IANOS
SUSTAINABLE SOLUTIONS
for islands' decarbonisation

D4.11 – iVPP Virtual energy Console (V1)

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Table of Contents

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 957810

List of Figures

List of Tables

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1. Introduction

1.1. Purpose and Scope of the Deliverable

This document has the main purpose of defining the preliminary set of functional and non-functional requirements for the Virtual Energy Console (VEC). It was not initially predicted in the project description of activities (DoA) to deliver this first version of the deliverable, but it was found to be important to clearly define at an early stage the VEC requirements for the developments needed to be performed.

The Virtual Energy Console is an iVPP module that consists of the User Interface (UI) dashboards for monitoring the whole VPP operation and will be developed during task T4.6 implementation. It will offer unique linked data exploration, perception and knowledge extraction for effective energy flows' assessment. Advances on visual analytics will be used to enable the dynamic connection of different datasets with several types of visualization. Indicative information of value, to be visualized through this component would entail: composition summary (mix) of VPP portfolio of units, dispatchable vs vRES installed capacity, and diagnostics history.

1.2. Structure of the Deliverable

Besides the introduction in this chapter, the deliverable is structured as follows:

- Chapter 2: presents the Virtual Energy Console (VEC) and the different modules;
- Chapter 3: presents the established requirements for the VEC and their short summary;
- Chapter 4: presents the conclusions and next steps.

1.3. Relation to other Deliverables

The Virtual Energy Console consists of the iVPP User Interface (UI) dashboards for monitoring the whole VPP operation and will be developed during task T4.6 implementation. The dashboard will allow the VPP operator to easily access different dataset and important information in line with IANOS KPIs such as generation mix of the VPP portfolio, penetration of RES in the system and historical data being of extreme importance in the capitalization of the algorithms developed in WP4 and the monitoring performed in both WP5 and WP6. State of the art visualization and visual analytics methods and tools, based on the functional requirements derived from T2.5 would be employed in order to provide the operator an intuitive environment, where it can quantitatively assess both the current operational capacity and running VPP operations.

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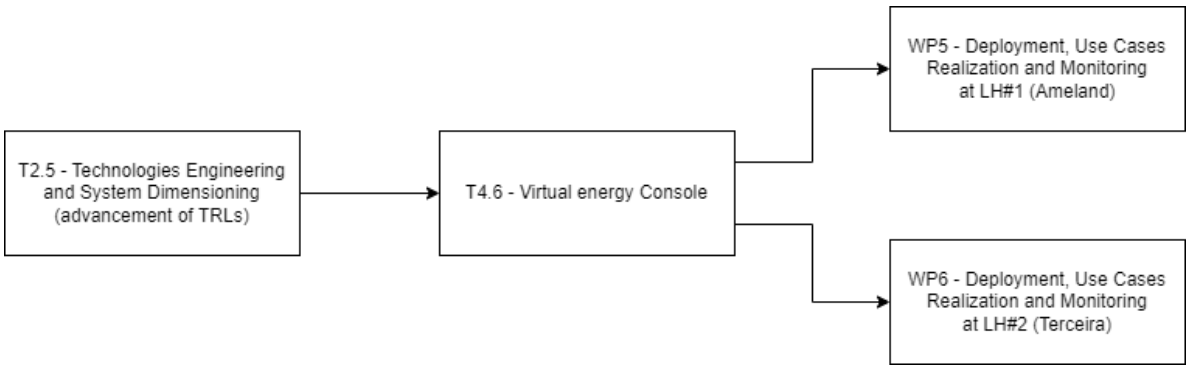

Figure 1 – Relation of other tasks to task 4.6.

1.4. Type of user

The final user of the Virtual Energy Console (VEC) is defined to be only the VPP Operator or Energy Community Manager. It will be the user's interface for VPP operators, deployed on a cloud-based server, accessible via any web browser, not requiring any additional hardware, and which will not take any automated decision on the operations of the assets. The requirements established on this document refer only to this premise and are adapted to the final user of the platform.

