

## ENVIRONMENTAL PRODUCT DECLARATION

# RAYCHEM ELECTRONIC THERMOSTATS

RAYCHEM NRG-DM AND SENZ-WIFI



RAYCHEM electronic thermostats are digital timer thermostats for electrical floor heating equipped with a large display and intuitive software.

**chemelex**<sup>®</sup>  
*excellence is everything*

Chemelex is a global leader in electrical heat tracing products and services, mineral-insulated fire rated wiring, electrical floor heating systems, and fluid Leak detection systems. The company supports customers with products and services in industries ranging from commercial and residential construction, data centers, energy, industrial process heating and transportation. Its products are marketed globally under leading brands including Raychem, Tracer, Pyrotex, and Nuheat.

Chemelex's Raychem brand is at the forefront of the heat tracing industry. Products include industrial process heating systems, pipe freeze protection, surface snow melting & de-icing, floor heating, and hot water temperature maintenance. Raychem's solutions are vital in sectors including energy, infrastructure, and commercial & residential building. Applications ensure accurate temperature maintenance for operational efficiency, enhanced safety and customer comfort.


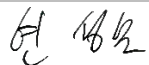


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**RAYCHEM NRG-DM and SENZ-WIFI**  
Electronic thermostat

According to ISO 14025  
and EN 15804+A2

|   |   |                               |
|---|---|-------------------------------|
| EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE   | UL Solutions<br>333 Pfingsten Rd, Northbrook, IL 60062  | www.ul.com<br>www.spot.ul.com |
| GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER   | UL Solutions General Program Instructions v.2.7 2022  |                               |
| MANUFACTURER NAME AND ADDRESS   | Chemelex, 15375 Memorial Drive, Houston, TX 77079, United States  |                               |
| DECLARATION NUMBER  | 4791545949.106.1  |                               |
| DECLARED PRODUCT  | 1 unit of NRG-DM<br>1 unit of SENZ-WIFI   |                               |
| FUNCTIONAL UNIT   | Control the ambient temperature set by the user in a defined temperature range of 5 to 40 °C in one zone, for electrical floor heating applications, and for the reference service life of the product of 10 years. |                               |
| REFERENCE PCR AND VERSION NUMBER  | Core PCR: EN 15804:2012+A2:2019<br>PCR: PEP-PCR-ed4-EN-2021 09 06<br>PSR: PSR-0005-ed3-EN-2023 06 06  |                               |
| DESCRIPTION OF PRODUCT APPLICATION/USE  | Under floor heating in residential and commercial applications  |                               |
| PRODUCT RSL DESCRIPTION (IF APPL.)  | 10 years  |                               |
| MARKETS OF APPLICABILITY  | Global  |                               |
| DATE OF ISSUE   | April 21, 2025  |                               |
| PERIOD OF VALIDITY  | 5 Years   |                               |
| EPD TYPE  | Product-specific  |                               |
| RANGE OF DATASET VARIABILITY  | N/A   |                               |
| EPD SCOPE   | Cradle-to-grave   |                               |
| YEAR(S) OF REPORTED PRIMARY DATA  | 2023  |                               |
| LCA SOFTWARE & VERSION NUMBER   | LCA For Experts 10.8  |                               |
| LCI DATABASE(S) & VERSION NUMBER  | Sphera MLC 2024.2   |                               |
| LCIA METHODOLOGY & VERSION NUMBER   | EF 3.1 (as per EN 15804+A2)   |                               |
| The PCR review was conducted by:  | PepEcoPassport  |                               |
|   | PCR Review Panel  |                               |
|   | <a href="mailto:contact@pep-ecopassport.org">contact@pep-ecopassport.org</a>  |                               |
| This declaration was independently verified in accordance with ISO 14025: 2006.<br><input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL | Cooper McCollum, UL Solutions    |                               |
|   | WAP Sustainability  |                               |
| This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:   | Peter Yeon, H.I.P. Pathway   |                               |
| This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:  | Peter Yeon, H.I.P. Pathway  |                               |



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## LIMITATIONS

**Exclusions:** EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

**Accuracy of Results:** EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

**Comparability:** EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

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## 1. Product Definition and Information

### 1.1. Description of Company/Organization

Chemelex is a global leader in electric thermal and sensing solutions, protecting the world’s critical processes, places and people. With over 50 years of innovation and a commitment to excellence, we develop solutions that ensure safety, reliability, and efficiency in diverse environments – from industrial plants and data centers to people’s homes. Chemelex delivers future-ready technologies, advanced engineering capabilities and local expertise backed by global standards. Our offering includes a leading portfolio from our trusted brands: Raychem, Tracer, Nuheat and Pyrotenax.

### 1.2. Product Description



Figure 1: NRG-DM  
Product Image

#### RAYCHEM NRG-DM

RAYCHEM NRG-DM thermostat is a smart electronic thermostat designed for electrical under floor heating. The NRG-DM is equipped with an ambient sensor and a floor sensor and is thus capable of monitoring and controlling floor heating cables in 4 different modes.



