AI FOR GREEN 2023

Status: Interim report submitted

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Basic data

Full title:	transpAIrent.energy - Transparent AI Forecasts for Green Energy in Austria
Short title:	transpAIrent.energy
Application ID:	52437680

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Total costs in EUR:	518,337
Requested federal funding in EUR:	420,567

Duration of Project:	Start Date: 01.05.2024 Duration in months: 36

The following content is:

Interim report

CORE DATA

Company / Organisation

COMPANY / ORGANISATION

Type of organisation:
Research Institution

Name of company / organisation:
AIT Austrian Institute of Technology GmbH

Master Data ID:
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Scientific discipline-group:
2 Technical Sciences

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29 Other and interdisciplinary Technical Sciences

Legal form:
Private limited liability company (Austria: GmbH)

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REPORTS

Overview

Overview of all reports

Report-Nr.	Report Type	From	To	Status	settled	FFG audited
1	Interim Report	5/1/2024	4/30/2025	In review	197.885	

Sum of all reports (audited costs, if available)

Partner	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Sum
AIT Austrian Institute of Technology GmbH	74.594	8.285	0	0	408	**83.287**
B-SEC better secure KG	32.115	0	0	0	0	**32.115**
Projektplanungs- Beratungs- und Entwicklungs GmbH	20.559	0	0	0	127	**20.686**
UBIMET GmbH	53.985	810	7.002	0	0	**61.797**
Sum	**181.253**	**9.095**	**7.002**	**0**	**535**	**197.885**

Contracted values (including cost reallocation)

	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total	Funding	Funding rate
AIT Austrian Institute of Technology GmbH	232.760	17.265	3.750	0	7.125	260.900	221.764	85,00
B-SEC better secure KG	80.100	0	11.250	3.000	1.875	96.225	76.980	80,00
Projektplanungs- Beratungs- und Entwicklungs GmbH	88.875	0	0	0	875	89.750	71.800	80,00
UBIMET GmbH	57.965	1.353	12.144	0	0	71.462	50.023	70,00
Total	**459.700**	**18.618**	**27.144**	**3.000**	**9.875**	**518.337**	**420.567**	**81,14**

Report 1 (Interim Report)

Reporting Period

Interim Report 1

REPORT

Report Type:
Interim Report

From:
5/1/2024

To:
4/30/2025

Current Approved Project Period:
WP-Span:
01.05.2024 - 30.04.2027

Report on content

1. Objective achievement and project status

The project is on track, illustrated by the following milestones. Its objectives have been mostly achieved as planned (except for one aspect of M2.4) and partly even ahead of the initial schedule:

M1.1 Project successfully started: At the beginning of the project in May 2024, a kick-off meeting was held in person (with possibility of online participation) at AIT. It established a shared understanding of the project structure, responsibilities, and administrative requirements. The internal organization, including digital infrastructure and coordination routines, was clearly defined. Already during the kick-off, the participants were highly engaged. A highlight is that this motivating and motivated project culture has been successfully maintained so far.

M2.1 Initial data collected: Historical data was collected from the APG and ENTSO-E transparency platforms in September 2024 and saved in the historic database. The respective API connectors were implemented as components and were re-used in the live data acquisition. In the same way, power plant connectors to obtain test site data for simulative tests were implemented.

M2.2 Quality of initial data validated: Quality assurance was achieved through 1. validation of schema, data types, missing values, and completeness 2. verification via preprocessing and usage in AI forecasts (M3.1, M3.2) as well as custom online AI verification checks. A standardized analytics database has been developed that is continuously updated from the historic database via a data pipeline service. For the initial data, this was completed in December 2024, but data quality validation continues for any new data.

M2.3 Initial AI-based weather forecasts available: The development of the AI-based weather and energy forecasts started with the beginning of the project and was carried out as planned. The weather forecast data has been made available to AIT via an API access in February 2025. The according developments of the AI-based energy forecast were completed by the end of March 2025 and presented to the consortium in April 2025. The AI-based forecasts are available in the UBIMET database and ready to be deployed in a test environment.

M2.4 Initial data sources published: By April 2025, documentation of primary data sources was completed using metadata for describing the source services and fetch jobs. Further, documentation of the data pipeline was done using software defined data assets for depicting and reproducing the data pipeline. Documentation is currently being finalized and consistency check development is ongoing, thus publication of the pipeline is pending, meaning this milestone has only been 80% achieved.

M3.1 Initial review of algorithmic methods documented: A rigorous state-of-the-art research on probabilistic time series forecasting with generative AI was conducted and documented. While many classes of generative AI algorithms have shown potential, the Generative Adversarial Network (GAN) was already extended to be conditional and suitable for time series forecasting as Conditional Time Series GAN (CTSGAN) in (Lu, 2022). Therefore, it was chosen to be implemented in the project as most promising generative AI method. As a comparison, transformers were chosen as the second generative AI algorithm.

M3.2 First version of algorithms developed: Three different baseline methods for comparison and three versions of the conditional time series GAN model were implemented by March 2025. The baseline models include a SARIMAX (seasonal autoregressive integrated moving average with exogenous factors) model, an LSTM (long short-term memory) network and a multivariate linear regression. The GAN-based models include the CTSGAN from (Lu, 2022), an enhanced version of it, as well as a combined model using an LSTM as well as a GAN-based model.

M4.1 Initial application requirements and use cases specified: An initial version of the application requirements and use cases was created in September 2024 and finalized with their documentation in deliverable D4.1 in November 2024. It outlines the general functional requirements, describes the platform architecture, defines the core use cases to be implemented, and specifies the charts for dynamic data visualization.

M4.2 transpAIrent.energy application platform running (first version): The first version of the platform was implemented and is live since December 2024 at https://en.ergie.at/. It currently hosts a growing knowledge compendium on energy topics, including content from and about the transpAIrent.energy project. By fully tracking the source-code and all content files of the platform from the first day in a publicly available repository on GitHub, it fulfils the transparency-related aspects.

M5.1. First version of operational optimization strategy developed: A first version of an operational optimization strategy was developed for a test asset in April 2025, ahead of the initial schedule. It prioritizes cost and peak load reduction – identified as key levers for optimized asset operation – and achieved a 54% cost reduction as well as zero PV curtailment in tests using historical data. The strategy will be extended by stochastic formulations and to include CO_2 emission reduction using forecasts from WP3.

M6.1 First scientific dissemination done: V. Alton successfully held a presentation titled “Probabilistische Vorhersagen relevanter Energiesystemvariablen mittels Generative AI (eng.: Probabilistic forecasts of relevant energy system variables using generative AI)” in a parallel session at the conference “Internationale Energiewirtschaftstagung (IEWT) 2025” in Vienna in February 2025. Thus, this milestone was achieved ahead of the initial schedule, highlighting the scientific relevance of the project approaches.

Milestones not listed have not yet begun.

2. Work performed in the reporting period

2.1. Projektmanagement

Fertigstellungsgrad: 33%

Deviations/changes:

Changes in human resources

AIT: Due to K. Maggauer’s limited temporal resources because of her responsibilities in other projects as well as to reduce the risk for the project that goes along with her potential (unplanned) unavailability, G. Mazza and V. Vana support her with project management and controlling tasks, being equally qualified because of their respective long experience in the successful execution of co-funded projects.

Description of the performed work:

Task 1.1 Project management:

At the beginning of the project, a kick-off meeting was held to establish a shared understanding of the project structure, administrative requirements, and collaboration framework. In addition to welcoming all consortium partners and introducing the participating organizations and teams, particular emphasis was placed on clarifying responsibilities, internal procedures, and formal requirements of the funding body. This included an overview of required cost accounting, time tracking, deliverables, and reporting duties, ensuring all partners could navigate the administrative aspects confidently from the outset.

The internal organization of the project was also defined in detail. This encompassed agreements on shared digital infrastructure (e.g., document storage in Microsoft Teams and code management on GitLab, file naming conventions, and access coordination), as well as the structuring of monthly coordination meetings (Jour Fixes), which serve as the central platform for continuous progress monitoring and early identification of deviations from the project plan.

The high level of commitment and professionalism shown by all partners during the kick-off laid the foundation for a transparent and reliable project culture that could be upheld to date. The structured project management approach – including regular reviews of time allocation, budget use, and milestone achievement – enables consistent quality assurance and timely task execution. This approach also supports the identification and coordination of interdependencies between tasks, thereby reducing risks throughout the project.

Quality control of the developed project content is based on a multi-stage principle: At least a four-eyes principle within the individual participating organizations/companies, followed by a multi-eyes principle through presentation of the methods/ results to the entire consortium (during the monthly Jour Fixes) and mutual proofreading of the resulting documents.

The next steps to be taken and incoming work packages/tasks are also discussed during the monthly Jour Fixes, thus guaranteeing the early and timely completion of the tasks. This also allows for the definition and coordination of dependencies between individual tasks, thereby minimizing project risk. Additionally, it is important to note that some tasks (in WP5 and WP6) have already been started ahead of schedule, which minimizes overall project risk.

2.2. Data collection, evaluation, and documentation

Fertigstellungsgrad: 75%

Deviations/changes:

Changes in human resources

AIT: At the beginning of the project, it was identified that S. Strömer cannot complete all of his initially planned tasks in WP2 due to responsibilities in other projects. For that reason, F. Leimgruber was given even more responsibility than initially planned with regards to WP2 tasks, being equally qualified in data pipeline administration. Moreover, due to F. Leimgruber's temporarily constrained temporal resources, C. Seragiotto, an experienced data scientist, has supported him with tasks related to data collection, evaluation, and documentation.

UBIMET: C. Benesch decided to leave UBIMET before the beginning of the project. Thus, A. Edletzberger stepped in as Task 2.3 leader and project leader from UBIMET side, being equally qualified in project coordination tasks. Moreover, N. Maniakowska left UBIMET before the beginning of the project. Her initially planned tasks were taken over by D. Plavcan, an expert for energy meteorology and algorithm development, who was furthermore supported by P. Kalogeras regarding irradiation forecasts. A. Liendo's initially planned tasks have been taken over by T. Versic, possessing equal qualifications as a meteorological data scientist, due to internal resource shifts. M. Mochart has been appointed to UBIMET's management board and has therefore handed over his project responsibilities to P. Athanasiadis, an experienced product manager in energy meteorology. Due to J. Siever's constrained temporal resources, he has been supported by A. Perenyi, L. Abulashvili, and S. Weinberger to ensure timely and efficient IT support. E. Volpert's and B. Malecic's expertise were utilized for the determination of the meteorological regions in WP2 and to extract historical weather forecasts from UBIMET's archives, respectively.

(Cost-neutral) Work plan change

The work plan for WP2 will be adjusted as follows, while keeping the costs the same: The work package end date will be shifted by six months to 30/11/2025, coinciding with the end of WP3. The reasons for this are as follows: Firstly, it was identified during the first project year that continuous data validation (Task 2.2) is crucial for – and thus should accompany – the development and especially the validation of high-quality AI algorithms in WP3. For example, regular data verification using an AI tool to measure deviation from expected time series shapes and distributions will be continued during that time, thereby ensuring consistency and further increasing the robustness of our AI forecasts. This aspect is crucial for the responsible use of AI methods through ensuring they are reliable and function as intended, thereby avoiding unintentional and unexpected harm. Secondly, even though the data processing pipeline (Task 2.4) is operational, and its components and documentation are prepared, it has not yet been published. This is because the codebases of the components are undergoing a process of documentation and code review to meet the high quality requirements and expectations of the project, which is not yet completed due to constrained temporal resources.

Description of the performed work:

Task 2.1 Identification and collection of diverse data sets:

The transparency platforms by ENTSO-E and APG, Electricitymaps, and UBIMET were identified as most relevant data sources. Data adaptors for the data source APIs have been tested and developed. A metadata schema for data sources and fetch jobs has been designed and implemented. A scheduled data fetching process has been designed, implemented, and put into production. It queries the identified data sources and stores the results in the data vault database. In-process monitoring and alerting has been implemented to aid development and operation in production by providing additional context and early warnings for unexpected issues (for example, data source schema changes that lead to necessary changes in the data collection platform). Moreover, an interface to the existing virtual biogas plant using the B-SEC Strompool REST API has been developed which enables the collection and monitoring of energy production and storage level data for the experimental tests in WP5.

More detailed information about the reviewed datasets are specified in the document representing deliverable D2.1.

Task 2.2 Data processing and comprehensive quality evaluation:

Data processing was implemented with the data orchestration platform Dagster. A bi-temporal database table for analytics has been created. Data quality has been checked with validation of data types, time intervals, and value ranges (for example, strictly non-negative solar power generation). Data verification has been done and will continue to be done periodically using an AI tool with an autoencoder model to measure deviation from expected time series shapes and distributions. The tool checks 1% to 99% percentile range and the interquartile range (IRQ, 1.5 times distance between 25% and 75% quartiles) and compares how values from a given time series match these value intervals. Checks were carried out for each day from 2019 to mid 2024. Data errors such as missing solar power production (all zero values throughout that particular day) or exactly zero total power generation in the control area were successfully identified using the tool. The tool also found the “anomaly” of the increased solar power generation in 2024 compared to the learned history (2019, …, 2023) which can be explained by a significantly higher installed PV capacity in 2024 compared to previous year-by-year changes.

More detailed information of the data processing and quality evaluation can be found in deliverable D2.1.

This task also comprised a comprehensive update of the data managment plan (DMP) for the project, which can be found in the attachments. F. Leimgruber was chosen as main responsible person for the DMP.

Task 2.3 AI-based weather forecasts:

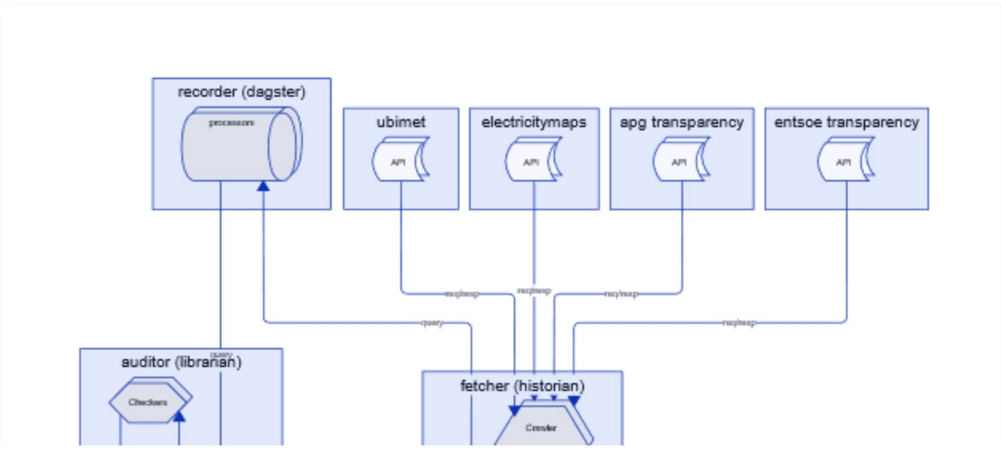
To address the complex requirements of energy system forecasting, this task aimed to adopt a twofold approach to temporal resolution. For assets requiring short-term responsiveness – such as battery storage systems coupled with PV installations – we planned on developing accurate forecasts within a time frame of minutes to hours. In contrast, for slower-reacting systems like biogas plants, we considered a planning horizon spanning several days. To achieve the outlined objectives, activities in Task 2.3 focused on leveraging AI techniques to enhance UBIMET’s weather and solar energy production forecasts. In addition, historical forecast data were used as input for the training of generative AI models in Task 3.2. The workflow for parameter management of solar power plants was also optimized.

The activities and development work encompassed the following aspects:

- *Recalibration of solar radiation forecasts***:** Solar radiation forecasts are highly relevant for PV production estimates. Shading has a significant impact in this context. In the UBIMET Consolidated Model (UCM), real-time station data are used to recalibrate the forecasts and remove systematic biases. If a measurement station is affected by shading, it results in considerable deviations in radiation measurements. To correct this, a Model Output Statistics (MOS) coefficient based on a machine learning model was developed. This coefficient is recalculated live for every location and time to calibrate the radiation forecast and mitigate shading effects.
- *Live weather forecast***:** AIT received access to the UBI:Connect API, through which weather forecasts for the next 96 hours are provided several times per day (hourly or every 6 hours) with hourly resolution. Parameters include temperature, wind, cloud cover, precipitation, and the improved radiation forecast.
- *Historical weather forecast*: Historical forecasts were required for the training of generative AI models. Meteorologically coherent areas within Austria’s energy supply regions were defined, and representative regional centers were determined. For these locations, historical ECMWF forecasts from 2019–2024 were computed from the UBIMET archive data and provided to AIT.
- *ECMWF update***:** ECMWF data form the foundation of UBIMET’s ML-based solar forecasts. In November 2025, ECMWF released a new model version. From that point onward, only forecasts based on the updated model were available. However, the ML-based forecasting model had been trained on the previous version’s data. Immediate retraining was not feasible due to the short runtime of the new model. Therefore, the impact of the model update was evaluated. It was found that the update led to improved forecast performance even without retraining. A four-month evaluation period supported this conclusion.
- *Impact of snow cover***:** In Austria, snow accumulation on PV panels can significantly reduce power output. To account for this effect in forecasts, a machine learning–based calibration factor was developed, which incorporates current snow depth, cloud cover, and time of day.
- *Automated master data management***:** Inputted master data of power plants can be faulty or incomplete. To mitigate this lack in information and avoid manual effort in correcting the data, a concept for an automation process for the imputation was developed and the execution was started. An automatic, file-based master data importer was developed to provide the necessary functionality in a customer-independent way. Future work entails the migration of the importer into a new unified master data library.

Task 2.4 Publication of data sources and processing pipeline:

The data processing pipeline is operational and provides data to internal use-cases. Its components and documentation are prepared, but not yet publicly available due to pending cleanup and documentation to meet quality requirements and expectations. Publication will be done after the interim report, including bugfixes. This represents a slight delay from the initial work plan. Consistency checking is ongoing and will be eventually incorporated into the pipeline to run on-demand as well as in an automated way as part of the pipeline production deployment. The data architecture comprising data collection, data flow, and data serving is shown in Figure 2.2.1.