2. Virtual Energy Console

The VEC is an interoperable user-friendly monitoring console (UI - User Interface) developed for the VPP operator to effectively assess and visualise energy flows on the Energy Community and different assets. It will provide the market with a complete and innovative dashboard that will be tested and validated in real world conditions.

The VEC dashboards will allow the VPP operator to easily access different dataset and important information in line with IANOS KPIs such as generation mix of the VPP portfolio, penetration of RES in the system and historical data. It is based on the existing Kiplo platform User Interface (UI) developed by Cleanwatts (CWD) that will be upgraded to include the necessary functionalities associated with the intelligent VPP operations including. In relation with them the Virtual Energy Console will be designed to embrace relevant advances in relation to the various services to be offered. It will use innovative visualization and visual analytics methods and tools, to provide the operator with an intuitive environment, where the operator can quantitatively assess both the current operational capacity and running VPP operations.

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The Virtual Energy Console will include necessary innovations on visual and data analytics, enabling the dynamic connection of different datasets with several types of visualization, so that user selection in one visualization feature can have a direct impact on the others. Indicative information of-value, to be visualized through this component will entail i) composition summary (mix) of VPP portfolio of units, ii) monitoring of dispatchable vs vRES installed capacity, iii) actuation of energy assets and iv) a diagnostics history.

In terms of communication with the various grid assets, the platform will exchange information and signals with the IoT devices and energy assets mainly using the Enterprise Service Bus (ESB) and if needed other secure standard TCP/IP and MQTT protocols.

The Virtual Energy Console is fundamentally a user interface application that will implement a set of modules (interaction and functionality sections) to meet the established requirements. The following modules will be developed:

- The "Energy Community Module" will comprise the creation, operation, and management procedures of the Energy Community. It will include, among others, the visualization of the historic, real-time and forecast data for the generation and consumption, the setup of a new energy community and integration of new participants.
- The "Flexibility Module" comprises the aggregation, flexibility, individual asset data visualization and change of setpoints. This module will show, for instance, the actual and forecasted aggregated flexibility and will provide the Community Manager with the ability to see and change the assets setpoints.
- The "User Management" will deal with the user authentication mechanisms, user definitions and data access restrictions. This will be mainly a module that will deal with the management features of the user interface.

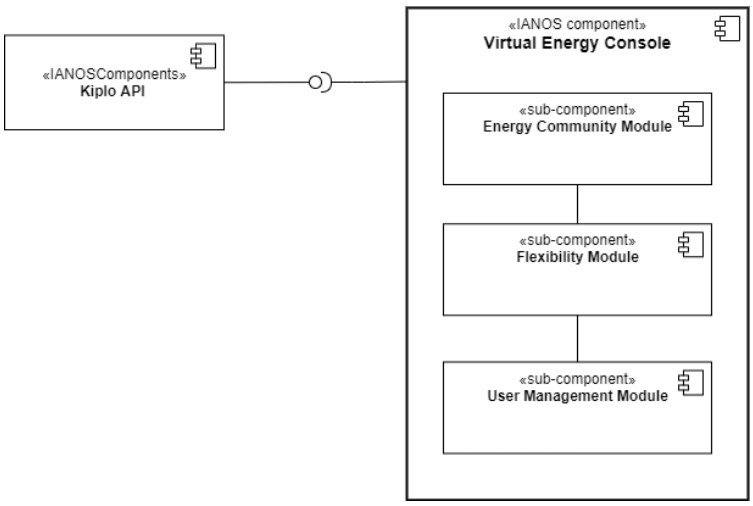

Figure 2 - Virtual Energy Console functionality Diagram.

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The energy assets dispatch decisions will originate at the Centralized Dispatcher using the algorithms of its different components. On the Virtual Energy Console, the VPP operator can change the dispatch setpoints of certain energy assets. The new setpoints will be sent to the assets through the Enterprise Service Bus (using Kiplo Core Communications and/or API Modules).