Figure 2: SENZ-WIFI  
Product Image

#### RAYCHEM SENZ-WIFI

RAYCHEM SENZ-WIFI is a modern design thermostat that provides high comfort and low energy costs for electrical floor heating. Suitable for new build or renovation projects, it can be used with all floor heating cables and heating mats. Available as standard in unique black design or with a white front plate. Other front plate options are also available. The thermostat can operate as a standard WIFI thermostat or be integrated in a group of thermostats and fully controlled by the SENZ-WIFI app. The thermostat can be controlled by voice command through Google Assistant and Amazon Alexa compatible smartspeakers.

Table 1: Products covered in the EPD

| PRODUCT NUMBER | PRODUCT NAME | POWER SUPPLY | MEASURING RANGE |
|----------------|--------------|--------------|-----------------|
| 1244-015152    | R-NRG-DM     | 230 V        | 5 – 40°C        |

### 1.3. Application

#### RAYCHEM NRG-DM

The Raychem NRG-DM thermostat is designed to control under floor heating in residential and commercial applications to give the best possible comfort at the lowest energy consumption.

#### RAYCHEM SENZ-WIFI

RAYCHEM SENZ WIFI-enabled programmable touchscreen thermostat is used for electrical underfloor heating



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applications.

## 1.4. Technical Requirements

The technical requirements are available on the Chemelex product page under engineering specifications:

<https://www.nvent.com/en-gb/raychem/products/nrg-dm-digital-timer-thermostat-0>

<https://www.nvent.com/en-dz/raychem/products/senz-wifi-digital-timer-thermostat-0>

## 1.5. Properties of Declared Product as Delivered

The product is packaged in a cardboard box.

## 1.6. Material Composition

Table 2: Material composition, per unit

| MATERIAL     | NRG-DM     | SENZ-WIFI  |
|--------------|------------|------------|
| PLASTIC      | 36         | 41         |
| ELECTRONICS  | 64         | 59         |
| <b>TOTAL</b> | <b>100</b> | <b>100</b> |

## 1.7. Manufacturing

### RAYCHEM NRG-DM

The production process includes the assembly of the PCBA, starting with solder paste inspection, automated SMD placement with AOI, manual component insertion, and in-circuit testing. Afterward, the PCBA is combined with plastic parts, along with the display components. A comprehensive functional test is then conducted, including software uploads and configuration. Finally, test logs are generated, and a box label is printed for each unit that passes the test, completing the assembly process.

This product is made using renewable electricity in the form of Renewable Energy Certificates (RECs). The manufacturer purchases Green-e certified RECs to cover the totality of the electricity used at the contract manufacturing facility in Denmark.

### RAYCHEM SENZ-WIFI

The manufacturing process for a thermostat consists of four main stages. First, in the PCBA production stage, solder paste is screened, and components are placed using automatic pick-and-place machines with optical inspection. Manual insert and wave soldering are performed, followed by circuit testing. In the boxbuild phase, the PCBA is assembled with plastic parts, and the display and GFCI components are integrated, with traceability ensured by linked labels. During the functional test, the thermostat undergoes a full test, including software uploads and log file creation, with a box label printed if it passes. Finally, in the packaging stage, thermostats are packed with accessories, grouped into larger boxes, and labeled for traceability throughout the packaging process.



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## 1.8. Packaging

The product packaging is made from recyclable materials.

The materials and components received from supplier for product manufacturing was also taken into account as per requirements from PSR section 3.1.5.1 (P.E.P. Association, 2023). An average packaging content of 5% of the reference input material has been considered and broken down as followed: 50% wood, 40% cardboard and 10% low-density polyethylene. This packaging is assumed to be disposed according to the European default scrap rates from Table 3 of the PSR in absence of specific data (P.E.P. Association, 2023).

## 1.9. Transportation

### RAYCHEM NRG-DM

The units are assembled in Denmark at the manufacturing site and shipped by truck to the Chemelex EU distribution center in Leuven. From Leuven the units are shipped by truck or air to customers all over Europe and Asia.

### RAYCHEM SENZ-WIFI

The units are assembled in Malaysia and shipped to the Chemelex EU distribution center in Leuven by air. From Leuven the units are shipped by truck or air to customers all over Europe and Asia.

## 1.10. Product Installation

Installation only requires the use of hand tools. No maintenance is required after installation.

## 1.11. Use

The electronic thermostats operate on electricity during their use stage. The Table 3 below summarizes the power consumption and the average running time information for the product.

**Table 3: Use stage details**

|                | POWER CONSUMPTION (WATTS) |           | RUNNING TIME (HOURS/YEAR) |
|----------------|---------------------------|-----------|---------------------------|
|                | NRG-DM                    | SENZ-WIFI | NRG-DM AND SENZ-WIFI      |
| FULL OPERATION | 1.8 W                     | 3.5 W     | 480                       |
| STEADY STATE   | 1 W                       | 0.5 W     | 8280                      |

## 1.12. Reference Service Life

The reference service life (RSL) of the products is 10 years.





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**1.13. Reuse, Recycling, and Energy Recovery**

The end-of-life disposal rates (recycling, energy recovery, and disposal) used in the study were based on EN 50639:2019 – Product category rules for life cycle assessments of electronic and electrical products and systems, Table G.4, as shown in Table 4 below.

