DWEEN solution architecture

PREPARED BY

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1. Executive summary

Energy Advice is ISO 27001:2022 certified, vulnerability of it's IT systems to threats is constantly checked through penetration tests.

The data security architecture of the Dween solution complies with the requirements of the NIS2 directive.

There is no possibility of external interference with the system. Each communication session is initiated exclusively by a server located within the company network, not from the cloud.

Virtual/physical server platform and communication channels are managed exclusively by the company's IT department.

Energy Advice does not require a permanent remote connection to the software installed at the company's IT infrastructure; each connection for software update or maintenance is agreed in advance with the company's IT department.

Dween solution is hosted in the Hetzner Online cloud.

2.Solution overview
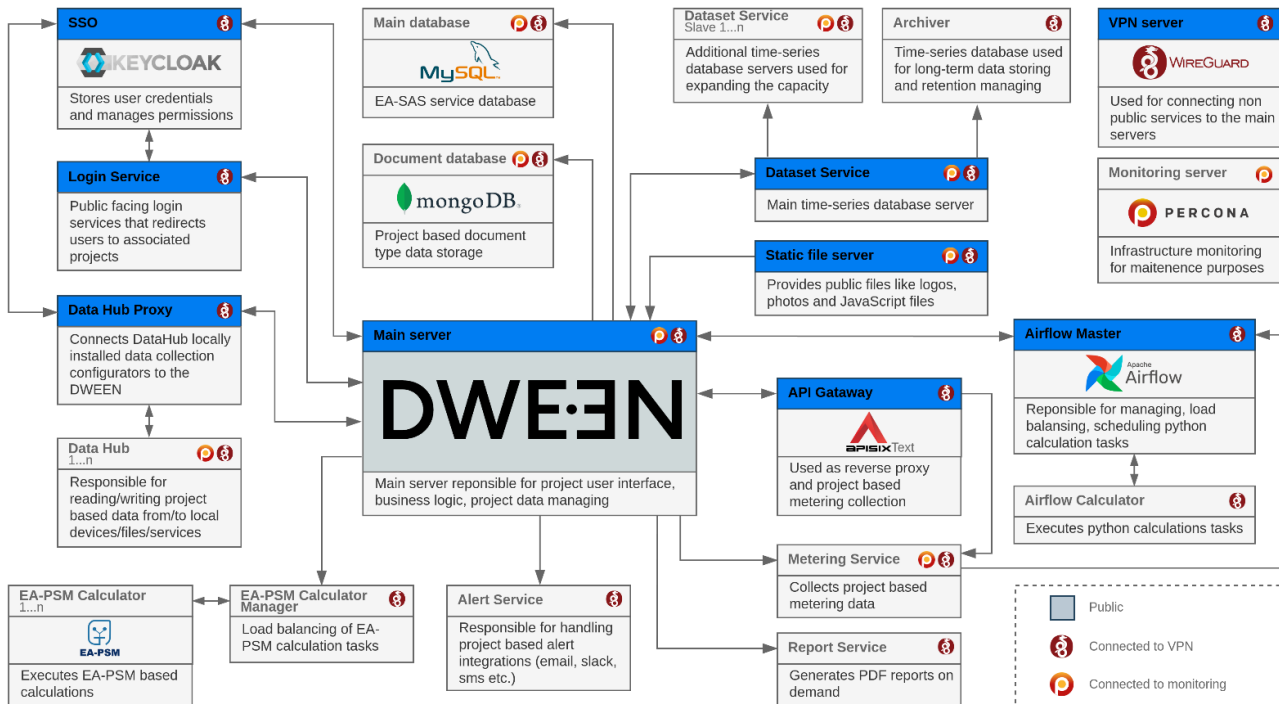
Picture 1 – Solution overview

Digital Twin solution for industrial systems, delivered via the DWEEN platform, integrates real-time data acquisition, visualization, analytics, and intelligent automation to optimize operational performance. The solution connects disparate sub-systems (SCADA, PLCs, metering devices & systems, etc.) into a unified operational model, enabling comprehensive monitoring, diagnostics, and control.

