D5.4 Ameland UCs Deployment Plan report

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Executive Summary

This document presents IANOS' Deliverable D5.4 - *Ameland UCs Deployment Plan report* developed under task T5.2 –*Deployment Plan and Risk Management* of Work Package 5 - *Deployment, Use Cases Realization and Monitoring at LH#1 (Ameland)*.

This deliverable presents a definition of the implementation guidelines for the assets involved in the 9 Technical Use Cases of IANOS project that will be demonstrated in the pilot sites of Ameland along with detailing issues on legal matters, involvement of the community and risks involved.

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Abbreviations and Acronyms

SG-CG	Smart Grid Coordination Group
CHP	Combined Heat and Power
DER	Distributed Energy Resources
DSO	Distribution System Operator
FEID	Fog-Enabled Intelligent Device
HEMS	Home Energy Management System
ICT	Information and Communication Technologies
IEC	International Electrotechnical Commission
KPI	Key Performance Indicators
LEC	Local Energy Communities
LH	Lighthouse
LV	Low Voltage
MV	Medium voltage
PV	Photovoltaic
RES	Renewable Energy Sources
SCADA	Supervisory Control and Data Acquisition
SGAM	Smart Grids Architecture Model
TSO	Transmission System Operator
TT	Transition Track
UC	Use Case
UML	Unified Modelling Language
V2G	Vehicle-to-Grid
iVPP	Intelligent Virtual Power Plant
WP	Work Package

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1. Introduction

1.1 Purpose and Scope of the Deliverable

IANOS project aims to decarbonize the energy systems of the Lighthouse Islands (Ameland and Terceira) and explore the possibility of replication in the Fellow Islands (Bora-Bora, Lampedusa, Nisyros). For this purpose, the project will demonstrate, under real-life operational conditions, a group of both technological and non-technological solutions adapted to harsh islandic conditions that are described in 9 Use Cases.

The Deliverable 5.4 – *Ameland UCs Deployment Plan Report* developed under task T5.2 - *Deployment Plan and Risk Management* presents a deployment plan to coordinate and facilitate the implementation of all systems and technologies on the island. This includes the presentation of guidelines for the implementation of key assets, detailing issues on legal matters, involvement of the community, etc. Furthermore the plan will include the configuration management, which describes the exact UCs and solutions to be implemented on the island. This results in a vision of future energy systems on an island.

1.2 Structure of the Deliverable

Deliverable D5.4 is structured as follows:

- Chapter 2: Use Cases Methodology is presented, comprising the overview of the Use Cases in respect to the transition tracks and demonstrator sites of the project, the standards used for the definition of the Use Cases and the participation of the partners in each Use Case.
- Chapter 3: Ameland Demonstrator is characterized. This chapter contains a general characterization of Ameland, followed by a characterization of the current energy system of the island.
- Chapter 4: Comprises the specifications and installation requirements for all the solutions that will be implemented in Ameland followed by the list of stakeholders where the solutions will be installed
- Chapter 5: Risk Management. This chapter details the risk management process and lists the main risks of the project.

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2 Use Cases Methodology

2.1 Use Cases Overview

Use Cases allow to identify, clarify and organize system requirements since they are made up of a set of possible sequences of interactions between different actors in a particular environment and related to a particular goal. The Use Cases that will be demonstrated in IANOS project are technical Use Cases which describe the functionality level of the system and therefore specify functions or services that the system provides to the user. Furthermore, these Use Cases intend to be generic about the technological implementation in order to ensure replicability.

Except Use Case 9, all Use Cases are connected with the intelligent Virtual Power Plant (iVPP) and basically describe the interaction between the different actors (iVPP platform included) in order to meet its aim.

The 9 Use Cases, that will be demonstrated in Ameland pilots, are clustered into 3 Energy Transition Tracks (TT) according to the challenges addressed and exploited opportunities. The Energy Transition Tracks are the following:

-TT#1 - Energy efficiency and grid support for extremely high RES penetration – which comprises UC1, UC2, UC3, UC4. This TT utilizes the iVPP logic to reduce energy curtailment and enabling a high RES penetration in the energy system.

-TT#2 - Decarbonization through electrification and support from non-emitting fuels – which comprises UC5, UC6, UC7, UC8. This TT demonstrates the potential of electrification as a mean to decarbonize relevant sectors along with non-emitting fuels utilization for cross-resource integration and circular economy.