**Table 4: End-of-life disposal rates**

|                              | MATERIAL RECOVERY RATE (%) | ENERGY RECOVERY RATE (%) | DISPOSAL RATE (%) |
|------------------------------|----------------------------|--------------------------|-------------------|
| COPPER                       | 60                         | 0                        | 40                |
| ALUMINUM                     | 70                         | 0                        | 30                |
| STEEL                        | 80                         | 0                        | 20                |
| PLASTIC                      | 20                         | 40                       | 40                |
| ELECTRONICS                  | 50                         | 0                        | 50                |
| MINERALS AND OTHER ADDITIVES | 0                          | 0                        | 100               |

**1.14. Disposal**

The thermostat must be disposed of as Waste Electrical and Electronic Equipment (WEEE directive) according to local regulations.

**2. Life Cycle Assessment Background Information**

**2.1. Functional Unit**

The functional unit is to “control the ambient temperature set by the user in a defined temperature range for 5 to 40°C in one zone, for floor heating applications, and for the reference service life of the product”.

The associated reference flow is one unit of electronic controller or thermostat installed.

**2.2. System Boundary**

This EPD is a Cradle-to-Grave study.

**2.3. Estimates and Assumptions**

All estimates and assumptions are within the requirements of ISO 14040/44 and EN 15804+A2. The primary data was collected as annual totals for electricity usage and production volume. The utility usage information was divided by the production to find a utility consumption per kilometer of cable produced.

**2.4. Cut-off Criteria**



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Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit.

## 2.5. Data Sources

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Primary data were collected by facility personnel and from utility bills and was used for all manufacturing processes. Whenever available, supplier data was used for raw materials used in the production process. When primary data did not exist, secondary data for raw material production was utilized from Sphera Managed LCA Content Database 2024.2.

## 2.6. Data Quality

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The geographical scope of the manufacturing portion of all life cycle modules is North America. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent. Time coverage of this data is considered excellent. Primary data provided by the manufacturer is specific to the technology used in manufacturing their product. It is site-specific and considered of good quality. Data necessary to model cradle-to-gate unit processes was sourced from Sphera Managed LCA Content LCI datasets.

## 2.7. Period under Review

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The period under review is the full calendar year 2023.

## 2.8. Allocation

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General principles of allocation were based on ISO 14040/44. To derive a per-unit value for manufacturing inputs such as electricity, thermal energy and water, allocation based on total production by mass was adopted. As a default, secondary Sphera Managed LCA datasets use a physical basis for allocation.



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## 3. Life Cycle Assessment Scenarios

It is assumed that all raw materials are delivered to the manufacturing facility via truck and ship, based on global region. Distances were calculated using the supplier location and the location of manufacturing.

**Table 5. Transport to the building site (A4)**

| NAME   | UNIT              | TRUCK  | RAIL  | SHIP  | AIR                      |
|--|-------------------|--|---|---|--------------------------|
| Vehicle type   |                   | Heavy Heavy-duty Diesel Truck / 53,333 lb payload - 8b | Rail transport cargo – Diesel, average train, gross tonne weight 1,000t/726t payload capacity | Bulk commodity carrier, 1,000 to 250,000 dwt payload capacity, deep sea | Cargo plane, 65t payload |
| Fuel efficiency for full vehicle                               |                   | 42 l/100km   | 1.17E-05 kg / kg  | 15,134 l/100km  | 0.00175 kg / lb          |
| Capacity utilization (including empty runs, mass based)        | %                 | 85   | 40  | 53  | 66                       |
| TRANSPORTATION INFORMATION                                     | UNIT              | NRG-DM   |   | SENZ-WIFI   |                          |
| Transport distance - truck                                     | km                | 2.15E+03   |   | 1.31E+03  |                          |
| Transport distance - ship                                      | km                | -  |   | 1.67E+04  |                          |
| Gross density of products transported                          | kg/m <sup>3</sup> | n/a  |   |   |                          |
| Weight of products transported (if gross density not reported) | kg                | 4.53E-01   |   | 4.17E-01  |                          |
| Volume of products transported (if gross density not reported) | m <sup>3</sup>    | n/a  |   |   |                          |

**Table 6. Installation into the building (A5)**

| NAME   | NRG-DM   | SENZ-WIFI | UNIT              |
|--|----------|-----------|-------------------|
| Ancillary materials  | 0.00E+00 | 0.00E+00  | kg                |
| Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)                        | 0.00E+00 | 0.00E+00  | m <sup>3</sup>    |
| Other resources  | 0.00E+00 | 0.00E+00  | kg                |
| Electricity consumption  | 0.00E+00 | 0.00E+00  | MJ                |
| Other energy carriers  | 0.00E+00 | 0.00E+00  | MJ                |
| Product loss per functional unit   | 0.00E+00 | 0.00E+00  | kg                |
| Waste materials at the construction site before waste processing, generated by product installation                                | 3.07E-01 | 2.53E-01  | kg                |
| Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal) | 0.00E+00 | 0.00E+00  | kg                |
| Biogenic carbon contained in packaging   | 1.32E-01 | 1.09E-01  | kg C              |
| Direct emissions to ambient air, soil and water  | 0.00E+00 | 0.00E+00  | kg                |
| VOC content  | 0.00E+00 | 0.00E+00  | µg/m <sup>3</sup> |



