another crucial issue is the interface between transmission and distribution systems, which is expected to evolve in next years. The increasing volume of distributed generation characterized by fluctuating generation units connected to the distribution grids, will change the behavior of the entire system, making it more challenging, for example, in balancing generation and demand at every single point in time.

A closer cooperation between TSOs and DSOs may be helpful to address several operational challenges such as congestion of transmission-distribution interface, congestion of transmission lines and distribution lines, voltage support between TSOs and DSOs, balancing challenges, and coordinated protection. This would allow to achieve a smooth transformation of the pan-European electricity network in next years.

[2] *European Commission, "EU Reference Scenario 2016 - Energy, transport and GHG emissions Trends to 2050", is aiming in an increase of the RES share of net power generation from around 20% in 2010 to 42% in 2030.*

The main goal of INTERPLAN project is to provide an integrated operation planning tool for the pan-European electricity network, with a focus also on the TSO-DSO interfaces, to support the EU in reaching the expected low-carbon targets.

A methodology for proper representation of a “clustered” model of the pan-European network is provided, with the aim to generate grid equivalents as a growing library able to cover all relevant system connectivity possibilities occurring in the real grid, by addressing operation planning issues at all network levels (transmission, distribution and TSO-DSO interfaces). In this perspective, the chosen top-down approach will actually lead to an "integrated" tool, both in terms of voltage levels, going from high voltage down to low voltage up to end consumer, and in terms of building a bridge between static, long-term planning and considering operational issues by introducing controllers in the operation planning. In addition, novel control strategies and operation planning approaches will be investigated in order to ensure the security of supply and flexibility of the interconnected EU electricity grids, based on a close cooperation between TSOs and DSOs.

Accordingly, the specific measurable objectives (O) of INTERPLAN which will be attained within the project duration are as follows:

Research objectives

- O1. Analysis of the European electricity grid, including the main interconnection issues, and criticalities, both within EU countries, and at pan-European level (WP2).

- O2. Detailed assessment of the regulatory framework in Europe including existing grid codes. Emphasis will be put on exploitation and analysis of previous projects and work, considering both pan-European level (transmission grid) and also looking down to flexibility present in the distribution grid, paying specific attention to address flexibility possibilities coming from storage, demand response individually or aggregated (WP2).

- O3. On the policy front a proposal with all possible amendments to the grid codes will be documented reflecting the work developed in the INTERPLAN. This will be a prime objective of the project as an attempt to deliver an elaborated report to a high degree of detail to make the proposed changes as receptive as possible for adaption by the appropriate authorities. The implications to European regulation will be elaborated and aligned to the recommendations on grid codes (WP2).

Innovation objectives

- O4. Definition of a set of detailed use cases to be addressed by future network planning and operation at all network levels, including TSO-DSO interfaces, and establishment of requirements for network models and grid equivalents (WP3).

- O5. Development of network models, and identification and characterization of a clustering method (WP4).

- O6. Development of a detailed approach for generating grid equivalents for different use cases (WP4).

- O7. Development of an operation planning tool for grid equivalents with the aim to control the operating conditions at all network levels, and apply adequate possible intervention measures through cluster and interface controllers (WP5).

Demonstration objective

- O8. Validation of INTERPLAN model and testing, with the aim to show the effectiveness of the tool to ensure stability and security of the interconnected EU electricity systems (WP6).

Dissemination objectives

- O9. Organize stakeholder workshops and other consultation activities to discover ways in which INTERPLAN can provide added value to the electricity market actors, and ways in which its functionality can be embedded in the actors' business processes and goals in order to increase the socio-economic impact of the project. (WP7).

- O10. Create opportunities for the exploitation of the INTERPLAN results through papers and publication in scientific journals, as well as presentations in relevant conferences (WP7).

The equivalenting architecture of INTERPLAN with its control logic suits the complexity of the integrated grid as it will evolve through the adoption of the most competitive technologies in the sustainability trajectory. Stability and security will be addressed at area, regional and pan-European level. Therefore, with this approach, INTERPLAN contributes to follow the long-run European goals in achieving security in a low-carbon electricity system, by ensuring reliable control over the power grid at all voltage levels, exploiting the flexibility potentials throughout the grid.
This will ensure that the future pan-European grid can host large quantity from RES, and will allow flexibility in presence of distributed generation.

INTERPLAN addresses the challenge of "Secure, Clean and Efficient Energy" in the 2016/2017 work programme. The related work programme topic is the LCE-05-2017: Tools and technologies for coordination and integration of the European energy system. The area targeted by the project is "Novel European grid and end-to-end energy system planning tools, including foreseeable features such as storage, aggregation, demand-response and integrating cost aspects" [2].
The following itemized list details how the various elements of the call are addressed by the INTERPLAN project:

1. "The increasing share of variable renewable energy sources and the 2020 and 2030 targets for the reduction of greenhouse gas emission in the EU are calling for important changes in our energy system: more flexibility, more active involvement of all stakeholders and more collaboration. The challenge is therefore to create and deploy common tools for planning, integration and operation across the energy system and its actors".

The operation planning tool developed within the INTERPLAN project will address the network challenges occurring at all voltage levels, related to the growing share of non-dispatchable distributed generation. The tool will focus on the exploitation of flexibility resources installed all over the network, and on their functional representation from the transmission and transmission-distribution interface perspective. The flexibility measures analyzed will be based on supporting technologies such as storage, and on the active participation of end-users, which are the centre of all activities through active demand response, and on aggregated services, smart use of infrastructure and smart response to system needs.

In detail, these flexibility measures will be included in the operation planning process as control parameters used to solve the operational issues identified in semi-dynamic simulations of grid equivalents through proper control system logics based on cluster controllers and/or interface

controllers.
As for the need of a more active involvement of all stakeholders and collaboration, INTERPLAN has a focus on TSO-DSO interfaces, by addressing the main issues occurring at the specific interfaces within the interconnected grid, and applying adequate intervention measures.
Among these issues, there is, for instance, the congestion which may occur at transmission-distribution interfaces, mostly due to both increasing loads, and increasing distributed generation connected to the distribution grid.
In such a context, the main idea of INTERPLAN to generate grid equivalents as a growing library able to cover all relevant system connectivity possibilities occurring in the real grid, and to develop novel control logics at all network levels, triggers the involvement of all stakeholders as well as a close coordination of TSOs and DSOs. This will ensure a joint new vision of the pan-European network to give more flexibility to electricity networks.

> 2. “Development of planning tools for Novel European grid and end-to-end energy system, including foreseeable features such as storage, aggregation, demand-response and integrating cost aspects”.

INTERPLAN provides a planning methodology of the pan-European electricity network, able to go down to the end user, and to allow active contributions throughout the network.
The operation planning tool for grid equivalents, based on semi-dynamic simulations, will allow to identify problems, and then apply intervention measures, such as efficient management of storage, aggregation and demand response, through cluster and interface controllers.
The key feature is its versatility in the concept of grid equivalents, which allows an accurate analysis of the complex ongoing network, through the local active elements in the grid.
Semi-dynamic simulations are a perfect tool for power system operation analysis and planning, in particular with respect to the arising problem of maintaining power balance and energy balance, which are main concerns tackled within INTERPLAN project.
The novel approach is to incorporate important security criteria into the simulation process. This is very important for the power system of the future, which due to its highly varying nature can often be pushed to its limits.

As for the integration of cost aspects, two main types of analysis will be carried out. Firstly, the operation planning tool developed in INTERPLAN will take into account minimization of costs as one of the planning criteria through optimal power flow (OPF), with the aim to minimize the cost of the power dispatch based on operating costs, and on tariff systems for external grids. Furthermore, an additional analysis will be carried out in order to consider the economic impact of the developed controllers. To this aim, under the same analyzed scenario, economic assessments will be done in absence and presence of the controllers, thereby providing useful information on a possible convenience of the developed control logics in terms of operating cost savings.

2.3 Concept and methodology

2.3.1 The concept underpinning INTERPLAN

Over the time, the operation of the internal electricity markets is becoming ever more connected with neighbouring electricity ones. Hence, stability, security and efficiency must be ensured at a higher hierarchical level than at national one, managing the local grid as part of a wider interconnected network. The current grid planning features are generally based on simulation tools and expert knowledge to find the optimal solution. However, the increasing complexity of the grids

requires control and operation planning tools even more advanced and homogenous among European nations. With these beliefs, the INTERPLAN idea is born.

INTERPLAN is a research project with the aim to develop a tool for grid operation planning based on the implementation of innovative control approaches, which will be designed by paying particular attention to the flexibility possibilities coming from storage, demand response, etc., to support the operation of the electricity network at national and pan-European level. In detail, to this aim, INTERPLAN will apply the following steps:

- Define detailed use cases for future grid planning and operation and related requirements;
- Identify a methodology for clustering (grid equivalenting);
- Develop a set of tools for operation planning in the integrated domains of steady-state and quasi dynamic (for flexibility assessment) and small signal stability (detection of conditions giving rise to critical modes of oscillations, finding measures in an optimal way).

The developed tool will constitute a library providing common control algorithms to be integrated across the energy system operators (TSO, DSO, TSO-DSO interfaces), based on a proper operation planning. Even if this target requires a significant investment, it brings valuable resources for the advancement of knowledge. A set of common rules can, in fact, enable network actors to operate more effectively across an interconnected market. Table 2 provides an example of two operation challenges with current solution and potential solutions offered by INTERPLAN, whereas Figure 1 shows the basic concept of INTERPLAN project in working in integrated way at different voltage levels, in a top-down approach, reaching up to the end-user.

The concept will be validated through digital simulation based on representative use cases and different simulation methods, as explained in more detail in the following sections.

Table 2: Examples of operation challenges, with current solutions, and potential solutions provided by INTERPLAN

Operation challenges	***Present situation***	***INTERPLAN progress***
Line congestion - DSO side	Curtailment of loads on the distribution.	Algorithms will be implemented to evaluate the optimal solution between different choices: network reinforcement varying demand, flexible sources, etc.
Balancing	Generally, the DSO is not involved in grid energy balancing.	Algorithms will be implemented to identify “local active elements” in the grid (e.g. not only energy storage systems, but also the distribution customers could actively participate into the balancing process).

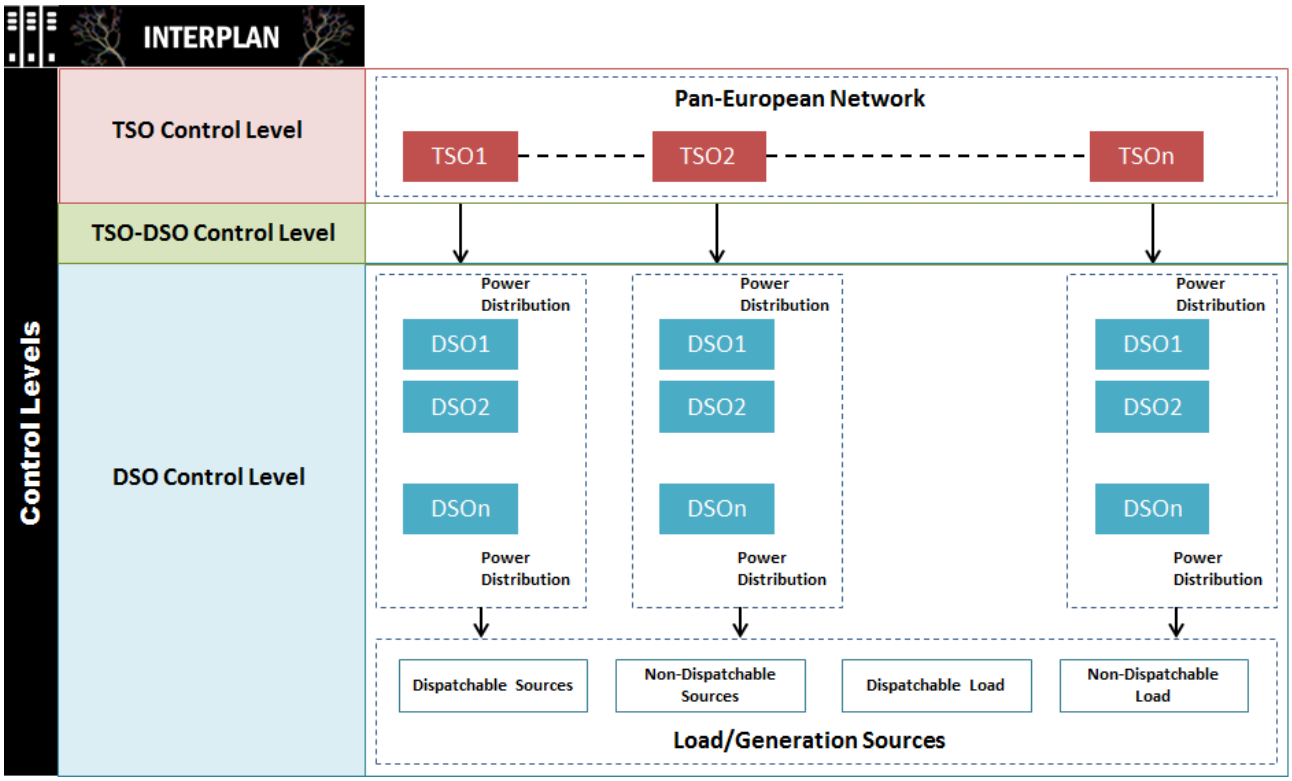

Figure 1: INTERPLAN concept

2.3.2 The INTERPLAN methodology

The basic INTERPLAN idea of covering the greater number of possible system connectivity and solving interconnectivity issues requires a thorough assessment by country in terms of: generation, load, transmission and balancing data, TSO - DSO interaction overview, existing grid codes. Therefore, the first phase of the work focused on a more in-depth analysis of existing projects and studies connected to the above cited themes. The exploitation, in particular, is oriented to identify more significant scenarios for the later definition of use cases and clustering methodology (grid equivalenting).