The VEC is thus the user's interface for VPP operators, deployed on a cloud-based server, accessible via any web browser, not requiring any additional hardware, and which will not take any automated decision on the operations of the assets.

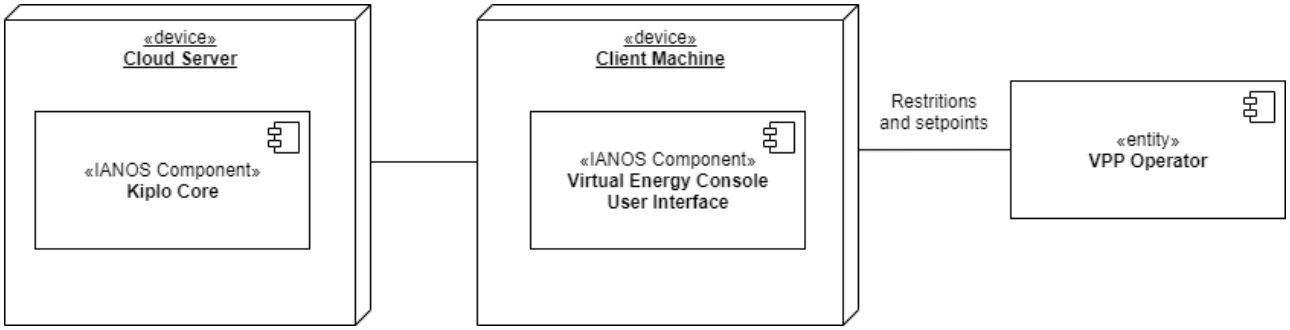

Figure 3 - Virtual Energy Console deployment diagram.

3. Virtual Energy Console requirements

This section presents the requirements for the different modules that will compose the VEC UIs. As mentioned, the VEC requirements also include and/or answer to the established requirements in T2.5, that the next table summarizes.

Table 1 -Virtual Energy Console requirements established on T2.5.

Requirements	Priority
Provides a GUI with user friendly visualization of data	High
Performs analysis and data representation in a very short time frame (seconds)	High
Allow easy and transparent access to data from all stakeholders	High
Utilize many tools for data visualization and representation	High
Communicate seamlessly with all the other iVPP modules	High
Allow remote operation	High
Is secure from cyber attacks	High

The list presented on the table before includes in some way different functional and non-functional needs on the same requirement. Some of them are inherently considered when developing such type of digital tool (e.g., cybersecurity) and will not be established directly as a requirement for the user interface itself.

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In the next table, a summary of the different module requirement is presented. Later within this document, on the next sub-sections, these requirements are described in a simplified manner that will be used later in the development and implementation of the web interface.

Table 2 -Summary of the established Virtual Energy Console requirements for development.

ID	Requirements
Energy Community Module	
CM #01	Show the location of participants on map
CM #02	Show the generation and consumption
CM #03	Show the generation and consumption forecasts
CM #04	Show shared energy
CM #05	Offer selection of the time interval and data granularity
CM #06	Offer selection of individual community and participant
CM #07	Show performance index (KPIs) of each Energy Community and Participant
CM #08	Add/Remove participant
CM #09	Define/View/Change participant contract details
CM #10	Setup a new community
ID	Requirements
Flexibility Module	
FM #01	Show the aggregated flexibility
FM #02	Show the aggregated flexibility forecast
FM #03	Offer selection of the time interval and data granularity
FM #04	Offer selection of individual community and participant
FM #05	Show asset historic data
FM #06	Show asset last setpoints status
FM #07	Show asset setpoints historical data
FM #08	Change assets dispatch setpoints
FM #09	Show performance of flexibility events
FM #10	Show IANOS KPI calculations
FM #11	Asset management
ID	Requirements
User Management	
UM #01	User authentication
UM #02	Define/View/Change user setting

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3.1. Energy Community Module

The "Energy Community Module" comprises the creation, operation, and management of REC including energy sharing between participants.