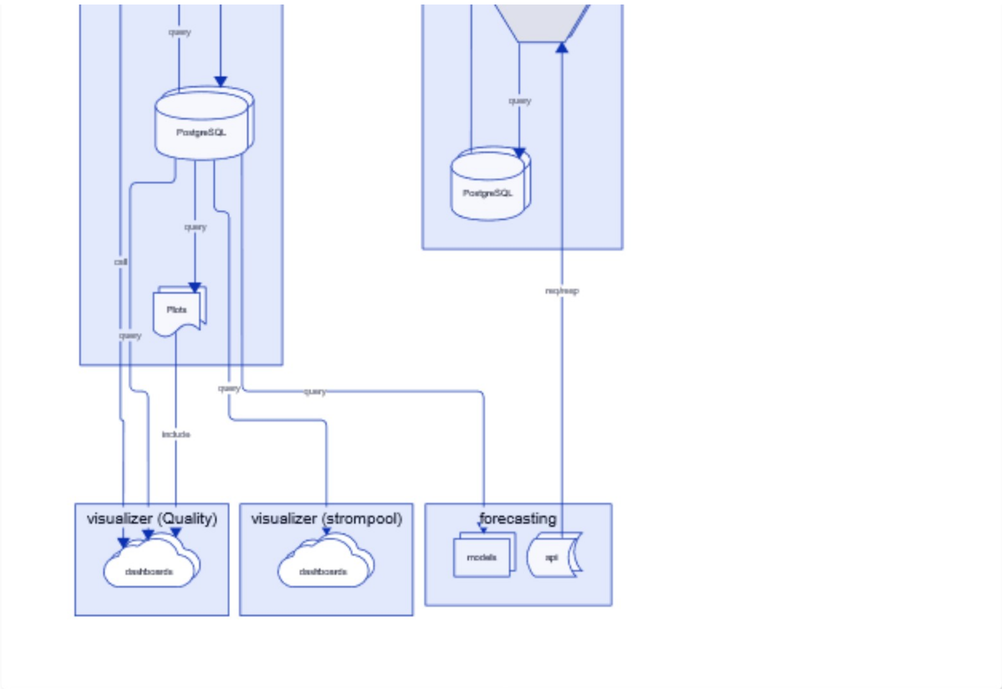


Figure 2.2.1: Data flow architecture

2.3. Algorithm development and validation

Fertigstellungsgrad: 50%

Deviations/changes:

Changes in human resources

AIT: At the beginning of the project, it was identified that S. Strömer and F. Leimgruber do not have enough temporal resources to complete all of their initially planned work in WP3 due to responsibilities in other projects. For that reason, WP3 tasks were mostly transferred to P. Widhalm who possesses an equal level of expertise due to his more than 15 years of experience in AI algorithm development and software engineering. Moreover, he is supported by V. Alton who is highly familiar with the latest developments in generative AI due to her studies of Computational Science, which she completed in May 2025 with a master thesis that is partly based on her work in this project.

Description of the performed work:

Task 3.1 Review and observation of algorithmic methods in generative AI:

As generative AI is a rapidly developing field, this task aimed to gather the state-of-the-art in generative AI for probabilistic time series forecasting. The approaches of GANs, diffusion models, and transformers were investigated in terms of their applicability and implementation efforts for the given energy forecasting tasks. Furthermore, additional methods like the Weak Innovation AutoEncoder from [Wang, 2024] were investigated during the review. All methods were analysed with the following criteria in mind:

- Is the algorithm suitable for conditional, probabilistic time series forecasting?
- Are there case studies showcasing the potential of the method in this sector?
- What is the implementational effort for this algorithm?
- Is the code for the algorithm/case study available (e.g., on GitHub)?

As a result of this investigation, the conditional time series GAN was identified as most suitable algorithm and therefore to be implemented first in this project. Moreover, transformers show high potential as well, and will therefore be implemented as a second algorithm for comparison.

Task 3.2 Implementation of probabilistic forecasting algorithms:

Implemented AI algorithms and baselines

For a comprehensive study about generative AI for probabilistic energy forecasting, not only the chosen generative AI methods were implemented but also baseline models to compare them and gain insight on the competitiveness of the algorithms. The following state-of-the-art baselines were implemented:

- SARIMAX (seasonal autoregressive integrated moving average with exogenous factors)
- LSTM (long short-term memory) network
- Multivariate linear regression

The generative AI models implemented for this task thus far are:

- Conditional Time Series GAN from (Lu, 2022)
- Enhanced version of the Conditional Time Series GAN
- Combined model with LSTM and Conditional Time Series GAN

All models were implemented in Python 3 following the pipeline framework developed in WP2, ensuring traceability and reproducibility. The implemented steps include data processing, feature selection, training of the models on designated training data, and forecasting on test data.

Implementation of the transformer-based algorithm is currently ongoing.

Forecasted parameters and algorithm performance

The following essential energy system relevant parameters were chosen to be live forecasted leveraging the aforementioned generative AI algorithms:

- Day-ahead prices
- CO_2 intensities
- Balancing activation probabilities

The live forecasts for all of these parameters are already running for (theoretically) any point in the future, but the quality control is not yet complete for the CO_2 intensity and balancing activation probability forecasts as opposed to the day-ahead price forecasts. For the latter, an evaluation of the generative AI models' effectiveness in forecasting them was conducted in two different market conditions: Normal operation without data from the energy crisis (normal mode) and a crisis scenario with extreme price fluctuations as experienced in the energy crisis (crisis mode). The results demonstrate that GAN-based models show potential in effective probabilistic forecasting, particularly in volatile market conditions, see Figure 2.3.1. While traditional models perform sufficiently well in stable scenarios, they struggle under crisis conditions, where GANs provide more reliable forecasts, which also enhances economic benefits. The robust outputs of GANs thus allow for better risk assessment and decision-making for electricity market participants.

These results have been presented at the "IEWT 2025" conference in Vienna. Moreover, they have contributed to V. Alton's master thesis, see Section "Dissemination and Exploitation".

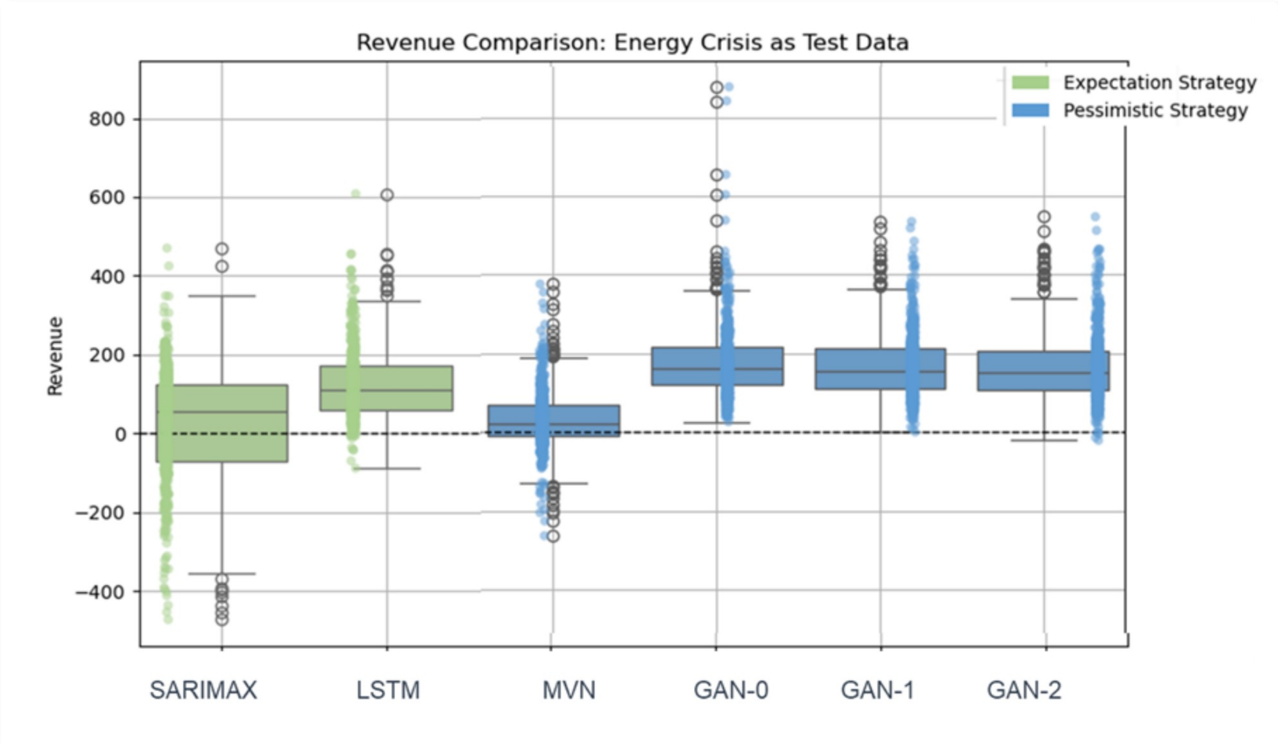


Figure 2.3.1: Results showing that GAN-based day-ahead price forecasts perform especially well in crisis mode, incurring very few/no losses compared to the baselines.

AI-based forecasting and real-time adjustment of operational schedules

Through discussions with relevant stakeholders – specifically flexible asset operators – an additional application area for our generative AI algorithms has been identified: Forecasting and real-time adjustment of operational schedules to prevent imbalance settlement. This helps reduce associated costs and mitigates strain on the grid. For this purpose, a two-stage approach has been devised: Firstly, an operational schedule to be submitted to the balancing group operator day-ahead is created based on the AI-based forecasts of relevant energy system parameters. Secondly, during actual operation, if conditions deviate from forecasts, the asset's operation is dynamically adjusted to remain aligned with the planned schedule. These adjustments are made using an AI algorithm trained on historical data to determine the optimal corrective actions.

The development of this AI-based real-time adjustment algorithm is currently ongoing.

Task 3.3 Validation of algorithms through backtesting and quality evaluation of forecasts: Not started yet.

2.4. Platform development and implementation

Fertigstellungsgrad: 40%

Deviations/changes:

Changes in human resources

AIT: Due to responsibilities in other projects, it was identified at the beginning of the project that S. Strömer cannot complete all his initially planned work in WP4. For that reason, most of the planned AIT tasks with regards to platform development were taken over by H. Koller, who is equally qualified for these tasks as an experienced software engineer.

B-SEC: S. Aistleitner joined B-SEC at the beginning of 2024 as a Software Engineer and contributes to the project as the software engineer specified as N.N. in the initial project plan.

Description of the performed work:

Task 4.1 Application requirements and use case specification:

The transpAIrent.energy platform has been designed to offer clear, accessible insights into energy-related metrics and AI-generated forecasts, targeting a broad audience including users without technical backgrounds. A key objective is to make all underlying data sources, calculations, and forecasting models transparent and traceable for the end user.

The platform consists of a CMS-driven website that serves as the main entry point, offering educational content and a "knowledge compendium" of energy terms and processes. Dynamic data visualizations are provided via an integrated web application backed by a web server, relational database (MariaDB), and time series database (InfluxDB). The architecture is modular, secure, and scalable, with automation tools (e.g., Ansible) used for reproducible deployments, and monitoring tools (e.g., Logstash, Elastic Cloud, Zabbix) ensuring system reliability and transparency, see Figure 2.4.1 below.

The platform supports several core use cases, including:

- Visualization of real-time and historical energy data, such as electricity prices and CO_2 intensity.
- Display of AI-based energy forecasts, enabling users to anticipate trends.
- Educational exploration of energy systems, supporting users in understanding how data and models are used.
- Programmatic data access for external systems via API endpoints, promoting open data usage.

Details about the application specifications, architecture, and use cases for the platform are specified in the document representing deliverable D4.1. It outlines the general functional requirements, describes the platform architecture, defines the core use cases, and specifies the charts for dynamic data visualization.

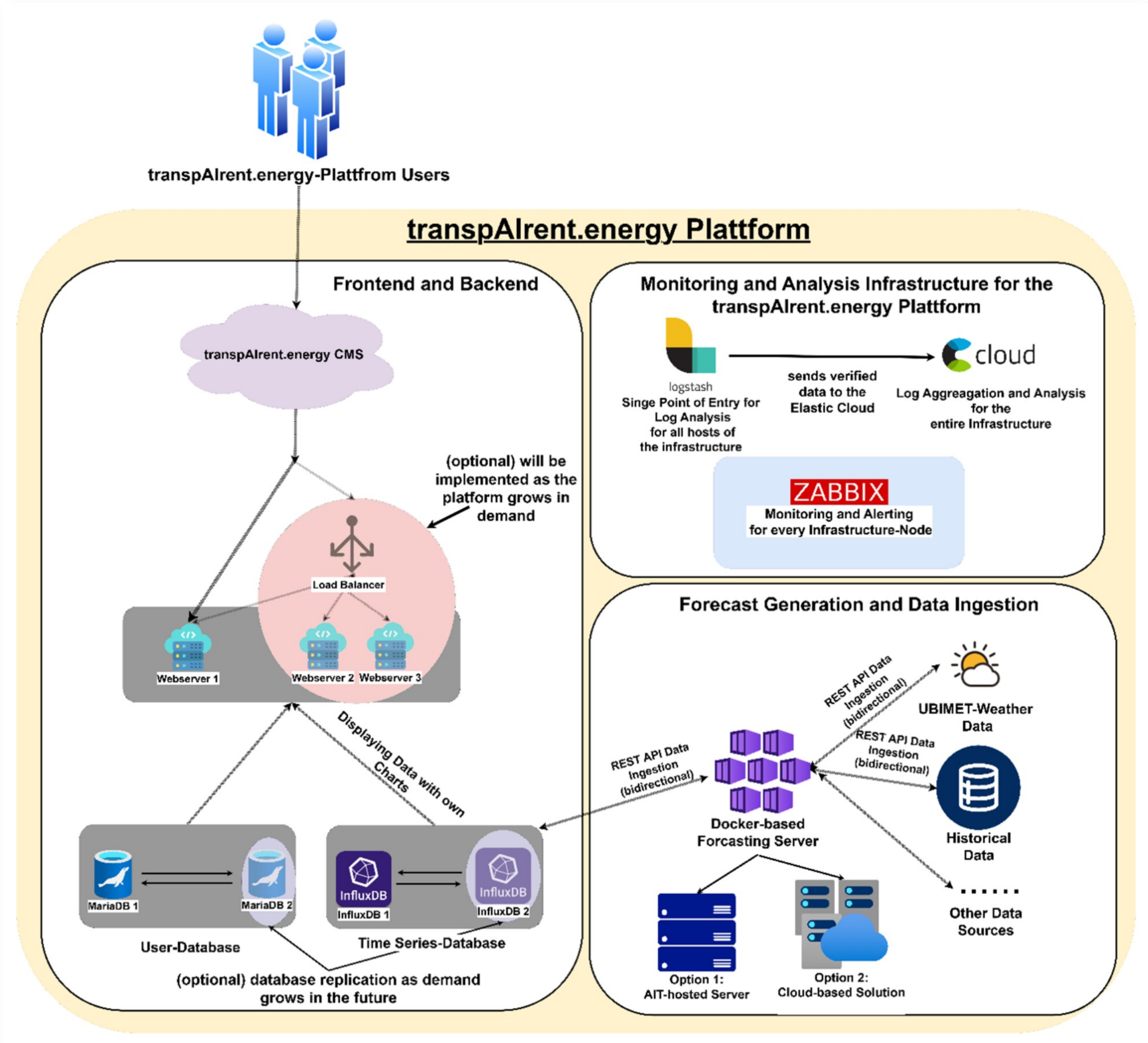


Figure 2.4.1: Planned architecture for the transpAIrent.energy platform.

Task 4.2 Platform implementation:

The platform https://en.ergie.at/ has been set up. A “knowledge compendium” on energy-system relevant information has been published on this website, e.g., on balancing reserve: https://en.ergie.at/wissen/regelreserve/. All contributions are written in markdown format, meaning they could easily be moved to the transpAIrent.energy domain if necessary and can be easily edited on https://github.com/ait-energy/en.ergie.at. It is still undecided whether en.ergie.at will replace the transpAIrent.energy domain or not. One advantage of en.ergie.at is that the website could continue to be hosted even after the project ends. The website also contains content that goes beyond the transpAIrent.energy project, thereby increasing its long-term impact and possible exploitation. The en.ergie.at platform also contains key information about the transpAIrent.energy project (https://en.ergie.at/projekte/transpairent-energy/), fostering project visibility. For the dynamic visualization platform, the groundwork has been laid by implementing ansible scripts for setup and maintenance of the data backend components, including configuration and monitoring. In addition, some parts of the interfaces for data transfer between the backend components have been specified, implemented, and tested.

Task 4.3 Operational optimization configurator implementation: Not started yet.

Task 4.4 Platform operation and maintenance: Not started yet.

2.5. Proof of concept

Fertigstellungsgrad: 20%

Deviations/changes:

Changes in human resources

AIT: P. Reisz has joined the project to support with Task 5.2 because Y. Wimmer has constrained temporal resources due to his responsibilities in other projects. She is highly competent in the creation of physical models of energy system components due to her master’s degree in applied physics. Moreover, she is currently enrolled in a second master’s degree programme in computational science and engineering, and part of her work for this project will go into her master thesis for this degree.

Deviation from the initial work plan

Task 5.1 and Task 5.2 were started earlier than initially planned, in May and November 2024, respectively, because it was realized that it is highly relevant to already think of the validation of the developed algorithms and approaches as well as to gain stakeholder feedback in the early stages of the project to achieve the highest possible impact. Thus, exchanges with asset operators regarding optimization strategies and suitable test assets/sites were sought from the beginning of the project. Moreover, the initial modelling activities for the digital twins were already started in November 2024 with an inspection of one of the test sites including an explanation on its operational characteristics relevant during modelling by its operator. Furthermore, access to data at four test sites was fixed with the signature of NDAs, completed in March 2025.

Description of the performed work:

Task 5.1 Development of a sustainable asset operational optimization strategy:

Integration of sustainability goals and consideration of various operational and location-specific constraints

Through exchanges with a test asset (PV-coupled battery with a commercial EV charging infrastructure) operator, it was identified that the reduction of grid charges by limiting peak loads is a significant lever in reducing their overall costs and thus should be a priority in the operational optimization strategy for their battery. Moreover, this contributes to system-friendly asset operation by reducing the strain on the grid and enhances the use of renewable electricity from the PV plant due to avoidance of curtailment. Based on this, a first operational optimization algorithm was set up for their battery, jointly optimizing for minimum costs, peak loads, and curtailment. It was tested based on historic data from the test site and day-ahead price forecasts, resulting in a cost reduction of 54% compared to operation without employing the operationally optimized battery. Moreover, curtailment of PV generation could be completely avoided by the optimized battery operation, see Figure 2.5.1. The optimization approach will be further enhanced by including CO_2 emission reduction as an optimization objective, based on the forecasts developed in WP3, thereby contributing to sustainability goals. Moreover, it will be applied to other test assets.