-TT#3: Empowered Local Energy Communities – that includes only UC9 and aims to engage and involve citizens into the decarbonization transition of the islands.

Furthermore, the Use Cases of IANOS project will be demonstrated (D) in at least one of the Lighthouse Islands during the course of the project and replicated (R) in the Fellow Islands.

Table 1 presents an updated overview of the Use Cases of IANOS project regarding the Transition Track associated and their demonstrator and replication sites.

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Table 1: Use Cases overview

Use Case Number	Use Case Name	Ameland	Terceira	Bora-Bora	Lampedusa	Nisyros
#TT1: Energy efficiency and grid support for extremely high RES penetration						
UC1	Community demand-side driven self-consumption maximization	D	D	-	-	R
UC2	Community supply-side optimal dispatch and intra-day services provision	D	D	-	R	-
UC3	Island-wide, any-scale storage utilization for fast response ancillary services	D	D	R	R	-
UC4	Demand Side Management and Smart Grid methods to support Power quality and congestion management services	D	D	-	R	R
#TT2: Decarbonization through electrification and support from non-emitting fuels						
UC5	Decarbonization of transport and the role of electric mobility in stabilizing the energy system	D	D	R	R	R
UC6	Decarbonizing large industrial continuous loads through electrification and locally induced generation	D	-	-	-	R
UC7	Circular economy, utilization of waste streams and gas grid decarbonization	D	-	R	R	R
UC8	Decarbonization of heating network	D	-	R	-	R
#TT3: Empowered Local Energy Communities						
UC9	Active Citizen and LEC Engagement into Decarbonization Transition	D	D	R	R	R

D: Demonstration / R: Replication

2.2 Participation and responsibilities

Each Use Case has the contribution of different partners of the project:

- Technological Providers (**T**): Partners which provide technological hardware solutions to be demonstrated in the Lighthouse Islands.
    - Local Partners (**L**): Partners located in the LH (e.g. municipalities).

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- Lighthouse island system's integrators (**LH**): Partners that cope with LH integration and operation and performance monitoring. Additionally, partners that are involved in the development of the iVPP platform.
- People Engagement Partners (**P**): Partners which are responsible for citizens or stakeholder's engagement in LH islands.
- Replication Activities Partners (**R**): Partners that will support Fellow Islands in the replication of the Use Cases.

Table 2 presents the participants for each Use Case as well as the characterization of the type of contribution to the Use Case according to the groups of partners described above:

Table 2: Partners' participations on the Use Cases

Partners	UC1	UC2	UC3	UC4	UC5	UC6	UC7	UC8	UC9
Municipality of Ameland	L	L	L	L	L	L	L	L	L
New Energy Coalition							P		P
TNO	LH	LH	LH	LH	LH	LH	LH	LH	
Alliander	L	L	L	L	L	L	L	L	
Amelander Energie Coöperatie	P			P					P
SuWoTec	T			T					
Hanze University									P
Neroa	LH	LH	LH	LH	LH	LH	LH	LH	
Repowered B.V.	LH	LH	LH	LH	LH	LH	LH	LH	
SeaQurrent Holding B.V.						T			
Bareau BV							T		
GasTerra B.V.							T		

T: Hardware Technology Provider **L**: Local Partners **LH**: Lighthouses' System Integration
P: People Engagement Partners **R**: Replication Activities Partners

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3 Ameland Demonstrator

3.1 General characterization

Ameland is one of the 5 inhabited Waddeneilanden (Wadden sea islands). The islands' total size is 58,83 km^2 and consists mostly of sand dunes. It is the third major island of the West Frisians. Ameland is connected to the mainland electrical grid and to the mainland natural gas grid. There are four villages in Ameland: Hollum, Ballum, Nes and Buren with a total population of 3.673.

Figure 1: Ameland's location

Ameland has its own Energy Community: Amelander Energie Coöperatie (AEC) which delivers clean energy to its customers. Currently, AEC has 286 members and 993 customers being the main organization to participate in Renewable Energy projects as well as in Energy Savings projects.

The larger part of Ameland consists of nature with an immerse variety of landscapes. Because of this variety there's an abundance of plants, but also many animals like over 60 different species of birds.

3.2 Site assessment and existing infrastructure

Ameland's current energy system state is described addressing the current energy supply and demand as well as a detailed description of the electricity and natural gas grid of the island.

