



PEP Ecopassport[®]

Product Environmental Profile-Ascend[®] Model ACRC Chillers with Integrated Free Cooling
DECEMBER 2024 RN TRNE-10001-V01.02-EN



Product Environmental Profile - PEP Ecopassport.
 Document in compliance with ISO 14025: 2006 "Environmental labels and declarations. Type III environmental declarations."

Company	Trane Technologies
Contact Information	TraneCommercialEPD@tranetechnologies.com
Registration Number	TRNE-10001-V01.02-EN

Company Description

Trane Technologies® is a world leader in heating and cooling systems, services, and solutions. Together with our brands, Trane® and Thermo King®, we bring efficient and sustainable climate innovations to buildings, homes, and transportation.

Trane helps customers succeed by providing innovative solutions that optimize indoor environments through a broad portfolio of energy-efficient heating, ventilating, and air conditioning systems, buildings, contracting and energy services, parts support, and advanced controls for homes and commercial buildings.

Trane serves engineers, contractors, and building owners on all continents and in an array of markets including education, healthcare, government, industrial/ manufacturing, data centers, lodging, retail, and commercial real estate. With more than 900 U.S. patents to date, Trane creates comfortable and energy-efficient environments around the world.

Trane systems and services have a reputation for reliability, high quality, and advanced innovation; and are available through a powerful distribution network. Trane employees and distributors are respected industry-wide for their skills and performance in designing, manufacturing, marketing, and supporting commercial and residential systems.

Product Information	
Reference Product	Ascend® Model ACRC with Integrated Free Cooling
Product Description	<p>Ascend® Model ACRC A combination of high-energy efficiency and quiet performance</p> <p>Trane model ACR air-cooled chillers deliver an industry leading combination of part-load and full-load efficiencies, while offering multiple sound reduction options for noise sensitive installations.</p> <ul style="list-style-type: none"> Capacity range: 150 to 550 tons Integrated Free Cooling—a factory installed and integrated water side economizer to help save on first cost, installation cost and energy cost throughout the life of the asset. Rapid Restart™ capability—After a power interruption, ACR chillers can quickly regain full operational capacity, so mission-critical applications can continue with reduced interruption. Optional harmonic filtration system—A filter design provides the harmonic solution to meet the requirements of IEEE® 519, reducing harmonic distortion to 5% or less total demand distortion (TDD). Maintenance-free, long-life motors—ACR chillers' compressor and condenser fans are powered by variable speed, permanent magnet motors that require no periodic maintenance and are designed for exceptionally long operational life. Transverse "open V" design condenser coils—This design allows easier cleaning of the condenser coils from the inside out, to keep the coils and the chiller properly functioning. Trane Intelligent Services® enabled—ACR chillers can be remotely monitored by Trane Intelligent Services (TIS) 24 hours a day. Enabled by Symbio® 800 with adaptive controls - Reliable controller platform with proven algorithms to ensure smooth operations. The ACR chiller's design is enhanced with the next-generation, low-global warming refrigerant R-513A. Light weight, anti-corrosive microchannel condenser coils lower refrigerant charge.
Functional Unit	To produce 1 kW of cooling, according to the appropriate usage scenario defined in the EN 14825 standard and during the 22-year reference lifetime of the product
Other Products Covered	List of other products covered in this PEP is presented in the section which concerned the extrapolation rules
Reference Lifetime*	22 Years

*Reference lifetime was defined as 22 years by the Product Category Rules which governed this analysis.

Technical Characteristics	
Data Point	Ascend® Model ACRC with Integrated Free Cooling
Chiller Technology	Air to water
Reversible or Non-reversible	Non-reversible
Cooling Capacity*	1043 kW
SCOP or SEER*	SEER = 5.29 kW/kW
Refrigerant Used	R-513A
Refill Threshold**	90%

*Note: Per the Product Category Rules and Product Specific Rules, chiller capacity and SEER must be calculated per European EN 14825 standards. These values and test conditions differ from ASHRAE and AHRI standards typically used in North America. They also do not take into account the use of free cooling in certain applications. For North America applications, please refer to existing product literature for other product capacity and efficiency metrics best befitting those local standards and test conditions. Do not use these values as substitutes or replacements for those other values.