Id	CM #01
Name	Show the location of participants on map
Description	Show the location of each community or its individual participants on a map depending on filter selection and user profile
Rationale	Using a map to show the location of the communities and its participants can be used to reinforce the sense of community and neighbourliness; it is also a powerful tool to identify localized abnormal events and coordinate maintenance actions
Status	To be implemented
Priority	Must have
Notes	A participant location is a sensitive information and consent is required

Id	CM #02
Name	Show the generation and consumption
Description	Show the generation and consumption (including imported from the grid and imported from the community) for each community or its individual participants, in energy and monetary units, depending on filter selection, time interval and granularity, and user profile
Rationale	The analysis of the aggregated generation and consumption data is essential to assess the technical and economic performance of each community and its participants
Status	To be implemented
Priority	Must have
Notes	A participant consumption might be viewed as a sensitive information and consent to use it is required; in this case, this consent should be part of the service/contract subscription

Id	CM #03
Name	Show the generation and consumption forecasts
Description	Show the generation and consumption forecasts (including imported from the grid and imported from the community) for each community or its individual participants depending on filter selection, time interval and granularity, and user profile
Rationale	The availability and accuracy of aggregated generation and consumption forecast is crucial for implementation of certain (energy market) services and the optimization of others; this information may also be useful to a consumer/prosumer in deciding its short-term market preferences or actions
Status	To be implemented
Priority	Must have
Notes	Forecasts might be available from external sources (e.g., HEMS, IANOS "Forecasting Engine" component)

Id	CM #04
Name	Show shared energy
Description	Show shared energy for each community or its individual participants, in monetary units, depending on filter selection, time interval and granularity, and user profile

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Rationale	The economic benefits resulting from participating on a community must be highlighted and summarized in order to foster its sustainability and growth
Status	To be implemented
Priority	Must have
Notes	In this context, energy sharing between members of each community are treated as “market” transactions

Id	CM #05
Name	Offer selection of the time interval and data granularity
Description	Provide time interval and data granularity selection controls in the appropriate views with the suitable dependencies and restrictions
Rationale	To properly analyse and assess the performance of a single community or participant it is necessary to view and compare different time intervals using different data granularities (from minutes to years)
Status	To be implemented
Priority	Must have
Notes	In some cases, the smaller data granularities may be conditioned by external factors that include data acquisition settings or market definitions. On the other hand, data protection preferences may also be put in place that restrict the data granularity in some scenarios

Id	CM #06
Name	Offer selection of individual community and participant
Description	Provide community and participant selection controls in the appropriate views with the suitable dependencies and restrictions
Rationale	To properly analyse and assess the performance of a single community or participant it is necessary to view and compare individual communities or participants
Status	To be implemented
Priority	Must have
Notes	This selection doesn’t apply for a single consumer/prosumer that must only access its own data with the possible exception of some general (screened) information about the other members of the community if intra-community energy trading is about/going to take place

Id	CM #07
Name	Show performance index (KPIs) of each Energy Community and Participant
Description	Show the performance indexes (KPIs) for each community or its individual participants, depending on filter selection, time interval and granularity, and user profile
Rationale	One or various performance indexes should be defined to help the community manager or the end-user in assessing the operational status and the economic benefits. These kind of performance indexes can also be useful in problem identification, corrective maintenance scheduling, and assessing the effect of corrective measures
Status	To be implemented
Priority	Nice to have
Notes	There is a large number of indexes defined for PV generation assessment. Economic indexes should also be easy to define depending on the business model Some KPIs defined by IANOS Use Cases may be presented here also