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3.2.1 Supply and Demand

The total energy usage in Ameland is approximately 490 TJ per year, excluding the NAM-platform. The NAM-platform now uses the gas it produces for gas compression which amounts up to 410 TJ/year. In 2022 the compressor will be replaced by an electrical compressor which increases the energy flow to the island with approximately 180 TJ/year.

The energy consumption fluctuates significantly every year and has been increasing in the past years. Figure 10 shows the energy usage per sector where it can be observed that the building environment sector (in green) has always been the largest consumer, while the transport sector (in orange) has been increasing over the years. Industry, energy, waste and water (in red), agriculture and fishing (in dark blue) and Heat (in blue) have been stable over the years and have a relatively low consumption in the island.

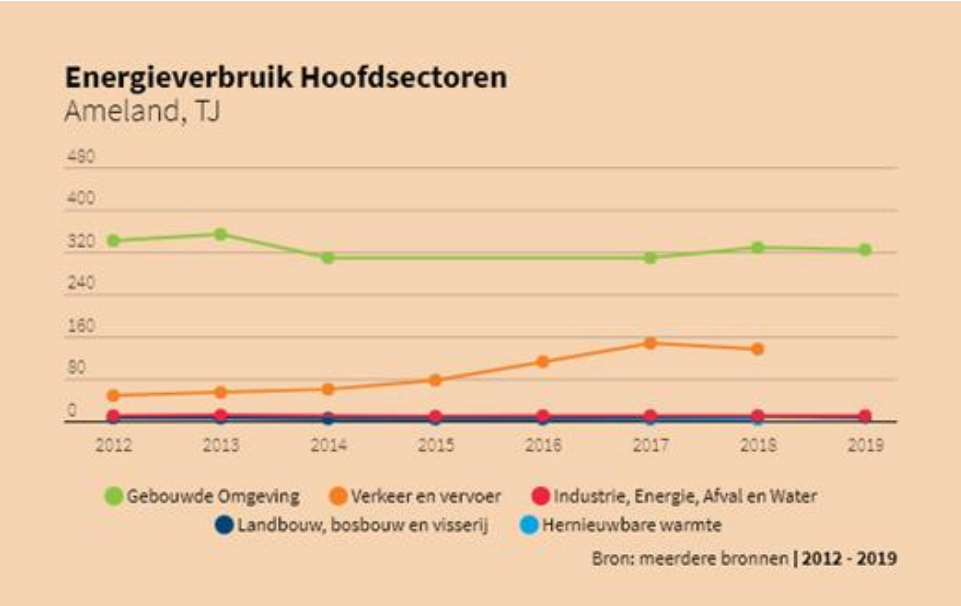

Figure 2: Energy consumption per sector in Ameland (2012-2019)

According to Figure 11, the majority of the energy used on Ameland comes from the connections with the mainland, nevertheless the solar farm and the solar panels in customer premises also generate 20 TJ per year.

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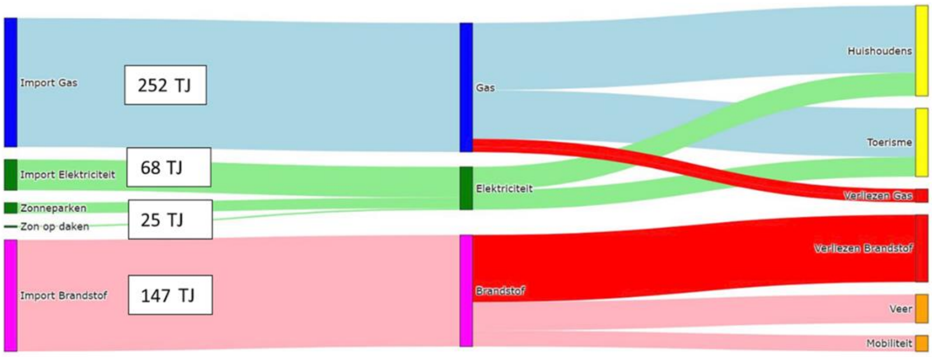

Figure 3: Energy consumption in Ameland

In most regions in the Netherlands, there is a decrease in natural gas and electricity usage in the summer, however due to the large number of tourists visiting Ameland each year, this decrease is significantly smaller in Ameland.

In Figure 12, the power over the mainland connector is shown. Peak demand is around 6 MW (from the mainland to the island), peak production (from island to mainland) is around 2,5 MW.