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**Table 7. Reference Service Life**

| NAME  | NRG-DM  | SENZ-WIFI | UNIT                 |
|---|---|-----------|----------------------|
| RSL   | 10  |           | years                |
| Declared product properties (at the gate) and finishes, etc.  | The product is packaged in a cardboard box.   |           | Units as appropriate |
| Design application parameters (if instructed by the manufacturer), including references to the appropriate practices and application codes) | Design in accordance with DIN EN 60730-1 (VDE 0631-1):2012-10; EN 60730-1:2011<br>DIN EN 60730-2-9 (VDE 0631 Teil 2-9):2011-07; EN 60730-2-9:2010 |           |                      |
| An assumed quality of work, when installed in accordance with the manufacturer's instructions   | 10  |           | years                |
| Outdoor environment   | The thermostats should not be used outdoors.  |           |                      |
| Indoor environment: temperature limitation  | +5°C to +40°C. IP21 rating.   |           | °C                   |
| Use conditions  | The thermostat is in use 100% of the time after installation but only operated with a very low frequency.   |           |                      |
| Maintenance   | No replacements are necessary.  |           |                      |

**Table 8. Operational energy use (B6)**

| NAME                            | NRG-DM   | SENZ-WIFI | UNIT  |
|---------------------------------|----------|-----------|-------|
| Lifetime of product             | 10       |           | years |
| Power consumption over lifetime | 1.19E+03 | 7.54E+02  | MJ    |

**Table 9. End of life (C1-C4)**

| NAME  |  | NRG-DM   | SENZ-WIFI | UNIT               |
|---|--|----------|-----------|--------------------|
| Recovery (specified by type)                      | Reuse                                    | 0.00E+00 | 0.00E+00  | kg                 |
|   | Recycling                                | 4.79E-02 | 5.46E-02  | kg                 |
|   | Landfill                                 | 7.47E-02 | 8.11E-02  | kg                 |
|   | Incineration                             | 2.35E-02 | 2.83E-02  | kg                 |
|   | Incineration with energy recovery        | 0.00E+00 | 0.00E+00  | kg                 |
| Disposal (landfill)                               | Product or material for final deposition | 7.47E-02 | 8.11E-02  | kg                 |
| Removals of biogenic carbon (excluding packaging) |  | 0.00E+00 | 0.00E+00  | kg CO <sub>2</sub> |

**Table 10. Reuse, recovery and/or recycling potentials (D), relevant scenario information**

| NAME   | NRG-DM   | SENZ-WIFI | UNIT |
|--|----------|-----------|------|
| Net energy benefit from energy recovery from waste treatment declared as exported energy in C3 (R>0.6)     | 0.00E+00 | 0.00E+00  | MJ   |
| Net energy benefit from thermal energy due to treatment of waste declared as exported energy in C4 (R<0.6) | 2.26E-01 | 2.97E-01  | MJ   |
| Net energy benefit from material flow declared in C3 for energy recovery                                   | 0.00E+00 | 0.00E+00  | MJ   |





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#### 4. Life Cycle Assessment Results

Table 11. Description of the system boundary modules

|                        | PRODUCT STAGE       |           |               | CONSTRUCTION PROCESS STAGE  |                  | USE STAGE |             |        |             |               |  |   | END OF LIFE STAGE |           |                  |          | BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY |
|------------------------|---------------------|-----------|---------------|-----------------------------|------------------|-----------|-------------|--------|-------------|---------------|--|---|-------------------|-----------|------------------|----------|---|
|                        | A1                  | A2        | A3            | A4                          | A5               | B1        | B2          | B3     | B4          | B5            | B6   | B7  | C1                | C2        | C3               | C4       | D   |
|                        | Raw material supply | Transport | Manufacturing | Transport from gate to site | Assembly/Install | Use       | Maintenance | Repair | Replacement | Refurbishment | Building Operational Energy Use During Product Use | Building Operational Water Use During Product Use | Deconstruction    | Transport | Waste processing | Disposal | Reuse, Recovery, Recycling Potential          |
| <b>Cradle to Grave</b> | X                   | X         | X             | X                           | X                | X         | X           | X      | X           | X             | X  | X   | X                 | X         | X                | X        | X   |



4.1 Life Cycle Impact Assessment Results, RAYCHEM NRG-DM

Modules B1-B5, B7 and C1 to be reported were all zero following the calculation, hence have not been included in the results tables for an easier reading experience.

