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# PRODUCT DESCRIPTION

Crossbreed Smarter Heating, Siemens Smart Energy

This document describes Crossbreed Smarter Heating, Siemens Smart Energy ("Product") and the capabilities and processes connected to it.

## About Crossbreed

Crossbreed provide an ecosystem of smarter energy services where systems, equipment and algorithms are connected into cloud-based energy optimisation solutions, to bring tangible financial, environmental and operational improvements in networks, buildings and homes. We call it the Crossbreed Energy OS.

**Vision** – Smarter Energy for a sustainable future
**Mission** - To accelerate the global transformation into a sustainable and efficient energy system, interconnecting energy data to algorithms.

The company was founded in 2011 and is co-owned by the founders, the global IT consultancy firm Data Ductus AB and INTIC Capital Partners. Crossbreed is located in Malmö, Sweden.

**Web:** crossbreed.se

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# Content

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## Description

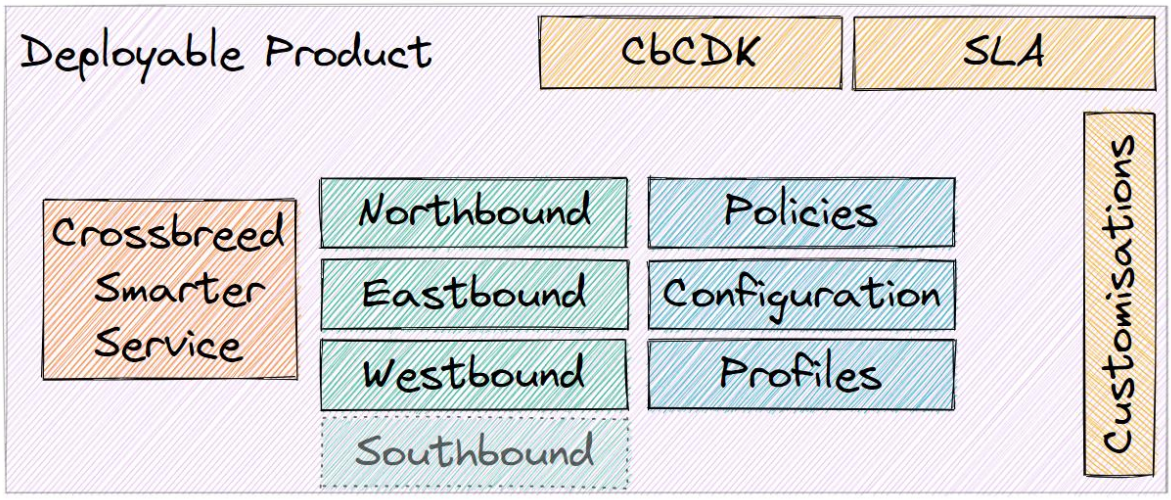
Crossbreed Smarter Heating, Siemens Smart Energy (“Product”) is an OEM service for district heating equipment providers offered to their customers, the property owners or energy operators, enabling energy optimization and monitoring of district heating systems in buildings.
Thanks to a combination of different securely integrated data sources and embedded AI algorithms, the Product supports the heating system to reduce energy usage in buildings without renouncing comfort and indoor climate.
Parallel to lowering the energy costs for building owners and providing better control of the heating system for the energy operator, the Product also reduces the buildings climate impact.

The Product can be used for apartment buildings, commercial buildings, and other premises with district heating as heat source.
With minor adjustments the solution could be adopted to thermal controller units supporting heat pumps, gas boilers or district cooling.

## Overview

Crossbreed Energy OS is an AWS, serverless, native platform that consists of a core framework of small building blocks to create core services and *Crossbreed* smarter services. The core services make the platform tick such as data collection, routing, service monitoring. Whereas the Smarter Services are the actual AI based energy related services that handles e.g optimizing energy consumption or CO2 emissions.
The Product itself shall be seen as the running service whereas the Crossbreed Smarter Services are *abstract* services to be customized and them realized into *concrete* services within the product.