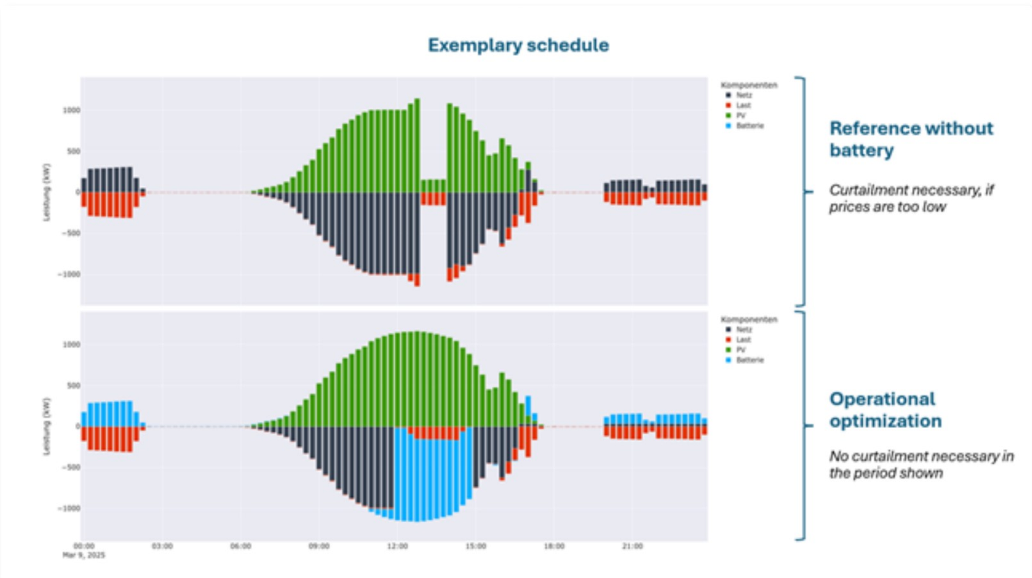


Figure 2.5.1: Result of the first operational optimization.

Enhanced stochastic formulations

Significant progress was made in advancing our AIT-internal modelling framework IESopt's stochastic optimization capabilities to include more complex properties which are not available in standard energy system models, thereby better catering to the needs of various stakeholders. Specifically, a detailed conceptual and technical evaluation was conducted to explore how complex stochastic optimization features – such as risk-aware decision-making (e.g. based on conditional Value-at-Risk) – can be integrated into IESopt to better reflect real-world uncertainties in energy system planning. A central outcome of this work was the identification of a generalized approach, namely, to define so-called "transition functions", that connect decisions and system states across multiple decision points. These functions are crucial to ensure temporal consistency, especially in the presence of uncertainties and overlapping modeling horizons. Moreover, transition functions are not only applicable in the context of stochastic optimization, but they can also be applied to pathway modelling with multi-stage decision structures and rolling horizon optimization through model predictive control. Various modeling paradigms, including perfect and myopic foresight, were analyzed in this context. To ensure high computational performance, a Julia-based implementation of the transition functions was chosen. Additionally, the applicability of the Monte Carlo Sample Average Approximation (MC-SAA) method and the SDDP.jl framework was assessed to handle large scenario spaces efficiently, equipping IESopt for robust use in uncertainty-driven operational planning during and beyond the project.

Integration of modeling-to-generate-alternatives (MGA) approaches

Regular in-depth exchanges were held between S. Strömer and a member of the doctoral program between AIT and TU Delft, which focusses on developing new methods for planning and operating future energy systems using artificial intelligence and machine learning. Her work is centred around MGA approaches with improved computational efficiency and better integration of parametric uncertainties. For that purpose, she has developed several mathematical formalizations of the MGA problem and considered the potential of different optimization-based methods, which she is currently integrating in IESopt. S. Strömer will leverage these outcomes for this task's completion.

<u>Task 5.2 Development of a digital twin and experimental tests</u>:

The initial steps for the development of detailed digital twins of the proof-of-concept sites using the AIT-internal simulation framework TESCA have been taken. For the experimental tests, data access was ensured to four test sites through NDAs. Moreover, partner PBEG provides access to a fifth test site at their office location. These sites comprise assets such as biogas plants, battery energy storage systems, PV plants, and electric vehicle charging infrastructure, among others.

The digital twin development was initialized for a biogas plant test site operated by *Bioenergie Bleier* with an inspection of the plant including a discussion of relevant modelling aspects with the operator. Biogas plants consist of several components, most importantly the combined heat and power (CHP) unit that produces electricity and heat, the organic feed receiving area, the digester, and the gas storage. Through literature review, it was identified that there is a lack of approaches providing a sufficient level of detail and correlation between feeding, biogas production rate, storage level, and CHP output. To bridge this gap, Task 5.2 focusses on the development of an approach that uses deep system understanding combined with processing of big amounts of data and statistical methods. So far, a data-driven method by applying binning was established to map the storage level to the electric CHP output of an – in principle – arbitrary biogas power plant. As a next step, numerical and fitting methods will be applied to do the mapping from organic feed and CHP output power to the storage level evolution. The digital twin's working version will also enable the extraction of quality indicators such as methane content and substrate-specific effective production rates of a respective biogas power plant. A publication on the developed methodology for the conference "IEEE SMC 2025" in Vienna has been submitted and moreover, this methodology will contribute to P. Reisz's master thesis, see section "Dissemination and Exploitation".

For the aforementioned biogas test site (*Bioenergie Bleier*), experimental validation tests are planned to be based on the recorded data of the:

- combined heat and power unit's (CHP) electric output power,
- biogas storage level,
- available information on the feeding (amount and type of organic waste deposited in the digester).

All of the aforementioned data can be obtained from the data-interface (API) created in WP2.

The development of digital twins for the other test sites is still pending.

<u>Task 5.3 Application of AI forecasts and stochastic optimization to an experimental test-site</u>: Not started yet.

2.6. Dissemination and exploitation

Fertigstellungsgrad: 15%

Deviations/changes:

Deviation from the initial work plan

Task 6.1 has started in June 2024, earlier than initially planned because maximising dissemination of the project results is an explicit objective of the project. Thus, a social media post on LinkedIn was created to publicly introduce the project after the kick-off meeting. Moreover, opportunities to present the research activities in WP3 at a national conference and the submission of a conference paper on the ongoing work in Task 5.2 were utilized. Furthermore, one master thesis has already been completed partly based on work completed for the project and another one is ongoing, highlighting the scientific relevance and innovation of the project approaches and increasing its impact through sustainable knowledge building as well as networking with universities.

Description of the performed work:

<u>Task 6.1 Scientific and public dissemination</u>:

Scientific dissemination:

Conferences (successful participations and submissions):

- Internationale Energiewirtschaftstagung (IEWT) 2025, Vienna, 26/02 to 28/02/2025: V. Alton, "*Probabilistische Vorhersagen relevanter Energiesystemvariablen mittels Generative AI (eng.: Probabilistic forecasts of relevant energy system variables using generative AI)*", successfully held a presentation in a parallel session.
- IEEE International Conference on Systems, Man, and Cybernetics (SMC) 2025, Vienna, 05/10 to 08/10/2025: P. A. Reisz, "*Biogas Power Plant Operation Modeling based on Statistical and Grey-box Methods*", submitted for the category "Work-in-Progress and Industrial Papers". (Accepted and presented papers will be copyrighted to IEEE, published in conference proceedings which will be eligible for inclusion in the IEEE Xplore® Digital Library, and submitted to Scopus for indexing.)

Master theses (completed and ongoing):

- Completed master thesis by V. Alton at University of Vienna with the title "*Application and Analysis of generative AI algorithms for probabilistic energy forecasts*", started in October 2024. It was carried out to obtain the degree Master of Science for the studies "066 910 master's programme Computational Science" under the supervision of Dipl.-Ing. Dr.techn. Lukas Exl Privatdoz. at the Institute of Mathematics.
- Ongoing master thesis by P. A. Reisz at Technical University of Vienna with the title "*Development of biogas power plant models based on statistical methods*", started in March 2025. It is carried out to obtain the degree "Master of Science" for the studies "066 646 master's programme Computational Science and Engineering" under the supervision of Privatdoz. Dipl.-Ing. Dr.techn. Thomas Strasser at the E325 - Institute of Mechanics and Mechatronics.

Public dissemination:

- LinkedIn post created by K. Maggauer in June 2024 containing an introduction of the project as well as announcing its launch with the successful completion of the kick-off meeting, including a photo from said meeting (see Figure 2.6.1).

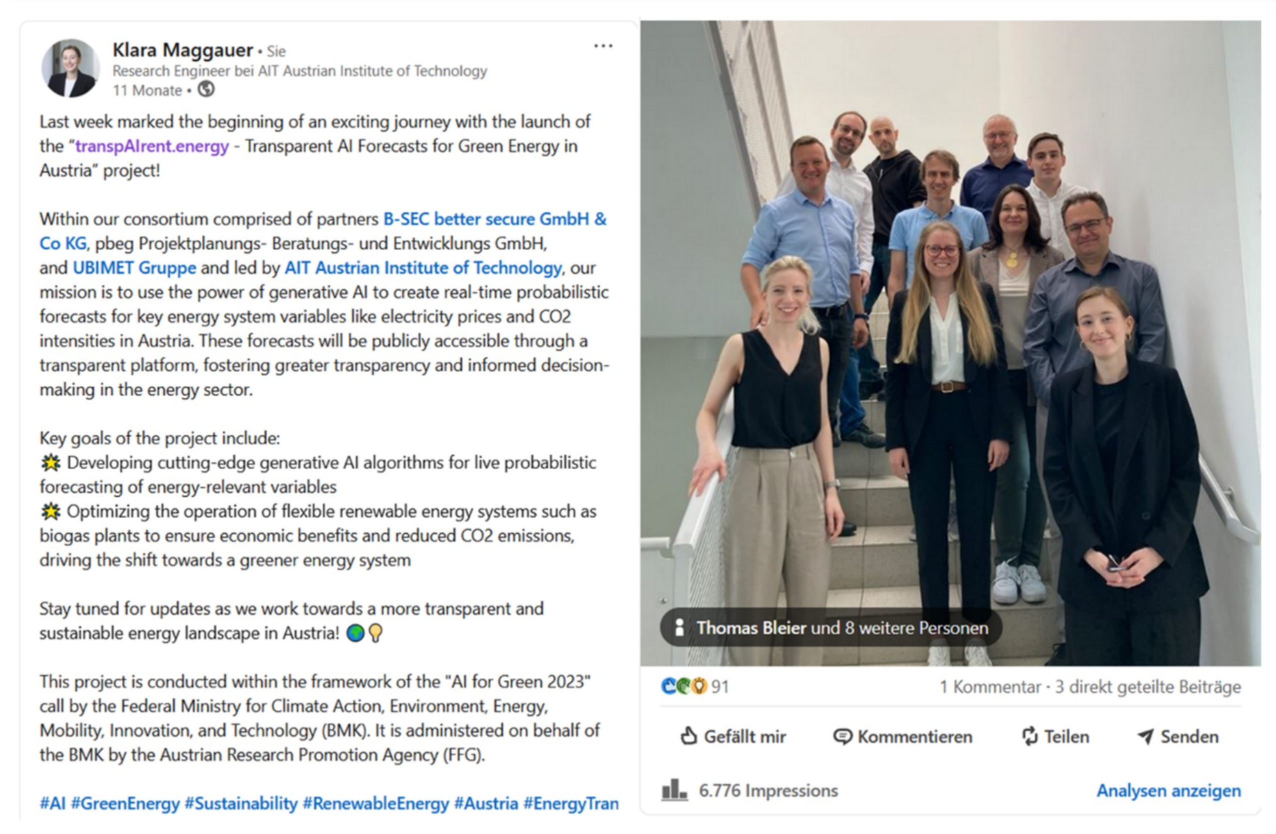


Figure 2.6.1: LinkedIn post announcing the project launch.

Task 6.2 Exploitation: Not started yet.

3. Explanation of significant changes in costs

There are no significant changes in costs to report in the first year of the project. However, a minor shift of UBIMET's personnel costs in the magnitude of EUR 1370 (incl. overheads) from WP2 to WP5 is planned. The reason for this shift is that weather forecasts by UBIMET need to be set up at the locations of the test sites later in the project than at the end of Task 2.3 (30/04/2025). These site-specific weather forecasts are crucial for the development and validation of the optimization algorithms in WP5. Specifically, the planned budget shift corresponds to resources for the setup of the weather forecasts at a maximum of six locations, which can be initialized collectively in a maximum of two instances. Moreover, machine hours and model data are also required for the calculation and provision of these production forecasts. The resulting costs are covered by UBIMET's remaining budget for asset costs and material costs. Accordingly, EUR 543 (incl. overheads) will be reallocated from WP2 to WP5 for asset costs and EUR 5142 (incl. overheads) will be reallocated from WP2 to WP5 for material costs.

Sources

Lu, 2022 Xin Lu, Jing Qiu, Gang Lei, Jianguo Zhu, Scenarios modelling for forecasting day-ahead electricity prices: Case studies in

Australia, Applied Energy, Volume 308, 2022, 118296, ISSN 0306-2619, https://doi.org/10.1016/j.apenergy.2021.118296.
https://www.sciencedirect.com/science/article/pii/S0306261921015555

Questions regarding the report

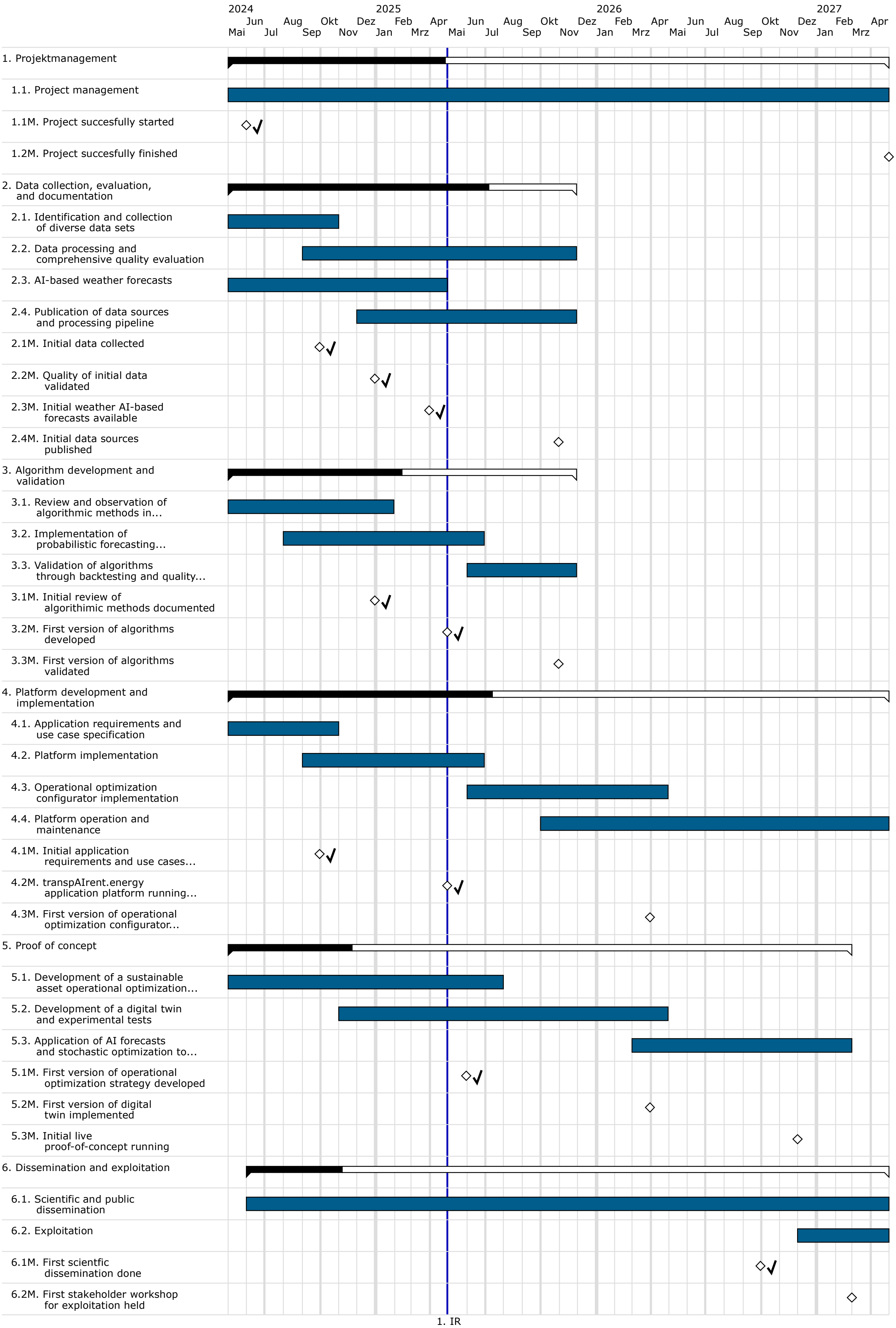
Apart from the updated schedule situation presented in the work plan, are there any events that delay or make impossible the implementation of the project or require a modification, e.g. insolvency proceedings, plant closures, sale of operations?
No

Has **any other funding** been applied for or already approved for the project, for parts of the project, or for individual persons billed, equipment used, or other investments?
No

Are there any changes to the ownership structure that have an impact on the SME classification?
No

Work plan status

GANTT chart


2024
2025
2026
2027
Mai Jun Jul Aug Sep Okt Nov Dez Jan Feb Mrz Apr Mai Jun Jul Aug Sep Okt Nov Dez Jan Feb Mrz Apr Mai Jun Jul Aug Sep Okt Nov Dez Jan Feb Mrz Apr
1. Projektmanagement
1.1. Project management
1.1M. Project succesfully started
1.2M. Project succesfully finished
2. Data collection, evaluation, and documentation
2.1. Identification and collection of diverse data sets
2.2. Data processing and comprehensive quality evaluation
2.3. AI-based weather forecasts
2.4. Publication of data sources and processing pipeline
2.1M. Initial data collected
2.2M. Quality of initial data validated
2.3M. Initial weather AI-based forecasts available
2.4M. Initial data sources published
3. Algorithm development and validation
3.1. Review and observation of algorithmic methods in...
3.2. Implementation of probabilistic forecasting...
3.3. Validation of algorithms through backtesting and quality...
3.1M. Initial review of algorithimic methods documented
3.2M. First version of algorithms developed
3.3M. First version of algorithms validated
4. Platform development and implementation
4.1. Application requirements and use case specification
4.2. Platform implementation
4.3. Operational optimization configurator implementation
4.4. Platform operation and maintenance
4.1M. Initial application requirements and use cases...
4.2M. transpAIrent.energy application platform running...
4.3M. First version of operational optimization configurator...
5. Proof of concept
5.1. Development of a sustainable asset operational optimization...
5.2. Development of a digital twin and experimental tests
5.3. Application of AI forecasts and stochastic optimization to...
5.1M. First version of operational optimization strategy developed
5.2M. First version of digital twin implemented
5.3M. Initial live proof-of-concept running
6. Dissemination and exploitation
6.1. Scientific and public dissemination
6.2. Exploitation
6.1M. First scientfic dissemination done
6.2M. First stakeholder workshop for exploitation held
1. IR