The choice of use cases will be obviously defined by scenarios analysis of the European electricity grids and should properly represent the actual cases of the current electric grids, for each analysed voltage level.

The “grid equivalenting”, which is conceptually the successive phase of the work, is the process to generate a grid equivalent model encompassing a large part of network substituted by a smaller counterpart having the same relevant properties. To this aim, the network models of previous use cases will be designed in numerical power system simulation environment. Then, a clustering methodology for transmission and distribution systems up to the end user level will be identified, and a detailed approach for generating grid equivalents will be developed for different use cases. In the same time, several important questions will be answered:

- What is the maximum level of RES/storage/demand response/etc. that still can be neglected whilst constructing the equivalent (the averaging effect) taking into consideration different operational problems and phenomena?
- What impact do they have on the equivalent characteristics and how to include them in the

equivalent model in a way that it is accurate and representative?
- Which parameters of the flexibility resources are the most valuable from the TSO perspective?

The focus is put on a functional representation of all flexibility resources installed deep in the network as seen from the transmission and transmission-distribution interface perspective.
This will allow to include them in the operation planning process in order to utilize them more effectively thus facilitating and incentivizing their subsequent deployment.

To assess operational planning aspects, key decisions regarding planning criteria/functionalities (e.g. maximizing RES share in generation portfolio in secure manner) will be taken for each use case. Among the planning criteria analyzed, also minimization of the costs will be taken into account, with the aim to minimize the cost of the power dispatch based on operating costs (e.g. cost function for generators) and on tariff systems for external grids.
The application of selected criteria to previous use cases will allow to construct significant showcases. Semi-dynamic simulation of grid equivalents for each showcase will provide the network behaviour and eventual operational problems (e.g. line congestion). In fact, semi-dynamic simulations are particularly suitable for planning studies as INTERPLAN project, in which long term load and generation profiles are defined in parallel with multiple contingency scenarios in correspondence of simulation periods from hours up to years with a user-defined time step sizes between each simulation. Typical visualisation of semi-dynamic simulation is presented in Figure 2 in order to visualise the principle of this kind of simulation. The post-processing or parallel-processing of the results will allow to identify operational problems to be solved by developing new control system strategies. These latter will be designed in order to apply adequate intervention measures through the appropriate control parameters such as storage, demand response and aggregation through cluster and interface controllers.

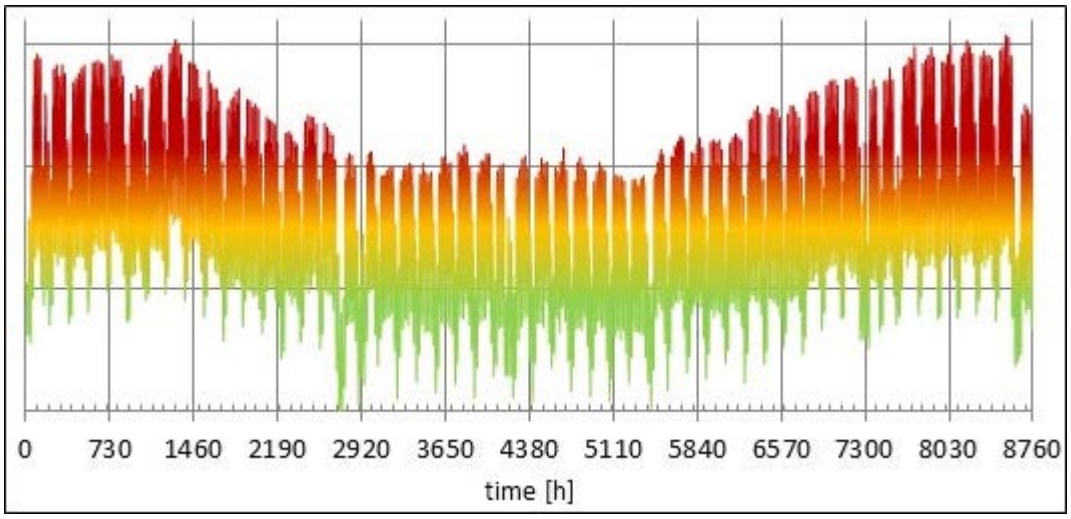

Figure 2: Load profile over the course of 8760 hours (= 1 year)

The relationships between key features of the project described in this section are reported in the MindMap in Figure 3. Figure 4 shows the relationships between operation planning inputs and INTERPLAN tool components.

Finally, a validation process will be applied through numerical simulation environment to prove the validity of the proposed concept. In detail, static and dynamic analysis will be led in lab environment in order to show the effectiveness of the tool (e.g., ability to avoid congestion

problems at interface TSO-DSO level or to apply adequate intervention measures). The validation process, in particular, is not a final phase of the work but is a permanent phase, which will allow to modify and improve the tools and models developed in previous phases.

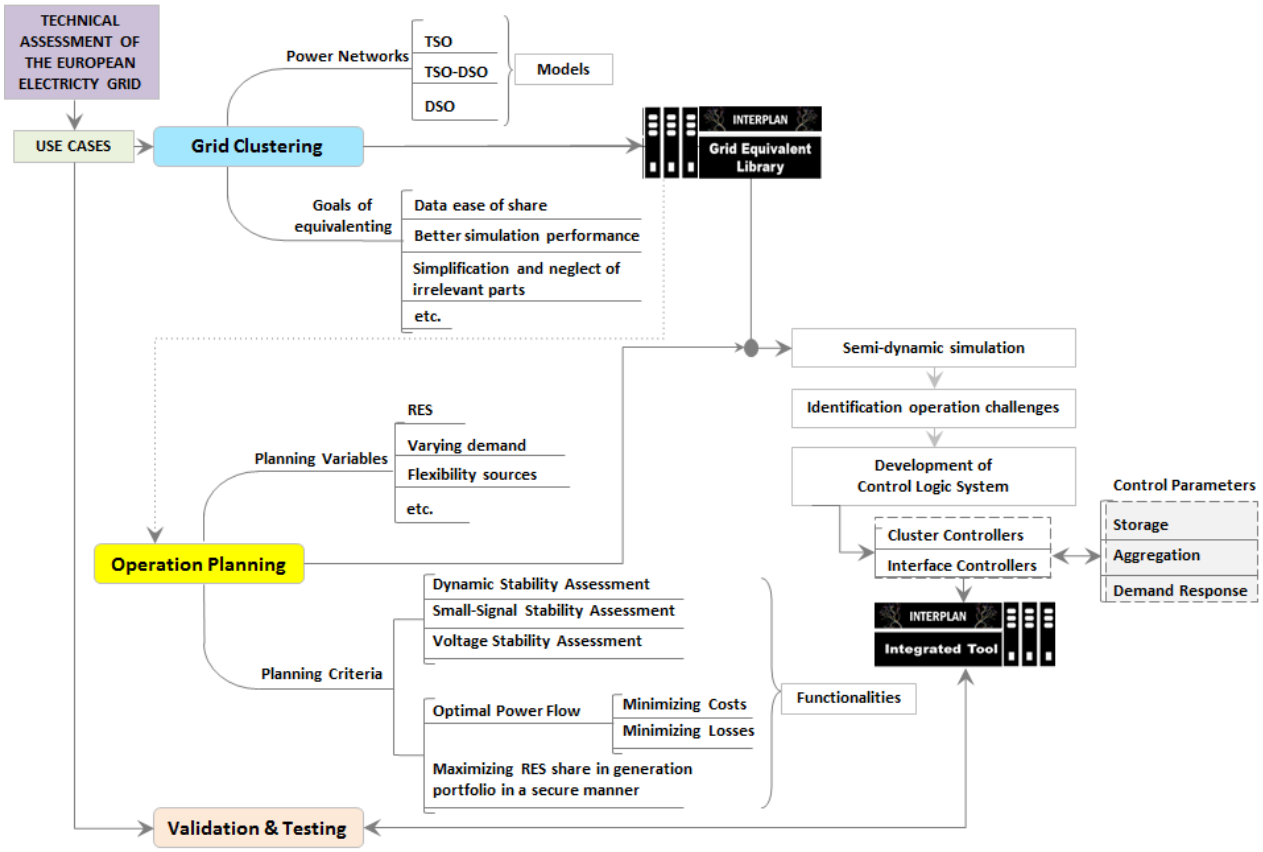

Figure 3: INTERPLAN MindMap

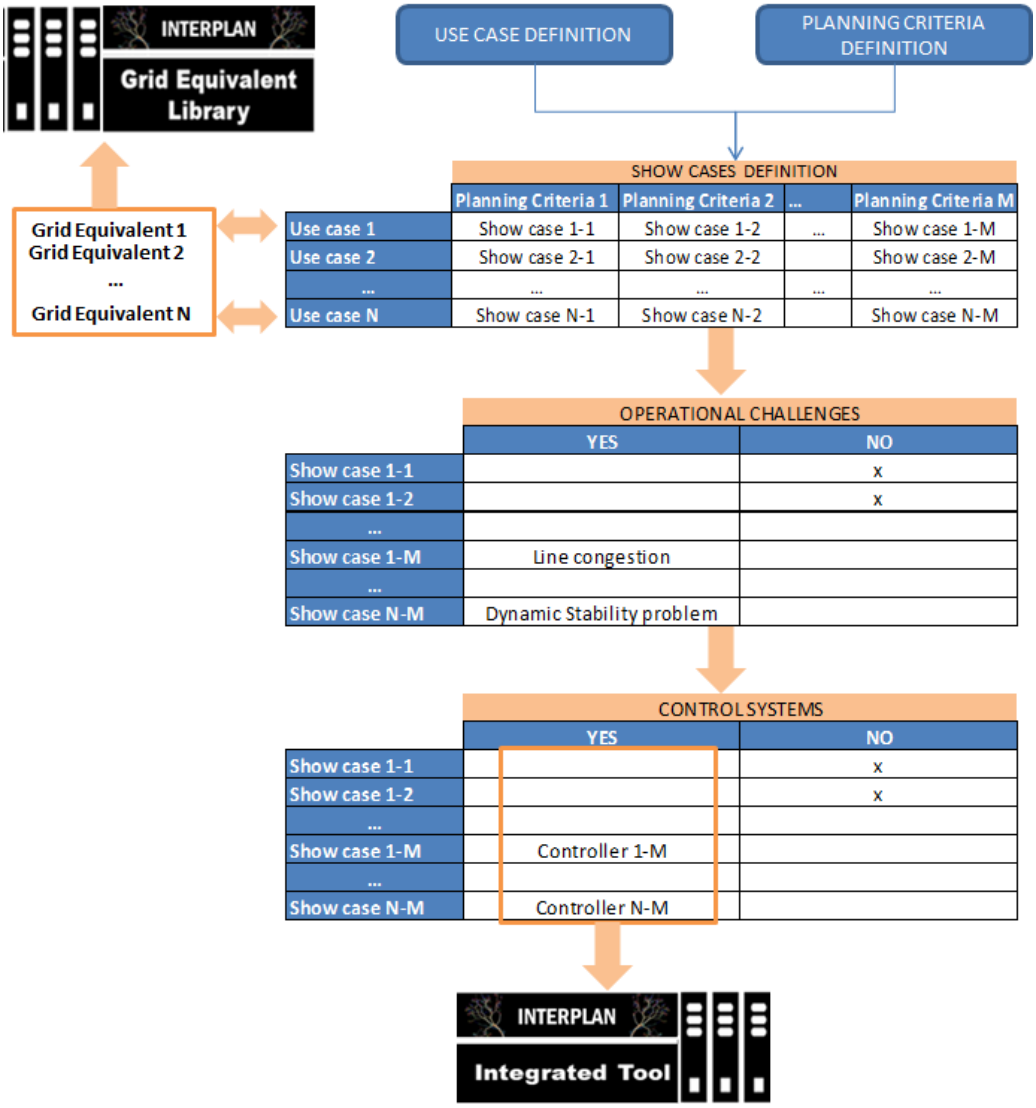

Figure 4: Relationships between operation planning inputs and INTERPLAN tool

2.4 INTERPLAN technical ad-hoc indicators

In order to assess INTERPLAN specific results, a set of technical ad-hoc indicators is identified. They imply the aim to find solutions that may help the current electricity system to evolve towards a pan-European network, which can maximize the penetration of RES while preserving the security of supply, by ensuring reliable control over the interconnected grid at all voltage levels. The fulfilment of the technical ad-hoc indicators will be measured by considering the progress against specific objectives presented below.