Figure 1. Overview Platform, Services & Product

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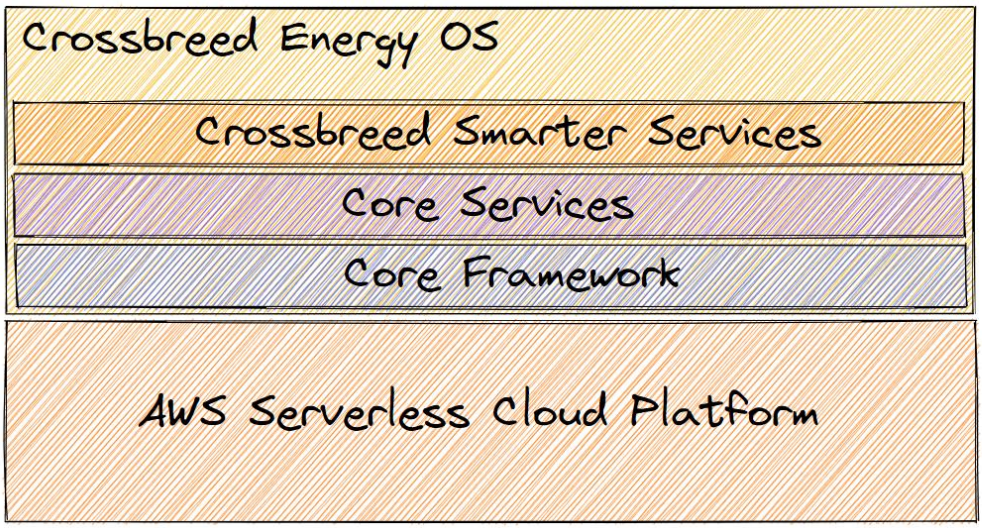


Further technical Information about Crossbreed Smarter Services and product operations In Crossbreed Appendix "Platform & Service releases Versioning and Life Cycle Management"

## Capabilities

By using multiple data sources and AI algorithms the Product reduces the energy demand (kWh) in the building, supporting the heating circuit to dynamically adapt to the real need of the property, instead of the static setting of the heating system (normally based only on the outdoor temperature).

### Energy efficiency

The Product measures and analyses the buildings heating system and energy needs continuously and in real-time.
By analysing and learning the buildings heating patterns, profile and thermal storage capacity (thermal inertia), and by adding social and external factors like weather to the calculation, the system autonomously learns to use only the amount of energy actually needed. These intelligent operations will generate lower energy usage, with a retained comfortable indoor climate.

### Operation of heating system

The Product uses the controller's existing heating curve to influence the heating. This is done by the AI functionality of the Product calculating an offset value, normally an addition to the measured outdoor temperature, which shifts the setpoint for supply temperature via the heating curve. In this way, the extraction of heat can be affected. The Product has safety functions that ensure that the controller unit returns to regular temperature control (should the service for instance be offline).
The Product saves energy by adapting the heating system to the actual need for heat.

The Product uses a predefined target temperature (i.e. 21 degrees with upper and lower boundaries) to dynamically adjust the heating so that the average indoor temperature is

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controlled towards this target temperature. The Product calculates the offset to adjust the heating approximately every 15 minutes.

### Calculation

The Product uses the calculation methodology “Normal year correction using energy signature” as it gives the fairest energy optimisation result. The energy saving is calculated as the difference between reference days (24 hours without the service controlling) and service days (24 hours with the service controlling). The savings are reported without heating for domestic hot water.

## Processes

The Product imports a defined list of data points from the district heating substation, the heat meter and indoor sensors, and exports a control parameter, which is calculated using the list of data, external data sources and algorithms. The control parameter is used by the district heating substations to reduce heating to a level that corresponds to the buildings actual heat demand, as described above.

### Communication of data point from controller

The Product requires communication of the I/O-list as defined in Table 1 below. The unit-column describes the units used by the Product. The interval column defines the required interval of data communication.