Costs

Interim Report 1

Consortium

Overview

Partner	Status	Editing by	Actual costs	Share of costs
AIT Austrian Institute of Technology GmbH	Interim report submitted		83.287,00	42,09%
B-SEC better secure KG	Interim report submitted	Partner	32.116,00	16,23%
Projektplanungs- Beratungs- und Entwicklungs GmbH	Interim report submitted	Partner	20.686,00	10,45%
UBIMET GmbH	Interim report submitted	Partner	61.797,00	31,23%
			197.886	

Cost Category

Partner	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
AIT Austrian Institute of Technology GmbH	74.594,00	8.285,00	0,00	0,00	408,00	83.287,00
B-SEC better secure KG	32.116,00	0,00	0,00	0,00	0,00	32.116,00
Projektplanungs- Beratungs- und Entwicklungs GmbH	20.559,00	0,00	0,00	0,00	127,00	20.686,00
UBIMET GmbH	53.985,00	810,00	7.002,00	0,00	0,00	61.797,00
	181.254	**9.095**	**7.002**	**0**	**535**	**197.886**

Personnel costs

Partner	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Total
AIT Austrian Institute of Technology GmbH	4.795,22	23.840,34	27.677,22	7.218,24	9.573,80	1.489,10	74.594,00
B-SEC better secure KG	0,00	1.491,38	2.069,26	27.879,86	675,00	0,00	32.116,00
Projektplanungs- Beratungs- und Entwicklungs GmbH	0,00	4.556,26	1.687,50	1.209,38	13.106,26	0,00	20.559,00
UBIMET GmbH	1.582,59	52.402,90	0,00	0,00	0,00	0,00	53.985,00
	6.378	**82.291**	**31.434**	**36.307**	**23.355**	**1.489**	**181.254**

AIT Austrian Institute of Technology GmbH

Overview

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	4.795,22					4.795,22
2. Data collection, evaluation, and documentation	23.840,34					23.840,34
3. Algorithm development and validation	27.677,22					27.677,22
4. Platform development and implementation	7.218,24					7.218,24
5. Proof of concept	9.573,80					9.573,80
6. Dissemination and exploitation	1.489,10					1.489,10
	74.594	**8.285**	**0**	**0**	**408**	**83.287**

Personnel costs

Name	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	OR	Hours	Actual costs
Alton, Verena	P	wissensch. MA	-	7,55	165,31	-	-	8,23	25%	181,09	7.924,95
Esterl, Tara	P	wissensch. MA	3,00	-	18,33	-	-	-	25%	21,33	2.216,72
Fanta, Sarah	P	wissensch. MA	-	-	-	20,75	-	-	25%	20,75	1.167,71
Hemm, Regina	P	wissensch. MA	-	-	8,00	-	-	-	25%	8,00	533,20
Kapeller, Judith	P	wissensch. MA	-	-	-	-	11,00	-	25%	11,00	680,49
Kathan, Johannes	P	wissensch. MA	-	-	-	-	25,56	-	25%	25,56	2.539,71
Koller, Hannes	P	wissensch. MA	-	10,00	-	36,50	-	-	25%	46,50	3.899,03
Leimgruber, Fabian Michael	P	wissensch. MA	-	292,60	2,10	-	-	-	25%	294,70	20.459,55
Maggauer, Klara	P	ProjektleiterIn	53,00	15,00	17,00	11,50	35,00	1,00	25%	132,50	7.973,19
Mazza, Giulia Ludovica	P	wissensch. MA	11,00	-	-	-	-	-	25%	11,00	585,75

Name	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	OR	Hours	Actual costs
Ortmann, Philipp	P	wissensch. MA	-	-	3,00	-	-	-	25%	3,00	231,83
Reisz, Petra	P	wissensch. MA	-	3,50	-	-	51,24	-	25%	54,74	2.075,33
Seragiotto, Clovis	P	wissensch. MA	-	3,20	-	-	-	-	25%	3,20	263,28
Strömer, Stefan	P	wissensch. MA	-	15,31	43,38	33,22	11,78	15,45	25%	119,14	8.241,51
Vana, Veronica	P	wissensch. MA	9,00	-	-	-	-	-	25%	9,00	708,41
Widhalm, Peter	P	wissensch. MA	-	-	162,27	-	-	-	25%	162,27	13.567,80
Wimmer, Yannick	P	wissensch. MA	-	-	0,50	-	21,00	-	25%	21,50	1.525,43
			76	**347**	**420**	**102**	**156**	**25**		**1.125,28**	**74.594**

Asset Utilization

Hourly Rate for Machine

Position	Hourly Rate for machine	Machine use in the reporting period	Utilization costs	Overhead Rate	Amount
Smartest - 2030P2	22,49	294,7	6.627,80	25%	8.284,75

Travel costs

Purpose of the journey	Period	Employees	Amount	Amount	Amount
Projektmeeting und Testanlagenbegutachtung mit dem Modellierungsteam	25.11.2024 - 25.11.2024	Maggauer	47,15	25,00	58,94
Projektmeeting und Testanlagenbegutachtung mit dem Modellierungsteam	25.11.2024 - 25.11.2024	Widhalm	41,79	25,00	52,24
Projektmeeting und Testanlagenbegutachtung mit dem Modellierungsteam	25.11.2024 - 25.11.2024	Reisz	55,18	25,00	68,98
Projektmeeting und Testanlagenbegutachtung mit dem Modellierungsteam	25.11.2024 - 25.11.2024	Strömer	23,05	25,00	28,81
Projektmeeting und Testanlagenbegutachtung mit dem Modellierungsteam	25.11.2024 - 25.11.2024	Alton	30,41	25,00	38,01
Projektmeeting und Testanlagenbegutachtung mit dem Modellierungsteam	25.11.2024 - 25.11.2024	Wimmer	28,51	25,00	35,64
Teilnahme und Abhaltung einer Präsentation auf der Internationalen Energiewirtschaftstagung...	26.02.2025 - 28.02.2025	Alton	100,00	25,00	125,00
					408

B-SEC better secure KG

Overview

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	0,00					0,00
2. Data collection, evaluation, and documentation	1.491,38					1.491,38
3. Algorithm development and validation	2.069,26					2.069,26
4. Platform development and implementation	27.879,86					27.879,86
5. Proof of concept	675,00					675,00
6. Dissemination and exploitation	0,00					0,00
	32.116	**0**	**0**	**0**	**0**	**32.116**

Personnel costs

Name	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Hours
Aistleitner, Stefan	P	wissensch. MA	-	-	25,50	195,30	-	-	220,80
Bleier, Sonja	P	wissensch. MA	-	-	6,00	52,50	-	-	58,50
Bleier, Thomas	P	wissensch. Leitung	-	18,00	12,00	80,50	12,00	-	122,50
Puecker, Dominik	P	technischer MA	-	-	-	150,30	-	-	150,30
Schmidt, Dennis	P	technischer MA	-	11,00	-	136,00	-	-	147,00
			-	**29**	**44**	**615**	**12**	**-**	**699,10**

Projektplanungs- Beratungs- und Entwicklungs GmbH

Overview

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	0,00					0,00
2. Data collection, evaluation, and documentation	4.556,26					4.556,26
3. Algorithm development and validation	1.687,50					1.687,50
4. Platform development and implementation	1.209,38					1.209,38
5. Proof of concept	13.106,26					13.106,26
6. Dissemination and exploitation	0,00					0,00
	20.559	**0**	**0**	**0**	**127**	**20.686**

Personnel costs

Name	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Hours
Fellner, Josef	P	technischer Support	-	24,00	6,00	5,50	23,00	-	58,50
Gremel, Christian	P	wissenschaftliche Mitarbeit	-	8,50	-	4,00	21,00	-	33,50
Mandl, Erich	P	wissenschaftliche Mitarbeit	-	-	-	-	6,00	-	6,00
Mandl, Josef	P	technischer Support	-	32,50	4,00	4,00	40,50	-	81,00
Samek, Eva-Maria	P	wissenschaftlicher Support	-	5,00	-	4,00	49,50	-	58,50
Trimmel, Bernhard	P	wissenschaftliche Leitung	-	11,00	20,00	4,00	93,00	-	128,00
			-	**81**	**30**	**22**	**233**	**-**	**365,50**

Travel costs

Purpose of the journey	Period	Employees	Amount	Amount	Amount
Teilnahme am Kick-off Meeting inkl. Präsentation zu AP5 in Wien	27.05.2024 - 27.05.2024	Gremel, Trimmel	86,52	25,00	108,15
Konsortialmeeting & Anlagenbesichtigung in Weingraben	25.11.2024 - 25.11.2024	Fellner, Mandl, Samek, Trimmel	15,12	25,00	18,90
					127

UBIMET GmbH

Overview

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	1.582,59					1.582,59
2. Data collection, evaluation, and documentation	52.402,90					52.402,90
3. Algorithm development and validation	0,00					0,00
4. Platform development and implementation	0,00					0,00
5. Proof of concept	0,00					0,00
6. Dissemination and exploitation	0,00					0,00
	53.985	**810**	**7.002**	**0**	**0**	**61.797**

Personnel costs

Name	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Hours
Abulashvili, Lasha	P	Schnittstellenentwicklung	-	21,00	-	-	-	-	21,00
Athanasiadis, Philipp	P	Nutzeranalyse, Produktentwicklung	-	41,42	-	-	-	-	41,42
Dobler, Matthias	P	Head of R&D and Forecasting	-	78,00	-	-	-	-	78,00
Edletzberger, Alexandra	P	Projektleitung	27,10	59,90	-	-	-	-	87,00
Kalogeras, Petros	P	Entwicklung WRF	-	47,00	-	-	-	-	47,00
Malecic, Barbara	P	Model Development Expert	-	15,30	-	-	-	-	15,30
Perenyi, Arpad	P	Core Developer	-	55,92	-	-	-	-	55,92
Plavcan, David	P	Data Services	-	171,50	-	-	-	-	171,50
Siever, Jan	P	IT Support	-	24,00	-	-	-	-	24,00
Sviha, Thomas	P	IT Support	-	8,33	-	-	-	-	8,33
Versic, Tadeja	P	Entwicklung Power Prediction	-	321,75	-	-	-	-	321,75
Volpert, Elena	P	Model Development Verifikation	-	11,00	-	-	-	-	11,00
Weinberger, Stephan	P	IT Support	-	11,24	-	-	-	-	11,24
			27	**866**	**-**	**-**	**-**	**-**	**893,46**

Asset Utilization

Hourly Rate for Machine

Position	Hourly Rate for machine	Machine use in the reporting period	Utilization costs	Overhead Rate	Amount
HPC Infrastruktur	0,45	1440	648,00	25%	810,00

Costs of Materials

Position	Reference source	Invoice date	Invoice no.	Amount	Amount	Amount
ECMWF Globale Modelldaten f. 1 Monat (Mai24) 5% aliquot	MetOffice	3/4/2024	I0134640	684,58	25	855,73
ECMWF Globale Modelldaten f. 1 Monat (Juni24) 5% aliquot	MetOffice	6/4/2024	I0135628	658,33	25	822,91
ECMWF Globale Modelldaten f. 3 Monate (Juli24-Aug24) 5% aliquot	MetOffice	7/2/2024	I0135935	1277,50	25	1.596,88
ECMWF Globale Modelldaten f. 3 Monate (Okt24-Dez24) 5% aliquot	MetOffice	10/3/2024	I0136833	1277,50	25	1.596,88
ECMWF Globale Modelldaten f. 3 Monate (Jan25-Mar25) 5% aliquot	MetOffice	1/3/2025	I0138046	1277,50	25	1.596,88
ECMWF Globale Modelldaten f. 1 Monat (Aug25) 5% aliquot	MetOffice	4/3/2025	I0139282	425,83	25	532,29
						7.002

Conditions

AIT Austrian Institute of Technology GmbH

Overview

Phase	Open
Conditions yet to be fulfilled	0 von 0

B-SEC better secure KG

Overview

Phase	Open
Conditions yet to be fulfilled	0 von 0

Projektplanungs- Beratungs- und Entwicklungs GmbH

Overview

Phase	Open
Conditions yet to be fulfilled	0 von 0

UBIMET GmbH

Overview

Phase	Open
Conditions yet to be fulfilled	0 von 0

Attachments

Interim Report 1

UPLOADS

Further Attachment

- transpAIrent.energy_Nachmeldung_MA.pdf
- transpAIrent.energy_D2.1.pdf
- transpAIrent.energy_DMP_updated.xlsx
- transpAIrent.energy_D4.1.pdf

PROJECT DATA

Core data of the project

CORE DATA OF THE PROJECT

Call Focus Area:
Generative AI models

Instrument
Cooperative project

Secondary categorization:
Energy transition

Research category:
Industrial Research

Short title of the project:
transpAIrent.energy

Full title of the project:
transpAIrent.energy - Transparent AI Forecasts for Green Energy in Austria

Planned start of project:
5/1/2024

Duration in months:
36

Current End of project:
4/30/2027

Project related keywords:
generative AI; probabilistic forecasting; transparency platform; multi-objective optimization; proof of concept

Project typ:
New Project

EXECUTIVE SUMMARY

Abstract (german):
Das Projekt transpAIrent.energy - Transparent AI Forecasts for Green Energy in Austria zielt darauf ab, mithilfe von generative artificial intelligence (AI)-Methoden probabilistische Live-Prognosen für energiesystemrelevante Größen wie Strompreise und CO2-Intensitäten in Österreich zu erstellen und eine transparente Plattform zu entwickeln, die diese öffentlich zugänglich macht. Diese Prognosen werden im Zuge des Projekts weiters dazu verwendet, eine Optimierungsstrategie für den Betrieb flexibler erneuerbarer Energieanlagen unter vielfältigen umwelt- und systemrelevanten Anforderungen zu entwickeln. Durch diese „Mehrziel“-Optimierungsstrategie werden gleichzeitig ein betriebswirtschaftlicher Nutzen, welcher Anreize erzeugt und eine niedrigere CO2-Intensität garantiert und so der Übergang zu einem umweltfreundlicheren Energiesystem gefördert.

Im Rahmen des Projekts werden im Speziellen folgende Ziele verfolgt:
1. Entwicklung eines innovativen generative-AI-basierten Algorithmus zur Erstellung probabilistischer Prognosen für energiesystemrelevante Größen und deren Live-Veröffentlichung auf einer transparenten Plattform;
2. Nutzung dieser Prognosen zur Optimierung flexibler erneuerbarer Energieanlagen, um deren Betrieb sowohl wirtschaftlicher als auch nachhaltiger zu gestalten.

Diese Ziele werden mithilfe von vier dedizierten Arbeitspaketen (APs) innerhalb des Projekts erreicht, die auf Folgendes abzielen:
• Datensammlung, -aufbereitung und -dokumentation, sowie die Erstellung von Wetterprognosen,
• Entwicklung von AI-basierten Prognosealgorithmen,
• Plattformentwicklung und -implementierung
• und Methodenvalidierung („Proof of Concept“) durch Simulation und Live-Tests.

Diese inhaltlichen APs werden darüber hinaus durch ein Projektmanagement-AP sowie ein Verbreitungs- und Verwertungs-AP ergänzt. Letzteres zielt darauf ab, den Mehrwert des Projekts für Österreich durch die transparente Live-Prognoseplattform sowie für eine nachhaltigere Energiezukunft durch den optimierten Betrieb erneuerbarer Energieflexibilitäten hervorzuheben und zu verbreiten und Verwertungsmöglichkeiten der Projektergebnisse zu unterstreichen.

Abstract (english):

The project transpAIrent.energy - Transparent AI Forecasts for Green Energy in Austria aims to employ generative artificial intelligence (AI) methods to create probabilistic live forecasts for variables relevant to the energy system – such as electricity prices and CO2 intensities – in Austria and to develop a transparent platform that makes them publicly accessible. Furthermore, these forecasts will be used in the project to develop an optimization strategy for the operation of flexible renewable energy systems under a variety of environmental and system-relevant requirements. This "multi-objective" optimization strategy simultaneously brings economic benefits, which create incentives, and guarantees lower CO2 intensity, thus promoting the transition to a more environmentally friendly energy system.
The project specifically pursues the following goals:
1. Development of an innovative generative AI-based algorithm for creating probabilistic forecasts for variables relevant to the energy system and publishing them live on a transparent platform;
2. Using these forecasts to optimize flexible renewable energy systems to make their operation both more economical and more sustainable.
These goals are achieved through four dedicated work packages (WPs) within the project, which focus on
• data collection, processing, and documentation as well as the creation of weather forecasts,
• development of AI-based forecasting algorithms,
• platform development and implementation,
• and method validation ("proof of concept") through simulation and live testing.
These content-related APs are moreover supplemented by a project management WP and a dissemination and exploitation WP. The latter aims to highlight and disseminate the added value of the project for Austria through the transparent live forecast platform as well as for a more sustainable energy future through the optimized operation of renewable energy flexibilities and to underscore the possibilities for exploiting the project results.

Role of Applicant

Role of partner:
Scientific Partner

Main task in project:
AIT's main responsibilities in the proposed project are

- **project management,**
- **the collection, processing, and documentation of data as input for the AI models,**
- **the development and implementation of innovative AI algorithms, including their validation and testing,**
- **the development of stochastic operational optimization strategies based on the AI forecasts,**
- **the implementation of digital twins of the proof of concept sites and conducting experimental simulative tests using them,**
- **leading the dissemination and exploitation of the project results.**

Key competences of the persons involved:

- **K. Maggauer is an experienced project leader and brings knowledge on energy system modeling.**
- **F. Leimgruber is an experienced software developer for numerical simulations and data pipeline administration and has years of experience in forecasting and generative AI algorithms.**
- **S. Strömer has years of expertise in the development of price forecasts, AI algorithms, and high-resolution energy system models.**
- **S. Fanta has a strong background in mathematics, algorithms, and stochastic optimization, and brings knowledge on balancing markets.**
- **P. Ortmann brings comprehensive knowledge on power market analysis, modeling, and forecasting.**
- **R. Hemm has profound expertise in multi-objective optimization techniques.**
- **Y. Wimmer brings expertise on the modeling of physical components as well as their optimization.**
- **S. Reuter has profound expertise on biogas plants and decarbonization of energy systems.**
- **J. Kapeller has comprehensive expertise in energy system modeling and optimization.**
- **T. Esterl contributes expertise in flexibility services and imbalance settlement.**
- **J. Kathan is an expert on energy system modeling and techno-economic evaluations.**

Results from other projects:

- **Energie Burgenland: AIT has developed a real-time imbalance settlement price forecast running at a customer, who is trading a significant amount of wind energy. It was very hard to predict as the trading strategies of all balance groups influence the area control error. New AI methods could improve the quality of the results.**

- **Enspired: AIT investigated and analyzed statistical properties of the German control area imbalance (as indicator for balancing energy prices and activation probabilities). We tested various standard forecasting methods, which revealed little additional performance compared to simple (mean, lagged) forecasting rules. The results hint at more complex AI methods, as well as probabilistic forecasts, being a crucial factor to achieve significant quality improvements.**

- **Flex+: Flexible components of customers were traded on real-time markets (e.g. a heat pump pool and boiler pool was prequalified to participate in the balancing markets). Especially, the stacking of use cases and the rebuy of electricity was challenging algorithm-wise and this will be improved in this project.**

- **NEFI_CE4T: The flexibility of skiing regions was traded on the short-term intraday market. Therefore, the first algorithm for intraday price forecast was developed. It is expected that new AI algorithms can improve the forecast significantly.**

- **FeldBATT: We have developed a trading strategy for a BESS to participate in the primary control market considering the real-time rebuy strategy as well as a security of supply service in case of blackout.**

- **Wien Energie: For a customer, we have simulated the possibility to trade on different el. markets. This project will enhance in comparison to that project the multi-market trading strategies.**

Project relevant infrastructure:

AIT has a comprehensive infrastructure for testing and further developing AI-based forecasting algorithms, including multiple computational clusters. Furthermore, two internal software tools - *IESopt* and *TESCA* - which were developed in-house and can be coupled with each other, are used in the project. These tools are energy system optimization and techno-economic simulation frameworks and used to develop an operational optimization strategy based on the AI forecasts and test the behaviour of the overall system under optimization in a controlled simulation environment (digital twin). Necessary licenses and software (e.g. GAMS, Python, Julia, PowerFactory, etc.) are held by AIT.