Table 12. EF 3.1 Impact Assessment Results, RAYCHEM NRG-DM, per unit

| EF 3.1  | A1 – A3   | A4       | A5       | B6       | C2       | C3       | C4        | D         |
|---|-----------|----------|----------|----------|----------|----------|-----------|-----------|
| GWP <sub>total</sub> [kg CO <sub>2</sub> eq]    | 6.61E-01  | 3.02E-02 | 6.42E-02 | 1.36E+02 | 1.07E-02 | 5.41E-02 | 1.76E-03  | -1.68E-01 |
| GWP <sub>fossil</sub> [kg CO <sub>2</sub> eq]   | 7.53E-01  | 2.96E-02 | 4.90E-03 | 1.34E+02 | 1.05E-02 | 5.40E-02 | 1.76E-03  | -1.69E-01 |
| GWP <sub>biogenic</sub> [kg CO <sub>2</sub> eq] | -9.37E-02 | 7.14E-05 | 5.92E-02 | 1.88E+00 | 2.53E-05 | 1.67E-06 | -5.83E-06 | 8.84E-04  |
| GWP <sub>land use</sub> [kg CO <sub>2</sub> eq] | 1.85E-03  | 5.03E-04 | 5.74E-05 | 2.63E-02 | 1.78E-04 | 1.72E-06 | 6.43E-06  | -7.43E-04 |
| ODP [kg CFC-11 eq]                              | 7.24E-12  | 4.41E-15 | 3.65E-15 | 4.20E-09 | 1.56E-15 | 9.19E-15 | 5.47E-15  | -2.10E-12 |
| AP [kg SO <sub>2</sub> eq]                      | 2.87E-03  | 3.19E-04 | 4.30E-05 | 2.10E-01 | 1.13E-04 | 2.35E-05 | 1.08E-05  | -2.54E-03 |
| EP <sub>freshwater</sub> [kg N eq]              | 4.02E-06  | 1.28E-07 | 2.02E-07 | 8.38E-04 | 4.53E-08 | 2.38E-09 | 3.98E-07  | -3.90E-07 |
| EP <sub>marine</sub> [kg N eq]                  | 7.51E-04  | 1.61E-04 | 2.25E-05 | 6.55E-02 | 5.70E-05 | 1.08E-05 | 2.61E-06  | -1.47E-04 |
| EP <sub>terrestrial</sub> [kg N eq]             | 8.06E-03  | 1.77E-03 | 2.23E-04 | 6.74E-01 | 6.28E-04 | 1.28E-04 | 2.75E-05  | -1.52E-03 |
| POCP [kg O <sub>3</sub> eq]                     | 2.14E-03  | 3.05E-04 | 5.11E-05 | 1.58E-01 | 1.08E-04 | 2.81E-05 | 7.90E-06  | -5.19E-04 |
| ADP <sub>element</sub> [kg Sb-eq]               | 4.98E-05  | 2.61E-09 | 3.51E-10 | 2.82E-05 | 9.24E-10 | 9.81E-11 | 1.25E-10  | -1.15E-04 |
| ADP <sub>fossil</sub> [MJ, LHV]                 | 1.40E+01  | 3.94E-01 | 6.71E-02 | 1.88E+03 | 1.40E-01 | 2.09E-02 | 2.92E-02  | -2.09E+00 |
| WDP [m <sup>3</sup> ]                           | 1.34E-01  | 4.63E-04 | 1.73E-04 | 4.34E+00 | 1.64E-04 | 5.98E-03 | 2.07E-04  | -8.89E-02 |

Table 13. Resource Use Indicators, RAYCHEM NRG-DM, per unit

| PARAMETER            | A1 – A3  | A4       | A5       | B6       | C2       | C3       | C4       | D         |
|----------------------|----------|----------|----------|----------|----------|----------|----------|-----------|
| PERE [MJ]            | 5.14E+00 | 3.39E-02 | 6.17E-03 | 2.02E+03 | 1.20E-02 | 5.14E-03 | 4.29E-03 | -8.73E-01 |
| PERM [MJ]            | 1.15E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| PERT [MJ]            | 5.25E+00 | 3.39E-02 | 6.17E-03 | 2.02E+03 | 1.20E-02 | 5.14E-03 | 4.29E-03 | -8.73E-01 |
| PENRE [MJ]           | 1.03E+01 | 3.94E-01 | 6.71E-02 | 1.88E+03 | 1.40E-01 | 2.09E-02 | 2.92E-02 | -2.09E+00 |
| PENRM [MJ]           | 3.76E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| PENRT [MJ]           | 1.40E+01 | 3.94E-01 | 6.71E-02 | 1.88E+03 | 1.40E-01 | 2.09E-02 | 2.92E-02 | -2.09E+00 |
| SM [kg]              | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| FW [m <sup>3</sup> ] | 4.82E-03 | 3.78E-05 | 7.78E-06 | 6.35E-01 | 1.34E-05 | 1.41E-04 | 6.29E-06 | -1.58E-03 |

Table 14. Output Flows and Waste Categories, RAYCHEM NRG-DM, per unit

| PARAMETER | A1 – A3  | A4       | A5       | B6       | C2       | C3       | C4       | D         |
|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|
| HWD [kg]  | 1.39E-06 | 1.51E-11 | 5.88E-12 | 4.64E-06 | 5.35E-12 | 1.11E-11 | 7.08E-12 | -1.32E-07 |
| NHWD [kg] | 2.80E-02 | 6.44E-05 | 1.74E-02 | 1.90E+00 | 2.28E-05 | 3.40E-03 | 7.46E-02 | 8.82E-02  |
| RWD [kg]  | 2.97E-04 | 7.18E-07 | 3.74E-07 | 1.80E-01 | 2.55E-07 | 7.20E-07 | 3.93E-07 | -1.58E-05 |
| CRU [kg]  | 1.51E-02 | 0.00E+00 | 2.36E-02 | 0.00E+00 | 0.00E+00 | 4.79E-02 | 0.00E+00 | 0.00E+00  |