Table 1, I/O-list

| Name | Type | Unit | Frequency | Requirement | CB ID | Climatix ID | Comment |
|---|---|---|---|---|---|---|---|
| Actual outdoor temperature | read | °C | <= 15 min | Mandatory | ODT | 1!N3ASTG10LK6MFV- | |
| Active outdoor temperature | read | °C | <= 15 min | Mandatory | ACTODT | 1!N3ASTG10KWTFCMU | |
| Supply temperature heating circuit | read | °C | <= 15 min | Mandatory | SSHCT | 1!N3ASTGK-9Y3HFMR | Value from controller [1] |
| Return temperature heating circuit | read | °C | <= 15 min | Mandatory | RSHCT | 1!N3ASTGK-A032Z1H | Value from controller [2] |
| | | | | | | | |
| Supply temperature primary side | read | °C | <= 15 min | Mandatory | MPST | 1!N3ASTHC-BG7OKIN | Value from heat meter |
| Return temperature primary side | read | °C | <= 15 min | Mandatory | MPRT | 1!N3ASTHC-B1QKZ6J | Value from heat meter |
| Aggregated massflow primary side | read | $m^3$ | <= 15 min | Mandatory | AMFPS | 1!N3ASTHC-C326ZSV | Value from heat meter |
| Massflow primary side | read | $m^3/h$ | <= 15 min | Mandatory | MFPS | 1!N3ASTHC-C85KKKB | Value from heat meter |
| Aggregated energy usage primary side | read | MWh | <= 15 min | Mandatory | AEUPS | 1!N3ASTHC-BQUOFIR | Value from heat meter |
| Heat demand primary side | read | kW | <= 15 min | Mandatory | HDPS | 1!N3ASTHC-BLP-OKR | Value from heat meter |
| | | | | | | | |
| Indoor temperature | read | °C | <= 60 min | Mandatory | IDT_O<1-n> | | Sensor data. [3] |
| | | | | | | | |
| Outdoor temperature offset | write | °C | at event | Mandatory | OFFODT | 1!6WHH6DKHICVDSS | The Crossbreed offset signal [4] |

1. There might be several of these (e.g. one for each radiator or ventilation circuit)
2. There might be several of these (e.g. one for each radiator or ventilation circuit)
3. A minimum of five indoor temperature sensors per building block. Climatix has multiple fixed sensor ids (if connected via controller)
4. Offset + Actual = Active (outdoor temperature). If this is 0 then Actual and Active outdoor temperature is the same.

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## Resolution

Table 2 defines the required resolution per unit of measure.

Table 2, required resolution of data

| Unit | Required resolution |
|---|---|
| ° C | 0.1 °C |
| kW | 0.1 kW |
| kWh | 1.0 kWh |
| m^3 | 0.1 m^3 |
| l/h | 1.0 l/h |

The control signal provided by the Product is limited in magnitude according to:
-12 ° C ≤ Outdoor temperature offset ≤ +12 ° C.

## Settings

The following settings are required by the Product. The settings are defined as part of the provisioning of a specific customer installation.

Table 3, required Service setting

| Settings | Description |
|---|---|
| Target temperature | Desired average indoor temperature |
| Limit low | The limit in indoor temperature under which the Service will not send a control signal. (if any indoor sensor that is part of the control is below this limit, it is not desirableto reduce heating further). Shorter periodsbelow this limit is allowed by the algorithm |
| Balance temperature | The limit in outdoor temperature above which the heating system will not provide heating to the building. This is a setting the substation controller, normally defined by the temperature program. |

## Algorithm

The algorithm calculates the control signal based on the I/O-list, the settings described in Table 3, and outdoor temperature forecasts. The algorithm determines if it is possible to reduce heating, and how much, based on its inputs, historical data and forecast data. The control signal is used to reduce heating only, (i.e., heating is not increased by the Product). The actions of the algorithm are described in Table 4.

Table 4, algorithm actions

| Action | Reason |
|---|---|
| Control agains target | Indoor temperature within boundary |
| Max control intensity | Indoor temperature is high |
| Control hysteresis | Deleyed control, Indoor temperature dips during a short time |
| Rollback | Rolling back to no offset (slope based) |
| No control action | Missing data or indoor temperature too low during a too long time |

## Sensors

Indoor temperature sensor data is required. The included sensors are used to calculate average indoor temperature and are individually compared against Limit low (see Setting).

## Support & SLA

All terms and conditions according to separate SLA Appendix for the Product.