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Id	CM #08
Name	Add/Remove participant
Description	Provide a simple way to add or remove (suspend) a participant from a community
Rationale	It's natural that the participants of a community might change as time passes for various reasons. The community manager must be able to easy update the system accordingly
Status	To be implemented
Priority	Must have
Notes	The possibility to extend this functionality to individual end-users can be considered in the future depending on the recruitment strategy and business model

Id	CM #09
Name	Define/View/Change participant contract details
Description	Provide a simple way to define, consult, and change the contract details of each participant. It may also be important for the community manager to change some specific detail for all the participants of a community at the same time, access the recent changes made by any participant, and compare the contracts of different participants
Rationale	It's natural that each participant needs to consult and change its contract details as time passes for various reasons
Status	To be implemented
Priority	Must have
Notes	In this context, contract details entail primarily the information related with the financial agreement between the participant and the entity that manages the community. Additional information might include grid energy acquisition and trading preferences

Id	CM #10
Name	Setup a new community
Description	Provide a way for a community manager to create a new community
Rationale	Since the platform may be used by several community managers and that each one might manage more than one community, it is necessary to have a simple procedure to setup a new community
Status	To be implemented
Priority	Must have
Notes	The procedure to setup a community should avoid repetitious, time consuming manual data entries to avoid errors and reduce the cost

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3.2. Flexibility Module

The "Flexibility Module" comprises the aggregation, dispatch and forecast of flexibility including various type of flexible assets. A set of different functional and non-functional requirements have been defined:

Id	FM #01
Name	Show the aggregated flexibility
Description	Show the aggregated flexibility (including down and up) for each community or its individual participants, in energy and monetary units, depending on filter selection, time interval and granularity, and user profile
Rationale	The analysis of the aggregated flexibility data is essential to assess the technical and economic performance of each energy community and its participants
Status	To be implemented
Priority	Must have
Notes	A participant disaggregated flexibility might be viewed as a sensitive information and consent to use it is required. In this case, this consent should be part of the service/contract subscription. Some of this information may be collected from the IANOS "Aggregation and Classification" and "Forecasting Engine" components

Id	FM #02
Name	Show the aggregated flexibility forecast
Description	Show the aggregated flexibility forecast (including down and up) for each community or its individual participants depending on filter selection, time interval and granularity, and user profile.
Rationale	The availability and accuracy of aggregated flexibility forecast is crucial for implementation of certain (flexibility market) services and the optimization of others; this information may also be useful to a consumer/prosumer in deciding its short-term market preferences or actions.
Status	To be implemented
Priority	Must have
Notes	Forecasts might be available from external sources (e.g., HEMS, IANOS "Aggregation and Classification" and "Forecasting Engine" components)

Id	FM #03
Name	Offer selection of the time interval and data granularity
Description	Provide time interval and data granularity selection controls in the appropriate views with the suitable dependencies and restrictions
Rationale	To properly analyse and assess the performance of a single community or participant it is necessary to view and compare different time intervals using different data granularities (from minutes to years)
Status	To be implemented
Priority	Must have
Notes	In some cases, the smaller data granularities may be conditioned by external factors that include data acquisition settings or market definitions. On the other hand, data protection preferences may also be put in place that restrict the data granularity in some scenarios

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Id	FM #04
Name	Offer selection of individual community and participant
Description	Provide community and participant selection controls in the appropriate views with the suitable dependencies and restrictions
Rationale	To properly analyse and assess the performance of a single community or participant it is necessary to view and compare individual communities or participants
Status	To be implemented
Priority	Must have
Notes	-

Id	FM #05
Name	Show asset historic data
Description	Provide the selection of individual assets to show their historic data (e.g., energy consumption, SoC, temperature)
Rationale	To properly analyse and assess the performance of an asset it is necessary to view and compare individual historical data
Status	To be implemented
Priority	Must have
Notes	-