The activities of INTERPLAN partners in numerous national and European funder research projects of similar topics, as well as their involvement in European Energy Research Alliance Joint Programme on Smart Grids (EERA JP SG) [3], have provided the INTERPLAN consortium a significant knowledge of the pan-European network future needs. The experience of the consortium also provided a good knowledge of the state-of-the-art solutions, thereby allowing to identify the possible drawbacks of the solutions proposed so far. Therefore, the technical objective of INTERPLAN is to propose solutions, which overcome these technical drawbacks and fully meet the pan-European network future needs.

The main INTERPLAN technical ad-hoc indicators are identified to measure the progress against specific objectives presented in the following, which are in line with the work programme.

Specific Objective #1: Enhancement of interconnections between Member States and energy networks.

The integrated grid is huge and complex. Nevertheless, it can be logically divided into coherent clusters that characterise specific sections of the grid from low voltage up to and including extra high voltage. These will be carefully selected to form active components of the grid that can be replicated to build the complex integrated grid. The consortium anticipates the numbers indicated below, but these will be further elaborated in the project and fine-tuned to constitute logical synthesis of active elements that serve a specific function within the integrated grid. The logical clusters can be further divided into grid equivalents representing active components that require diverse modelling. The relative ad-hoc indicators identified are summarized in Table 3.

Table 3: Technical ad-hoc indicators to measure the progress against Specific Objective #1

Ad-hoc indicator	***Target***	***Description***
Logical physical clusters in which the grid is divided	>20	Provide results on how the targeted physical clusters can characterize specific sections of the grid from low voltage up to and including extra high voltage
Models for the typical logical clusters	20	Provide results on how the models for the typical logical clusters can be replicated to build the complex integrated grid
Models for grid equivalents representing the original networks	At least twice of the logical clusters	Provide results on how the targeted grid equivalents model can represent the original networks
Show cases for dynamic simulation	5	Models representing different characteristic operational conditions (use cases) and resulting problems of static and dynamic nature to be tackled by proper operational planning

Specific Objective #2: Increase of network observability through the development of control system logics operating at all voltage levels

Following the logical clustering of the integrated grid referred to above direct controllers for managing the physical clusters and interfacing controllers for effective linking of the physical clusters to form the integrated grid will be developed to build the required functionalities. The diverse functionalities of the integrated grid will be carefully analysed and the extent of interfacing will be judged and adequately complemented through the work in INTERPLAN. The relative ad-hoc indicators identified as a minimum requirement are summarized in Table 4.

Table 4: Technical ad-hoc indicators to measure the progress against Specific Objective #2

Ad-hoc indicator	***Target***	***Description***
Controllers for the typical logical cluster	20	Provide results on how the targeted controllers for logical clusters can improve the grid observability
Interface controllers	50	Provide results on how the targeted

between the typical logical clusters		interface controllers for logical clusters can improve the grid observability

Specific Objective #3: Advances in managing all relevant flexibility resources as "local active elements" within the grid

Flexibility will play a very important role in the emerging technologies in support of the energy transition. Storage is becoming a critical component of the electricity grid in transition adequately contributing to the effective use of intermittent RES generation and the operational control of the emerging grid with physical inertia being replaced with virtual alternatives. It is within the main objective of INTERPLAN to provide the required models for incorporating storage and demand response in the active components of the integrated grid thus incorporating the required flexibility for efficient use of resources. Different technologies of storage meeting complementary requirements of the integrated grid will be modelled thus facilitating the analysis and operation of the active integrated grid. Similarly, different flexible loads will be modelled representing their physical response to the needs of the system thus allowing their inclusion in the overall system modelling for analysis and control. All these initial thoughts will be further elaborated in the INTERPLAN project to complement the readily available model library for system analysis and control with an exhaustive list of models that cover mature technologies and flexible loads with their distinct operational characteristics. The relative ad-hoc indicators identified are summarized in Table 5.

Table 5: Technical ad-hoc indicators to measure the progress against Specific Objective #3

Ad-hoc indicator	***Target***	***Description***
Effective models for storage	8	Provide results on how the targeted models for different technologies of storage can contribute to the effective use of intermittent RES generation and the operational control of the emerging grid.
Effective models for demand response	10	Provide results on how the targeted models for demand response can provide the required flexibility for efficient use of resources.

The technical ad-hoc indicators above will be monitored and updated during the project execution, based on the relative results achieved in the various project phases. Moreover, they will be discussed with members of the AB (presented in Section 4), in order to improve and rationalize the monitoring process, and to involve other suggested indicators.
Moreover, a set of impact ad-hoc indicators is identified to monitor the project progress against specific objectives related to the knowledge transfer and dissemination. The relative ad-hoc indicators are shown in Table 6.

Table 6: Impact ad-hoc indicators to measure the progress against knowledge transfer and dissemination objectives

Ad-hoc indicator	***Target***
Publications in (peer reviewed) scientific journals and international conferences	10
Newsletter Subscription	>100
Ready-to-use models of grid equivalents in CIM format available for download from the website	10

Target stakeholder participants for the related workshops (per workshop)	>10

2.5 Expected impacts

2.5.1 Overall expected impact

In the following, the ways through which INTERPLAN project intends to achieve the overall expected impacts set by the work programme are described.

Overall expected impact #1: Relevance and compatibility with the broad EU energy policy context such as Climate-Energy packages, Energy Union.

INTERPLAN addresses planning, development and operational issues of the integrated grid capable of handling efficiently and effectively intermittent RES technologies, storage in its broader context, flexible aggregated demand capable of offering demand response services complementing other system flexibilities as a positive response to the needs of intermittent sources of energy. In this respect, INTERPLAN responds to the strategic objectives of EU for reducing emissions by 40% by 2030 and be No 1 in RES technologies achieving a 27% RES target in final energy use over the same period. Moreover, INTERPLAN is responding to the paradigm change from “generation is following load” to “load following the generation” by building the grid with the end user in the centre of all activities: active demand response, aggregated services, smart use of infrastructure and smart response to system needs. All these tie in well with the objectives set out in the Energy Union for No 1 in RES and smart EU energy system with consumers at the centre and related issues in the 10 key actions of the SET Plan and the 13 themes of the SET Plan Integrated Roadmap.

Overall expected impact #2: Contribution to ongoing policy developments in the field of the design of the internal electricity market, of the retail market, ongoing discussions on self-consumption.

INTERPLAN moves away from the radial design of the grid and approaches its planning, development and operation from a technology neutral view, allowing active contributions throughout the network hence in support of the ongoing policy developments.
The end user is transformed to an active contributor to the grid functioning optimising self-consumption, improving market operation by building aggregated services throughout the grid that complement the diversified services of operators, thus building a more dynamic internal electricity market capable of optimising resources and leading the way towards the planned sustainable economy.

Overall expected impact #3: Contribution to enhanced interconnections between Member States and/or between energy networks.

INTERPLAN approaches the grid as being interconnected allowing seamless extension from country to country by offering tools to improve its synthesis and analysis. The key to its versatility lies in the concept of equivalenting (clustering) allowing accurate analysis of the complex pan-European network without losing the vital contribution of local active elements thus utilising the benefits of distributed resources in an optimal pan-European perspective. With this approach, INTERPLAN via effective cluster and interfacing controllers contributes to the objectives for

building one single energy network within the interconnected Europe allowing the contributing benefits of complementary energy networks to the electricity network.

2.5.2 Specific expected impact

In the following, the ways through which INTERPLAN project intends to achieve the specific expected impacts set by the work programme are described.

Specific expected impact #1: Optimized grid planning and design at European level, maximizing the capacity of the grid to host variable renewables, take full advantages of a pan-European grid for stability and security.

INTERPLAN is addressing the planning, development and operation of the integrated grid from the European perspective without losing the myriad benefits of distributed resources and smart controllers spread throughout the grid. In this respect the optimization studies through INTERPLAN will address the economic dimension from a holistic view hence exploiting to the full potential the benefits of the diversity of north, south, east and west.
The equivalenting architecture of INTERPLAN with the cluster and interface controllers, effective models for storage, aggregated demand response suits the complexity of the integrated grid as it will evolve through the adaption of the most competitive technologies in the sustainability trajectory. Stability and security will be addressed at area, regional and pan-European level offering ease in the synthesis and analysis but fully responsive to the requirements of the pan-European dimension.

Specific expected impact #2: Safe, secure, efficient and coherent data handling, enabling more cross border trading and real time balancing.

INTERPLAN will use system and user data through the logical interfaces to be handled by national data operators that will provide the required security that will safeguard the provider. For INTERPLAN to be effective and responsive requires reliable data at the prescribed latency. This is anticipated to be available hence contributing to the smooth functioning of the electricity market in Europe and achieving optimal use of resources at all times.

Specific expected impact #3: Enabling new flexibility services to the grid associated with new business opportunities, offering the access to cheaper energy for the consumers and maximising the social welfare.

INTERPLAN is going to develop a platform for analysis, development and operation of the interconnected grid of tomorrow with the seamless integration of the intermittent sustainable technologies, supporting technologies such as storage and aggregated flexibilities through the active participation of the end users through demand response activities.
These will utilise the advanced features of INTERPLAN of equivalenting, cluster and interface controllers for normal and dynamic stability assessments. These possibilities will facilitate the evolution of the electricity grid in a direction that will optimise resource availability in line with the sustainable policies of Europe and create diverse opportunities for new market participants to emerge, that will exploit the emerging business opportunities: New emerging technologies, utilization options, aggregated solutions, Virtual Power Plant possibilities, energy communities as outlined in the Winter Package, energy islands for advanced security of supply etc.

Specific expected impact #4: Increasing the potential of exchanges between energy networks, enhanced security of supply, create business opportunities, avoidance of curtailment, offering new services to the grid.

As outlined in specific expected impact #3, INTERPLAN will facilitate the evolution of the electricity grid in an optimal way from the end user with the aggregated services to the grid to the most sophisticated centrally managed generating station including large offshore wind farms harnessed through dedicated DC grids. This development will safeguard the local element with the hierarchical central needs of the system. This approach will offer the detailed benefit of socialising infrastructure where needed and only through justifiable techno-economic benefit. As outlined INTERPLAN will inherently take on board the justifiable benefits of other energy networks when they offer enhanced security of supply at a lower cost. This approach will maximise the use of all available energy resources since load responds positively to all available resources of energy as and when they are made available. Such an inherent system approach will contain curtailment and will limit it to extreme situations when the system integrity is in jeopardy.

Specific expected impact #5: Account for human behaviour in the design of infrastructure and demand-response to avoid blockages due to social acceptance, placing the consumer at the center of the energy system.