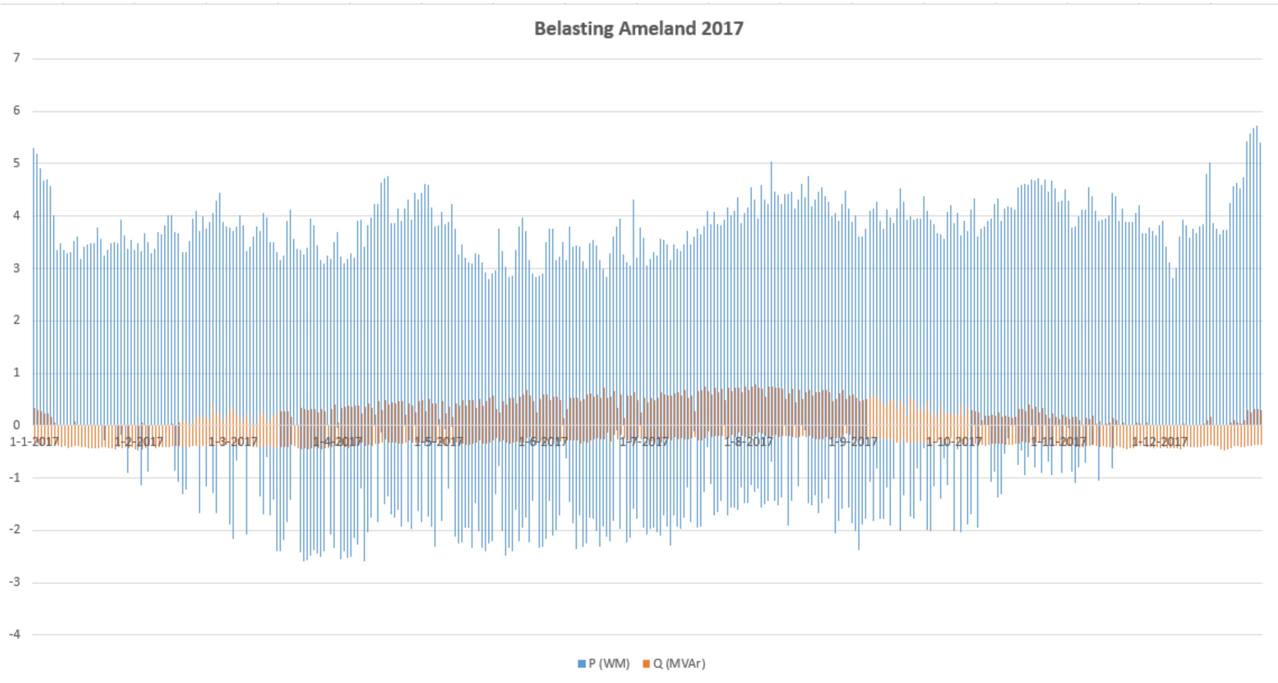

Figure 4: Power over the mainland connector in Ameland (2017)

3.2.2 Electricity Grid

In Figure 13, the midvoltage grid of Ameland is shown. The 4 parallel lines in the lower righthand corner depict the connection to the mainland. At present, there are 2 cables, during the year 2021, 2 extra cables (the blue ones) will be installed.

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Figure 5: Ameland's MV electricity grid

3.2.3 Natural Gas Grid

The Natural Gas Grid of Ameland consists of an 8 bar, 3 bar and 200 millibar grid. The gas is transported from the mainland gas grid by Stedin.

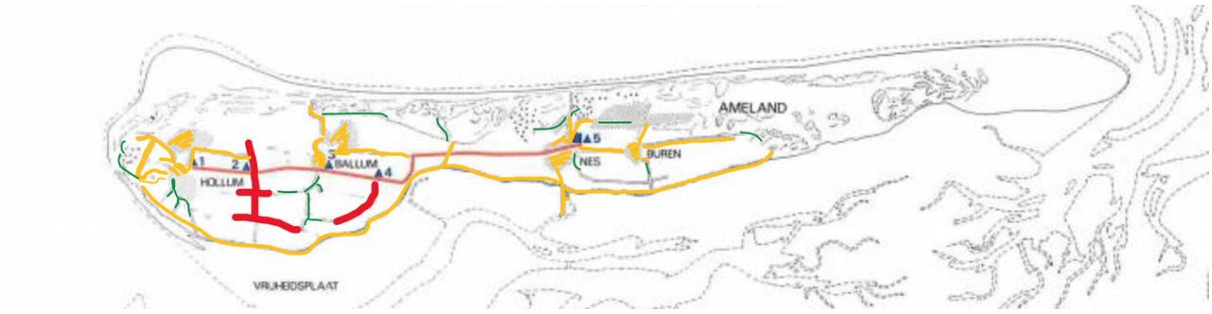

Figure 6: Ameland's gas grid

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4 Specification and Installation