**Refill threshold denotes the ratio of refrigerant (expressed as a %) at which a refill back up to the original charge takes place. Per the Product Category Rules, the refill threshold is considered 90% by default.

Constituent Materials >> Total weight of the reference product: 11,670 kg					
Plastics as % of weight		Metals as % of weight		Others as % of weight	
Product only: 11,670 kg					
Thermoplastic polyolefins	1.6%	Steel	63.7%	Refrigerant	2.1%
Other plastics	1.8%	Aluminum	12.7%	Other miscellaneous	2.4%
		Other metals	15.7%		
Packaging only: 0 kg					
	0%		0%		0%
Total plastics	3.4%	Total metals	92.1%	Total others	4.5%

Life Cycle Stages	
Manufacturing	The manufacturing stage includes the production of raw and intermediate materials, as well as transportation to the manufacturer's last logistic platform of ACRC Chillers. The final assembly of the product is carried out at Trane's plant in Pueblo, Colorado, USA. As a member of SteelZero, Trane has pledged to procure, specify or stock 50% net-zero steel by 2030 and 100% net-zero steel by 2050; the Pueblo facility is one of the first to begin to utilize this low-carbon steel. The main process steps for production include cutting, rolling, machining, brazing, welding, painting, sub- and final assemblies, and end-of-the-line testing.
Distribution	The transport from Trane's manufacturing facility to the customer was considered. The distance was calculated using averages for all shipped orders in 2023.
Installation	The installation stage includes diesel used to fuel machinery used to move and place the product during installation. This unit is typically shipped without any required packaging, so no modeling of packaging disposal was required.
Use	The use stage is conducted in alignment with the PSR, which models energy use associated with comfort cooling applications. This chiller can be equipped with integrated free cooling, which will help to significantly reduce product energy usage during operation during times of lower outdoor temperatures in a process cooling application requiring cooling all year round like data centers. Refrigerant replacement and electricity usage are both considered in this stage.
End of Life	The end-of-life stage includes transportation to the end-of-life facility of the disposal of product. End of life fates were modeled by material for the region where they are being disposed, in this case the United States. Impacts associated with recycling of the product were modeled via the cut off approach.
Benefits and loads beyond the system boundaries	Throughout the life cycle of the product, net loads and benefits beyond system boundaries are included.

Data Quality and Software	
Geographical Representativeness	The geographical scope of this PEP is North America.
Temporal Representativeness	Primary data was collected from 2023. Secondary data refers to the Sphera MLC published in 2024. The temporal coverage for each secondary process used in the LCA model is specified in the metadata section of the MLC database.
Technological Representativeness	Overall technology representativeness is considered good.
Software and Database Used	Sphera LCA for Experts 10.8.0.14 Sphera Managed LCA Content 2024.1

Energy Model Used	
Manufacturing	Manufacturing electricity considers the eGRID specific region from which the product is being manufactured from Sphera's MLC. Natural gas used during manufacturing is country specific, in this case the United States.
Distribution	No energy consumption occurs during the distribution stage.
Installation	No energy consumption occurs during the installation stage.
Use	Use stage electricity is modeled using an average United States grid mix dataset.
End of Life	No energy consumption occurs during the end of life stage.
Benefits and loads beyond the system boundaries	End of life benefits consider average US electricity.