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|          |          |          |          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| MFR [kg] | 4.08E-03 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.25E-01 |
| EEE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.26E-01 |
| EET [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

**Table 15. Additional Indicators, RAYCHEM, NRG-DM, per unit**

| PARAMETER              | A1 – A3  | A4       | A5       | B6       | C2       | C3       | C4       | D         |
|------------------------|----------|----------|----------|----------|----------|----------|----------|-----------|
| PM [disease incidence] | 3.38E-08 | 3.12E-09 | 4.20E-10 | 1.65E-06 | 1.11E-09 | 1.17E-10 | 1.19E-10 | -2.05E-08 |
| IRP [kBq U235 eq]      | 3.12E-02 | 1.04E-04 | 5.55E-05 | 1.92E+01 | 3.69E-05 | 1.03E-04 | 5.26E-05 | -1.81E-03 |
| ETP [CTUe]             | 1.01E+01 | 2.93E-01 | 4.95E-02 | 6.97E+02 | 1.04E-01 | 1.21E-02 | 3.63E-02 | -1.46E+00 |
| HTCE [CTUh]            | 3.48E-10 | 5.96E-12 | 1.06E-12 | 3.99E-08 | 2.11E-12 | 6.07E-13 | 6.40E-13 | -1.08E-10 |
| HTnCE [CTUh]           | 7.53E-09 | 2.66E-10 | 7.55E-11 | 5.49E-07 | 9.43E-11 | 4.95E-11 | 1.58E-11 | -2.92E-09 |
| LU [Pt]                | 1.42E+01 | 1.94E-01 | 2.35E-02 | 1.32E+03 | 6.88E-02 | 5.17E-03 | 4.90E-03 | -1.85E+00 |

## 4.2 Life Cycle Impact Assessment Results, RAYCHEM SENZ-WIFI

Modules B1-B5, B7 and C1 to be reported were all zero following the calculation, hence have not been included in the results tables for an easier reading experience.

**Table 16. EF 3.1 Impact Assessment Results, RAYCHEM SENZ-WIFI, per unit**

| EF 3.1  | A1 – A3   | A4       | A5       | B6       | C2       | C3       | C4        | D         |
|---|-----------|----------|----------|----------|----------|----------|-----------|-----------|
| GWP <sub>total</sub> [kg CO <sub>2</sub> eq]    | 7.12E-01  | 3.85E-02 | 6.42E-02 | 8.65E+01 | 1.20E-02 | 6.19E-02 | 1.93E-03  | -1.96E-01 |
| GWP <sub>fossil</sub> [kg CO <sub>2</sub> eq]   | 7.95E-01  | 3.82E-02 | 4.54E-03 | 8.53E+01 | 1.18E-02 | 6.19E-02 | 1.93E-03  | -1.96E-01 |
| GWP <sub>biogenic</sub> [kg CO <sub>2</sub> eq] | -8.45E-02 | 4.75E-05 | 5.96E-02 | 1.20E+00 | 2.85E-05 | 2.88E-06 | -6.35E-06 | 9.38E-04  |
| GWP <sub>land use</sub> [kg CO <sub>2</sub> eq] | 1.89E-03  | 3.31E-04 | 5.31E-05 | 1.67E-02 | 2.00E-04 | 1.33E-06 | 7.07E-06  | -8.50E-04 |
| ODP [kg CFC-11 eq]                              | 7.74E-12  | 5.13E-15 | 3.38E-15 | 2.68E-09 | 1.76E-15 | 8.79E-15 | 6.04E-15  | -3.16E-12 |
| AP [kg SO <sub>2</sub> eq]                      | 3.45E-03  | 5.58E-04 | 4.06E-05 | 1.34E-01 | 1.27E-04 | 3.95E-05 | 1.18E-05  | -2.65E-03 |
| EP <sub>freshwater</sub> [kg N eq]              | 4.17E-06  | 8.83E-08 | 1.41E-07 | 5.33E-04 | 5.09E-08 | 2.41E-09 | 4.79E-07  | -4.37E-07 |
| EP <sub>marine</sub> [kg N eq]                  | 7.95E-04  | 2.53E-04 | 2.50E-05 | 4.17E-02 | 6.40E-05 | 1.92E-05 | 2.85E-06  | -1.64E-04 |
| EP <sub>terrestrial</sub> [kg N eq]             | 8.46E-03  | 2.78E-03 | 2.11E-04 | 4.29E-01 | 7.06E-04 | 2.20E-04 | 3.01E-05  | -1.69E-03 |
| POCP [kg O <sub>3</sub> eq]                     | 2.31E-03  | 6.03E-04 | 5.04E-05 | 1.00E-01 | 1.21E-04 | 4.93E-05 | 8.65E-06  | -5.74E-04 |
| ADP <sub>element</sub> [kg Sb-eq]               | 1.35E-04  | 3.89E-09 | 3.25E-10 | 1.80E-05 | 1.04E-09 | 9.67E-11 | 1.37E-10  | -1.18E-04 |
| ADP <sub>fossil</sub> [MJ, LHV]                 | 1.40E+01  | 4.81E-01 | 6.21E-02 | 1.20E+03 | 1.57E-01 | 2.18E-02 | 3.21E-02  | -2.68E+00 |
| WDP [m <sup>3</sup> ]                           | 1.81E-01  | 3.83E-04 | 1.90E-04 | 2.76E+00 | 1.85E-04 | 7.49E-03 | 2.29E-04  | -9.37E-02 |