INTERPLAN addresses the development, planning and operation of the electrical grid through a synthesis of clusters of homogeneous nature that are technology neutral building on the strengths of aggregated end users and the benefit they offer to the system at large. The evolution of the electricity grid based on the end user at the center of the energy system offers inherently the platform for social acceptance maximising their contribution to the energy mix of each and every Member State.
In this respect INTERPLAN by its own nature and structure will support the energy transition process and nurture the build-up of a participatory culture which is so desirable for the success of this venture.

2.6 Measures to maximize the impact

2.6.1 Dissemination and exploitation of results

Since INTERPLAN activities are spread across Europe, a special emphasis will be on covering, properly coordinated, uniform dissemination and exploitation of project results and activities. In this subsection the key elements of the proposed dissemination and exploitation plans are outlined (mainly covered by WP7).
Some examples of detailed measures to maximise impact are the following:

- close cooperation with stakeholders, including their feedback and input consistently at all stages of the project
- strategic scientific dissemination (see D7.1 "Dissemination and cooperation plan")

Further and more detailed measures of maximising the impact will be elaborated in D7.6 and D7.7 "Exploitation activities" (first and final versions respectively).

2.6.2 Communication activities

The INTERPLAN consortium is fully aware that communication is a key complement for

exploitation and dissemination strategies to fully achieve the envisaged impact and contribution to a European “Innovation Union”. Therefore, this continuous process aims at raising awareness of as many relevant actors as possible on the activities and results derived from the project in order to:

- promote and position the project results;
- reach and involve society at large (general public) as a key driver for behavioural change; get a critical mass of “early adopters”, starting from pilot users, to have relevant feedback on the effectiveness of the system;
- promote “best practices” towards energy departments and other public or private administrations;
- support the exploitation of project results.

The detailed "Communication strategic plan" is available in INTERPLAN D7.1 (Confidential Report).

3 Workplan - Detailed implementation

The work plan is structured to allow a logical progression of needed activities and closely follows the objectives and methodology described in the previous sections. The list of work packages (WPs) with corresponding partners' responsibility is shown in Table 7.

Table 7: List of WPs with corresponding partners' responsibility

WP No	***WP Title***	***Lead partner***
1	Coordination and project management	ENEA
2	Technical assessment and regulatory status of the European electricity grid	UCY
3	Requirements, scenarios and use cases definition	DERlab
4	Grid equivalenting	AIT
5	Operation planning and semi-dynamic simulation	ENEA
6	INTERPLAN model validation and testing	FRAUNHOFER IEE
7	Dissemination, communication and exploitation	DERlab

3.1 Summary of work packages

INTERPLAN project consists of seven WPs, described in the following:

- **WP1** “Coordination and project management” aims at the timely delivery and high quality of the project results through overall monitoring, efficient organizational and financial coordination, as well as on-going quality control, and meeting contractual commitments to the European Commission (EC).

- **WP2** “Technical assessment and regulatory status of the European electricity grid” aims to quantify the basis for defining significant use cases and adaptive clustering methods that can facilitate the INTERPLAN targeted planning and operational objectives. Emphasis will be put on exploitation and analysis of previous projects and studies (e.g., e-Highway2050), considering both Pan-European level (transmission grid) and also looking down to flexibility present in the distribution grid, paying specific attention to address flexibility possibilities coming from storage, demand response singly or aggregated. The status of the grid codes and related regulation will be elaborated in support of the scenarios to be developed under INTERPLAN. The detailed assessment of the regulatory status of the European electricity grid will ensure that the INTERPLAN solutions will bring innovation, based on the current standards and regulations, and will be validated through the targeted workshops with the TSOs, DSOs, the EU Task Force for Smart Grids, etc. Moreover, the developments achieved through the project will be transformed into policy requirements to be addressed to the Regulators and the Operators for possible amendments to the grid codes (national and / or European).

- **WP3** “Requirements, scenarios and use cases definition” will define the requirements, scenarios and the use cases for the INTERPLAN models. The requirements and use cases

definition will be based on the analysis done in WP2 for the regulatory framework and grid codes. The outcome of this WP will be used as a guideline for the implementation of the grid equivalent models in WP4, the simulation in WP5 and validating those models in WP6.

- **WP4** "Grid equivalenting" will generate grid equivalent models at different voltage levels to be integrated in the operation planning tool and semi-dynamic simulation environment in WP5. Grid equivalents will be generated based on the developed INTERPLAN use cases and requirements in WP3. Network models will be generated in a digital simulation environment. Then, a clustering method, both for transmission and distribution levels systems up to the end-user level, will be identified and characterized. Based on that a detailed approach for generating grid equivalents representing the original networks according to the required granularity by the individual use cases will be developed.

- **WP5** "Operation planning and semi-dynamic simulation" will develop the operation planning tool and control system logics for transmission and distribution levels, and transmission-distribution interfaces, based on WP4 grid equivalents. Different showcases will be established, based on several operation planning criteria such as small-signal stability assessment, dynamic stability assessment, voltage stability assessment, OPF, and maximizing RES share in generation portfolio in a secure manner, as well as on the varying behavior of power system objects subject to planning, such as RES, demand, and flexibility resources. Then, semi-dynamic simulations of grid equivalents will be performed for each identified showcase to identify possible problems. For each of these problems, the possible solutions and proper control parameters (i.e., storage, demand response, and aggregation) will be defined. Thus, control system logics will be developed for applying adequate intervention measures through cluster controllers and/or interface controllers.

- **WP6** "INTERPLAN model validation and testing" will focus on validating, testing and verifying in a simulation environment the developed models and tools from WP4 and WP5. The real time co-simulation environment will eventually be used as a tool for the demonstration of the "proof of concept". The operational tools will be tested on scenarios build up on the use cases. The results from the simulative tests will then fed back into WP4 and WP5 in order to improve and correct the developments. The interfaces defined in WP3 will be realized in order to provide a seamless connection between the simulation environment and the operational tool and network models. A steady evaluation of the actions and performance of models and tools will be done in order to provide a continuous evolution of the methods.

- **WP7** "Dissemination, communication and exploitation" aims at the dissemination and communication of non-confidential scientific results to the industry and scientific community during the project execution. This WP will ensures that the newly developed knowledge will be exploited on board international scale among industry, key users, national and international authorities, standardization bodies and other relevant stakeholders. In detail, the right channels and methods for achieving feedback on the activities and outcome of the project will be identified through a strategic dissemination plan. In order to present the external identity of the project in a consistent way in all communication material, a project visual identity will developed through project logo, website, social media, flyers, brochures, newsletter, etc. Scientific results will be published as papers in technical journals and/or presented at international conferences, aiming at a scientific dissemination of relevant outcomes. Knowledge transfer will be ensured through regular exchange, physical

workshops or other joint activities. In addition, a stakeholder analysis will be performed in order to establish cooperations and to get feedback on the project results and activities. Finally, a strategic exploitation plan will be developed in order to transfer the project results and models to industry and identify the target groups in different market sectors.

3.2 Work packages description

3.2.1 Work package 1 - Coordination and project management

WP1 aims at the timely delivery and high quality of the project results through overall monitoring, efficient organizational and financial coordination, as well as on-going quality control, and meeting contractual commitments to the European Commission (EC).

WP1 has started at Month 1 and will last until M36 and the Lead Beneficiary is ENEA.

3.2.1.1 Objectives

WP1 aims to ensure a successful completion of the project goals on time within the limits defined by the budgetary framework, and quality adequate for European standards. The main goals of WP1 are:

- Managing the project resources
- Ensuring compliance with the Grant Agreement (GA) and the Consortium Agreement (CA)
- Coordinating the interaction between partners and WPs
- Ensuring that deadlines are met within the Consortium
- Coordinating the overall evaluation of results and deliverables
- Managing administrative, legal and financial issues

3.2.1.2 Description of work and role of partners

The management task will focus on a centralized control and monitoring with the transferred responsibilities to Work Package Leaders (WPLs) and Task leaders. This WP will be linked to all others and will ensure communication among WPs, and between the INTERPLAN project and the EC. WP1 will receive information and results from WP2 - WP7 activities and from the linked activities within the EERA JP SG, which is also a member of the Advisory Board (AB). The WP is led by the Coordinator (ENEA), based on the contribution from all partners.

WP1 consists of the following two tasks:

Task 1.1 Procedural and quality management (**ENEA**, AIT, DERlab, UCY, FRAUNHOFER IEE, IEN) **[M1 - M36]**
The Project Coordinator (PC) will be responsible for the scientific, administrative and financial coordination of the project, by managing the interaction between partners and WPs, ensuring that deadlines for task and deliverables are met, coordinating the overall evaluation of results and deliverables, and managing all administrative and financial issues in efficient way.

Within this task, a data management plan will be provided within the first months of the project execution to support the management of the data which will be generated, processed and collected by the consortium. In addition, the Ethics Requirements has been already established at M1, by

outlining the methodology for recruiting the stakeholder workshops' participants.

This task will also include a monitoring process for the identified technical ad-hoc indicators, according to which, they will be updated during the project execution based on the outcomes from the other WPs. This process will also include further ad-hoc indicators suggested by stakeholders involved in the AB.

Finally, interaction with the other European initiatives will be ensured in order to promote continuous feedback and to effectively maintain the link with the development of the Pan-European network.

Task 1.2 Management and reporting on administrative and financial aspects (**ENEA**, AIT, DERlab, UCY, FRAUNHOFER, IEN) **[M1 - M36]**
This task aims to manage the compilation of periodic activity reports and financial ones according to the Financial Guidelines of the EC. These reports will be based on non-official reports and interim activity developed by WPLs. They will be made available every 6 months throughout the duration of the project to monitor the activities progress and the budget spending for early detection of any issues that might arise, related to eventual overspending or underspending.

3.2.1.3 WP 1 Deliverables

There are two public deliverables foreseen in WP1.

D1.1: Ethics requirements [M1] - Public
It will outline the methodology for recruiting the stakeholder workshops' participants, informed consent forms and sheets - Task 1.1.

D1.5: Project handbook (DoW) [M3] - Public
The handbook will specify in detail the DoW, in order to promote an effective trans-disciplinary work in the consortium and ensure an adequate communication among partners - Task 1.1.

3.2.1.4 Milestones

No milestones are foreseen for WP1.

3.2.2 Work Package 2 - Technical assessment and regulatory status of the European electricity grid

WP2 has started at Month 1 and will last until M36 and the Lead Beneficiary is UCY.

3.2.2.1 Objectives

The main objective of WP2 is to identify relevant basis to later define significant use cases and a clustering method. Emphasis will be put on exploitation and analysis of previous projects and studies (e.g. eHighway), considering both Pan-European level (transmission grid) and also looking down to flexibility present in the distribution grid, paying specific attention to address flexibility possibilities coming from storage, demand response singly or aggregated. The specific objectives are the following:

1. *Country based assessment*: detailed study, by country, of the main interconnection issues (e.g. TSO-DSO) and criticalities (e.g. congestion).
2. *Pan European interconnection assessment*: detailed study of the main interconnection issues and criticalities, at Pan-European level.
3. *Regulatory framework study by country and at Pan-European level*, including existing grid codes.
4. *Proposal for a unified European regulatory framework* - including new grid codes.

3.2.2.2 Description of work and role of partners

INTERPLAN addresses planning, development and operational issues of the integrated grid capable of handling efficiently and effectively intermittent RES technologies, storage in its broader context, flexible aggregated demand capable of offering demand response services complementing other system flexibilities as a positive response to the needs of intermittent sources of energy. In view of this, the aim of WP2 is to concentrate on the technical assessment of the state of the art, of national and European practices, regulatory and grid code practices aiming to identify possible steps capable of providing an integrated planning tool for the implementation of new control and operation approaches at all network levels (transmission, distribution and transmission-distribution interfaces).
Moreover, WP2 aims to quantify the basis for defining significant use cases and adaptive clustering methods that can facilitate the INTERPLAN targeted planning and operational objectives. Emphasis will be put on exploitation and analysis of previous projects and studies (e.g., eHighway), considering both Pan-European level (transmission grid) and also looking down to flexibility present in the distribution grid, paying specific attention to address flexibility possibilities coming from storage, demand response singly or aggregated. The status of the grid codes and related regulation will be elaborated in support of the scenarios to be developed under INTERPLAN. Finally, the developments achieved through the project will be transformed into policy requirements to be addressed to the Regulators and the Operators for possible amendments to the Grid Codes (national and / or European).