Comprises the specifications and installation requirements for all the solutions that will be implemented in Ameland followed by the list of stakeholders where the solutions will be installed

4.1 Virtual Power Plant

All assets which are installed on Ameland or will be installed on Ameland are to be connected to the virtual power plant. The adopted Functional Architecture of the Virtual Power Plant is depicted below.

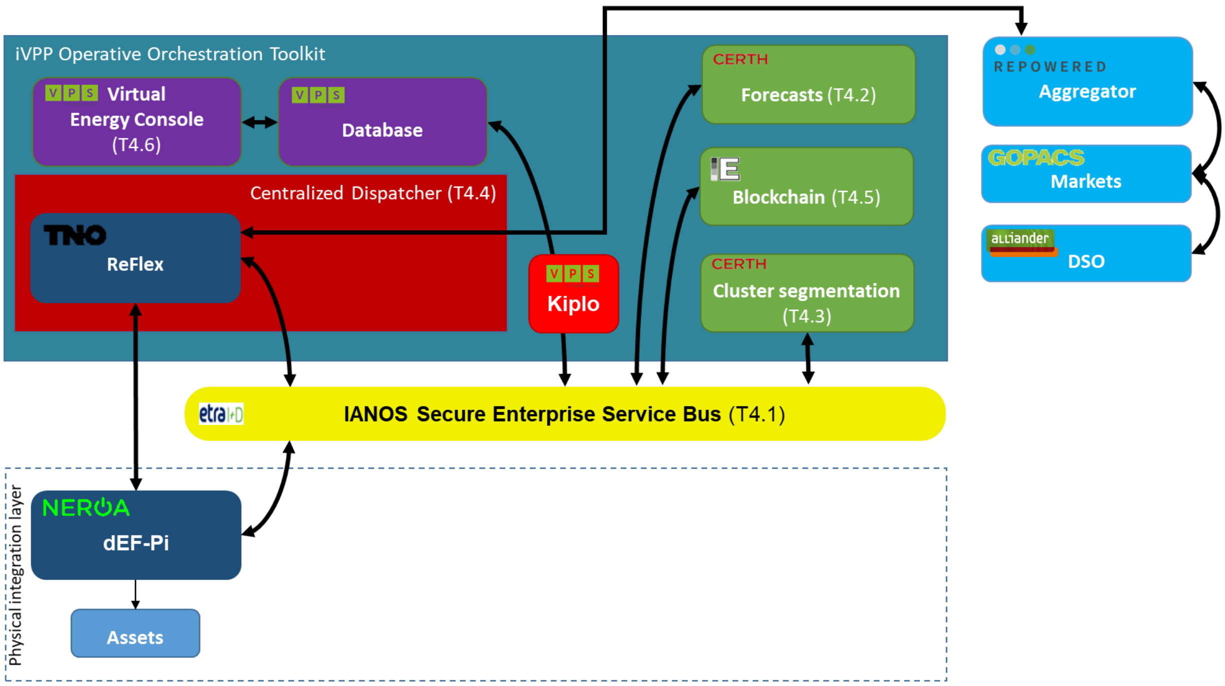

Figure 7 Functional Architecture Virtual Power Plant

The realization of the Virtual Power Plant is a combined effort of a number of parties within IANOS. The main architecture of the VPP is developed in task 2.1 and adapted to each island.

4.1.1 Project

The projects is executed by NEROA, Repowered and TNO.

4.1.2 Legal

Data used can private data which means according to the GDPR-laws a number of contracts have to be put in place with the party owning the system, with the parties using the system and with the residents supplying the data.

According to Dutch Law a DSO isn't allowed to execute congestion management in the way the TSO (TenneT) is. For pilot projects it is possible to ignore these rules. The

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replicability of the VPP in other regions in the Netherlands however will be difficult to realize because of this limitation.

Regulations for congestion management by the DSO are currently under review, aligning them with EU clean energy package (CEP). These updated regulations would increase the replicability options.

4.1.3 Involvement

Involvement of the community is mostly restricted to seducing the community in sharing their data in order for the system to function properly.