Solution's key components:

- DWEEN DataHub for real-time retrieval of operational parameters.
- Digital Twin Model representing the plant's mass and energy balance in real-time.
- Configurable Dashboards offering KPI tracking, performance reports, and deviation alerts.
- Modules for control recommendations, automated control, efficiency prediction, and maintenance forecasting.
- Customizable Reports for stakeholders at all levels.
- Integration with external systems (e.g., weather forecasting, electricity market, etc.).
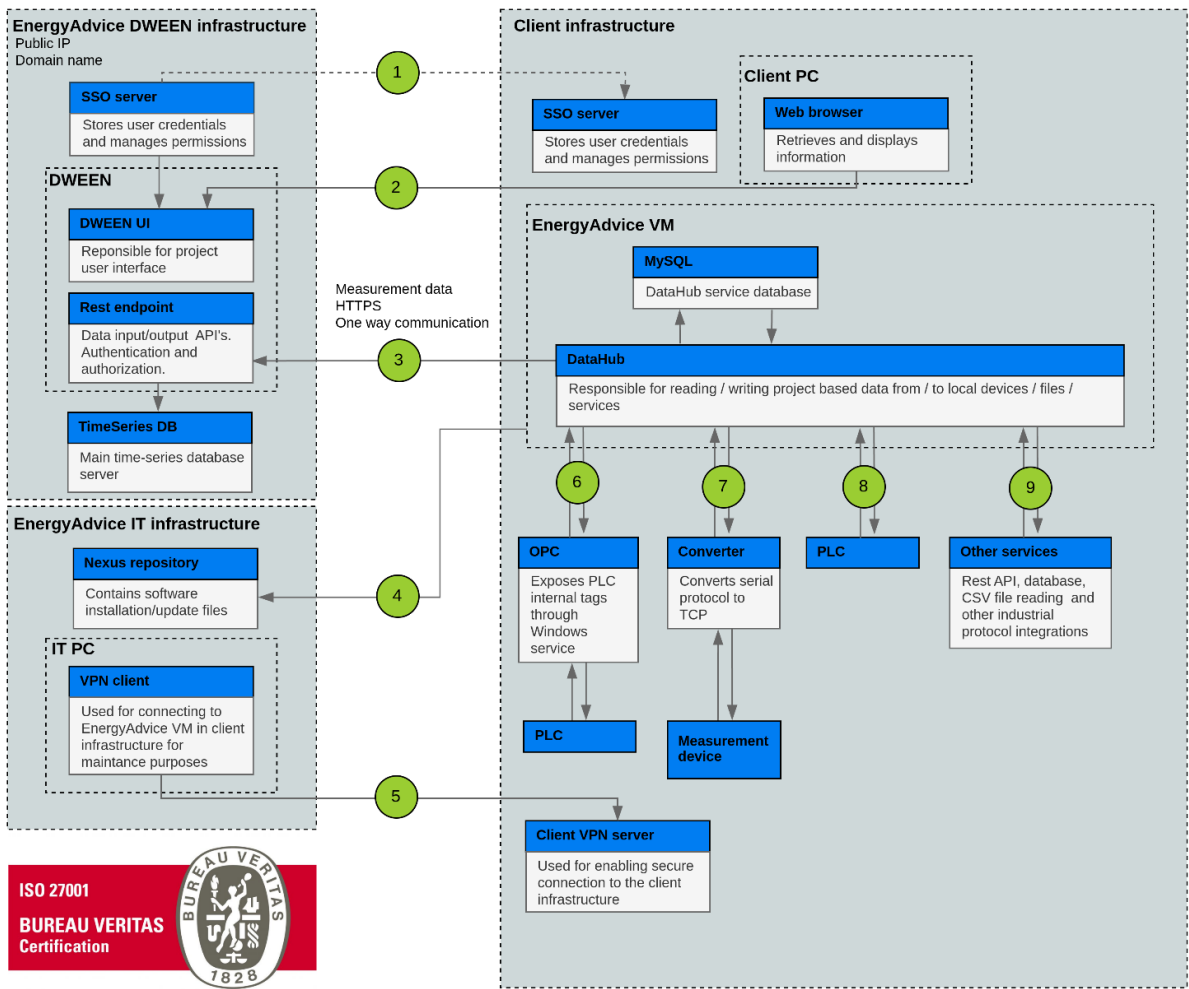
Platform supports both manual operator guidance and automated control, reducing human error, improving efficiency, and enabling proactive maintenance. The architecture is scalable and modular, allowing future extension based on business priorities.