Moreover, AIT is involved in an ambitious interdisciplinary research program led by J. Cremer together with TU Delft, within which six doctoral students will carry out their research activities. The focus of the five-year doctoral program is on developing new methods for planning and operating future energy systems using artificial intelligence and machine learning. J. Cremer, co-director of the TU Delft AI Energy Lab and principle scientist at AIT, will mentor this project.

Tasks of third party providers:

None.

Project Manager

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Giefinggasse 4
1210 Wien

Location of project

Giefinggasse 4
1210 Wien

Bank details

BANK DETAILS

IBAN: **AT392011128869864440**	BIC: **GIBAATWW**
	Name of bank: **Erste Bank der oesterreichischen Sparkassen AG**

Incentive Effect

Funding is only permissible in case of an incentive effect. This means that funding can only be granted if it enables the applicant to take up additional activities that would not be carried out without funding, or only to a lesser extent, or at a different location.

If it is planned to carry out the **project unchanged** without granted funding, **no funding** will be granted.

Would you carry out the project without funding?
no

Uploads

UPLOADS

Further Attachment

- KMU_Erklärung_PBEG.pdf
- 20230920_LOI_KBVOe.pdf
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- transpAIrent.energy_DMP.pdf

CONTENT DESCRIPTION

1. Project

1.1. Motivation

Initial situation and our motivation

In the proposed project, we aim to bridge the gap between state-of-the-art artificial intelligence approaches and today's energy market complexity, all while contributing to the transition towards a more sustainable energy system through the creation of the transparency platform "*transpAIrent.energy*". It equips all potential energy system participants with open access to AI-based forecasts for energy system relevant variables in Austria, which can be used to optimize renewable energy assets, thereby creating a more fair, efficient, and ecological energy system. Our motivation to carry out this project stems from three key challenges facing the Austrian electricity system, which we will outline below and demonstrate how our project addresses them.

1. **Predictive Accuracy and Efficiency:** The short-term fluctuations in the electricity market parameters are influenced by a myriad of factors ranging from renewable energy infeeds to system demands, e. g. frequency restoration. Given the volatile nature of these factors, conventional forecasting tools often fall short. By employing state-of-the-art generative AI, we aim to enhance the predictive accuracy of these parameters, particularly in a probabilistic manner. This will provide a more granular, actionable insight into the market movements, aiding stakeholders in making informed decisions.
2. **Transparency and Accessibility:** Data transparency is one of the most important pillars of a sustainable, future proof, efficient, liquid, and competitive electricity market. It is particularly relevant in the interaction of different market participants, as the scope for market power (if existent) to be abused can be avoided through open and equivalent access to data and forecasts. The *transpAIrent.energy* platform enables the public provision of short- (hours) to mid-term forecasts of important energy system parameters (e. g. CO_2 intensities or balancing energy activations) for Austria and further facilitates the development of efficient and competitive energy markets. Furthermore, since there is a lack of forecast availability for certain energy system variables specifically for Austria, our platform will support Austria's energy system in terms of integration and competition.
3. **Proof of Concept and Impact Evaluation:** Ideas, when confined to theory, often fail to realize their full potential. To tangibly showcase the benefits of our forecasts, we propose the integration with a virtual power plant. By employing stochastic operational optimization – based on our probabilistic AI forecasts – we can assess the real-world implications of our predictions. This not only validates our approach but also provides valuable insights into its sustainability and environmental impacts. Publishing the resulting data and results on an open platform, incentivizes adoption from decentral actors that are not considered "big players".

In essence, our motivation is to harness the power of AI to create a paradigm shift in how electricity market data and other energy system relevant data such as CO_2 intensity in Austria is predicted, consumed, and acted upon. By bridging the gap between cutting-edge technology and free/open access for all market participants, we envision a future where energy markets are more efficient, transparent, and environmentally conscious.

Project contributions to achieving the goals and the chosen focal area(s) of the call

The proposed project contributes to the goals of the call by (1) **developing innovative generative AI algorithms** to create probabilistic forecasts for variables relevant to the energy system in Austria, such as electricity prices and CO_2 intensities, and (2) using these forecasts to optimize the operation of flexible renewable and agricultural energy systems under a variety of environmental and system-relevant requirements. This simultaneously creates economic benefits that generate incentives and guarantees lower CO_2 intensity, thus promoting the transition to a more environmentally friendly energy system, thereby **contributing to Austria's climate goals by reducing the use of resources and energy.**

Added value the project will have on the organizations involved

The added value of the project and its results for the organizations involved in the project are comprehensively presented in Chapter 3.

Contribution of the funding to the implementation of the project

Because this project employs innovative approaches that are far from being market-ready and it brings a lot of common good, companies alone cannot invest the financial means to fund it. Thus, without the FFG's funding, the project cannot be realized.

1.2. Project goals and approaches

Goals & methods

In the proposed project, we pursue two primary **goals**: (1) developing innovative generative AI algorithms to generate probabilistic forecasts for energy system-relevant variables and live publishing them on a transparent platform, and (2) leveraging these forecasts to optimize flexible renewable energy assets to make their operation more economic, efficient, and sustainable.

In order to guarantee an efficient workflow and that all project results contribute to our goals, we structure our project into a comprehensive **methodological design**, consisting of the following **approaches**:

- **Data collection, evaluation, and documentation**: Since generative AI methods rely on data, we not only review the availability of datasets necessary for their development, but also conduct thorough quality and consistency evaluations of all identified datasets and apply correction mechanisms if necessary. Moreover, we apply AI techniques to create highly spatially and temporally resolved weather forecasts, which are crucial for the optimization of renewable energy assets. This contributes to our objective of more sustainably and efficiently operated energy systems. In line with our overarching goal of increased transparency, we document our approaches, code, and results and create a database that unifies the processed datasets and publish both the documentation and the database on our platform. This moreover ensures measurable and transparent progress.
- **Algorithm development and validation**: Based on the processed datasets, we review, implement, and validate generative AI forecasting algorithms and apply them to timeseries forecasting for energy system-relevant variables. Moreover, we evaluate these forecasts' quality through standardized measures and backtesting. This contributes to our first goal of developing innovative generative AI algorithms. Furthermore, transparency and quantifiable results are guaranteed through publishing documentation and all outcomes on our platform.
- **Platform development and implementation**: To achieve our goal of increased transparency, we implement a publicly accessible platform. We closely involve relevant stakeholders in its design to ensure user-friendliness. On the platform, all data, methods, and results of our project are transparently published. Moreover, a simple operational optimization configurator is implemented which enables a large number of "low volume" asset operators to estimate our operational optimization strategy's benefit for their own assets, which empowers local and regional generation of renewable energy.
- **Proof-of-concept**: To quantitatively validate our AI-algorithms and evaluate their applicability, we develop a multi-objective stochastic operational optimization strategy for renewable energy assets based on our AI generated forecasts. Furthermore, we conduct experimental tests through applying the developed optimization strategy on a digital twin of three real sites as well as the sites themselves for proof of concept. To ensure economic, ecological, as well as efficiency benefits, we combine minimizing CO_2 emissions, with decreasing costs, and other objectives such as increased self-sufficiency within our optimization strategy. The optimization results represent a quantitative metric to measuring the benefit of our approach. All results are transparently published on our platform.

Moreover, we apply project management efforts to monitor and ensure progress within the project, and conduct dissemination and exploitation activities, that highlight and distribute the value added by the project through our transparent platform as well as its contribution to a more sustainable energy future through the optimized operation of renewable energy flexibilities and underscore the possibilities for exploiting the project results.

Sustainability

Enhanced sustainability is addressed in multiple dimensions of our research: Our multi-objective optimization strategy for renewable energy asset operation simultaneously minimizes both costs and CO_2 emissions, while respecting constraints such as grid connection limits or self-sufficiency requirements. This aligns with **ecological** and **economic** sustainability goals by fostering increased renewable energy asset adoption through guaranteed economic gains and reduced carbon intensity. **Climate neutrality** is thereby supported by promoting the transition towards a more environmentally friendly energy system. Additionally, **social** benefits are attained through reducing economic risks associated with renewable asset operation, especially benefiting vulnerable consumers by publicly offering uncertainty-robust probabilistic forecasts that safeguard against unexpected financial losses and ensure consistent profits. Moreover, a large number of "low volume" renewable asset operators gain access to transparent data and forecasts on our platform, which they would otherwise not have. Furthermore, we actively involve relevant stakeholders in the design of our transparency platform, thereby strengthening regional value creation.

Gender-specific topics

Since people are not the object of our proposed research activities, the project is **not directly gender-relevant**. Even so, all project activities will steer clear of gender biases, guarantee equal opportunities, and promote a balanced gender mix. Throughout the project, we will be mindful of the language in all reports, outcomes, guidelines, and communication and dissemination materials, ensuring they are inclusive and maintain gender neutrality. At the beginning of the project, a discussion with all participants ensures a shared understanding of this emphasis.

1.3. Innovation content

Overview

transpAIrent.energy aims to advance **generative AI** (gAI) for improved prediction in the energy sector. While gAI has made strides in image, video, and audio generation, its use in energy time series data is underexplored. This project leverages gAI models like GANs, Transformers, and Diffusion models to create **probabilistic forecasts** based on historical data, enhancing short-term operational optimization and risk management. It focuses on accurate forecasts of **electricity prices** (focusing on day-ahead, intraday, and balancing energy prices/activation probabilities), **CO_2 intensities**, and control area imbalances, benefiting stakeholders across the energy sector. The project contributes to data transparency and accessibility by providing high-resolution, real-time forecasts, supporting informed decision-making and climate change mitigation.

Generative AI

GAI has witnessed remarkable progress in recent years, driven by the widespread adoption in image, video, and audio generation. While the application of gAI to time series data has been explored, it has predominantly focused on synthetic data. However, these models can be conditioned on historical data, enabling the creation of fictitious future scenarios. Their stochastic nature gives rise to a multitude of potential outcomes, leading to “natural” probabilistic forecasts.

- **Generative Adversarial Networks** (GANs) have been a de facto standard during past years. They consist of a generator and a discriminator network engaged in a competitive learning process. GANs excel in generating diverse and high-quality data, making them ideal for creating realistic future time series representations [15].
- **Transformers** have lately surged in popularity, particularly in handling complex relationships within long time series data and have the potential to revolutionize how we model and forecast time series data by uncovering intricate connections [9]. Their attention mechanism enables them to capture dependencies and patterns across extensive temporal sequences, which may be of high importance for capturing seasonalities.
- While less explored than GANs and Transformers, **diffusion models** show promising results in time series forecasting. They focus on modeling the evolution of data through time, offering a different perspective on generating future scenarios [11].

Generative AI in the Energy Sector

In the *transpAIrent.energy* project, these gAI techniques will be adapted and applied to the energy sector, specifically in the prediction of electricity prices, CO_2 intensities, or the control area imbalance. This extends beyond synthetic data generation (a stable use case for gAI models during recent years) and aims to provide **probabilistic forecasts** that enable accounting for risk aversion in short-term, uncertain operational optimization. Depending on the time horizon of the forecast, different models will be used.

A review of the state-of-the-art in PV solar power forecasting recommends using GANs for forecasting [6]. GANs can also be used for short-term load forecasting [1]. However, the usage of GANs in this field is very limited. There, only four exogenous variables (maximum and minimum temperature, day of the week, and month) are used. Another approach that is already used for renewable scenario forecasts are unsupervised distribution learning methods that consider spatiotemporal correlation based on GANs [8]. This approach has been shown to generate realistic time series for stochastic processes. In [3], the potential feasibility of extending this to other approaches, detailing initial work using a diffusion model even for **multivariate time series forecasts** is further shown.

Outlier and Anomaly Detection

The application of the GAN-based approach in [18] to energy system time series data showed to significantly enhance the detection of irregularities by considering the entire variable set concurrently, thereby capturing latent interactions amongst different factors. Extending this approach to energy systems could lead to the development of more robust and efficient anomaly detection, particularly in identifying previously “invisible” errors due to erroneous sensor measurements or similar artifacts. Furthermore, the use of gAI allows not only detecting anomalies, but also fixing potential errors by introduction of synthetic data points. This will be the basis of the data processing done in *transpAIrent.energy*, to not be forced to remove observations from the training data set, that is – due to the nature of the Austrian energy markets – limited in available history.

Imbalance energy

A specific investigation of the **control area imbalance** (CAI) will be conducted, as necessary baseline for forecasting balancing energy prices and activation probabilities. In addition to imbalance energy, APG also publishes data on the CAI seven minutes after each quarter hour [10] which can then be used for further predictions. Influenced by the CAI, the imbalance price is determined by the Balance Group Coordinator APCS, based on a predefined methodology. Further, APG publishes indicative imbalance settlement prices, based on preliminary data, every five minutes [2].

Forecasting the CAI therefore plays a critical role in the successful **integration of decentral renewable energy sources** into the energy landscape. Besides being helpful to grid operators, accurate CAI forecasts can also inform **demand response**, which can help reducing additional needs for fossil fuel generation to balance the grid.

In the past, predicting the CAI was very challenging. In *transpAIrent.energy*, we will investigate how far gAI methods outperform conventional forecasting methods, especially due to the possibility of "naturally" creating probabilistic statements. This is very valuable in dynamic energy markets where renewable energy generation, demand response, and weather conditions fluctuate consistently, increasing the need to capture and **evaluate possible uncertainty**.

Data transparency and accessibility

Transparency in Europe has improved significantly in recent years, culminating in Regulation (EU) No 543/2013 of 14 June 2013 [5]. It requires European member state data providers and owners to provide information related to electricity generation, demand, transmission, and balancing. This requirement was implemented via the **ENTSO-E Transparency Platform**, intended to serve as a platform for central data transparency [13]. Information on the generation, demand, transmission, balancing, outages, congestion management, and system operation is collected from different data providers such as TSOs, power exchanges, and other qualified third parties. Further data sources include:

- In Austria, APG meets the obligations of Regulation (EU) No 543/2013 with publication on their national "**Markttransparenz**"- platform [19]. Moreover, on APG's "**RRAP**" information on tender results (FCR, aFRR, mFRR), announced reserve tenders and merit order lists (aFRR, mFRR) are available. The rights of use of all documents and data provided on the RRAP are held by APG. No license or other right is granted to anyone. Reproduction is only permitted for personal and informative use; any other reproduction or use is expressly prohibited [20].
- **Electricity Maps** provides electricity data for more than 160 regions. Historical data on gCO2eq/kWh on an hourly basis is accessible for free, accessible via Open Data Commons Open Database license. Real time and forecast data are only commercially available [12]. However, crucial information on hydro power CO_2 emissions is based on previous years' averages, which may distort estimations, especially for countries like Austria.
- Data on day-ahead and intraday spot market amounts and prices are provided shortly after the gate-closure time at the **EPEX Spot** website [16]. Commercial use is permitted, and licenses are issued for special purposes. Day-ahead market data is also published on the homepage of **EXAA**, Austria's leading energy exchange. Current trading results and historical market data are provided there. License conditions are not clarified on the website [14].
- **Regelleistung.net** publishes data on tenders and activated values for different control blocks, inter alia Austria, on its website [7]. Tendering data is split into transfer capacity and core demand available for FCR, aFRR, and mFRR. The contents are protected by copyright, reproduction requires prior written permission from the German TSOs.
- On the **APCS** website, annual balancing energy costs and revenues are provided as Excel files [4]. Furthermore, comprehensive information on FCR, aFRR, and mFRR tenders are posted in the restricted area of the APCS clearing platform limited to balancing energy suppliers that have registered within the site.

To summarize, data transparency is generally robust in Europe, yet challenges arise in harmonizing and combining available data. Ambiguities exist in data accessibility, with occasional limitations due to unavailable or restricted license information.

Conclusion

Our project is crucial for enhancing data transparency and accessibility. It will offer accurate, freely available forecasts benefiting a wide range of stakeholders, including FSPs and aggregators seeking optimized operations. Additionally, it addresses the need for reliable CO_2 information, complementing existing platforms like Electricity Maps. We aim to provide high-resolution CO_2 forecasts and probabilistic predictions for essential energy sector variables, supporting climate change mitigation efforts.

Challenges in project implementation

Risks	Solution approaches	WP(s)
Data preparation and processing problems (data quality and accessibility, delays)	Experienced data scientists are involved in the project and a comprehensive data processing pipeline will be developed.	WP 2
High model complexity	Building probabilistic AI models can be computationally intensive and complex, requiring substantial resources. Cloud resources and computational clusters are employed to solve this.	WP 3
Biased or unreliable forecasts due to poorly calibrated models	The project has an entire work package dedicated to this topic, so sufficient time and manpower have been allocated in advance to ensure a successful model validation.	WP 2-3, 5
Unforeseen site-specific challenges during live testing (e. g. equipment malfunctions, bad weather)	Thorough site assessments before initiating live tests will be conducted; plans to address unexpected challenges will be implemented; open communication with site operators to adapt to evolving conditions during testing will be maintained	WP 5
Time shifts within the task timelines (impact on milestones) or overall delay	Delays can occur due to the dependencies of tasks. The work packages are therefore planned such that even though results are integrated in a building-up manner, the necessary flexibility is still guaranteed.	WP 1-6
Unexpected additional costs arise	The costs are continuously recorded by the project management and compared to the planned values. In the event of unexpected deviations, the focus is increasingly placed on the core objectives of the project without lowering the quality standards.	WP 1-6
Key personnel is unexpectedly not available	All the partners involved have several qualified staff members who can take over the tasks in the event of a sudden absence while maintaining quality standards and ensuring continuity.	WP 1-6

2. Consortium

2.1. Composition of project team

Composition of the project team

Many interdisciplinary questions concerning innovative AI algorithms, energy system optimization, forecasting, and IT are raised in the proposed project. In order to answer them, a broad spectrum of know-how is needed, which is provided by the consortium composed of

- **AIT Austrian Institute of Technology GmbH** (AIT), Austria's largest research and technology organization and leader of the consortium,
- **Projektplanungs- Beratungs- und Entwicklungs GmbH** (PBEG), an industrial partner, who contribute data and their technical knowledge in strategic energy system planning,
- the IT company **B-SEC better secure KG** (B-SEC) who support in the areas of IT implementation and virtual power plant integration,
- and the weather forecasting company **UBIMET GmbH** (UBIMET), who are responsible for AI based weather forecasts.