4.1.4 Specifications

The VPP is the intelligent central system which optimizes the energy flow in the system on the parameters set by the operator/aggregator. These parameters can have a financial, environmental (CO2 emissions) and/or social basis. On Ameland the community, represented by the municipality of Ameland and the local energy cooperative Amelander Energie Coöperatie, decide the weight of these different parameters. The system optimizes the energy flow based on:

- required energy – in the form of natural gas, heat, electricity and hydrogen (prepared to future other energy carriers)
- available energy – currently produced or stored in batteries and other forms of energy storage
- forecast of energy to be produced or converted

4.1.5 Installation Requirements

Some data within the VPP might be personal data in which case the GDPR-rules apply. To minimize chances of data-leaks, the systems of the VPP which use this data have to be installed in the Netherlands without the possibility of access from abroad.

4.1.5.1 Connections to assets

The already existing assets on Ameland will be connected to the VPP through the dEF-Pi platform if possible. This will be the case for all public assets: solar farms, electrolyzer, the fuel cell at Klein Vaarwater, the biobased battery V1 and tidal kite.

There still are some discussions on the way to connect the privately owned assets. The value of the data is depending on the percentage of residents (and owners of holiday homes) to provide the data. Below a certain percentage it isn't possible to extrapolate the

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required data to be able to be used in the VPP. It isn't certain how this percentage will develop over time. An other option to require residential data is to measure the sub stations in the electricity network to determine the amount of energy which is produced locally. On Ameland we will pursue both options. This will be the case for the residential solar panels, the privately owned methane fuel cells and the micro CHP's.

Measurements only

The following assets will be measured only as these can't be controlled:

- Residential solar panels
- Solar farms
- Tidal kite

Controllable assets

The following assets will be measured and controlled (in power supply, storage, conversion or usage):

- Battery pack at the Ballumerbocht solar farm
- Biobased battery
- Electrolyzer
- Fuel cell at Klein Vaarwater
- Micro-CHP 's
- Private Methane Fuel Cells

4.1.6 Stakeholders

ALLIANDER	-	Alliander is the responsible DSO for Ameland and will provide network data for the VPP.
CERTH	-	CERTH is producing Forecasts (T4.2) based on weather forecasts and available and required energy and also for segmen
ENG	-	Within Task 4.5 ENG is realizing a P2P transactive layer.
ETRA	-	ETRA develops the Secure Enterprise Service Bus (SESB) in task 4.1.
NEROA	-	NEROA is responsible for connecting the VPP to all assets
REPOWERED	-	Repowered aggregates the date provided by the VPP and
TNO	-	TNO realizes the Central Dispatchers (T4.4) within Reflex.
VPS	-	VPS is responsible for realizing the Energy Console (T4.6) and the Database and connection to the SESB

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4.2 Fuel Cell

On the largest recreational park of the island, a 500 kWe Fuel Cell will be installed. This Fuel Cell will work as an innovative CHP where the heat produced by the Fuel Cell will be fed into an already existing local heat net. Along with the 500 kWe Fuel Cell, the park also has 2*75kWe CHPs.

4.2.1 Project

The projects is initiated by Klein Vaarwater and supported by municipality of Ameland and Alliander.

4.2.2 Legal

No legal issues are identified at this time.

4.2.3 Involvement

Involvement of the community is not applicable for this asset, although the operation of the system will be communicated to the local population.

4.2.4 Installation Requirements

The Fuel Cell needs hydrogen. During the design phase of the project, the method of delivering hydrogen (tube trailer, pipe line directly from the electrolyzer) will be determined.

4.2.5 Specifications

The fuel cell will have be 500 kW. The details of the Fuel cell will be determined during the design phase of the project.

4.2.6 Stakeholders

ALLIANDER	-	Alliander is the responsible DSO for Ameland and will provide network data for the VPP.
KLEIN VAARWATER	-	Klein Vaarwater is the project owner.
MUNICIPALITY	-	The municipality of Ameland is supporting the project in requiring financing of the project.

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4.3 Biobased batteries

SuWoTec will install a 120 kWh (50 kW charging capacity) biobased battery close to a new construction with 13 houses in the city of Nes. This will be the (scaled up) Mark2 version of this battery, the Mark1 (prototype) version is currently operating at Living Lab EnTranCe. The biobased battery Mark3 is the end goal of this development. After a successful demonstration on Ameland, this version can be demonstrated.