Component	Description
SSO (Keycloak)	Stores user credentials and manages permissions.
Login Service	Public-facing login service that redirects users to associated projects.
Data Hub Proxy	Connects locally installed data collection configurators to DWEEN.
Data Hub	Responsible for reading/writing project-based data from/to local devices/files/services.
EA-PSM Calculator	Executes EA-PSM based calculations.
EA-PSM Calculator Manager	Load balancing of EA-PSM calculation tasks.
Alert Service	Handles project-based alerting (email, Slack, SMS, etc.).
Main Server (DWEEN)	Core server responsible for user interface, business logic, and project data management.
Main Database (MySQL)	DWEEN service database for structured project data.
Document Database (MongoDB)	Stores project-based unstructured document-type data.
Dataset Service	Main time-series database service.
Dataset Service Slave	Additional time-series service to expand capacity.
Static File Server	Serves static files like logos, photos, JavaScript files.
Archiver	Manages time-series data archiving and retention.
VPN Server (WireGuard)	Allows secure non-public connections to the main services.
Monitoring Server (Percona)	Monitors infrastructure for maintenance purposes.
API Gateway	Reverse proxy and project-based metering collection.
Metering Service	Collects project-based metering data.
Report Service	Generates PDF reports on demand.
Airflow Master	Manages scheduling and load balancing of Python tasks.
Airflow Calculator	Executes Python calculation tasks.

Table 1 - Server requirements

3. Application architecture

3.1. Application communication

Picture 2 – Application communication

Traffic type, name	Description	Protocol, port
1. Authorization	SSO connection traffic used for authenticating users which connects to the web-based DWEEN user interface	HTTPS, 443
2. User interface connection	Used to send UI data to the user web broswer from the DWEEN server	HTTPS, 443
3. DataHub to DWEEN main server connection	Link is used for two purposes: - DataHub initiates requests to the main DWEEN server in order to push collected process data to the main database. - DataHub initiates request in order to pull set-points data from the main DWEEN server.	HTTPS, 443
4. Connection to the EnergyAdvice repository	Used for downloading required initial installation files of the DataHub sofware. It is also used to download update files for the software.	HTTPS, 10010 vpn.energyadvice.lt
5. Support connection	Connection is used by EnergyAdvice personel in order to: - Update DataHub calculation/writing/reading processes configuration; - Install DataHub software at the initial phase of the project; - DataHub software updates	
6. Data exchange through OPC DA	Used when OPC DA service is installed on client SCADA computer. In this case additional OPC DA – HTTP converter is installed on SCADA computer as a Windows service which is used for communication with DataHub. DataHub initiates HTTP requests for data reading and writing to the converter which is connected to the OPC DA service. Converter works as a passive component does not have any internal scheduled logic and only processes requests from the DataHub. Requires single HTTP port to get requests from DataHub.	HTTP, 12580 (can be changed – controlled by EnergyAdvicce)
7. Data exchange through protocol converter	Used when the target system or device can communicate with serial or closed protocol. In this case either a software or hardware protocol converter is installed. DataHub makes data read and write requests to the converter.	TCP, port depends on the converter
8. Data exchange through direct connection to the PLC	Used when only the direct connection to the PLC is available in order to read and write data. In this case DataHub makes direct request to the PLC using supported industrial protocols (ussually S7 or Modbus TCP).	TCP, port depends on PLC
9. Other data exchange integrations	Used for other data exchange integrations required for the project scope. This could include weather, electricity price forecast services, buisiness logic related databases and other external services API integratons.	Depends on the integration