Qualification of the consortium

Two **AIT** research fields – Integrated Energy Systems (IES) and Hybrid Power Plants (HPP) – are involved in the project. IES contributes its expertise in AI based energy price and generation forecasting under consideration of market characteristics, techno-economic and environmental parameters, as well as in multi-objective optimization of flexible renewable assets and virtual power plants. HPP brings their knowledge in the modeling of energy system technologies, handling and validating large amounts of data, as well as the development of advanced forecasting concepts. Conjointly, these teams are ideally suited for the tasks of processing data, developing innovative AI forecasting algorithms, as well as the multi-objective optimization of flexible assets. Moreover, they possess the necessary skills for modelling energy systems as digital twins.

PBEG is responsible for the validation of the developed forecasting algorithms and optimization strategies. To conduct experimental live tests, it is required to have access to the necessary infrastructure and resources. PBEG contributes with their renewable assets and provides data for backtesting. Their years of experience in the field of marketing of RES energy qualifies them as an optimal complement to AIT's expertise.

B-SEC is responsible for the development and implementation of the *transpAIrent.energy* platform. They initially focused on security consultancy, however, in 2022, they expanded into energy management in collaboration with PBEG. B-SEC designed and implemented an IT architecture and software platform for aggregating biomass power plants called the *Strom Pool Manager* application, which provides one source of time series and market data for the project, and builds the foundation for the *transpAIrent.energy* platform. Moreover, B-SEC's team of software developers bring profound expertise in software development and data integration and are thus ideally qualified for the platform implementation.

UBIMET provide AI-based spatially and temporally detailed weather forecasts to the project, which are a crucial input for AI-based forecasts of energy system variables. They are ideally suited for this task because they are the globally leading provider of meteorological forecast systems and information and own vast computational resources.

Gender balance

The entire project consortium has a 37% share of women, matching the industry-typical value of a maximum of 38% in the natural sciences. However, the project is led by Klara Maggauer, M. Sc. (AIT), improving the share of responsibility and decision-making power held by women in the project.

3. Benefit and exploitation

3.1. Benefit for customers and users and in terms of sustainability

Benefits for the organizations involved

The successful implementation of the project enhances the competitiveness of all organizations involved, positioning them as leaders in AI-driven energy forecasting and renewable energy optimization. The results achieved in this project enable the involved organizations to develop new products for future customers who are interested in a sustainable and efficient renewable asset operation. Knowledge and expertise gained during the project can be disseminated within the organizations and to the broader industry, fostering further innovation and growth. More specifically, the following benefits for the involved organizations are attained:

- **AIT**: AIT is able to deepen their expertise in AI based forecasting. In addition to the development of innovative algorithms, they are able to validate their applicability and quality in this project and can use promising ones beyond the end of the project. Moreover, the project leads to the creation of a comprehensive database of validated and processed datasets, as well as the development of a data processing pipeline, both of which can be used beyond the scope of the project. In addition, new insights concerning multi-objective optimization of renewable assets and their optimal marketing will be gained during the project. Furthermore, AIT is able to further develop existing frameworks, namely *IESopt* and *TESCA*.
- **PBEG**: PBEG will have access to advanced predictive models that outperform traditional forecasting methods. This not only enhances accuracy but also equips them with probabilistic data, aiding in scenario analysis and risk mitigation. Through the use of better forecasts and the development of optimal operation strategies they can further enhance their existing business models. Moreover, the results of the experimental tests provide them with quantitative indications concerning the added benefit of their assets' optimized operation using AI forecasts.
- **B-SEC**: As software and ICT developer, B-SEC will be able to broaden their knowledge in the areas of software development and data integration. Moreover, they will profit from the opportunity of expanding their footprint in the area of

renewable energy IT solutions.
- **UBIMET**: UBIMET will benefit through the automatization of their technical-parameter management for the adaption of forecasts, which will be a result of the project. Moreover, they gain access to real sites and are able to validate their AI based weather forecasts using data from these sites.

Benefits for customers and users

In addition to the benefits for the involved organization, customers and users will benefit in the following ways:

- **Open access & real-time insights**: The integration of live forecasts on a public platform allows all users to integrate this data into their real-time decision process. It further equips a large number of local/ decentral producers and consumers with transparent and validated information, allowing for sustainable decision making and strategy adjustments.
- **Improved decision making**: More accurate and reliable probabilistic forecasts for energy system relevant variables improves decision-making for energy management if they are leveraged to create optimization strategies. The optimized operation of renewable assets results in
  - improved efficiency by leading to better utilization of RES,
  - cost reductions by reducing operational costs through scheduling energy generation to align with demand forecasts,
  - improved grid stability by reducing imbalances,
  - and more seamless integration of RES into the energy grid.
- **Reduced costs**: The ability to control load or generation during periods of high concurrency can delay or reduce the investment costs of grid expansion. As forecasts play a critical role in the successful integration of RES into the energy landscape, *system operators* as well as *flexibility providers* and *operators of home storage systems* will profit from the *transpAIrent.energy* platform. In addition, more investment clarity and investment security in new technologies is created through uncertainty-robust probabilistic forecasts.

Sustainability and social benefits

While the willingness to contribute to the overall energy transition is consistently rising, most “low volume” renewable asset operators currently do not have access to reliable forecasts – neither real-time prices, nor CO_2 intensities, nor similar market parameters. This essentially forces them into non-flexible operational schedules, solely aimed at optimizing against day-ahead market prices and their economic benefit. Short-term forecasts as well as environmentally important parameters aid with a more sustainable (while still economically viable) operational planning. Furthermore, by optimizing renewable energy assets, the project contributes to a more sustainable energy ecosystem by reducing reliance on fossil fuels and minimizing environmental impact.

Moreover, the proposed project will make a significant contribution to Austrian data transparency and, thus, to the advancement of a more sustainable resource consumption through the development of sustainable operational optimization strategies. Furthermore, the *transpAIrent.energy* project results will be prepared as blueprints in collaboration with the entire consortium, aiming to facilitate their transferability. The results will be made available to a wide range of stakeholders in order to promote the expansion of 100% renewable energy. The concepts developed, as well as the technological advances (such as the new forecasting solutions), will be made available to all interested parties via the developed platform.

3.2. Exploitation by project participants

Use and exploitation of project results

The project has a multi-layered approach to exploitation due to the diverse areas of application of the developed approaches. The results of the project can be used by the project participants in a variety of ways and will expand the existing market potential of the involved companies in the long term:

- **AIT**: Through its diverse problem definition, the proposed project enables AIT to implement and advance its core research vision of fostering innovation. Through participation in the project, AIT can strengthen its position as a leading research and technology organization by developing innovative generative AI algorithms for energy system forecasting. This research may lead to publications, patents, and recognition in the field. The algorithms to generate probabilistic forecasts for energy system-relevant variables and the platform developed in the project will also be used at AIT after the end of the project. Moreover, the further development of existing infrastructure, such as the optimization framework *IESopt* and the techno-economic simulation framework *TESCA*, as well as forecasting methods for the energy sector is an important basis for future research and demonstration projects, including e. g., sector coupling approaches.
- **PBEG**: PBEG gains access to cutting-edge AI and forecasting technologies, enhancing its capabilities in strategic planning and technical expertise. This extensive technological innovation will enable them to develop new products and services. Moreover, the multi-objective optimization of flexible renewable energy assets leads to cost savings, increased profitability, and greenhouse gas emission savings, enhancing the attractiveness and sustainability of PBEG’s business model. For PBEG, the results of the project will be used as blueprint for the future.
- **B-SEC**: B-SEC expands its expertise in IT implementation within the energy sector, gaining further insights into the unique challenges and opportunities in this domain. Moreover, involvement in such a project may open up new business opportunities for B-SEC, particularly in providing cybersecurity solutions for energy-related applications. For B-SEC, this research project provides an opportunity to broaden and develop additional competencies in their energy marketing activities started in 2022. The results developed in this research project will be used as the foundation for broadening the footprint of the company in the energy sector, and as a starting point of the development of potential further products and services that can be offered on the market.
- **UBIMET**: UBIMET has the possibility to validate and improve their AI based weather forecasts using data from real sites during the project, strengthening their business model as a partner for energy system operators. Furthermore, adaptation of solar energy forecasts comprises plant technical-parameter management, which at the time being is done manually. Within the project, this process will be automatized, making solar power forecasts available to a wider range of costumers, especially smaller companies, e. g. in the agricultural or energy system asset operation sectors. Moreover, UBIMET is able

to evaluate whether their usual forecasting window for solar power of one day in advance in a 15-minute temporal resolution is enough when using the forecasts as input to generative AI models for energy system variables. If this is not appropriate, they are able to adjust their forecasting window for this context, enabling them to address a wider range of customers, also in the field of generative AI forecasts.

Know-how and property rights

The project will generate new knowledge and intellectual property (detailed regulation in the consortium agreement). There are several target groups for this know-how. The registration of intellectual property rights will be pursued, in particular where direct incorporation into products is not possible.

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WORK PLAN

1. Projektmanagement

Description of the procedure (methods, risks, solutions)

WP1 oversees the management of the project, focusing on coordinating the internal and external project team, monitoring progress and costs for work packages, and ensuring quality and schedule adherence for milestones and deliverables. This encompasses timely reporting, resource allocation, and internal and external communication. The outcomes of individual work packages and the final results are presented as a comprehensive final report and a publishable report. The application of project management methods aims to uphold the high quality of results and reports.

Methods:

- Classic methods of project management
- Internal coordination through project meetings, webcos
- External coordination through consortium and project meetings
- Reporting
- Risk management

Risks and solution approaches:

- Risk 1: Resources for the project are not available or are withdrawn --> Solution: This risk is mitigated through continuous progress monitoring and regular inquiries during project meetings to secure resource availability.
- Risk 2: Delays in project activities may extend project duration --> Solution: Continuous monitoring of project progress relative to objectives to identify and address potential delays promptly.
- Risk 3: Complexity due to multi-layered technical challenges and possibly conflicting requirements --> Solution: To minimize these risks, implementing project partners are involved in relevant WPs/activities from the project's inception and regular meeting are held to avoid conflicts between WPs.

Time period: 01.04.2024 - 31.03.2027

Milestones:

1.1. Project succesfully started

The project was started and a kick-off meeting was held.
End date: 30.04.2024

1.2. Project succesfully finished

The required results were achieved in the project and the project was successfully completed administratively with the funding provider.
End date: 31.03.2027

Tasks:

1.1. Project management

Task 1.1 focuses on project control, ensuring efficient budget utilization by all partners and the timely achievement of tasks and milestones. Deviations from the project plan are detected early and communicated to the funding provider. Classic project management methods, including planning, progress monitoring, and risk management, are applied. Regular internal and external project meetings and web conferences will be held to ensure both content and financial control of work packages.
Time period: 01.04.2024 - 31.03.2027

Deliverables:

1.1. Interim report 1

First interim report as per the funding contract.

1.2. Interim report 2

Second interim report as per the funding contract.

1.3. Final report

Final report as per the funding contract.

1.4. Publishable report

Final project report for publication as per the funding contract.

2. Data collection, evaluation, and documentation

Description of the procedure (methods, risks, solutions)

Work Package 2 is focused on the creation of AI-based weather forecasts and the identification, collection, and processing of diverse datasets

- derived from publicly accessible platforms such as APG Markttransparenz,
- and from measured and observed data, e. g. biomass and PV power plant generation data and balancing energy

activations from B-SEC's *Strom Pool Manager* platform.
Given the reliance of generative AI algorithms on large amounts of input data, a comprehensive data-consistency check and correction mechanism will be developed. The processed data and weather forecasts serve as input for the AI algorithms developed in WP3. To foster transparency, all developed models, data processing pipelines, and results will be published under a permissive license.

Methods:

- Design and implementation of data processing pipeline, including a database that unifies the processed datasets
- Development of weather parameter forecasts using AI techniques
- Public documentation of approaches, code, and results

Risks and solution approaches:

- Risk 1: Data quality and consistency issues --> Solution: Development of robust data-consistency check and correction mechanisms.
- Risk 2: Limited data availability for Austria --> Solution: Potential for extrapolation of publicly available data from other (similar) European countries as substitute.
- Risk 3: Resource-intensive creation of AI weather forecasts and data processing (risk of delays or resource constraints) --> Solution: Optimized data processing pipelines and usage of cloud computing resources.

Time period: 01.04.2024 - 30.04.2025

Milestones:

2.1. Initial data collected

Initial data collection to be validated is available.
End date: 31.08.2024

2.2. Quality of initial data validated

The quality of the initial data was rigorously validated.
End date: 30.11.2024

2.3. Initial weather AI-based forecasts available

The initial AI generated solar and related weather-parameter forecasts in the desired temporal and spatial resolution are available in the database.
End date: 28.02.2025

2.4. Initial data sources published

Initial data sources are publicly available on the platform.
End date: 31.03.2025

Tasks:

2.1. Identification and collection of diverse data sets

Recognizing the dependency of generative AI algorithms on large amounts of input data, this task will focus on:

- Conducting a thorough review of publicly available datasets and exploring ways to combine them into valuable input data (e. g. extrapolating public data from other countries to Austria).
- Developing an interface to an existing virtual biogas plant using a power plant connector, enabling the collection and monitoring of real-time market data (e. g. balancing energy activations from B-SEC's Strom Pool Manager / power plant automation systems).

These strategies will be combined to form a unified internal database (see T2.2), which will be used for training and backtesting of forecasting algorithms in T3.2 and T3.3. In addition to incorporating historical data, we will establish an automated live-update procedure to perpetually assimilate new data points. The architecture, sources, and contents of this database will be documented and publicly disclosed, as outlined in T2.3.
Time period: 01.04.2024 - 30.09.2024

2.2. Data processing and comprehensive quality evaluation

Task 2.2 is centered around utilizing the datasets acquired in Task 2.1 and ensuring their proper preprocessing (e. g. resampling, format conversion) for integration into a standardized database (e. g. InfluxDB for timeseries data). Given the large amount of input data, the likelihood of encountering data discrepancies, either as missing or inaccurately recorded data points, is heightened. Throughout this task, we will analyze the available data, interpolate (using classical regression models or high-dimensional generative AI approaches) or remove missing entries, and develop an extensive quality validation procedure. Each attribute/parameter of the dataset will be assessed not only for physical bounds (e. g. negative solar irradiance) but also for its reasonability within a broader context. Innovatively, we will leverage a largely untapped capability of generative adversarial networks (or diffusion models if better performing) for outlier detection and imputation.
Time period: 01.08.2024 - 31.12.2024

2.3. AI-based weather forecasts

Addressing the intricacies of energy system forecasts necessitates a dual approach to temporal resolution, catering to the diverse requirements of various assets. While battery storages paired with PV systems demand precise real-time forecasts for the imminent minutes to hours, inert or slower systems like biogas plants require a planning horizon of multiple days. In Task 2.3, we use advanced AI techniques to generate solar generation and associated weather parameter (e. g. temperature) forecasts, enabling the capture of multi-dimensional dependencies and correlations. These varied weather forecasts are refreshed periodically throughout the day and directly integrated into the database (see T2.2), serving as input for our generative AI forecasts (see T3.2). To make AI weather forecasts easily accessible for small companies, automated technical-parameter management will be developed within the project and documented on our platform, allowing to quickly adapt them to a range of assets.
Time period: 01.04.2024 - 31.03.2025

2.4. Publication of data sources and processing pipeline

In alignment with our core objective of enhancing data and energy system transparency in Austria, we are committed to publicly documenting both the algorithmic methodologies as well as the complete data pipeline on our platform (see WP4). This will encompass:

- Identifying each primary data source, akin to how "Electricity Maps" highlights various sources for their CO_2 emission estimates.
- Further, describing and depicting the data preprocessing pipeline (e. g. utilizing a pipeline orchestrator like Dagster).
- Finally, documenting the approaches and results of the quality evaluation (e. g. quantity of missing values), coupled with a detailed exposition of our GAN-based consistency checking.

Every component of the data processing pipeline, notably the innovative consistency check, will be disclosed as open-source – either in the form of source code or data pipeline configuration files – under a permissive license on GitHub and a link to it will be incorporated on our platform.
Time period: 01.11.2024 - 30.04.2025

Deliverables:

2.1. Documentation of data validation

Documentation of all reviewed datasets and outcomes of their validation.

2.2. Publication of algorithmic methodologies and complete data pipeline

Description of algorithmic methodologies and complete data pipeline on platform.

3. Algorithm development and validation

Description of the procedure (methods, risks, solutions)

Work Package 3 uses the datasets and weather forecasts from WP2 and is dedicated to reviewing, implementing, and validating generative AI forecasting algorithms, focusing on transformer-based architectures, generative adversarial networks, and diffusion models. The algorithms will be applied to timeseries forecasting in energy systems, and their performance will be evaluated against a benchmark based on standard error measurements and KPIs obtained from extensive backtests. The entire process, including source codes and model descriptions, will be meticulously documented and published on our proposed platform (see WP4).