4.3.1 Project

The projects has been initiated by SuWoTec.

4.3.2 Legal

No legal issues are identified at this time.

4.3.3 Involvement

Involvement of the community is not applicable for this asset, although the operation of the system will be communicated to the local population.

4.3.4 Installation Requirements

The battery can be installed on all types of electricity networks.

4.3.5 Specifications

The battery’s charging capacity will be 50 kW

The battery’s energy storage will be 120kWh.

4.3.6 Stakeholders

SUWOTEC	-	SuWoTec is developing the battery and will be installing the battery on Ameland.
MUNICIPALITY	-	The municipality of Ameland is supporting the project.

4.4 Hydrogen water taxis

The hydrogen water taxis which are planned to be developed during the IANOS project have not been designed yet. At this moment there is no information on these taxis.

Alternatives for the usage of hydrogen are being developed, like transport (municipal vehicles), heat grid (in Nes) and seasonal storage (a.o. the Fuel Cell in Klein Vaarwater).

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4.5 Tidal Kite

The TidalKite development, installation, testing and operation will be executed in a separate project. The IANOS scope focuses on integrating the TidalKite into the Ameland grid and in the central dispatcher. The SeaQurrent TidalKite technology is developed to harness energy from tidal flows. It consists of an underwater kite that makes it possible to cover a larger energy harvesting area, perpendicular to the flow.

4.5.1 Project

The TidalKite test setup near Ameland consists of a monopile mooring that anchors the TidalKite system and a grid connection cable connected to the Ameland electricity grid as operated by Liander.

4.5.2 Legal

No legal issues are identified at this time.

4.5.3 Involvement

Involvement of the community is not applicable for this asset, although the operation of the system will be communicated to the local population.

4.5.4 Installation Requirements

The TidalKite needs a certain water flow to be effective. The sea inlet between Ameland and Terschelling provides a stable and predictable (ebb and flow) water flow.

4.5.5 Specifications

The TidalKite system as projected for future deployment has a capacity of 500 kW and it is connected to the grid via a 10kV power cable. A TidalKite pilot unit will be deployed in the IANOS project.

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4.5.6 Stakeholders

SEAQURRENT - SeaQurrent develops the TidalKite.

4.6 Auto generative High-Pressure Digester

The partners in this project couldn't meet the requirements of the investors which made the investors decide to withdraw the funding. The municipality of Ameland is now looking for ways to find an alternative for digesting the restaurant waste and sludge from the water treatment plant.

4.6.1 Project

The project lead lies with the municipality of Ameland. The way forward is now being discussed with the local restaurants, NEC, Wetterskip Fryslân (responsible for local waste water treatment plant).

4.6.2 Legal

It is forbidden to discharge waste into the sewage water. This means the restaurants cannot use a food waste shredder. But because of the special status of Ameland this rule can be ignored if Wetterskip Fryslân agrees on that. Replicability of this solution in other regions of the Netherlands will be more difficult.

4.6.3 Involvement

The community (i.e. local restaurants) are taking part in the discussion about the way forward in this matter.

4.6.4 Installation Requirements

N.A.

4.6.5 Specifications

N.A.

4.6.6 Stakeholders

RESTAURANTS	-	Local restaurants are a discussion partner to determine in which way the restaurant waste will be digested..
NEC	-	NEC has a lot of knowledge on digesting and is gathering information on the amount and type of biomassa on Ameland.
MUNICIPALITY	-	The municipality of Ameland is supporting the project in requiring financing of the project.
WETTERSKIP	-	Wetterskip Fryslân owns the local waste water treatment plant.

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4.7 Electrolyser

Hydrogen will be an energy carrier which can be used to store energy for a longer period or to be stored for peak usage. At this moment a number of types of usages are being researched: transport, heat grid and seasonal storage.

4.7.1 Project

The electrolyzer is planned to be installed at the Ballumerbocht near the solar farm and battery which will be realized there. The purchase, installation and exploitation of the electrolyzer is initiated by the municipality of Ameland.

Koninklijke Van Twist is developing a new electrolyzer and will install a 400V version on Ameland. Depending on the tests of that electrolyzer, a larger version will be bought from that company or via a tender.

4.7.2 Legal

No legal issues are identified at this time.

4.7.3 Involvement

Involvement of the community is not applicable for this asset, although the operation of the system will be communicated to the local population.