In WP2, four tasks are addressed with active participation of all partners. Details of the targeted tasks are as follows:

Task 2.1: Country based assessment: detailed study, by country, of the main interconnection issues (e.g. TSO-DSO) and criticalities (e.g. congestion) (<u>UCY</u>, ENEA, AIT, FRAUNHOFER IEE, IEn**) [M1 - M6]**
The current practices in all countries represented in the consortium will be duly analysed through the prevailing national grid rules and practicing regulation aiming to:

- Identify adapted policies in handling the three main constituents of the emerging technologies that promise to play a leading role in the years ahead: Intermittent RES generation, storage of all technologies and flexible demand response (DR) (Electric vehicles, heating and cooling fall in the last two categories since embedded storage can be utilised as a highly flexible demand response constituent that can play a very important and highly useful role in the future energy mix).
- Qualify shortcomings in current practices that need to be addressed in developing and operating the emerging grids.
- Identify responding practices that lead the way to the adaption of the emerging technologies referred to above and how these can be extrapolated and adapted to play a

wider role in the scenarios to be developed under INTERPLAN.

Task 2.2: Pan European interconnection assessment: detailed study of the main interconnection issues and criticalities, at Pan-European level (IEn, DERlab, UCY**) [M1 - M10]**
The identified practices in the countries of the consortium and related analysis and synthesis conducted in task 2.1 will be extrapolated to cover all Member States aiming to identify:

- Commonalities and stronger evidence in the countries of the consortium as to what is required to be accomplished through INTERPLAN.
- Extent the conclusions of the above bullet with further evidence and experience from practices in other Member States giving to the content a more European character leading to stronger and more conclusive evidence on the critical issues of grids in operation and possible interconnection limitations needed to be addressed within the INTERPLAN project.

Task 2.3: Regulatory framework study by country and at Pan-European level, including existing grid codes (UCY, AIT, DERlab, FRAUNHOFER IEE, IEN**) [M1 - M18]**
Current policies and practices in the countries of all partners extended to cover all the Member States will be thoroughly studied in tasks T2.1 and T2.2. This task will take this work a step further and relate it to current status of national and European grid codes and related regulatory policies. This work will assist in qualifying and quantifying the limitations faced by the industry in adapting to the requirements of the emerging technologies and relate it to the content that developments should address in order to make them responsive to the needs of the system. The deliverables of this task will be cross referenced to the findings of T2.1 and T2.2 and assist in elaborating requirements to the detail required by policy makers. The outcome of this work will be a useful input to T2.4 for developing the policy and grid codes that will be responsive to the requirements of the emerging technologies and be aligned to the needs of the industry for managing the sustainable solutions that emerging technologies support.

Task 2.4: Proposal for possible amendments to grid codes and implications on European regulations (UCY, ENEA, DERlab**) [M18 - M36]**
Based on the work done in T2.3 and the validated innovation developments in WP 3, 4, 5 and 6 of INTERPLAN, the objective of this task is to elaborate the required amendments and / or extensions of grid codes and regulation policies in member states and EU at large. The WP will concentrate on a proposal with all possible amendments to the grid codes suitably documented reflecting the work developed in INTERPLAN. This will be a major objective of the project as an attempt to deliver an elaborated report to a high degree of detail to make the proposed changes as receptive as possible for adaption by the appropriate authorities. The implications to European regulation will be elaborated and aligned to the recommendations on grid codes. To make the deliverables of T2.4 as responsive as possible, the Advisory Board will be mobilised with the participation of a representative number of stakeholders, that will include experts from the EU Expert Group 3, which will be consulted for playing an active role in the proceedings of the targeted workshops aiming to secure their views and finally their consent for the solutions put forward through INTERPLAN. Three distinct iterations of the proposed solutions will be targeted through well planned workshops of not more than 15 well selected specialists in the field (at least 8 will be broader representatives of the stakeholders and the remaining will be specialists from the members of the consortium). These workshops will be in Brussels to assist the participation of the selected Specialists during the months of M27, M30 and M33. The final outcome will be a well-documented report in M36 with all the policy and grid code recommendations for wider dissemination.

3.2.2.3 WP 2 Deliverables

D2.1 Limitations in analytical tools of the interconnected grid [M6] - Public
A detailed report covering the available tools and models including related limitations and criticalities for interconnecting the emerging technologies in the countries of the consortium extended to cover all member states.

D2.2 Grid code and regulation limitations [M10] - Public
A detailed report with identified limitations of grid codes and regulation in the seamless inclusion of the emerging technologies in development and operation practices.

D2.3 Targeted workshops with the stakeholders [M33] - Public
Three distinct targeted workshops with the participation of external specialists representing equally the regulators, TSOs and DSOs, as well as the EU Expert Group 3.

D2.4 Grid code recommendations [M36] - Public
A detailed report with all the policy and grid code recommendations for wider dissemination.

3.2.2.4 Milestones

The milestones related to WP2 are MS1 and MS2 defined in Table 8 below.

Table 8: WP2 related milestones

Milestone number	Milestone name	Related work package(s)	Due date (in month)	Means of verification
MS1	Deliver a detailed European view of state of the art	**WP2**	M10	Lessons learned from projects in Europe are clearly identified forming the starting point of INTERPLAN use cases and project objectives.
MS2	Secure acceptance of possible amendments to the grid codes by the stakeholders	**WP2**	M33	Successful completion of third workshop with documented acceptance of stakeholders.

3.2.3 Work Package 3 - Requirements, scenarios and use cases definition

WP3 will start at Month 4 and will last until M12 and the Lead Beneficiary is DERlab.

The main objective of this WP is to define the requirements and the use cases for the INTERPLAN integrated operation planning tool. The requirements and the use cases defined in this WP will set the scope for the implementation in WP4-6. The requirements and the use cases will be based on

the regulatory framework and grid code analysis done in WP2.

3.2.3.1 Objectives

The objectives of this WP are to:

- Define the requirements for the INTERPLAN integrated operation planning tool based on the regulatory framework and grid code analysis done in WP2.
- Define the use case for network models (TSO, DSO, TSO-DSO interface) and grid equivalent models.
- Select the specific requirements that should be covered in INTERPLAN models.
- Select a set of use cases to be implemented in the INTERPLAN models covering the specific requirements.

3.2.3.2 Description of work and role of partners

WP3 consists of the following two tasks:

Task 3.1: Define INTERPLAN requirements (DERlab, ENEA, AIT, UCY, FRAUNHOFER IEE, IEn) **[M4 - M12]**
This task will elicit the details requirements for the network models and interfaces (TSO, DSO, TSO-DSO) taking into consideration the regulatory framework and grid code analysis done in WP2. The results of this task will be a set of requirements that needs to be taken into consideration for network models. The requirements will be documented in D3.1: “INTERPLAN requirements”.
All project partners will be involved in drafting the requirements and DERlab will be responsible for leading the Task.

Task 3.2: Identification of scenarios and definition of INTERPLAN use cases (**DERlab**, ENEA, AIT, UCY, FRAUNHOFER IEE, IEn) **[M4 - M12]**
This task will define and analyse the use cases for the INTERPLAN models. The definition and analysis of the use cases will be depending on the regulatory framework and grid code analysis in WP2.There will be a high interaction between this task and task 3.1 definition of the requirement. The scenario selection and use cases definition will take into consideration the requirements defined in task 3.1. The results of this task will be a set of use cases for network models (TSO, DSO, TSO-DSO interface) and grid equivalent models which is going to be used in the implementation in WP4-6. The use cases will be documented in D3.2: “INTERPLAN use cases”.
All project partners will be involved in identification of scenarios and defining the use cases and DERlab will be responsible for leading the Task.

3.2.3.3 WP 3 Deliverables

D3.1: INTERPLAN requirements [M12] - Public

This deliverable will present the final the requirements used for the INTERPLAN models which is going to be a guideline for the use cases definition and the implementation in WP4-6.

D3.2: INTERPLAN scenarios and use cases [M12] - Public

This deliverable will present the final results of use cases definition and analysis which is going to be a guideline for the implementation in WP4-6.

3.2.3.4 Milestones

The milestone related to WP3 is MS3 defined in Table 9 below.

Table 9: WP3 related milestones

Milestone number	Milestone name	Related work package(s)	Due date (in month)	Means of verification
MS3	Complete use case design	**WP3,** WP4, WP6	M12	The use cases definition phase in WP3 is complete: all use cases are available to be shared among connected WPs partners (WP4 and WP6).

3.2.4 Work Package 4 - Grid equivalenting

WP4 will start at Month 7 and will last until M36 and the Lead Beneficiary is AIT.

3.2.4.1 Objectives

WP4 is going to provide and generate grid equivalent models to be integrated in the operation planning and semi-dynamic simulation environment in WP5. This will be done based on the developed INTERPLAN use cases and requirements within WP3. This will be done in a two-step approach:

1. Development of grid equivalent models based on the use cases and requirements gained in the early project phase.
2. Iterative update and improvement of the grid equivalent models based on the experiences in both the simulation tool design (WP5) and validation (WP6).

The lower the voltage level the more important is to have available an approach to characterise networks as well as to generate simplified grid equivalents, since it is not possible to consider all existing networks (including full models) in an integrated planning tool. For that reason in the first step the following approach will be applied:

1. Network model (TSO, DSO, TSO-DSO interface) construction in a digital simulation environment.
2. Identification and characterization of a clustering method (both for transmission and distribution system up to the end user level).
3. Development of a detailed approach for generating grid equivalents for different use cases.

Inputs: WP4 is going to receive detailed information about the use cases and requirements to be considered in the first stage. WP4 will receive demand and requirements for improvement of the grid equivalents from WP5 and WP6.
Outputs: WP4 will provide and deliver grid-equivalents covering all voltage levels to be incorporated in WP 5 operation planning and semi-dynamic simulations environment.

3.2.4.2 Description of work and role of partners

Task 4.1 Network models at different voltage level - requirements and characterisation (FRAUNHOFER IEE, ENEA, AIT, DERlab, UCY, IEN) [M7 - M12]
Main aim of the task is to define and analyse already existing and available grid models at different voltage levels of the Pan-European power system (e.g. project e-Highway2050, iGREENGrid) aiming in the definition and construction of a realistic TSO-DSO grid example grids. This includes a simulation performance analysis of TSO-DSO grids based on the WP3 use cases and requirements, since the performance of grid simulations depends basically on the number of nodes and the type of simulation to be performed (static, semi-dynamic etc.). The models will be build up in DIgSILENT PowerFactory.

Task 4.2 Identification and characterization of a clustering method (AIT, ENEA, DERlab, UCY) [M10 - M16]
The first step is the definition and description of required information between TSOs and DSOs (in both directions) in order to formulate standardised interfaces of the grid models. In particular in the distribution network level the grid characterization in terms of losses, voltage characteristics, effectiveness of control strategies is crucial and need to be defined. Based on that an approach for clustering low, medium and high voltage grid will be developed and introduced.

Task 4.3 Detailed approach for generating grid equivalents for different use cases (AIT, ENEA, DERlab, UCY, IEN) [M13 - M36]
Development of an approach to generate simplified grid equivalents representing the original networks according to the required granularity by the individual use cases. This equivalents for instance may be two-bus grid equivalent or representative grid equivalents (with a few more nodes). If a use case does not allow such a two-bus simplification (due to result accuracy) accurate grid models will be designed.
The reduction of grids to grid equivalents requires to assign load/generation data of the replaced grid to suitable locations in the grid equivalent. In order to enable it a methodology to link end users (DER profiles) to reasonable locations in the grid equivalent is going to be developed.
Based on the experiences and results of WP5 and WP6 the grid equivalents are going to be iteratively improved and enhanced if required.

The ENTSO-E Initial Dynamic Model of Continental Europe is intended to describe the general dynamic behavior of the ENTSO-E Continental Europe power system suitable for transient analysis. Since the model covers the continental European grid (former UCTE grid) it fits well into the project description. FRAUNHOFER IEE has applied for the model and received the anonymized version for third parties (other than utilities). As stated the model is anonymized and without any graphic information, thus some refinement work is necessary. Publicly available open street map data will be filtered for contained power system infrastructure objects. The corresponding geo-referenced objects will be merged with PowerFactory data. Since the data volume is high, excessive scripting solutions are necessary. The final result will be a better usable version for the ENTSO-E Initial Dynamic Model of Continental Europe.