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**Table 17. Resource Use Indicators, RAYCHEM SENZ-WIFI, per unit**

| PARAMETER  | A1 – A3  | A4       | A5       | B6       | C2       | C3       | C4       | D         |
|------------|----------|----------|----------|----------|----------|----------|----------|-----------|
| PERE [MJ]  | 4.35E+00 | 2.42E-02 | 5.71E-03 | 1.28E+03 | 1.35E-02 | 5.04E-03 | 4.73E-03 | -1.12E+00 |
| PERM [MJ]  | 8.00E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| PERT [MJ]  | 4.43E+00 | 2.42E-02 | 5.71E-03 | 1.28E+03 | 1.35E-02 | 5.04E-03 | 4.73E-03 | -1.12E+00 |
| PENRE [MJ] | 1.08E+01 | 4.81E-01 | 6.21E-02 | 1.20E+03 | 1.57E-01 | 2.18E-02 | 3.21E-02 | -2.68E+00 |
| PENRM [MJ] | 3.23E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| PENRT [MJ] | 1.40E+01 | 4.81E-01 | 6.21E-02 | 1.20E+03 | 1.57E-01 | 2.18E-02 | 3.21E-02 | -2.68E+00 |
| SM [kg]    | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| FW [m³]    | 7.38E-03 | 2.77E-05 | 7.90E-06 | 4.04E-01 | 1.51E-05 | 1.76E-04 | 6.95E-06 | -1.71E-03 |

**Table 18. Output Flows and Waste Categories, RAYCHEM SENZ-WIFI, per unit**

| PARAMETER | A1 – A3  | A4       | A5       | B6       | C2       | C3       | C4       | D         |
|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|
| HWD [kg]  | 1.67E-06 | 4.03E-11 | 5.44E-12 | 2.95E-06 | 6.01E-12 | 1.08E-11 | 7.80E-12 | -2.49E-07 |
| NHWD [kg] | 2.67E-02 | 5.49E-05 | 1.47E-02 | 1.21E+00 | 2.56E-05 | 2.76E-03 | 8.10E-02 | 9.08E-02  |
| RWD [kg]  | 3.14E-04 | 1.09E-06 | 3.47E-07 | 1.15E-01 | 2.86E-07 | 7.67E-07 | 4.34E-07 | -1.81E-05 |
| CRU [kg]  | 4.46E-03 | 0.00E+00 | 2.18E-02 | 0.00E+00 | 0.00E+00 | 5.46E-02 | 0.00E+00 | 0.00E+00  |
| MFR [kg]  | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| MER [kg]  | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.64E-01  |
| EEE [MJ]  | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.97E-01  |
| EET [MJ]  | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |

**Table 19. Additional Indicators, RAYCHEM SENZ-WIFI, per unit**

| PARAMETER              | A1 – A3  | A4       | A5       | B6       | C2       | C3       | C4       | D         |
|------------------------|----------|----------|----------|----------|----------|----------|----------|-----------|
| PM [disease incidence] | 4.62E-08 | 1.13E-08 | 3.95E-10 | 1.05E-06 | 1.24E-09 | 1.59E-10 | 1.31E-10 | -2.14E-08 |
| IRP [kBq U235 eq]      | 3.21E-02 | 1.20E-04 | 5.14E-05 | 1.22E+01 | 4.15E-05 | 1.13E-04 | 5.82E-05 | -2.01E-03 |
| ETP [CTUe]             | 8.24E+00 | 3.65E-01 | 5.82E-02 | 4.44E+02 | 1.17E-01 | 1.10E-02 | 4.18E-02 | -1.74E+00 |
| HTCE [CTUh]            | 3.79E-10 | 6.75E-12 | 9.91E-13 | 2.54E-08 | 2.37E-12 | 5.63E-13 | 7.25E-13 | -1.30E-10 |
| HTnCE [CTUh]           | 8.87E-09 | 2.28E-10 | 7.79E-11 | 3.50E-07 | 1.06E-10 | 4.68E-11 | 1.77E-11 | -3.23E-09 |
| LU [Pt]                | 9.69E+00 | 1.28E-01 | 2.17E-02 | 8.37E+02 | 7.72E-02 | 5.14E-03 | 5.40E-03 | -1.91E+00 |



## 5. LCA Interpretation

The use stage (B6) contributes to the majority impacts across the life cycle stages, and across all indicators, except for ADP - elements, as shown in Figure 3. This is due to the electricity consumed during the use of the product over its lifetime of 20 years. For the abiotic depletion potential, the manufacturing stage is the largest contributor, due to the raw materials inputs to manufacturing.