4.7.4 Installation Requirements

The electrolyzer will be controlled by the VPP and will be connected to the grid of the solar farm and battery pack.

4.7.5 Specifications

Initial electrolyzer will be 400W

The final electrolyzer will be in the range of 1-2MW.

4.7.6 Stakeholders

MUNICIPALITY	-	The municipality of Ameland is initiating the purchase, installation and exploitation of the electrolyzer and supports the pilot project of Koninklijke van Twist.
VAN TWIST	-	Koninklijke van Twist will install a pilot model of a new electrolyzer on Ameland.

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5 Risk Management

The project partners within the Ameland Lighthouse meet every month. New risks that occur will be registered in the risk register. At that moment a risk owner is appointed, and the initial risk chance and effect are being determined. If possible mitigation actions are derived and the mitigated risk chance and effect are determined for that risk, with an action owner/responsible.

5.1 Risk classification

The project team determines the chance (very small chance – very big chance) a risk will occur and what the impact (very low impact – very high impact) of the risk is. Each classification corresponds with a number. The two numbers of the risk are multiplied to determine whether the risk can be accepted or not, according to the details in the list below.

Risks		
Impact	**Value**	**Description**
Very high	5	Threatens the success of the business and/or the project
High	4	Substantial impact on time, cost or quality
Average	3	Notable impact on time, cost or quality
Low	2	Minor impact on time, cost or quality
Very low	1	Negligible impact
Chance	**Value**	**Description**
Very big	5	Very likely to occur
Big	4	Likely to occur
Average	3	May occur
Small	2	Unlikely to occur
Very small	1	Very unlikely to occur
Rating	**Colour**	**Description**
Rating >= 15		Unacceptable, mitigation necessary
5 <= Rating < 15		Undesirable, mitigation optional
Rating < 5		Acceptable, mitigation not necessary

Figure 8 risk classification basis

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5.2 Current risks

In the table below the current risks are mentioned.

ID	Project	Event or condition	Description of the consequence/impact	Impac	Chanc
R-01	AHPD	Conditions for funding (independent director, finances company in oder, balanced budget) are not being met.	Project delay or cancellation of project	Very high	Very big
R-02	Battery Pack (3MWh)	Battery pack will not be 3MWh (after design phase)	Contract conditions IANOS not met?	Very high	Very small
R-03	Charging Infrastructure	Tender of province is postponed	Still 5 charging stations available to use within IANOS	Very low	Small
R-04	Electrolyser	No electrolyser available in H2Watt to be used in IANOS	H2 users cannot be provided	Average	Average
R-05	Fuel Cell (500KWe)	Klein Vaarwater isn't going to start the project		High	Small
R-06	Solar Park Ballumerbocht (3MW)	Not meeting deadline of subsidy (SDE) resulting in no business case	Possible consequences:1) delay in approval by partners 2) delay in tendering process 3) longer design phase needed	Very high	Average
R-07	NAM Platform	Connection to NAM platform is delayed	Possible consequences:1) no room on grid for renewable energy, 2) no reduction in CO2 emissions, 3) cancel connection because of remaining timeline (2035)	High	Small

Figure 9 overview of risks

Risks which can be easily mitigated - for instance by planning adjustments and/or organisation adjustment, and/or risks with a very low chance and very low impact are not registered in the risk register.

The core team of the Ameland Lighthouse – i.e. the project manager and the lighthouse manager – discuss the risks on a regular basis and determine the status of the risk and mitigation actions, and update the risk register based on that analysis.

The initial classification of current risks shows that there are 2 unacceptable risk and 3 undesirable risks: R-01, R-02, R-04, R-05, R-07. For these risks mitigation actions are devised.

Risk classification		Impact				
		Very low	Low	Average	High	Very high
Chance	Very big	0	0	0	0	1
	Big	0	0	0	0	0
	Average	0	0	1	0	1
	Small	1	0	0	2	0
	Very small	0	0	0	0	1

Figure 10 Initial risk classification

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After execution of the mitigation actions, there still remain 2 undesirable risks: *R-05 Klein Vaarwater doesn't start the project* and *R-07 Connection to NAM platform is delayed*.

Risk classification		Impact				
		Very low	**Low**	**Average**	**High**	**Very high**
Chance	**Very big**	0	0	0	0	0
	Big	0	0	0	0	0
	Average	0	0	0	0	0
	Small	1	0	0	2	0
	Very small	0	0	1	0	3

Figure 11 Mitigated risk classification

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