3.2.4.3 WP 4 Deliverables

There are two public deliverables foreseen in WP4, of which one will be updated at the end of the

project (D4.2).

D4.1: Method for clustering distributions grid [M17] - Public
The report focuses on describing an approach for clustering distribution grids covering the different use cases for semi-dynamic and integrated grid planning (covering all network levels).

D4.2: Approach for generating grid equivalents for different use cases [M22, update M36 as D4.3] - Public
The report describes in detail the approach for generating grid equivalents representing the original networks according to the required granularity by the individual use cases for integrated grid planning.

3.2.4.4 Milestones

Beyond MS3 already defined in Table 9, there are other three milestones in common with other WPs and three purely WP4 related milestones, as shown in Table 10 below.

Table 10: WP4 related milestones

Milestone number	Milestone name	Related work package(s)	Due date (in month)	Means of verification
MS4	Implementation of transmission grid data	**WP4**	M12	Transmission grid models are reduced and ready for calculation.
MS5	Complete network characterization and clustering	**WP4**	M16	Approach and method for network characterisation and clustering in WP4 is completed.
MS6	Complete grid equivalents	**WP4**	M20	Grid equivalents in WP4 are available for semi-dynamic simulation in WP5.
MS7	Complete operation planning phase	WP4, **WP5**, WP6	M24	Grid equivalents simulations are complete for each showcase in WP5: results are available to be shared among connected WPs partners (WP4 and WP6).

MS11	Complete real-time co-simulations	WP4, WP5, **WP6**	M30	Simulations (dynamic tests) are performed, and results can be fed back to WP4 and WP5
MS12	Complete validation of models and functionalities	WP4, WP5, **WP6**	M36	Models and functionalities from WP4 and WP5 are validated

3.2.5 Work Package 5 - Operation planning and semi-dynamic simulation

WP5 will start at Month 8 and will last until M36 and the Lead Beneficiary is ENEA.

3.2.5.1 Objectives

In WP5, different showcases will be established, based on several operation planning criteria such as small-signal stability assessment, dynamic stability assessment, voltage stability assessment, maximizing RES share in generation portfolio in a secure manner, and OPF for minimization of losses and costs, as well as on the varying behaviour of power system objects subject to planning, such as RES, demand, and flexibility resources. In order to develop the control systems to be integrated in the INTERPLAN tool for transmission, distribution, and transmission-distribution interfaces, semi-dynamic simulations of grid equivalents will be performed for each identified showcase. DIgSILENT Power Factory simulation environment will be used to model the use cases based on the WP4 outcomes. The possible problems as well as the possible intervention measures and the appropriate control parameters (i.e., storage, demand response, and aggregation) will be identified. Then, the control system logic to be developed by using DIgSILENT Simulation Language (DSL), will apply adequate intervention measures through cluster controllers and/or interface controllers. This WP will strongly interact with WP3, WP4 and WP6. Relatively to this latter, the testing results will be sent back to this WP, with the aim to improve the control systems developed.

3.2.5.2 Description of work and role of partners

WP5 consists of three tasks described in the following:

Task 5.1: Definition of showcases (IEn, ENEA, AIT, DERlab, UCY**) [M8 - M14]**
This task will establish the show cases for semi-dynamic simulations, based on several operation planning criteria and on the varying behaviour of power system objects subject to planning.

Task 5.2: Operation planning tool development and semi-dynamic simulation of grid equivalents (ENEA, AIT, DERlab, UCY, FRAUNHOFER IEE, IEn**) [M10 - M24]**
This task will focus on the modeling grid equivalents for each use case (output of WP4) through DIgSILENT. Then, semi-dynamic simulation of grid equivalents for each showcase will be performed, and the possible criticalities as well as the possible solutions will be identified, properly managing appropriate control parameters.

Task 5.3: Control system logics development (FRAUNHOFER IEE, ENEA, AIT, DERlab, UCY, IEn**) [M16 - M36]**
This task will focus on developing the control system logic by using DIgSILENT Simulation Language (DSL), and on applying adequate intervention measures through cluster controllers and interface controllers. The developed control system logics will be a set of algorithms able to cover a significant number of operational challenges within the chain transmission - end user.
In addition, an analysis will be also carried out in order to consider the economic impact of developed controllers. Therefore, information on a possible convenience in terms of cost savings will be provided.

3.2.5.3 WP 5 Deliverables

There are three public deliverables foreseen in WP5, of which one will be updated at the end of the project (D5.3).

D5.1: INTERPLAN showcases [M12] - Public
A detailed report with identified showcases for semi-dynamic simulations - Task 5.1.

D5.2: Operation planning and semi-dynamic simulation of grid equivalents [M24] - Public
A detailed report focusing on the results of semi-dynamic simulations of grid equivalents for each showcase, with the identified operation criticalities and possible solutions - Task 5.2.

D5.3: Control system logics: cluster and interface controllers (first version) [M30] (final version) [M36] - Public
This deliverable will present the description of developed logic controllers, also focusing on a summary of the issues and benefits of their application - Task 5.3.

3.2.5.4 Milestones

Beyond Milestones MS7, MS11 and MS12 already defined in Table 10, there is another milestone, i.e., MS8, which is related to WP5 as shown in Table 11 below.

Table 11: WP5 related milestones

Milestone number	Milestone name	Related work package(s)	Due date (in month)	Means of verification
MS8	Complete control logic development	**WP5**, WP6	M30	INTERPLAN integrated tool is complete in WP5: results are available to be shared with WP6 for the validation phase.

3.2.6 Work Package 6 - INTERPLAN model validation and testing

WP6 will start at Month 8 and will last until M36. The Lead Beneficiary is FRAUNHOFER IEE.

3.2.6.1 Objectives

In this WP the proposed use cases from WP 2 and 3 will be realized in a simulation environment

and the developed models and tools from WP 4 and 5 will be validated, tested and verified. Real time co-simulation experiments will be used for the demonstration of the “proof of concept”. The simulation environment will make use of already existing subsystems as far as possible. To this end, it is currently planned to use the OpSim co-simulation framework from FRAUNHOFER IEE with the Pandapower network calculation package for the Python programming language. These tools also include standard data models, which will be used as interfaces between the co-simulation parts. Currently, there have been four main parts identified: (i) the real-time physical network simulation (ii) the controllers simulation (iii) the grid cluster simulation and (iv) the OpSim message bus. Parts may be detailed or added during the requirements specification phase in WP3. WP6 will contain the processing and realization of the use cases from WP2 and 3 as well as the preparation of the simulated networks which serves as basis for simulation of the tools from WP 4 and 5. The operational tools will be tested on scenarios build up on the use cases from WP3 and show cases from WP5. The results from the simulative tests will then fed back into WP4 and 5 in order to improve and correct the developments. The interfaces described in WP3 will be realized in order to provide a seamless connection between the simulation environment and the operational tool and network models.
After completing the infrastructure tasks T6.1 and T6.2, the simulation runs will be set up and the scenarios will be performed. In this phase the functionalities of the tools from WP4 and 5 can be verified and improved. A steady evaluation of the actions and performance of models and tools will be done in order to provide a continuous evolution of the methods.

3.2.6.2 Description of work and role of partners

WP6 consists of the following tasks:

Task 6.1: Preparing use cases from WP2 and WP3 and identify scenarios and relevant test networks (DERlab, FRAUNHOFER IEE, IEn**) [M8 - M18]**
This task will build up on the use cases defined in WP 2 and 3 and serve as the basis for an agreement on the use cases which should be validated in the real time simulations. The simulation scenarios will be set up here. In order to run the simulations, detailed network models have to be generated and implemented in the simulation environment. These models can be in PowerFactory format and should be derived from the models defined and used in WP 4 and 5. They are eventually automatically converted into the Pandapower format. The task includes identifying those use cases which will be validated in the simulation, define scene and setting of the use cases so that they can be integrated in the simulation, identify (parts of) networks and (historical) time series of power generation and demand, as well as forecasts thereof, which will be the basis of the simulation, prepare the test network(s) in a supported format, and prepare use case scenarios on the basis of time series or/and steady state data.
Concerning the time series used as simulation input data, the task will preferably make use of time series used in WP4 and 5 already. Eventually, synthetic time series have to be defined which support demonstration of the use cases. Concerning specific partner contributions to this task, it is currently proposed that DERlab and IEn review regulations and use cases in order to define simulation experiments and specify time series, and that FRAUNHOFER IEE prepares the time series and test networks for the simulation.

Task 6.2: Setting up co-simulations and preparing, modifying and setting up interfaces and connection to the tools (FRAUNHOFER IEE, ENEA, DERlab, IEn**) [M12 - M24]**
In this task, the afore gathered informations and data will be used to define concrete simulation test scenarios based on the use cases. Time series and network data are brought together in order to

generate a running simulation. Also the input and output via the interfaces will be tested and validated. In order to obtain a seamless integration and connection of the developed tools from WP 4 and 5, and to fulfill the need of standardized interfaces which provides sustainability, a common agreement on data model and interfaces inside the developed tools has to be found. The task includes implementation of networks and scenarios in the simulation environment, agreeing on data models and interfaces for exchange data between subtools and simulation, synchronization of interfaces between simulation and operational tools, testing the scenarios based on use cases as well as interfaces and data exchange, static and dynamic test of situations and networks (snapshot), and definition of outputs/analysis data.
Concerning specific partner contributions to this task, it is currently proposed that DERlab defines test scenarios based on the use cases and generates final time series, FRAUNHOFER IEE sets up the co-simulation, converts input data as needed and sets up the real-time simulation part, and that FRAUNHOFER IEE, ENEA and IEn together prepare interfaces for connection of the co-simulation subsystems.

Task 6.3: Perform the tests and simulations (FRAUNHOFER IEE, ENEA, DERlab, IEn**) [M18 - M30]**
In this phase, the simulations will be performed with the attached tools from WP 4 and 5. The results will then be fed back into WP 4 and 5 in order to improve the development of the models and control tools. The task includes final setup of the simulations, run the simulations, produce steady state data, and prepare and provide the output data.
Concerning specific partner contributions to this task, it is currently proposed that FRAUNHOFER IEE generally supports the co-simulation and operates the real-time simulation subsystem, ENEA and IEn operate the clustering subsystem with support by AIT from WP4, and controller developers support their individual controller simulation from WP5.

Task 6.4: Evaluation (IEn, DERlab, FRAUNHOFER IEE**) [M8 - M36]**
This task is a permanent task and will start together with WP 4 and 5. It will serve to maintain the developments and ensure a compatibility with the simulations. Also the results will be analysed and validated. The task includes the steps validation of models and functionalities, and performance analysis.
It is currently proposed that individual partners contribute to this task by evaluating their individual subsystems and algorithm performance. This is again strongly supported by WP4 and WP5 ongoing developments.

3.2.6.3 WP 6 Deliverables

There are three public deliverables foreseen in WP6.

D6.1: INTERPLAN scenarios which will be validated in the simulation [M18] - Public
A detailed report on the INTERPLAN scenarios which will be validated in the simulation. This report will consist of a description of the use case, the simulated network and the time series which will characterize each of the validated scenarios - Task 6.1.

D6.2: Documentation of the data model and interfaces used in INTERPLAN [M24] - Public
A detailed description of the implemented interfaces of the simulation and the controllers. Also the used data model will be described in this report - Task 6.2.

D6.4: Report on the validation tests [36] - Public

A detailed report with systematic presentation of the results of the evaluation of models, functionalities and performance. Where applicable, the report will allow to identify how accurate the use case (utilizing the equivalents) is in comparison to the full model - Task 6.4.

3.2.6.4 Milestones

Beyond MS3, MS7, MS8, MS10 and MS12 defined earlier, there are other two milestones, which are related to WP6 as shown in Table 12 below.

Table 12: WP6 related milestones

Milestone number	Milestone name	Related work package(s)	Due date (in month)	Means of verification
MS9	Definition and implementation of scenarios to be validated in simulation	WP6	M18	INTERPLAN scenarios to be validated in the simulation are set up.
MS10	Complete simulation environment for validation	WP6	M24	The simulation environment is ready to run validation tests

3.2.7 Work Package 7 - Dissemination, communication and exploitation

WP7 starts at Month 1 and will end at Month 36. The Lead Beneficiary is DERlab.