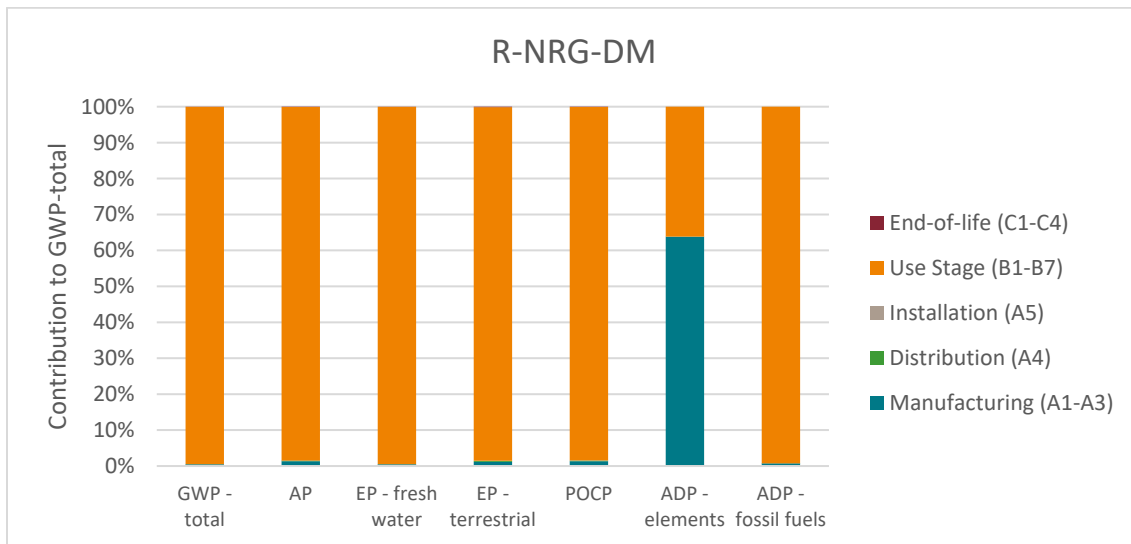


Figure 3: LCA Results for NRG-DM, by life cycle stage

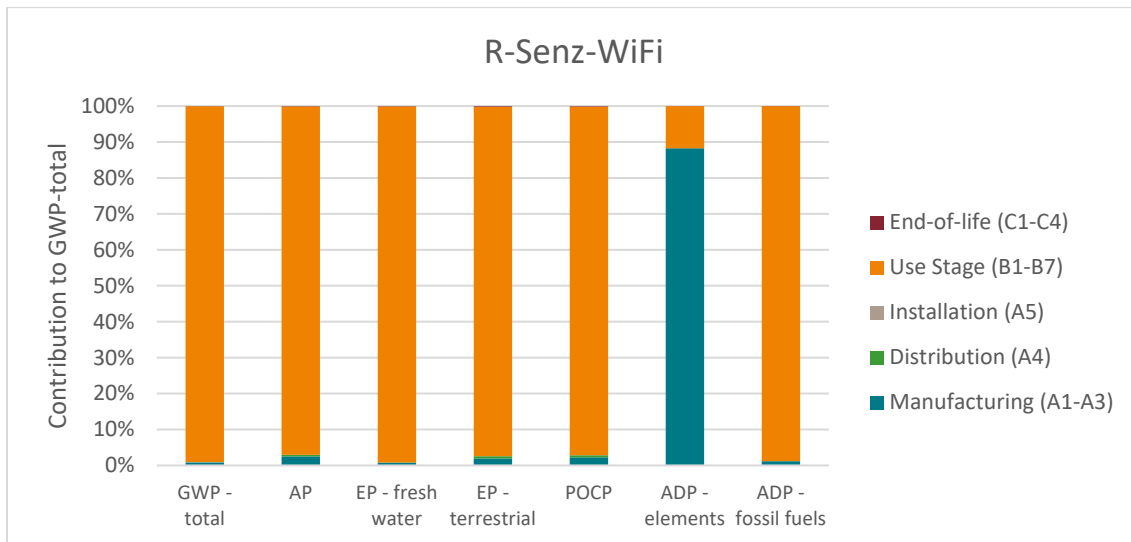


Figure 4: LCA Results for SENZ-WIFI, by life cycle stage



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## 6. Environment and Health During Installation

Further information about the product installation can be found on the Chemelex RAYCHEM website product page:  
<https://www.nvent.com/en-gb/raychem/products/nrg-dm-digital-timer-thermostat-0>

<https://www.nvent.com/en-dz/raychem/products/senz-wifi-digital-timer-thermostat-0>

### 6.1 Environmental Activities and Certifications

The manufacturing site holds the following certifications:

- EN ISO 9001 quality management certified - since 2002
- ISO 14001 and 45001
- IPC-A-610 Acceptability of Electronics Assemblies Endorsement Program
- IPC-7711B/-7721 Repair and Modification of Printed Boards and Electronic Assemblies
- IPC-J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies
- DIN EN ISO / IEC80079-34 Explosive atmospheres: Application of quality management systems for Ex Product manufacture

The carbon emissions of the NRG-DM products associated with their raw materials and manufacturing processes (cradle-to-gate) are offset using third-party RECs that support renewable energy to help reduce their environmental impacts.

### 6.2 Further Information

Further information about the product can be found on the Chemelex RAYCHEM website product page:

<https://www.nvent.com/en-gb/raychem/products/nrg-dm-digital-timer-thermostat-0>

<https://www.nvent.com/en-dz/raychem/products/senz-wifi-digital-timer-thermostat-0>





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## 7. References

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