Methods:

- Continuous review and monitoring of the state-of-the-art in generative AI and related forecasting topics, including frequent coordination with PhD researchers in the field of AI (AIT's cooperation with TU Delft)
- Adaptation and implementation of generative AI algorithms based on state-of-the-art implementations in the Python ecosystem (e. g. using PyTorch)
- Quality assessment based on standardized measures (e. g. RMSE), as well as a full backtest to estimate real-world performance

Risks and solution approaches:

- Risk 1: Complex and extremely fast evolving field of research (possibility to overlook important achievements) --> Solution: Support by frequent coordination with PhD researchers in the field of AI (AIT's cooperation with TU Delft)
- Risk 2: Bad performance of forecast --> Solution: Parallel investigation and implementation of multiple distinct approaches to not rely on a single algorithm

Time period: 01.04.2024 - 31.10.2025

Milestones:

3.1. Initial review of algorithimic methods documented

Documentation of initial review of algorithmic methods is available.
End date: 30.11.2024

3.2. First version of algorithms developed

The first version of the algorithms was designed and developed.
End date: 31.03.2025

3.3. First version of algorithms validated

The first version of algorithms underwent thorough validation.
End date: 30.09.2025

Tasks:

3.1. Review and observation of algorithmic methods in generative AI

In the rapidly evolving domain of generative AI, maintaining an up-to-date understanding of the state-of-the-art is a challenging yet crucial task. This underscores the necessity for a thorough initial review and further continuous monitoring of emerging developments and concepts, particularly in their application to timeseries forecasting in energy systems and beyond. The focus will be on three pivotal topics:

- transformer-based architectures,
- generative adversarial networks,
- and diffusion models,

each exhibiting unique behaviors and possessing distinct advantages and disadvantages. Task 3.1 represents a critical initial step in this review process and will be concluded with a comprehensive documentation on our transparency platform (see WP4), thereby empowering further advancements in energy research and forecasting.
Time period: 01.04.2024 - 31.12.2024

3.2. Implementation of probabilistic forecasting algorithms

Task 3.2's core objective is the application and refinement of generative AI algorithms for forecasting essential energy system relevant parameters (e. g. CO_2 intensity, balancing activations). It is therefore dedicated to the implementation of the most promising AI forecasting algorithms identified in Task 3.1. To facilitate a thorough comparison and quality assessment in Task 3.3, a minimum of two distinct approaches will be selected. Task 3.2 is contingent upon the processed data and weather forecasts from WP2 and will utilize input data directly from the there-developed database. To ensure the feasibility of this task, we will leverage existing tools and frameworks available within the Python ecosystem, such as PyTorch, which offers sophisticated implementations of transformers, GANs, and diffusion models. The full source-code of all models and approaches will be published as open-source, under a permissive license, on GitHub and a link to it will be put on our platform (see WP4).
Time period: 01.07.2024 - 31.05.2025

3.3. Validation of algorithms through backtesting and quality evaluation of forecasts

Task 3.3 focuses on the transparent assessment of the forecasting algorithms implemented in Task 3.2. To facilitate this, a "naive" benchmark algorithm (based on e. g. NeuralProphet, StatsForecast) will be employed. Both this and all developed algorithms will undergo evaluation on out-of-sample data based on two criteria:

1. Standard error measurements (e. g. RMSE)
2. KPIs derived from a backtesting (e. g. CO_2 emission reductions)

While the first criterion provides academic relevance and aids in comparing against other methodologies from literature, it alone does not convey the forecasts' anticipated quality or projected real-world outcomes. Consequently, for the second criterion, we use the forecasts as inputs for the multi-objective operational optimization planner developed in Task 5.1. It formulates decisions based on the available forecasts and implements them throughout the out-of-sample data duration. This allows comparing multiple KPIs across different methodologies and highlights the practical impact of our approach.

Time period: 01.05.2025 - 31.10.2025

Deliverables:

3.1. Algorithm review and implementation documentation

Documentation of algorithm review and implementation plan on platform.

3.2. Algorithm validation result documentation

Documentation of algorithm validation results on platform.

4. Platform development and implementation

Description of the procedure (methods, risks, solutions)

In WP4, we develop the IT platform, "*transpAIrent.energy*", by leveraging existing architecture and software components from B-SEC's Strom Pool Manager. This platform will consist of

- an end user web application,
- API interfaces to access the WP2 database as input for the AI models and for storing evaluation results for user access,
- interfaces to simulated and eventually real biomass power plants for using the AI forecasts in digital twin and live testing,
- and backend services for data handling and storage.

Methods:

- Design of the platform's architecture based on B-SEC's Strom Pool Manager
- Specification of functional requirements and user stories for the platform and software
- Implementation of software components by reusing components from the existing application, based on current state-of-the-art frameworks and platforms (e.g., Docker, InfluxDB, MySQL, React, Flask, Rest-APIs, MQTT)
- Setup and operation of the platform on a cloud-based infrastructure

Risks and solution approaches:

- Risk 1: Integrating diverse components may pose technical challenges and compatibility issues --> Solution: Thorough compatibility testing and iterative integration phases to identify and address issues early
- Risk 2: Platform may struggle to handle increased load and data volume as user demand grows --> Solution: Design of platform with scalability in mind and use of cloud resources and monitoring tools to dynamically adjust resources as needed to ensure optimal performance

Time period: 01.04.2024 - 31.03.2027

Milestones:

4.1. Initial application requirements and use cases specified

An initial version of the application requirements and use cases was specified.
End date: 31.08.2024

4.2. transpAIrent.energy application platform running (first version)

The first version of the platform was implemented and is running.
End date: 31.03.2025

4.3. First version of operational optimization configurator implemented

The initial version of an operational optimization configurator was put into operation on the platform.
End date: 28.02.2026

Tasks:

4.1. Application requirements and use case specification

In this task, the functional requirements for the *transpAIrent.energy* application will be collected and documented based on use cases and user stories created during the initial project phase. We have gathered LOIs from stakeholders, declaring their intent to support us in this matter. This task will include the development of UI/UX concepts for the end user and administrative parts of the application, as well as the specification of the API interfaces for the algorithms and models developed in WP2 and WP3. The requirements will be documented in the existing tool used by B-SEC for the development of other applications (Redmine).
Time period: 01.04.2024 - 30.09.2024

4.2. Platform implementation

Based on the requirements specified in Task 4.1, the software for the *transpAIrent.energy* application will be implemented. For this implementation, existing technologies and software components from B-SEC's Strom Pool Manager will be reused where possible for optimal efficiency. Moreover, this task includes testing and evaluation of the developed software.
Time period: 01.08.2024 - 31.05.2025

4.3. Operational optimization configurator implementation

The *transpAIrent.energy* web application will also provide an operational optimization configuration feature. It gives users a basic evaluation of their own assets' optimized operation based on our generative AI forecasts. Parameters such as the types of assets and system sizes can be easily specified by the user based on simplified pre-configured models of energy system components. Task 4.3 focuses on the implementation of this operational optimization configurator, including the requirements specification, software implementation of both the frontend UI as well as backend APIs to the databases and the model, and user acceptance testing with a selected focus group of relevant

stakeholders and interested users.
Time period: 01.05.2025 - 31.03.2026

4.4. Platform operation and maintenance

Following the completion of the primary development phases in Task 4.2 and Task 4.3, ongoing operation and maintenance of the *transpAIrent.energy* platform are necessary for the remainder of the project. This includes hosting project outcomes and facilitating other project activities, such as the proof of concept in WP5. During these phases, we anticipate minor change requests and software adaptations, and this task provides the necessary resources to implement them.
Time period: 01.09.2025 - 31.03.2027

Deliverables:

4.1. Application requirements and use case specification

Documentation of the application requirements and specified use cases.

4.2. Application software development report

Report on the application software development.

4.3. Application usage statistics report

Report containing the usage statistics of the platform.

5. Proof of concept

Description of the procedure (methods, risks, solutions)

Work Package 5 centers on assessing the AI-based forecasting algorithms developed in WP3 for their applicability and value. This involves leveraging these forecasts to construct a stochastic operational optimization algorithm, which will be subjected to testing in two stages: First, simulative tests using digital twins of three real sites equipped with diverse renewable energy assets, followed by live tests at these locations. The results of these evaluations, and comprehensive documentation of the optimization algorithm, will be made publicly accessible on our platform (see WP4).

Methods:

- Stochastic optimization based on probabilistic generative AI forecasts
- Digital twin development using techno-economic simulations
- Simulative and live experimental testing

Risks and solution approaches:

- Risk 1: Technical complexities and extensive computational resources during optimization algorithm development --> Solution: Thorough feasibility assessments and prototyping before full-scale development will be conducted; efficient coding practices to optimize algorithm performance will be applied; cloud computing resources will be leveraged
- Risk 2: Unforeseen site-specific challenges during live testing (e. g. equipment malfunctions, bad weather) --> Solution: Thorough site assessments before initiating live tests will be conducted; contingency plans to address unexpected challenges will be implemented; open communication with site operators to adapt to evolving conditions during testing will be maintained

Time period: 01.10.2024 - 31.01.2027

Milestones:

5.1. First version of operational optimization strategy developed

The first version of an operational optimization strategy was developed.
End date: 30.04.2025

5.2. First version of digital twin implemented

The projectteam successfully implemented the first version of a digital twin.
End date: 28.02.2026

5.3. Initial live proof-of-concept running

An initial live proof-of-concept was established and is operational at at least one of the test sites.
End date: 31.10.2026

Tasks:

5.1. Development of a sustainable asset operational optimization strategy

Using AIT's "*IESopt*" optimization framework, we develop and implement an innovative multi-objective operational planning software based on our AI forecasts in Task 5.1. It allows to optimize and market energy system assets and focusses on:

1. **Integration of sustainability goals:** Embedding environmental sustainability within the model by enforcing greenhouse gas emission restrictions and considering various operational and location-specific constraints (e. g. limiting peak grid load).
2. **Enhanced stochastic formulations:** While *IESopt* already supports stochastic optimization approaches, the goal is to include more complex properties (like quantile optimization), which are not available in standard energy system models, to better cater to the needs of various stakeholders.
3. **Integration of modeling-to-generate-alternatives (MGA) approaches:** Incorporating MGA strategies provides operators with a spectrum of nearly optimal decisions, ensuring flexibility and balance in operation schedules.

Time period: 01.10.2024 - 30.06.2025

5.2. Development of a digital twin and experimental tests

In Task 5.2, we develop a digital twin using AIT's techno-economic simulation framework "*TESCA*" to test our forecasts and optimization strategy in a controlled simulation environment, which is crucial due to the technical risks associated with the innovative nature of generative AI forecasting and stochastic operational optimization under diverse conditions. This task includes:

1. **Development of a digital twin:** Development of a detailed digital twin of the proof-of-concept sites using *TESCA*, ensuring high accuracy through representation of physical aspects.
2. **Interface and initial validation:** Coupling of the digital twin with the real site in read-only mode, evaluating its performance over a specified period, and making necessary adjustments to address discrepancies between modeling and reality.
3. **Experimental tests:** Upon validation, the operational optimization model developed in Task 5.1 is tested using the digital twin, focusing on technical, environmental, and economic outcomes.

Time period: 01.06.2025 - 31.03.2026

5.3. Application of AI forecasts and stochastic optimization to an experimental test-site

The focus of Task 5.3 is to demonstrate the applicability of our generative AI-based forecasts and their integration into the stochastic operational optimization strategy developed in Task 5.1 through an experimental live proof of concept. To preemptively address potential complications of a real-world implementation, we consider results of the digital twin tests in Task 5.2. The proof of concept will be conducted at three test locations – two biogas plants and one office building – with diverse sector-coupled flexibilities. Access to one of the sites is granted by the partner PBEG and via LOIs and tight connections with consortium members to the other two. We aim to achieve several objectives and adhere to specific constraints, such as

- reducing peak grid load,
- minimizing local heat generation CO_2 emissions,
- increasing self-sufficiency,
- tapping into the potential of grid-connected e-vehicles through smart charging (including bidirectional chargers),
- utilizing the overall flexibility (heat storage, battery storage),
- and efficiently supplying balancing energy while properly scheduling slow/inert biogas plants.

Time period: 01.02.2026 - 31.01.2027

Deliverables:

5.1. Digital twin optimization result documentation

Description of digital twin setup and optimization results.

5.2. Live test site optimization result documentation

Documentation of the live test sites' setups and optimization results.

6. Dissemination and exploitation

Description of the procedure (methods, risks, solutions)

The aim of WP6 is to ensure the public and scientific dissemination and exploitation of our project results by

- deriving strategies to multiply the use of the *transpAIrent.energy* platform, thereby heightening the visibility of our project and highlighting its impact,
- pursuing stakeholder engagement to ensure user-friendliness and applicability of out platform and approaches,
- increasing scientific excellence and strengthening cooperation, networking, and technology transfer.

Methods:

- **Multiplicability:**
- Close cooperation with relevant stakeholders in the form of workshops
- Creation of validated “lessons learned” on AI-based technologies for forecasting and data publication on our platform from the experiences of the project
- Examination of optimal marketing strategies and derivation of financial options to increase investment in new flexible assets based on our project results
- Organizational and regulatory recommendations for all relevant technology fields of the projects are derived from the experiences gathered within the project

- **Visibility:**
- Scientific dissemination: open access publications, presentations at scientific conferences, etc.
- Presentations in various networks
- Public dissemination: Press releases, contributions to social media (e.g. LinkedIn), etc.

Risks and solution approaches:

- Risk: Lack of acceptance of the new services developed --> Solution: Relevant stakeholders are involved from the beginning of the project and our methods and their value added are transparently communicated on our platform

Time period: 01.04.2026 - 31.03.2027

Milestones:

6.1. First scientfic dissemination done

First publication in a scientific context (e.g., open access papers, posters, conference presentations) is done.
End date: 31.08.2026

6.2. First stakeholder workshop for exploitation held

A workshop to coordinate with and disseminate the project results among relevant stakeholders was successfully carried out.
End date: 31.01.2027

Tasks:

6.1. Scientific and public dissemination

The results of the project will be made visible to the scientific community. To this end, the project partners will participate in at least two energy-related conferences. In addition, national and international events will be addressed in order to present the main results to as wide an audience as possible. Moreover, the project will be presented in national research networks. Finally, a journal publication on the topic of AI-based forecasting will be aimed at, with a special focus on Open Data and Open Access principles. The non-scientific dissemination measures are aimed at the general public, users of renewable energy systems, and potential users of AI-based forecasts. In addition, a specialist audience in the form of experts from industry, trade, and administration is addressed. Target-specific formats are developed, selected, and carried out (e.g., workshops, focus groups, informational events).
Time period: 01.04.2026 - 31.12.2026

6.2. Exploitation

In terms of exploitation, a target-specific approach ensures that relevant stakeholders and interest groups are included in the process. The results of the project will be made available to a wide range of potential users through the developed platform. Optimal utilization strategies will be developed in the form of blueprints, which should facilitate their transfer. Moreover, relevant stakeholders are involved in the development of our platform and informed of its value added through dedicated workshops, thereby increasing acceptance, user-friendliness, and applicability and strengthening regional value creation. For the purpose of stakeholder involvement, we have gathered several LOIs from stakeholders, declaring their support in this matter.

Time period: 31.10.2026 - 31.03.2027

Deliverables:

6.1. Exploitation roadmap

A document containing a strategy for the use and exploitation of all project results developed collaboratively among all participating organizations. It includes details on the target groups, channels, type of exploitation, events to be used for exploitation activities, frequency of exploitation activities, narrative, etc.

6.2. Documentation of two public dissemination activities

Documentation of two public dissemination activities (e.g., news articles, fair participations, newsletters, talks).

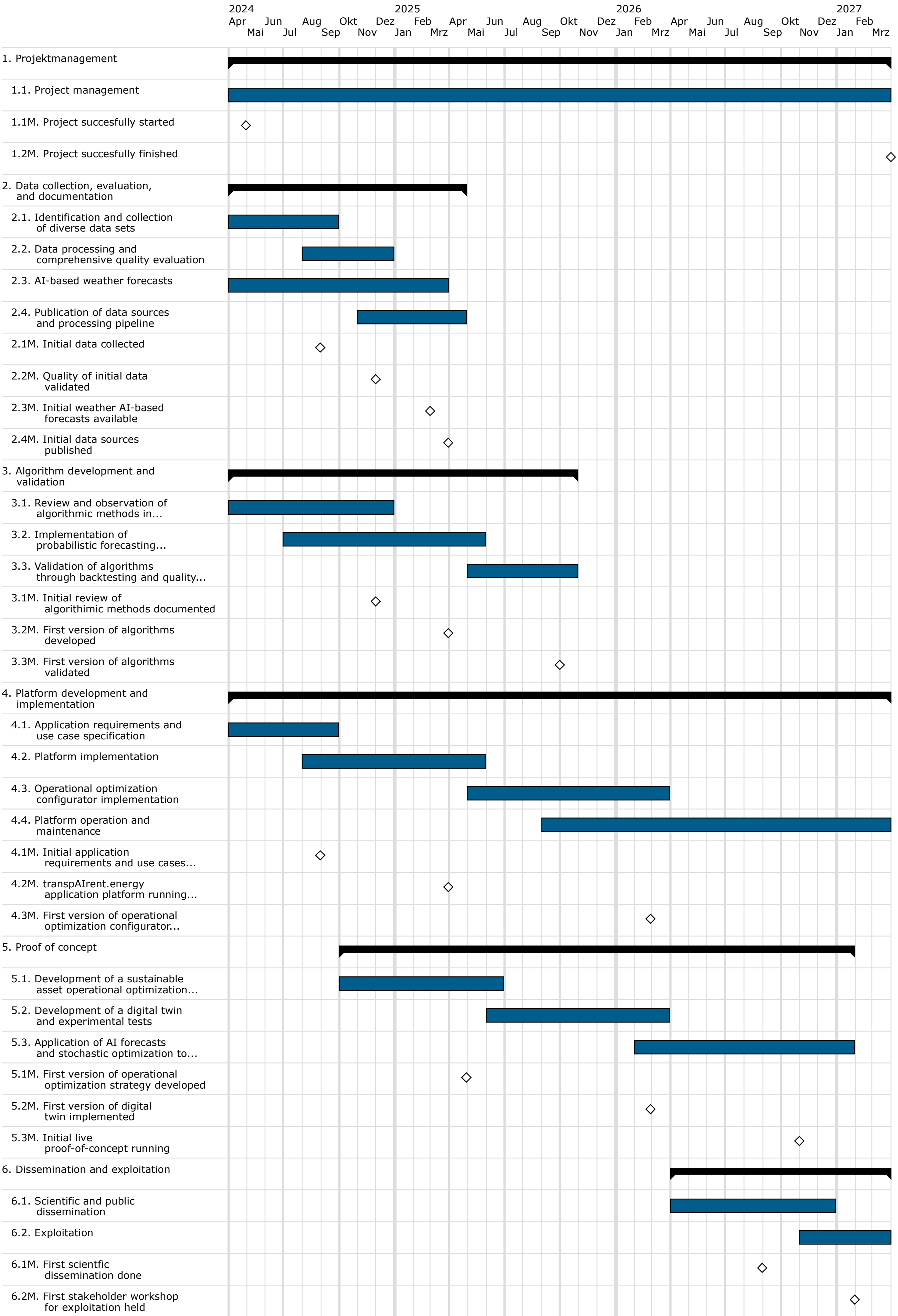
6.3. Two scientific publications

Two scientific publications (e.g., open access papers, posters, conference presentations).

6.4. Stakeholder workshop documentation

Documentation of the stakeholder workshops and all gathered inputs from stakeholders.

GANTT chart



SUSTAINABILITY TARGETS

Targets can be selected from a maximum of **3** main categories.