3.2.7.1 Objectives

This WP aims at the dissemination and communication of non-confidential scientific results to the industry and scientific community during the project execution. The WP ensures that the newly developed knowledge will be exploited on board international scale among industry, key users, national and international authorities, standardization bodies and other relevant stakeholders. The specific objectives are the following:

- To create a project image and establish the right dissemination tools (e.g. logo, website, social media, flyers, brochures, newsletter).
- To disseminate the project activities and results to different target groups.
- To obtain feedback from experts in the field (including industry) on the project activities.
- To define a plan for exploitation of the project results, maximizing innovation and market impact based on continuous review of market opportunities and standardization as relevant to the project scope.
- To perform stakeholder analysis and establish cooperation with interesting stakeholders.
- To contribute, upon invitation by the INEA, to common information and dissemination activities to increase the visibility and synergies between H2020 supported actions.

3.2.7.2 Description of work and role of partners

WP7 consists of the following tasks and partners' contributions.

Task 7.1: Project marketing (**DERlab**, ENEA, AIT, UCY, FRAUNHOFER IEE, IEn**) [M1-M6]**
Dissemination plan
In this task a strategic dissemination plan will be defined where the schedule, target audiences, communication channels and responsibilities of project partners are described for each key message. An important activity is also to identify the right channels and methods for achieving feedback on the activities and outcome of the project. Project visual identity and marketing In order to present the external identity of the project in a consistent way in all communication material, a project visual identity is developed. The identity consists of a project logo, general guidelines and templates and a project brochure/flyer. The public website will be created and maintained by DERlab. It will serve as a basic tool for external communications and it is updated regularly. The website will be suitable for different levels of interest and expertise: it will be attractive for both scientists and generally interested persons. It will be online starting from the 3rd month. Each project partner will create a link from their own website to the project website. In order to ensure dissemination of the project activities and results to a wider public, several activities will be performed, such as: media coverage by using dedicated PR platform for press releases (e.g. newswire), social media (e.g. dedicated professional LinkedIn account, Twitter, Facebook, YouTube channel or similar) and project newsletter. A partner portal will be created for internal use which will form the basis for the internal project communication.

Task 7.2: Scientific dissemination (**IEn,** ENEA, AIT, DERlab, UCY, FRAUNHOFER IEE) **[M3-M36]**
In this task, scientific results will be published as papers in technical journals and/or presented at international conferences, aiming at a scientific dissemination of relevant outcomes. Results obtained under the different work packages will be published in top-ranked in peer-reviewed international journal and conference proceedings, such as IEEE Transactions on Smart Grids, IET Generation, Transmission and Distribution, Renewable Energy, Applied Energy etc. Open access journals will be also considered for publication of research findings, if relevant.

Task 7.3: Cooperation, knowledge transfer and event organization (**DERlab,** ENEA, UCY, IEn) **[M1-M36]**
The main objective of this task is to create synergies with several project/initiatives in progress and dealing with the scope of the project. Knowledge transfer can be carried out through regular exchange, physical workshops or other joint activities. This task will also foster the establishment of liaisons with relevant international initiatives, networks and platforms dealing with similar topics. DERlab will ensure a close contact with relevant academia, industry and research institutes from Europe and the US via its network. Furthermore, workshops, special sections, events, etc. will be organized at national and international scientific conferences (e.g. IRED, Cigré, IEEE) to discuss the project results with various stakeholders.

Task 7.4: Stakeholder analysis and quality feedback (**DERlab**, ENEA, UCY) **[M1-M36]**
The main objective of this task is to perform a stakeholder analysis and establish cooperation with interesting stakeholders to get feedback on the project results and activities. This feedback would enhance the project outcomes. Furthermore, interesting stakeholders will be invited to workshops and special events in task 7.3. Task 7.5: Exploitation activities (DERlab, ENEA, UCY) [M24-M36]

The task will identify the main exploitable results and analyse their market potential. A detailed exploitation plan will be created. It will describe the overall exploitation strategy of the consortium as a whole and also strategic exploitation plan for individual partners. The exploitation plan will focus on:

- Transfer the project results and models to industry;
- Identify the target groups in different market sectors.

3.2.7.3 WP 7 Deliverables

The following public deliverables are planned in WP7:

D7.2: Promotion and marketing material [M6] - Public
This deliverable will present the website and dissemination material (such as: flyers and brochures) for the project.

D7.3: Progress report on the cooperation with national and international projects and initiatives (first year) [M12] - Public
This annual report will give an overview on the project cooperation with national and international projects and initiatives.

D7.4: Progress report on the cooperation with national and international projects and initiatives (second year) [M24] - Public
This annual report will give an overview on the project cooperation with national and international projects and initiatives.

D7.5: Progress report on the cooperation with national and international projects and initiatives (third year) [M36] - Public
This annual report will give an overview on the project cooperation with national and international projects and initiatives .

3.2.7.4 Milestones

The milestones related to WP7 are shown in Table 13 below.

Table 13: WP7 related milestones

Milestone number	***Milestone name***	***Related work package(s)***	***Due date (in month)***	***Means of verification***
MS13	Project dissemination material	**WP7**	M6	- Project website online - Print-out flyers and brochure
MS14	First stakeholder workshop is organised	**WP7**	M18	The first stakeholder workshop has taken place.

4 Project as a whole

4.1 Transdisciplinary work

As already mentioned in Section 3, INTERPLAN project consists of 7 WPs with related Tasks which are strongly correlated each other, as shown in Figure 5.

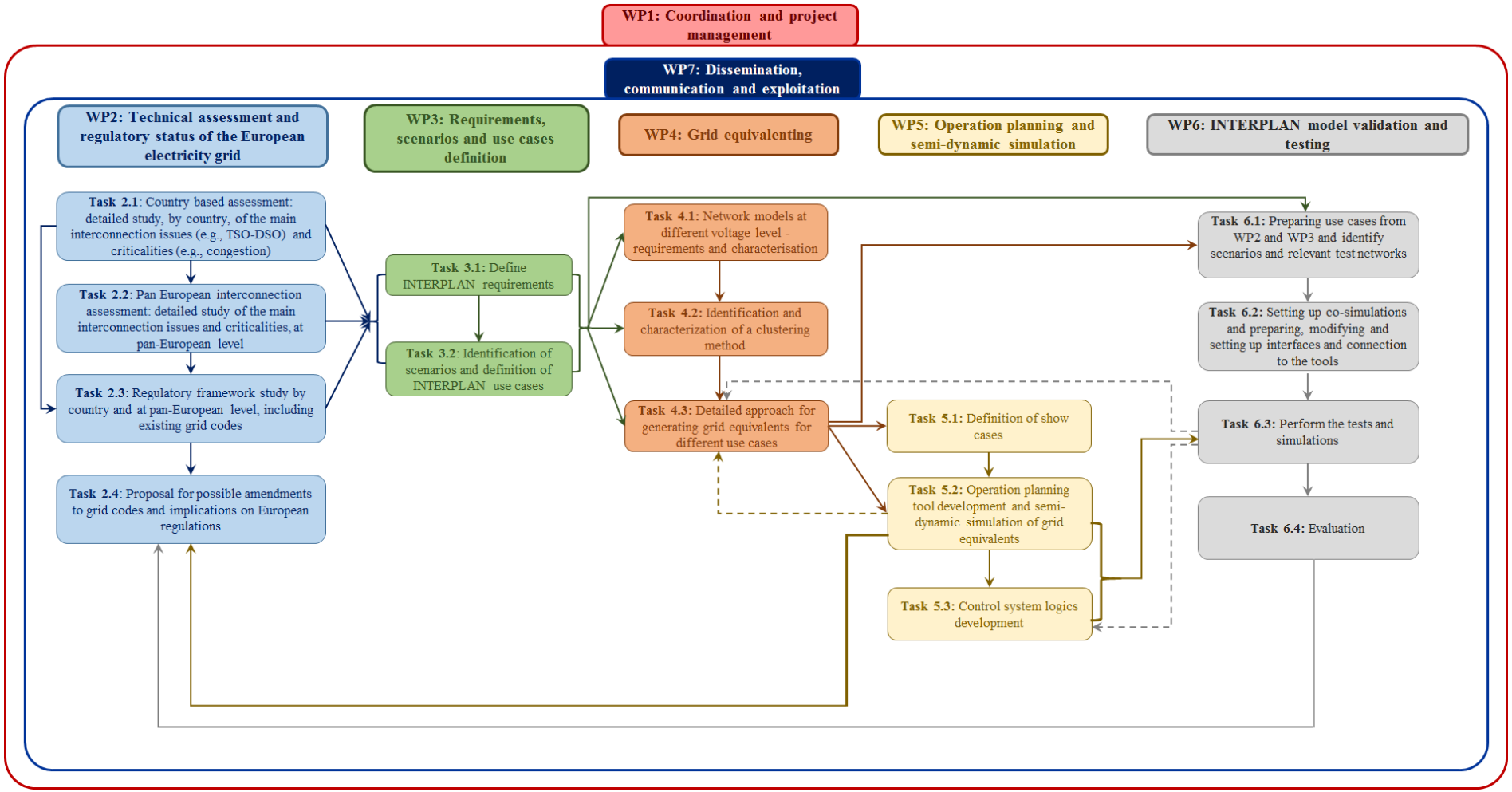

Figure 5: INTERPLAN Pert Chart

4.2 Timing of the different work packages and their components

The timing of the different WPs and their tasks is shown in Figure 6 as GANTT Chart.

Month:																																			
The INTERPLAN Time Plan	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1 Coordination and project management																																				
Task 1.1 Procedural and quality management																																				
Task 1.2 Management and reporting on administrative and financial aspects																																				
WP2 Technical assessment and regulatory status of the European electricity grid																																				
Task 2.1 Country based assessment: detailed study, by country, of the main interconnection issues (e.g. TSO-DSO) and criticalities (e.g. congestion)																																				
Task 2.2 Pan European interconnection assessment: detailed study of the main interconnection issues and criticalities, at pan-European level																																				
Task 2.3 Regulatory framework study by country and at pan-European level, including existing grid codes																																				
Task 2.4 Proposal for possible amendments to grid codes and implications on European regulations																																				
WP3 Requirements, scenarios and use cases definition																																				
Task 3.1 Define INTERPLAN requirements																																				
Task 3.2 Identification of scenarios and definition of INTERPLAN use cases																																				
WP4 Grid equivalenting																																				
Task 4.1 Network models at different voltage level - requirements and characterisation																																				
Task 4.2 Identification and characterization of a clustering method																																				
Task 4.3 Detailed approach for generating grid equivalents for different use cases																																				
WP5 Operation planning and semi-dynamic simulation																																				
Task 5.1 Definition of showcases																																				
Task 5.2 Operation planning tool development and semi-dynamic simulation of grid equivalents																																				
Task 5.3 Control system logics development																																				
WP6 INTERPLAN model validation and testing																																				
Task 6.1 Preparing use cases from WP2 and WP3 and identify scenarios and relevant test networks																																				
Task 6.2 Setting up co-simulations and preparing, modifying and setting up interfaces and connection to the tools																																				
Task 6.3 Perform the tests and simulations																																				
Task 6.4 Evaluation																																				
WP7 Dissemination, communication and exploitation																																				
Task 7.1 Project marketing																																				
Task 7.2 Scientific dissemination and event organization																																				
Task 7.3 Cooperation, event organization and knowledge transfer																																				
Task 7.4 Stakeholder analysis and quality feedback																																				
Task 7.5 Exploitation activities																																				

Figure 6: INTERPLAN GANTT Chart

4.3 INTERPLAN management structure

To guarantee the flexible coordination of the activities that will be carried out in the INTERPLAN project, a smooth decision process, and a prompt management of risks and unforeseen events, a proper management structure is needed.

Figure 7 shows the INTERPLAN management structure, with interactions among the various bodies involved.