Table 2 - Application communication
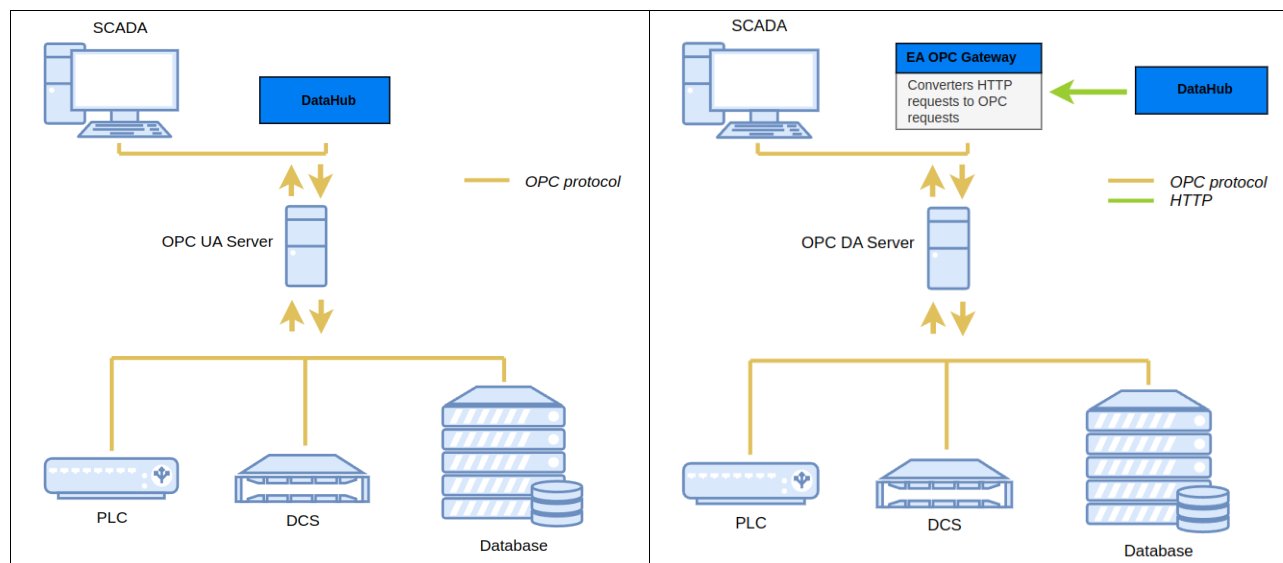
3.2. OPC connection architecture

When customer's control system solution is based on OPC communication architecture, it is used as a preferred way for DWEEN Datahub to exchange data with the system.

Datahub integration depends on the version of the installed OPC server (OPC DA or OPC UA). EA OPC Gateway is only required for OPC DA server since it is a legacy OPC version and uses DCOM for remote authentication which is unstable with newer Windows versions. In the case of OPC UA, DWEEN Datahub connects directly to the OPC server.

EA OPC Gateway needs to be installed and configured as a Windows service on a computer running OPC Server.

Supported architecture:

- OPC DA – Windows XP SP2 and newer, no protocol version requirements,
- OPC UA – No OS requirements, supported OPC protocol version is 1.*

Picture 3 – OPC connection architecture

Service	Description
OPC server	Software, responsible for communication between PLC's, SCADA software and other data sources. Installed on site, usually on the SCADA computer. It holds configured current tag values (measured values, setpoints, internal variables, states, calculation results, etc.) that are constantly synced between connected data sources. OPC server acts as a gateway and can be used to exchange data with technological equipment, avoiding direct communication. Two versions of the OPC Server are known so far, OPC UA and OPC DA.
OPC client	Software that communicates with the OPC server using the OPC protocol, used to obtain tag list and exchange data with technological equipment using predefined tag names.
EA OPC Gateway	Software that is used as a gateway/protocol converter between OPC server and DataHub software. Communicates with OPC server via OPC protocol and responds to the HTTP requests that are initiated by the DWEEN Datahub. In this configuration DWEEN Datahub only sends HTTP requests and OPC communication protocol is implemented on the EA OPC Gateway. Software needs to be installed on the computer running OPC server.

Table 3 - Application communication

4. System requirements

Deployment is dependable on the existing operating system.

| Operating system	Windows Server	Linux
Version	-	Ubuntu Server latest LTS
CPU	Linux	Linux
Memory	16 GB	16 GB
Storage	70GB SSD	50 GB SSD
Modules deployment	Windows services	Docker composed setup

Table 4 – System requirements

Dween team is responsible for maintaining Datahub modules and installing software updates. OS maintenance and upper layer maintenance (either virtual machine or physical hardware) is carried out by the customer.

Service	Description
MySQL server	stores configuration files
Datareader	software responsible for managing data reading
Datawriter	software responsible for managing data writing
Jobrunner	software responsible for internal scheduled calculations
Reverse proxy	single point of entry for local requests. Required for Datahub UI
Datahub UI	web service for providing local UI for managing configuration of the DataHub software modules