Id	FM #06
Name	Show asset setpoints status
Description	Show the current/last known setpoint status of each asset
Rationale	Knowing the current/last known setpoint status of each asset is important for the community manager to obtain confirmation of activations conducted according to schedule. The actual conditions of the assets are important to evaluate and validate that the remote control has been successful.
Status	To be implemented
Priority	Must have
Notes	This information might be available from external sources or other IANOS components (e.g., HEMS, IANOS “Enterprise Service Bus” or “Centralized Dispatcher” component)

Id	FM #07
Name	Show asset setpoints historical data
Description	Show the historical assets setpoints timeseries according to the information obtained from external sources or other IANOS components that have influence on the setpoints definition (e.g., IANOS Centralized Dispatcher)
Rationale	Accessing the setpoint historical data of each asset is important for the community manager to obtain confirmation and proof that activations were conducted according to schedule
Status	To be implemented
Priority	Must have
Notes	This information might be available from external sources or other IANOS components (e.g., HEMS, IANOS “Enterprise Service Bus” component)

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Id	FM #08
Name	Change assets dispatch setpoints
Description	Provide to the community manager the ability to change the assets dispatch setpoints
Rationale	Changing the defined setpoints from the IANOS Centralized Dispatcher might be useful for the community manager to overlay some algorithm imperfection. It will also provide the ability to remote control the assets according to the needs in the absence of the automatization procedures
Status	To be implemented
Priority	Must have
Notes	This information might be performed using external sources or other IANOS components (e.g., HEMS, IANOS "Enterprise Service Bus" or Centralized Dispatcher components)

Id	FM #09
Name	Show performance of flexibility events
Description	Show the asset actuations performed and the quantify the amount of energy or power flexibility
Rationale	Showing the flexibility events and the power or energy exchanged on each one can be used to access the performance of each actuation
Status	To be implemented
Priority	Must have
Notes	This information might be performed using external sources or other IANOS components (e.g., HEMS, IANOS "Enterprise Service Bus" or Centralized Dispatcher components)

Id	FM #10
Name	Show IANOS KPIs
Description	Show the possible IANOS KPIs defined in the different Use Cases
Rationale	Important visualization of data following the IANOS project metrics for the validation and evaluation of each Use Case
Status	To be implemented
Priority	Must have
Notes	The dashboard will show the possible IANOS KPIs according to the defined calculations established in each Use Case. The information for performing the calculations might be available from external sources or other IANOS components (e.g., HEMS, IANOS "Enterprise Service Bus" component)

Id	FM #11
Name	Asset management
Description	Provide the ability to perform asset management, including the creating new assets, modifying their characteristics and deleting
Rationale	Important to manage the aggregated assets
Status	To be implemented
Priority	Should have
Notes	-

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3.3. User management

The "User Management" comprises the user authentication and user settings definition.

Id	UM #01
Name	User authentication
Description	Provide a mechanism to assure the secure authentication of a user.
Rationale	A secure authentication and authorization mechanism is mandatory for any system of this nature that is accessed by different type of users via public links.
Status	Implemented
Priority	Must have
Notes	-

Id	UM #02
Name	Define/View/Change user settings
Description	Provide a simple way to define, consult, and change the user settings including access credentials, identification details, and application preferences.
Rationale	For convenience, security, and data protection requirements it's necessary to let the user view and change the personal settings.
Status	Implemented
Priority	Must have
Notes	-

4. Conclusions and next steps

This document is the first version of the deliverable D4.11 that establishes the IANOS Virtual Energy Console dashboard requirements. The VEC is an iVPP module that consists of the UI dashboards for monitoring the whole VPP operation. The document presents an overview description and rationale for each specified requirement that are in line with the IANOS objectives and were derived by the initial functional and non-functional requirements established in D2.5. These requirements will now be further detailed by the Cleanwatts development teams to be included on the development sprints. Some of the requirements have interlinked dependencies from other tasks developments in WP5 and WP6 that will give important feedback and information for the dashboard design.

The next version of this deliverable will include an overview and analysis of the established requirements implementation.

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