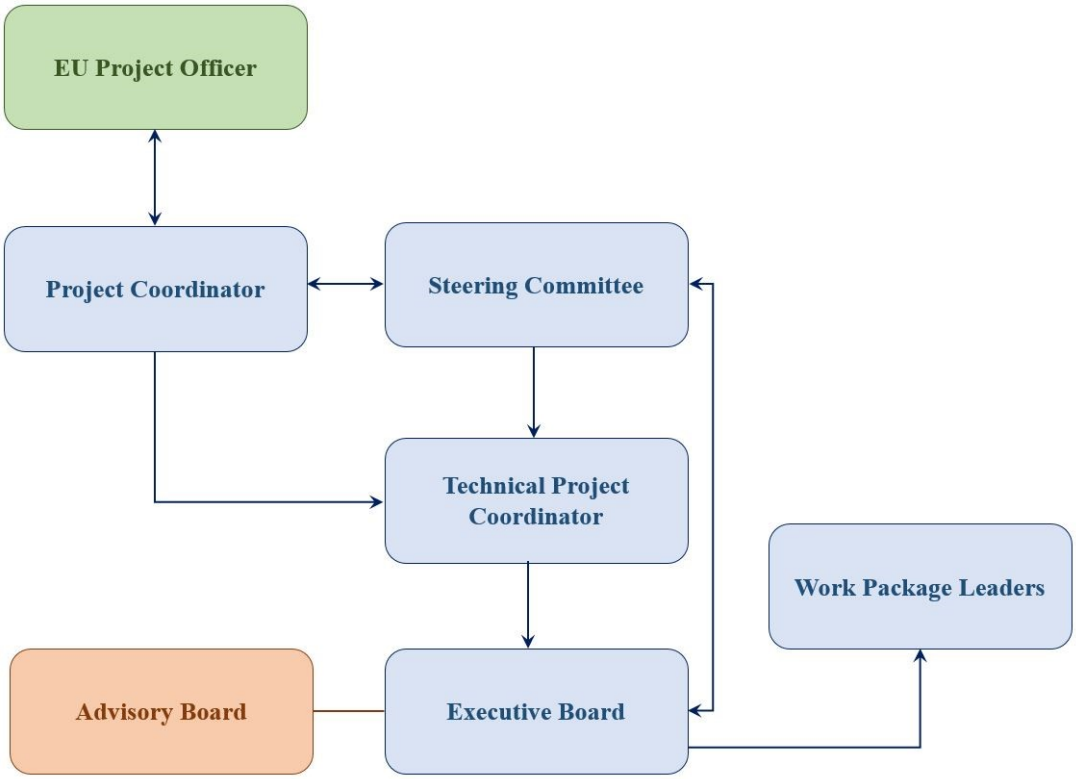

Figure 7: INTERPLAN Management Structure

The collaboration within the consortium and with the EC is, first of all, based on the GA. Relevant for the proper implementation of the project work are especially Annex 1 (i.e., Description of Action (DoA) Part A and B) and Annex 2 (estimated budget).
Moreover, the consortium's work is based on the CA, which has been duly prepared by the Coordinator (ENEA) and signed by each partner before the beginning of the project.

The Project Coordinator is ENEA, represented by Dr. Giorgio Graditi. It will ensure the overall planning, execution and control of the INTERPLAN project and constitutes the legally identified interface of the Consortium with the EC, both for legal and financial issues.

The Technical Project Coordinator (TPC) of INTERPLAN is Helfried Brunner (AIT), and he has been nominated by the Consortium during the proposal preparation phase. The TPC will chair and activate the Executive Board (EB).

To ensure the effectiveness of the work and coordination among each partner, the governing structure of INTERPLAN consists of the Steering Committee (SC) and the EB. The SC is

composed by a representative of each partner involved in the INTERPLAN consortium and is in charge of the evaluation and the validation of the work performed by each WP. The EB is the supervisory technical board for the execution of the project and shall report to, and be accountable to, the SC, as indicated by the two-way arrow communication line in Figure 7. The EB consists of the PC, the TPC, and Work Package Leaders (WPLs), chaired by the TPC.

The WPLs are responsible for the detailed coordination, planning, monitoring and reporting of their specific WPs, for the coordination of the tasks within the WPs, and with the other WPs in the project.

The AB is an appropriate platform for external members to participate in the INTERPLAN project. The involvement of these stakeholders will extend the INTERPLAN network and will provide valuable input to the EB, thereby constituting a consultative body for the WPLs. The AB will also have an important role in supporting the targeting of transfer of knowledge and dissemination. During the proposal preparation phase, the following organisations have already accepted the INTERPLAN invitation and sent a formal Letter of Support (LoS) to this initiative, also appointing a high-level representative to the AB:

- EAC (Electricity Authority of Cyprus) / Industry DSO (Cyprus);
- EERA JP SG / Public research alliance;
- DNV GL / Industry (Netherlands);
- ELECTRICA SA / DSO (Romania);
- University Politehnica of Bucharest (UPB) / University and MicroDERlab /Research group (Romania);
- Netz Oberösterreich GmbH and Salzburg Netz GmbH / DSOs (Austria).

5 Internal communication

5.1 INTERPLAN portal

Since its start in November 2017, the project has relied on a specific portal, i.e., INTERPLAN portal developed by DERlab (as WP7 Leader), that supports efficiently the organization and management of the project as well as communication among the partners. INTERPLAN portal is password-restricted and accessible to the partners only, and it is the primary platform for the project documentation and for managing all documents.

The portal is a web-based document management system and therefore enables all participants to access it via a web-browser. The portal area is structured according to the project workflow. All documents and files are uploaded, managed, and updated in the corresponding WP folders.

The main functionalities of INTERPLAN portal are described in the following:

- Collecting contact details of all project members also with photos;
- Visualizing the status of deliverables under preparation;
- Changing in real-time deliverables under preparation, to share information among partners;
- Collecting all documents/data produced throughout the project's duration;
- Discussing with members;
- Planning internal milestones;
- Visualizing the interactive GANTT Chart;
- Visualizing a calendar for events;
- Notifications on project status and updates also related to partners' activities on the portal.

5.2 Web-meetings

A general web-meeting is to be organized monthly by the PC and the TPC. At least one representative of each partner is required to participate or to be represented by the deputy. These web-meetings are explicitly announced by the TPC via email a week before, by also including a brief agenda.

Partners are invited to check the agenda and add items to be discussed. Likewise, each partner is expected to attend the web-meetings in an active and reliable manner. If anyone is unable to be present, he / she ought to give prior notice to the PC and the TPC and send feedback to relevant points raised in the agenda.

The agenda usually focuses on the following areas of discussion:

- progress within each WP with a particular focus on due deliverables;
- management issues.
- recent and coming events attended by INTERPLAN members;
- dissemination activities.

Moreover, other web-meetings are scheduled on a regular basis within individual WPs. These web-meetings are announced via email by the respective WPL. This latter is also responsible for writing minutes. Finally, to guarantee an effective management of each Task within the Project, web-meetings are also scheduled at Task level, with Task leader responsible for announcement of meetings via email and for writing minutes.

The tools mostly used for these calls cover Skype, GoToMeeting and Lync.

5.3 Physical meetings

Physical meetings will be organised for the regular meetings of the:

- Executive Board - every 6 months
- Steering Committee - every year
- Advisory Board - every year (same time and venue as Steering Committee)

These meetings will be scheduled as follows:

- M1 - ENEA Portici RC, Napoli, Italy (kick-off meeting).
- M6 - Executive Board (to be defined).
- M12 - Executive Board - Steering Committee - Advisory Board (to be defined).
- M18 - Executive Board (to be defined).
- M24 - Executive Board - Steering Committee - Advisory Board (to be defined).
- M30 - Executive Board (to be defined).
- M36 - Final Meeting - ENEA Portici RC, Napoli, Italy.

With reference to the physical meetings of the EB, partners who are not involved in the EB, but are responsible of Tasks and / or other specific activities in the project can take part in the meetings.

Moreover, two Technical Review Meetings will take place under convocation of the EC. During these meetings, the EC, with the help of external evaluators, will evaluate the progress of the project during the reporting period of reference. This aspect will be further discussed in Subsection 5.3.

6 Communication with stakeholders

INTERPLAN aims to provide solutions that will complement the capabilities of the industry in analysing and operating the interconnected grid with high penetration of distributed resources. In this respect it is the objective of the consortium to work closely with the industry, operators, policy entities and standardisation bodies for responding effectively to their needs and at the same time creating the right bi-directional communication and response for validating the identified solutions and developments.

Communication with stakeholders is coordinated by DERlab as WP7 leader. However, should any project partner already have an established line of contact with a specific stakeholder, then the partner should take care of the communication and dissemination with this stakeholder - additionally and beyond the stakeholder communication by DERlab. That means that ach partner takes care of maintaining communication with their corresponding stakeholders. Such activities include:

- following up on invitations to stakeholder workshops
- following up on the needed input from stakeholders

6.1 Communication with potential stakeholders

The project aims to continuously expand its stakeholder network in order to have as detailed feedback as possible and to extend the project visibility. Through a dialogue with the scientific community and industry, the project will be reaching potential stakeholders to ultimately involve them in the project as a project stakeholder.

A preliminary list of stakeholders for the INTERPLAN project including the members of the advisory board, who supported the project in the planning phase, will be identified. In order to expand this list, a questionnaire including a few questions on specific areas of expertise/interest as well as involvement in other international/EU/national projects within the scope of INTERPLAN project will be circulated to the potential contact persons identified by the consortium. The received feedback will be investigated by the steering committee of the project and based on the conclusions, the stakeholders will be identified. It should be mentioned that the list of stakeholders will be growing till the end of the project considering the needs of the project.

The consortium will be systematically reaching out to all stakeholders informing them about the ongoing activities and involving them (where applicable). For interaction with stakeholders the project employs the channels such as the newsletter, dedicated email campaigns, social media.

These activities include communication and dissemination through the project website, press releases, social media, project website as well as dedicated workshops at scientific conferences as described in **Chapter 2.2 Scientific dissemination**. These events will address major European players in the field to communicate the INTERPLAN results to achieve a widespread dissemination of the obtained methods and tools.

6.2 Communication with confirmed stakeholders

The aims of the communication with confirmed stakeholders are to obtain feedback on the project outcomes and to increase project visibility within the stakeholder group. This interaction will be

carried out though the following means:

1. *In-depth interviews with stakeholders*: Relevant stakeholders will be contacted personally by e-mail and/or phone. Involvement of external stakeholders will increase the project impact, by fostering a culture of cooperation between research infrastructures, grid operators and scientific communities. Input from stakeholders will be also essential for R&D needs and priorities, revisions of the project scope, goals and progresses, suggestions for further technical ad-hoc indicators to be applied to the research activities, as well as for the identification of risks and barriers.

2. *Workshops*: Meetings and workshops with various stakeholder groups are foreseen in the project, to influence further exploitation of the results in order to increase the socio-economic impact of the achieved results. Workshops will be organised throughout the project duration under WP2 and WP7. In more details, under WP2, three distinct targeted technical workshops will be organised with the participation of AB members and selected stakeholders consisting of external specialists representing equally regulators, TSOs and DSOs, as well as the EU Expert Group 3. The aim is to secure their views and finally their consent for the solutions put forward through INTERPLAN. Whereas under WP7, other dissemination events and workshops will be organised which will be open to the public and all the project stakeholders will be invited to these events. The aim of organising such events is to communicate the project results and to achieve a widespread dissemination of the obtained methods and tools as well as to get feedback from a wider audience. It is expected that stakeholders will be actively participating in the workshops thus deciding and acting together with the project partners.

Moreover, the members of the stakeholders group will be regularly informed about the latest project activities, results and events through quarterly newsletters and social media.

7 Conclusions

This D1.5 document presents the detailed description of the work to be done in INTERPLAN project. The document describes the project's goal and relation to the Work Programme, by also presenting the specific and measurable objectives which will be attained within the project duration. The concept underpinning INTERPLAN, the innovative methodology proposed, as well as the expected impacts together with the measures to maximize the impact of the project are presented.

It also presents the work plan with description of the seven work packages with definition of partners' roles, Tasks, deliverables, milestones and risks and the corresponding mitigation measures. Moreover, to show the strong correlation among work packages and tasks, the Pert and GANTT charts are presented.

To guarantee the flexible coordination of the activities, a smooth decision process and a prompt management of risks and unforeseen events, a proper management structure is needed. Therefore, the management structure is presented through a brief description of each body involved.

The key aspects of internal communication are discussed through definition of the main channels such as INTERPLAN portal, web-meetings and physical meetings. Finally, the issue of communication of stakeholders is also addressed since one of the main objectives of the consortium is to work closely with the industry, operators, policy entities and standardisation bodies for responding effectively to their needs and creating the right bi-directional communication and response for validating the identified solutions and developments.

8 References

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9 Annex

9.1 List of Figures

9.2 List of Tables