Environmental Impacts

per kW corresponding to the functional unit									
Environmental Impact Indicators		Total Life Cycle Impacts (Excluding Module D)		Manufacturing A1-A3	Distribution A4	Installation A5	Use B1-B7	End of Life C1-C4	Module D
Climate change - total	GWP	1.30E+03	kg CO2 eq	5.02E+01	1.99E+00	6.54E-03	1.23E+03	1.64E+01	-1.48E+01
Climate change - fossil fuels	GWPf	1.30E+03	kg CO2 eq	5.04E+01	1.99E+00	6.54E-03	1.23E+03	1.63E+01	-1.48E+01
Climate change - biogenics	GWPb	-5.36E-02	kg CO2 eq	-3.53E-01	-2.14E-03	0.00E+00	2.29E-01	7.26E-02	5.10E-02
Climate change - land use and land use transformation	GWPlu	1.88E-01	kg CO2 eq	7.77E-02	1.11E-03	0.00E+00	1.10E-01	1.12E-04	-4.34E-02
Ozone depletion	ODP	7.34E-09	kg CFC-11 eq	1.39E-10	2.94E-13	1.83E-13	7.20E-09	6.54E-13	-7.62E-12
Acidification	AP	1.80E+00	mole of H+ eq	1.95E-01	9.91E-03	9.73E-05	1.59E+00	1.28E-03	-8.70E-02
Eutrophication, freshwater	Epf	9.19E-04	kg P eq	2.00E-04	1.01E-05	2.01E-09	7.07E-04	1.81E-06	-1.98E-05
Eutrophication, marine aquatic	Epm	4.00E-01	kg of N eq	3.56E-02	4.94E-03	4.47E-05	3.58E-01	5.17E-04	-1.11E-02
Eutrophication, terrestrial	Ept	4.33E+00	mole of N eq	3.83E-01	5.45E-02	4.88E-04	3.89E+00	5.71E-03	-1.17E-01
Photochemical ozone formation	POCP	1.16E+00	kg NMVOC eq	1.02E-01	1.01E-02	1.23E-04	1.05E+00	1.19E-03	-3.56E-02
Abiotic resource depletion – elements	ADPe	3.40E-03	kg Sb eq	3.17E-03	2.62E-07	0.00E+00	2.30E-04	-8.47E-09	-1.39E-03
Abiotic resource depletion – fossil fuels	ADPf	2.05E+04	MJ	5.76E+02	2.63E+01	9.03E-02	1.99E+04	4.87E+00	-1.64E+02
Water use	WU	2.80E+02	m3 world eq	1.01E+01	1.19E-01	0.00E+00	2.69E+02	1.90E-01	-3.81E+00

per kW corresponding to the functional unit									
Inventory Flow Indicators		Total Life Cycle Impacts (Excluding Module D)		Manufacturing A1-A3	Distribution A4	Installation A5	Use B1-B7	End of Life C1-C4	Module D
Use of renewable primary energy, excluding renewable primary energy resources used as raw materials	ERP	5.53E+03	MJ	1.52E+02	1.16E+00	0.00E+00	5.38E+03	4.47E-01	-5.57E+01
Use of renewable primary energy resources used as raw materials	ERM	8.07E+00	MJ	8.07E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy resources	ER	5.54E+03	MJ	1.60E+02	1.16E+00	0.00E+00	5.38E+03	4.47E-01	-5.57E+01
Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials	ENRP	2.05E+04	MJ	5.54E+02	2.63E+01	9.03E-02	1.99E+04	4.87E+00	-1.65E+02
Use of non-renewable primary energy resources used as raw materials	ENRM	2.41E+01	MJ	2.41E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources	ENR	2.05E+04	MJ	5.78E+02	2.63E+01	9.03E-02	1.99E+04	4.87E+00	-1.65E+02
Use of secondary materials	USM	4.72E+00	kg	4.72E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	URSF	0.00E+00	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	UNRSF	0.00E+00	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy	RE	0.00E+00	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water	NUFW	8.97E+00	m3	7.45E-01	3.87E-03	0.00E+00	8.22E+00	4.44E-03	-6.41E-01
Hazardous waste disposed	HWD	2.01E-05	kg	9.20E-06	3.55E-09	0.00E+00	1.08E-05	1.02E-09	-3.90E-07
Non-hazardous waste disposed	NHWD	1.33E+01	kg	5.21E+00	2.62E-03	0.00E+00	6.75E+00	1.34E+00	-2.40E+00
Radioactive waste disposed	RWD	2.04E+00	kg	1.25E-02	7.94E-05	0.00E+00	2.03E+00	1.50E-04	-1.60E-03
Components for re-use	CRU	0.00E+00	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	MRE	8.89E+00	kg	8.92E-01	0.00E+00	0.00E+00	0.00E+00	8.00E+00	0.00E+00