Table 5 – DWEEN Datahub modules

5. Security architecture
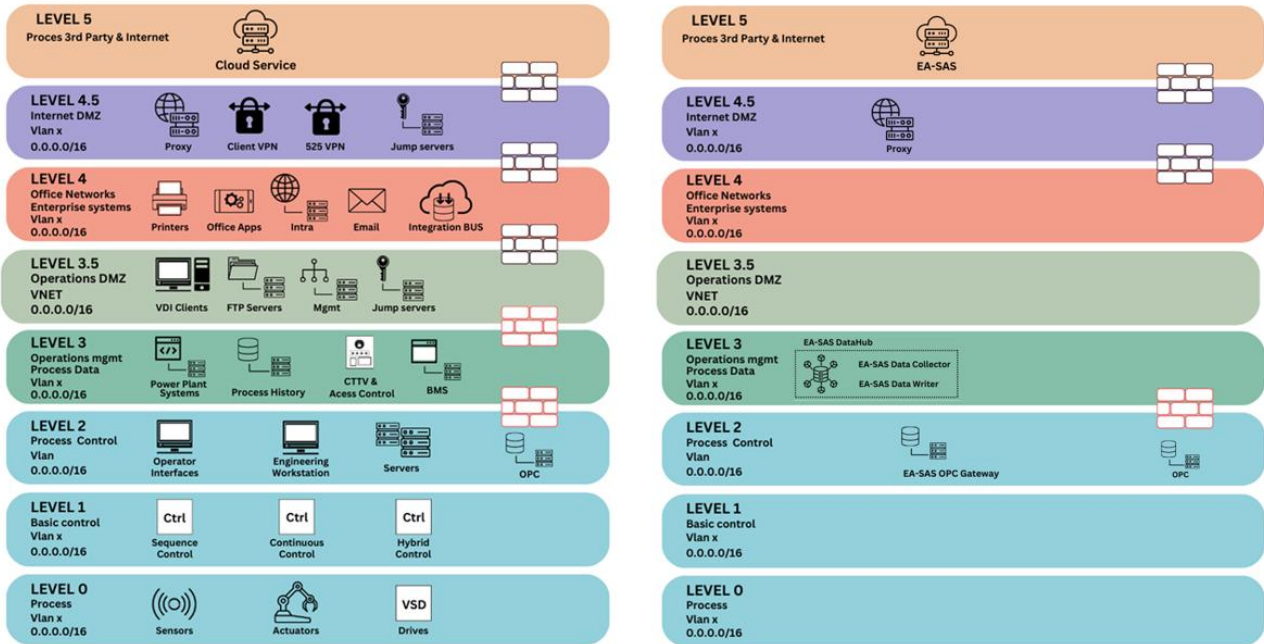
Picture 4 – Security architecture

6. Deployment workflow

Key milestones:

- Setting up remote connection to the SCADA PC.

    Pre-requisite: remote connection software is required.

- Setting up VM for Datahub management component.

    Local infrastructure is required.

- Establishing connectivity to the OPC / PLC / SCADA.

    Pre-requisite: vendor documentation.

- Visualization dashboard setup.

- Building the model for Digital Twin, model templated adjustment.

- Setting up integrations with external parties.

7. EA-OPC gateway

Deployment of EA-OPC gateway is dependent on the installed Windows operating system version.

Windows 7 or newer:

- Prepare files. Extract EA_OPCConverter.zip to a dedicated directory. We suggest to use C:\energyadvice\EA_OPCConverter.

- Identify the name of the OPC server. This can be achieved by using any OPC testing client:

  o Start OPC client. Detected server list should appear on the left in a tree view.

  o Usually more than one OPC server is detected. Most of the time only one of the OPC servers contains PLC tags and other are not configured. To identify the correct one, connect to each server individually and try to expand the server in a tree view or read all available tags of the server. If you will find tag list inside with naming that represents the PLC tag addresses, save this OPC server name for the next steps.

- Change settings. Open EA_OPCConverter folder and find the file named EA_OPCConverter.xml. This a configuration file that contains settings for the EA-OPC gateway. The following lines must be changed:

  o "--progid=Studio.Scada.OPC.5" needs to be changed to "—progid=<<IDENTIFIED_OPC_SERVER_NAME>>". In other words, replace placeholder progid with the identified OPC server name that was identified in the previous steps.

  o --bindHost must be changed to the local IP address of the PC that the gateway is being installed on. Note that if PC has more than one network card, administrator should use the IP that will be used by DWEEN DataHub to read/write data via port described in setting –bindPort.

  o --bindPort is the port used by DWEEN DataHub to read/write data to the EA-OPC gateway. This setting should be only changed if the default port value of 12580 is already used or other port is prefered. If this parameter is changed the EnergyAdvice team must be informed.