1: No Poverty

Neuzuordnung FFG

2: Zero Hunger

Neuzuordnung FFG

3: Good Health and Well-being

Neuzuordnung FFG

4: Quality Education

Neuzuordnung FFG

5: Gender Equality

Neuzuordnung FFG

6: Clean Water and Sanitation

Neuzuordnung FFG

7: Affordable and Clean Energy

Neuzuordnung FFG

Ensure access to affordable, reliable and modern energy services

Central target Central target

Substantially increase the share of renewable energy (globally)

Central target Central target

Significantly increase energy efficiency

Central target Central target

8: Decent Work and Economic Growth

Neuzuordnung FFG

9: Industry, Innovation and Infrastructure

Neuzuordnung FFG

10: Reduced Inequalities

Neuzuordnung FFG

11: Sustainable Cities and Communities

Neuzuordnung FFG

12: Responsible Consumption and Production

Neuzuordnung FFG

Ensure sustainable consumption and production patterns

Central target | Central target

Achieve the sustainable management and efficient use of natural resources

Central target | Central target

13: Climate Action

Neuzuordnung FFG

Take urgent action to combat climate change and its impacts

Central target | Central target

Strengthen resilience / adaptive capacity to climate-related hazards / natural disasters

Secondary target | Secondary target

Integrate climate change measures into national policies, strategies and planning

Secondary target | Secondary target

Improve awareness-raising / capacity-building on climate change mitigation, adaptation, impact reduction and establish early warning systems

Secondary target | Secondary target

14: Life below Water

Neuzuordnung FFG

15: Life on Land

Neuzuordnung FFG

16: Peace, Justice and Strong Institutions

Neuzuordnung FFG

17: Partnership for the Goals

Neuzuordnung FFG

INVOLVEMENT OF DEMANDING PARTIES

Individuals as end users

Neuzuordnung FFG

Involvement is given

Involvement is given

Utility companies in the field of energy, transport, water, waste

Neuzuordnung FFG

Involvement is given

Involvement is given

Companies in other manufacturing and services sectors

Neuzuordnung FFG

Involvement is given

Involvement is given

Associations (interest groups, NGOs)

Neuzuordnung FFG

Involvement is given

Involvement is given

CONSORTIUM

Currently approved consortium

Company / Organisation	Role of partner	informed	disinvited	Status
Consortium Leader: AIT Austrian Institute of Technology GmbH	Scientific Partner			Interim report submitted
B-SEC better secure KG	Company Partner	9/15/2023 3:47 PM		Interim report submitted
Projektplanungs-Beratungs- und Entwicklungs GmbH	Company Partner	9/12/2023 3:59 PM		Interim report submitted
UBIMET GmbH	Company Partner	9/29/2023 9:56 AM		Interim report submitted

COMPARISON APPLICATION/CONTRACT

Costs & funding (contract)

Consortium

Overview

Partner	Status	Editing by	Planned Costs	Share of costs	Funding	% FFG funding
AIT Austrian Institute of Technology GmbH	Interim report submitted		260.900,00	50,33%	221.764,00	85,00%
B-SEC better secure KG	Interim report submitted	Partner	96.225,00	18,56%	76.980,00	80,00%
Projektplanungs- Beratungs- und Entwicklungs GmbH	Interim report submitted	Partner	89.750,00	17,31%	71.800,00	80,00%
UBIMET GmbH	Interim report submitted	Partner	71.462,00	13,79%	50.023,00	70,00%
			518.337		**420.567**	

Costs and FFG funding per Partner role

	Planned Costs	Share of costs	FFG funding	Percentage of FFG funding on total costs
Scientific Partner	260.900,00	50,33%	221.764,00	42,78%
Company Partner	257.437,00	49,67%	198.803,00	38,35%
	518.337		**420.567**	**81,14%**

Cost Category

Partner	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
AIT Austrian Institute of Technology GmbH	232.760,00	17.265,00	3.750,00	0,00	7.125,00	260.900,00
B-SEC better secure KG	80.100,00	0,00	11.250,00	3.000,00	1.875,00	96.225,00
Projektplanungs- Beratungs- und Entwicklungs GmbH	88.875,00	0,00	0,00	0,00	875,00	89.750,00
UBIMET GmbH	57.965,00	1.353,00	12.144,00	0,00	0,00	71.462,00
	459.700	**18.618**	**27.144**	**3.000**	**9.875**	**518.337**

Personnel costs

Partner	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Total
AIT Austrian Institute of Technology GmbH	13.979,00	51.133,78	109.182,05	11.843,21	30.633,48	15.988,33	232.760,00
B-SEC better secure KG	0,00	3.337,50	6.275,00	58.837,50	8.312,50	3.337,50	80.100,00
Projektplanungs- Beratungs- und Entwicklungs GmbH	0,00	5.625,00	6.750,00	10.125,00	66.375,00	0,00	88.875,00
UBIMET GmbH	4.192,75	53.772,25	0,00	0,00	0,00	0,00	57.965,00
	18.172	**113.869**	**122.207**	**80.806**	**105.321**	**19.326**	**459.700**

Funding

Partner	FFG funding	Total financing	Total cost	% FFG funding
AIT Austrian Institute of Technology GmbH	221.764,00	221.764,00	260.900,00	85,00%
B-SEC better secure KG	76.980,00	76.980,00	96.225,00	80,00%
Projektplanungs- Beratungs- und Entwicklungs GmbH	71.800,00	71.800,00	89.750,00	80,00%
UBIMET GmbH	50.023,00	50.023,00	71.462,00	70,00%
	420.567	**420.567**	**518.337**	**81,14%**

Costs for WP

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	18.171,75				750,00	18.921,75
2. Data collection, evaluation, and documentation	113.868,53	7.107,61	12.893,75		62,50	133.932,39
3. Algorithm development and validation	122.207,05	11.510,58				133.717,63
4. Platform development and implementation	80.805,71		9.000,00		1.687,50	91.493,21
5. Proof of concept	105.320,98		1.500,00	3.000,00	1.750,00	111.570,98
6. Dissemination and exploitation	19.325,83		3.750,00		5.625,00	28.700,83
	459.700	**18.618**	**27.144**	**3.000**	**9.875**	**518.337**

AIT Austrian Institute of Technology GmbH

Overview

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	13.979,00				750,00	14.729,00
2. Data collection, evaluation, and documentation	51.133,78	5.754,42				56.888,20
3. Algorithm development and validation	109.182,05	11.510,58				120.692,63

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
4. Platform development and implementation	11.843,21					11.843,21
5. Proof of concept	30.633,48				750,00	31.383,48
6. Dissemination and exploitation	15.988,33		3.750,00		5.625,00	25.363,33
	232.760	**17.265**	**3.750**	**0**	**7.125**	**260.900**

Funding	Amount	% of costs
FFG funding	221.764,00	85,00%
	221.764	**85,00%**

Personnel costs

Name	CV	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Hours	€/h	OR	Planned costs
Esterl, Tara		P	wissensch. MA	30	15	15	-	-	-	60,00	86,62 €	25%	6.496,66
Fanta, Sarah		P	wissensch. MA	-	150	150	-	-	-	300,00	47,37 €	25%	17.764,81
Hemm, Regina		P	wissensch. MA	-	-	100	-	-	-	100,00	47,37 €	25%	5.921,60
Kapeller, Judith		P	wissensch. MA	-	-	-	-	70	-	70,00	48,33 €	25%	4.228,88
Kathan, Johannes		P	wissensch. MA	-	-	-	-	30	-	30,00	92,90 €	25%	3.483,75
Leimgruber, Fabian		P	wiss. Mitarbeiter	-	200	400	-	-	-	600,00	55,92 €	25%	41.940,00
Maggauer, Klara		P	Projektleiterin	120	50	-	-	-	100	270,00	47,37 €	25%	15.988,33
N.N.,		N	Projektmanagementsupport	-	-	-	-	-	-	0,00	67,43 €	25%	0,00
Ortmann, Philipp		P	wissensch. MA	-	-	50	-	-	-	50,00	67,43 €	25%	4.214,06
Reuter, Stefan		P	wissensch. MA	-	100	-	-	-	-	100,00	47,37 €	25%	5.921,60
Strömer, Stefan		P	wissensch. MA	-	300	870	200	30	170	1.570,00	47,37 €	25%	92.969,16
Wimmer, Yannick		P	wissensch. MA	60	-	150	-	350	-	560,00	48,33 €	25%	33.831,00
				210	**815**	**1.735**	**200**	**480**	**270**	**3.710,00**			**232.760**

Asset Utilization

Hourly Rate for Machine

Position		Hourly Rate for machine	Amount of hours used in the project	WPs	Utilization costs	Overhead rate	Amount
SmarTEST-Labor		23,02	600	2, 3	13.812,00	25%	17.265,00

Costs of Materials

Position	Reference source	WPs	Without Overhead	Overhead	Amount
Open Access Publication	Publication fee	6	3.000,00	25%	3.750,00

Travel costs

Position	Destination	WPs	Amount without Overhead	Overhead	Amount
Consortium meetings	Austria, t.b.d.	1	600,00	25%	750,00
Project meetings	Austria, t.b.d.	5	600,00	25%	750,00
Workshops	Austria, t.b.d.	6	1.000,00	25%	1.250,00
International conference, t.b.d.	Europe, t.b.d.	6	1.500,00	25%	1.875,00
National conferences	Austria, t.b.d.	6	2.000,00	25%	2.500,00
					7.125

Funding

Type of financing	Amount	% Funding
FFG funding	221.764,00	85,00%

B-SEC better secure KG

Overview

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	0,00					0,00

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
2. Data collection, evaluation, and documentation	3.337,50		750,00		62,50	4.150,00
3. Algorithm development and validation	6.275,00					6.275,00
4. Platform development and implementation	58.837,50		9.000,00		1.687,50	69.525,00
5. Proof of concept	8.312,50		1.500,00	3.000,00	125,00	12.937,50
6. Dissemination and exploitation	3.337,50					3.337,50
	80.100	**0**	**11.250**	**3.000**	**1.875**	**96.225**

Funding	Amount	% of costs
FFG funding	76.980,00	80,00%
	76.980	**80,00%**

Personnel costs

Name	CV	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Hours	€/h
Bleier, Sonja		P	wissensch. MA	-	-	40	140	-	-	180,00	✔
Bleier, Thomas		P	wissensch. Leitung	-	30	20	140	20	30	240,00	✔
N.N. (Senior) Software Engineer,		P	wissensch. MA	-	-	80	390	70	-	540,00	✔
Puecker, Dominik		P	technischer MA	-	-	-	450	-	-	450,00	✔
Schmidt, Dennis		P	technischer MA	-	40	-	300	100	40	480,00	✔
				-	**70**	**140**	**1.420**	**190**	**70**	**1.890,00**	

Costs of Materials

Position	Reference source	WPs	Without Overhead	Overhead	Amount
Cloud Infrastructure for transpAIrent platform	Pay-per-use cloud infrastructure (IaaS and PaaS cloud services from different vendors) for hosting/running the software applications developed in the project	2, 4, 5	6.000,00	25%	7.500,00
Open Access Publication	Publication fee	4	3.000,00	25%	3.750,00
					11.250

Third-Party costs

Position	Name of contractor	WPs	Amount
Automation Engineering for digital twin	Necessary adoptions/automation engineering tasks for integrating the power plant automation...	5	3.000,00

Travel costs

Position	Destination	WPs	Amount without Overhead	Overhead	Amount
Project Meetings	Vienna, Ransdorf	2, 4, 5	500,00	25%	625,00
Scientific Dissemination / Conferen Publication	TBD	4	1.000,00	25%	1.250,00
					1.875

Funding

Type of financing	Amount	% Funding
FFG funding	76.980,00	80,00%

Projektplanungs- Beratungs- und Entwicklungs GmbH

Overview

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	0,00					0,00
2. Data collection, evaluation, and documentation	5.625,00					5.625,00
3. Algorithm development and validation	6.750,00					6.750,00
4. Platform development and implementation	10.125,00					10.125,00
5. Proof of concept	66.375,00				875,00	67.250,00
6. Dissemination and exploitation	0,00					0,00
	88.875	**0**	**0**	**0**	**875**	**89.750**

Funding	Amount	% of costs
FFG funding	71.800,00	80,00%
	71.800	**80,00%**

Personnel costs

Name	CV	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Hours	€/h
Fellner, Josef		P	technischer Support	-	10	20	20	180	-	230,00	✓
Gremel, Christian		P	wissenschaftliche Mitarbeit	-	10	20	20	180	-	230,00	✓
Mandl, Erich		P	wissenschaftliche Mitarbeit	-	10	20	20	180	-	230,00	✓
Mandl, Josef		P	technischer Support	-	10	20	20	180	-	230,00	✓
Samek, Eva-Maria		P	wissenschaftlicher Support	-	30	20	50	230	-	330,00	✓
Trimmel, Bernhard		P	wissenschaftliche Leitung	-	30	20	50	230	-	330,00	✓
				-	**100**	**120**	**180**	**1.180**	**-**	**1.580,00**	

Travel costs

Position	Destination	WPs	Amount without Overhead	Overhead	Amount
Projektmeetings	national	5	700,00	25%	875,00

Funding

Type of financing	Amount	% Funding
FFG funding	71.800,00	80,00%

UBIMET GmbH

Overview

Cost	Personnel costs	Asset Utilization	Costs of Materials	Third-Party costs	Travel costs	Total
1. Projektmanagement	4.192,75					4.192,75
2. Data collection, evaluation, and documentation	53.772,25	1.353,19	12.143,75			67.269,19
3. Algorithm development and validation	0,00					0,00
4. Platform development and implementation	0,00					0,00
5. Proof of concept	0,00					0,00
6. Dissemination and exploitation	0,00					0,00
	57.965	**1.353**	**12.144**	**0**	**0**	**71.462**

Funding	Amount	% of costs
FFG funding	50.023,00	70,00%
	50.023	**70,00%**

Personnel costs

Name	CV	Typ	Function	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Hours	€/h
Benesch, Claudia		P	Innovation Managerin	50	100	-	-	-	-	150,00	✓
Dobler, Matthias		P	Head of R&D and Forecasting	10	200	-	-	-	-	210,00	✓
Liendo, Adriana		P	Software Developerin	-	305	-	-	-	-	305,00	✓
Maniakowska, Natalia		P	Core Developer	-	100	-	-	-	-	100,00	✓
Mochart, Michael		P	Innovationsmanagement	10	55	-	-	-	-	65,00	✓
Siever, Jan		P	IT Support	-	160	-	-	-	-	160,00	✓
				70	**920**	**-**	**-**	**-**	**-**	**990,00**	

Asset Utilization

Hourly Rate for Machine

Position	Hourly Rate for machine	Amount of hours used in the project	WPs	Utilization costs	Overhead rate	Amount

Position	Hourly Rate for machine	Amount of hours used in the project	WPs	Utilization costs	Overhead rate	Amount
HPC Infrastruktur	0,7217	1500	2	1.082,55	25%	1.353,19

Costs of Materials

Position	Reference source	WPs	Without Overhead	Overhead	Amount
ECMWF Globale Modelldaten f. 12 Monate 5% aliquot	MetOffice	2	9.715,00	25%	12.143,75

Funding

Type of financing	Amount	% Funding
FFG funding	50.023,00	70,00%

Further funding

Have you applied for other public funding from the FFG or other funding agencies for this project or parts thereof?
No

CONDITIONS

AIT Austrian Institute of Technology GmbH

Overview

Phase	Open
Conditions yet to be fulfilled	0 von 0

B-SEC better secure KG

Overview

Phase	Open
Conditions yet to be fulfilled	0 von 0

Projektplanungs- Beratungs- und Entwicklungs GmbH

Overview

Phase	Open
Conditions yet to be fulfilled	0 von 0

UBIMET GmbH

Overview

Phase	Open
Conditions yet to be fulfilled	0 von 0

CONTRACTUAL DOCUMENTS

Checking the key data

Contractual Partners

Name of the company / organization	Address	Need for correction

Consortium Lead AIT Austrian Institute of Technology GmbH Company registration number: 115980i	Giefinggasse 4 1210 Wien
B-SEC better secure KG Company registration number: 455322t	Hauptplatz 16 7374 Weingraben
Projektplanungs- Beratungs- und Entwicklungs GmbH Company registration number: 284962m	Ransdorf 20 2813 Lichtenegg
UBIMET GmbH Company registration number: 248415t	Donau-City-Straße 11 1220 Wien

Costs and funding

Total costs:
518.337,00 €

Total financing:
420.567,00 €

AIT Austrian Institute of Technology GmbH

(Consortium Lead)

Approved costs according to contract:

260,900.00 €

Funding components:

Type of funding component: **Grant**

Amount of the funding component: **221,764.00 €**

BMK

Bank details for payment

IBAN:
AT392011128869864440

BIC:
GIBAATWW

Name of bank:
Erste Bank der oesterreichischen Sparkassen AG

B-SEC better secure KG

Approved costs according to contract:

96,225.00 €

Funding components:

Type of funding component: **Grant**

Amount of the funding component: **76,980.00 €**

BMK

Projektplanungs- Beratungs- und Entwicklungs GmbH

Approved costs according to contract:

89,750.00 €

Funding components:

Type of funding component: **Grant**

Amount of the funding component: **71,800.00 €**

BMK

UBIMET GmbH

Approved costs according to contract:

71,462.00 €

Funding components:

Type of funding component: **Grant**

Amount of the funding component: **50,023.00 €**

BMK

Time table

Start of the funding period: **4/1/2024**

End of the funding period: **3/31/2027**

The start of the funding period: **The start date should be changed**

Corrected start of the funding period: **5/1/2024**

Corrected end of the funding period: **4/30/2027**

Further Events

Event	Date
Interim Report	31.05.2025
Interim Report	31.05.2026
Final report	31.07.2027

Conditions

AIT Austrian Institute of Technology GmbH

Overview

Phase	Open	Fulfillment
Conditions before contract	0 von 0	
Conditions before initial installment	0 von 0	
Conditions in the ongoing project	0 von 0	

B-SEC better secure KG

Overview

Phase	Open	Fulfillment
Conditions before contract	0 von 0	
Conditions before initial installment	0 von 0	
Conditions in the ongoing project	0 von 0	

Projektplanungs- Beratungs- und Entwicklungs GmbH

Overview

Phase	Open	Fulfillment
Conditions before contract	0 von 0	
Conditions before initial installment	0 von 0	
Conditions in the ongoing project	0 von 0	

UBIMET GmbH

Overview

Phase	Open	Fulfillment
Conditions before contract	0 von 0	
Conditions before initial installment	0 von 0	
Conditions in the ongoing project	0 von 0	

Acceptance

Decision on how to proceed:
The contract can be created with the described changes

This application has already been submitted on the 30.05.2025 at 11:13.

Contract

Signatures

Contract:

Name of company / organisation	Signature sheet	Signature	Partner Status
Consortium lead AIT Austrian Institute of Technology GmbH			
B-SEC better secure KG			
Projektplanungs- Beratungs- und Entwicklungs GmbH			
UBIMET GmbH			

Export contract and signatures

PUBLICATION

Project can be published externally:
YES, please publish project information