Materials for energy recovery	MER	0.00E+00	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	EE	2.24E+00	MJ	1.86E-01	0.00E+00	0.00E+00	0.00E+00	2.06E+00	0.00E+00

Per device corresponding to the reference product									
Environmental Impact Indicators		Total Life Cycle Impacts (Excluding Module D)		Manufacturing A1-A3	Distribution A4	Installation A5	Use B1-B7	End of Life C1-C4	Module D
Climate change - total	GWP	1.35E+06	kg CO2 eq	5.23E+04	2.08E+03	6.82E+00	1.28E+06	1.71E+04	-1.55E+04
Climate change - fossil fuels	GWPf	1.35E+06	kg CO2 eq	5.26E+04	2.08E+03	6.82E+00	1.28E+06	1.70E+04	-1.55E+04
Climate change - biogenics	GWPb	-5.60E+01	kg CO2 eq	-3.69E+02	-2.24E+00	0.00E+00	2.39E+02	7.58E+01	5.32E+01
Climate change - land use and land use transformation	GWPlu	1.97E+02	kg CO2 eq	8.11E+01	1.16E+00	0.00E+00	1.14E+02	1.16E-01	-4.52E+01
Ozone depletion	ODP	7.66E-06	kg CFC-11 eq	1.45E-07	3.06E-10	1.91E-10	7.51E-06	6.83E-10	-7.96E-09
Acidification	AP	1.88E+03	mole of H+ eq	2.03E+02	1.03E+01	1.02E-01	1.66E+03	1.33E+00	-9.08E+01
Eutrophication, freshwater	Epf	9.59E-01	kg P eq	2.09E-01	1.06E-02	2.09E-06	7.38E-01	1.89E-03	-2.06E-02
Eutrophication, marine aquatic	Epm	4.17E+02	kg of N eq	3.72E+01	5.16E+00	4.66E-02	3.74E+02	5.40E-01	-1.15E+01
Eutrophication, terrestrial	Ept	4.52E+03	mole of N eq	4.00E+02	5.69E+01	5.10E-01	4.06E+03	5.96E+00	-1.22E+02
Photochemical ozone formation	POCP	1.21E+03	kg NMVOC eq	1.07E+02	1.06E+01	1.28E-01	1.09E+03	1.24E+00	-3.72E+01
Abiotic resource depletion – elements	ADPe	3.55E+00	kg Sb eq	3.31E+00	2.74E-04	0.00E+00	2.40E-01	-8.84E-06	-1.45E+00
Abiotic resource depletion – fossil fuels	ADPf	2.14E+07	MJ	6.02E+05	2.75E+04	9.42E+01	2.07E+07	5.08E+03	-1.71E+05
Water use	WU	2.92E+05	m3 world eq	1.05E+04	1.24E+02	0.00E+00	2.81E+05	1.99E+02	-3.97E+03