- Start the gateway. Using windows terminal navigate to the files folder and start the services using following commands:

  "EA_OPCConverter.exe install" and "EA_OPCConverter.exe start"

Windows XP:

- Prepare files. Extract EA_OPCConverter.zip to a dedicated directory. We suggest to use C:\energyadvice\EA_OPCConverter.

- Install vcredist_2010_x86.exe which can be found inside the extracted folder.

- Identify the name of the OPC server. This can be achieved by using any OPC testing client:

  o Start OPC client. Detected server list should appear on the left in a tree view.

  o Usually more than one OPC server is detected. Most of the time only one of the OPC servers contains PLC tags and other are not configured. To identify the correct one, connect to each server individually and try to expand the server in a tree view or read all available tags of the server. If you will find tag list inside with naming that represents the PLC tag addresses, save this OPC server name for the next steps.

- Using windows terminal navigate to the files folder and start the windows service configuration software using the command "nssm.exe install".

- Program window will show up. The following fields should be filled:
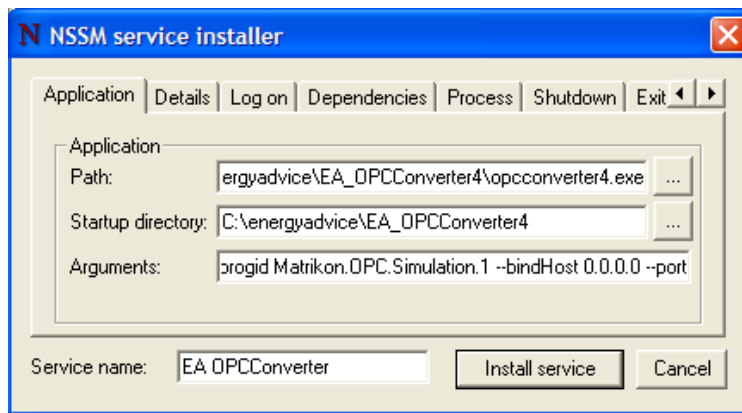
- Application tab:

  Path: C:\energyadvice\EA_OPCConverter4\opcconverter4.exe

 Startup directory: C:\energyadvice\EA_OPCConverter4

  Arguments:

  o "--progid=Studio.Scada.OPC.5" needs to be changed to "—progid=<<IDENTIFIED_OPC_SERVER_NAME>>". In other words, replace placeholder progid with the identified OPC server name that was identified in the previous steps.

  o --bindHost must be changed to the local IP address of the PC that the gateway is being installed on. Note that if PC has more than one network card, administrator should use the IP that will be used by DWEEN DataHub to read/write data via port described in setting –bindPort.

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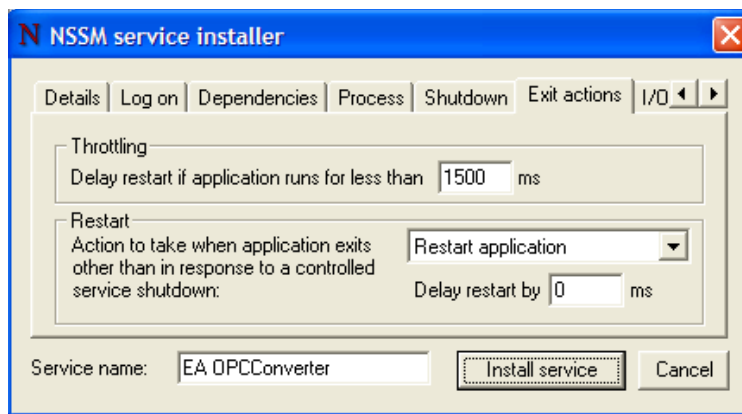
- Details tab:

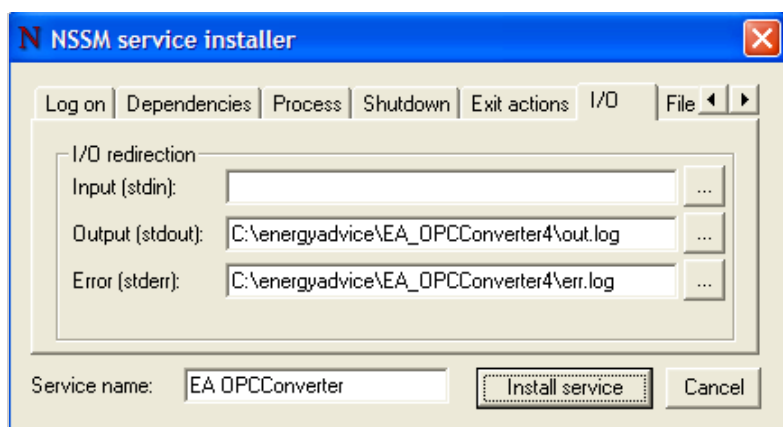 Startup type: Automatic (Delayed Start)
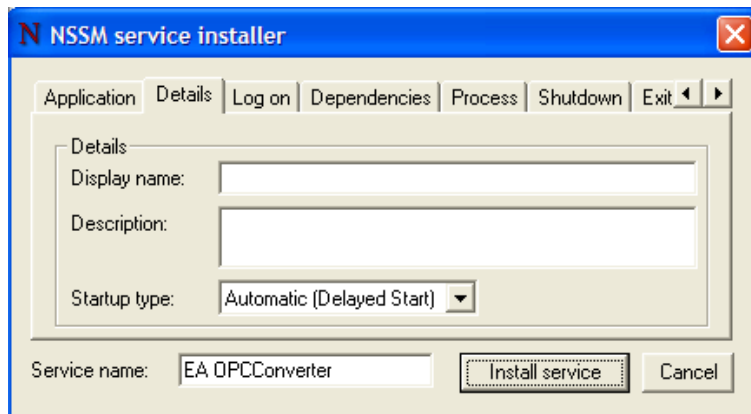
- Exit actions tab:

  Exit actions: Restart: Restart Application

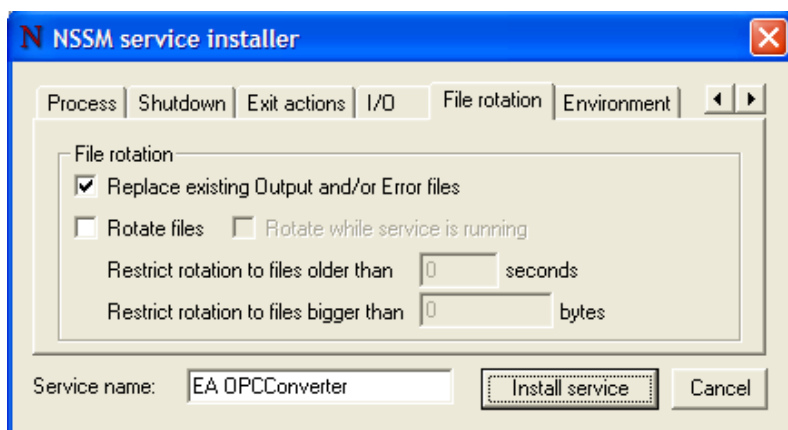- I/O tab:

  stdout:C:\energyadvice\EA_OPCConverter4\out.log
  stderr: C:\energyadvice\EA_OPCConverter4\err.log

- File rotation tab:

  Replace existing Output and/or Error files

  Service name: EA OPCConverter

- After the configuration is done, complete the step by pressing Install service.

Proprietary operating systems:

EA-OPC gateway is meanwhile tested on Windows 2000 OS. Deployment process might be slightly different from the above. Please contact Energy Advice team for assistance.

Testing EA-OPC Gateway:

EA-OPC can be tested by opening any web browser and navigating to "http://127.0.0.1:12580/tags" URL. The page should load and display all tags found in the configured OPC server. The tags should match those found with any OPC test client.

8. Dysfunctions of the solution

Situation	Duration	Actions	Responsible
Lack of connection	<10 min	Alert email, SMS (operator, IT)	Operator
	>10 min	Activation of manual control	Operator

Table 6 – Dysfunctions of the solution

9. Miscellaneous

DWEEN DataHub Software is required to collect data from either Scada or PLC and deliver it to the DWEEN Cloud. Dween team will remotely install the Software on Customer's virtual or dedicated server at the Customer's location.

Customer will provide a virtual or physical server (even in the case of a physical server, a virtualization layer is recommended). The recommended version of the operating system is Ubuntu Server 22 LTS.

Customer will provide temporary remote access to the server using TeamViewer or AnyDesk software. Installation time – up to 2 hours. Assistance may be required if a reboot is necessary.

Customer is responsible for configuring the intranet and external network, as well as configuring the VPN between DWEEN Datahub and DWEEN Cloud.