Per device corresponding to the reference product									
Inventory Flow Indicators		Total Life Cycle Impacts (Excluding Module D)		Manufacturing A1-A3	Distribution A4	Installation A5	Use B1-B7	End of Life C1-C4	Module D
Use of renewable primary energy, excluding renewable primary energy resources used as raw materials	ERP	5.78E+06	MJ	1.58E+05	1.22E+03	0.00E+00	5.62E+06	4.66E+02	-5.81E+04
Use of renewable primary energy resources used as raw materials	ERM	8.43E+03	MJ	8.43E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy resources	ER	5.78E+06	MJ	1.67E+05	1.22E+03	0.00E+00	5.62E+06	4.66E+02	-5.81E+04
Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials	ENRP	2.13E+07	MJ	5.78E+05	2.75E+04	9.42E+01	2.07E+07	5.08E+03	-1.72E+05
Use of non-renewable primary energy resources used as raw materials	ENRM	2.52E+04	MJ	2.52E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources	ENR	2.14E+07	MJ	6.04E+05	2.75E+04	9.42E+01	2.07E+07	5.08E+03	-1.72E+05
Use of secondary materials	USM	4.93E+03	kg	4.93E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	URSF	0.00E+00	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	UNRSF	0.00E+00	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy	RE	0.00E+00	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water	NUFW	9.36E+03	m3	7.77E+02	4.04E+00	0.00E+00	8.58E+03	4.64E+00	-6.69E+02
Hazardous waste disposed	HWD	2.09E-02	kg	9.60E-03	3.70E-06	0.00E+00	1.13E-02	1.07E-06	-4.07E-04
Non-hazardous waste disposed	NHWD	1.39E+04	kg	5.44E+03	2.74E+00	0.00E+00	7.04E+03	1.40E+03	-2.51E+03
Radioactive waste disposed	RWD	2.13E+03	kg	1.30E+01	8.28E-02	0.00E+00	2.12E+03	1.57E-01	-1.67E+00
Components for re-use	CRU	0.00E+00	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	MRE	9.28E+03	kg	9.31E+02	0.00E+00	0.00E+00	0.00E+00	8.35E+03	0.00E+00
Materials for energy recovery	MER	0.00E+00	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	EE	2.34E+03	MJ	1.94E+02	0.00E+00	0.00E+00	0.00E+00	2.15E+03	0.00E+00

Extrapolation Factors

ACRC products are part of a homogenous family of Trane chillers. Additional products covered by this PEP are detailed below, with the reference product denoted in blue. Extrapolation factors are provided for units both with and without free cooling, aside from ACRC 150, ACRC 375, and ACRC 440 as free cooling is not an option for these products.

ACRC 150
ACRC 165
ACRC 180
ACRC 200
ACRC 225
ACRC 250
ACRC 275
ACRC 300
ACRC 330
ACRC 375
ACRC 380
ACRC 440
ACRC 450
ACRC 500
ACRC 550

For products other than the reference product, the environmental impacts can be calculated using the below extrapolation rules. The following tables contain factors to be used in the extrapolation of LCIA results for the ACRC Chillers covered in this report. These scaling factors are intended to allow interested parties to determine the environmental impacts of ACRC products of interest.

To use these scaling factors, individuals should:

1. Identify the LCIA result of interest and product of interest.
2. Multiply the results in the reference product's environmental impact indicator table, found on page 4-6, by the corresponding cell in the table that pertains to the product of interest, found below.

Product	Extrapolation Factors - Functional Unit					Extrapolation Factors - Declared Unit					
	A1-A3	A4	A5	B1-B7	C1-C4	A1-A3	A4	A5	B1-B7	C1-C4	
With Free Cooling	ACRC 165	1.34	1.34	1.83	1.03	1.34	0.73	0.73	1.00	0.56	0.73
	ACRC 180	1.30	1.30	1.70	1.04	1.30	0.77	0.77	1.00	0.61	0.77
	ACRC 200	1.24	1.24	1.53	1.03	1.24	0.81	0.81	1.00	0.67	0.81
	ACRC 225	1.14	1.14	1.31	1.01	1.14	0.87	0.87	1.00	0.77	0.87
	ACRC 250	1.07	1.07	1.21	1.02	1.07	0.88	0.88	1.00	0.84	0.88
	ACRC 275	1.14	1.14	1.11	1.00	1.14	1.03	1.03	1.00	0.90	1.03
	ACRC 300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	ACRC 330	0.94	0.94	0.92	1.00	0.94	1.02	1.02	1.00	1.09	1.02
	ACRC 380	1.02	1.02	0.78	1.02	1.02	1.30	1.30	1.00	1.30	1.30
	ACRC 450	0.90	0.90	0.69	1.03	0.90	1.30	1.30	1.00	1.49	1.30
	ACRC 500	0.85	0.85	0.63	1.05	0.85	1.34	1.34	1.00	1.66	1.34
ACRC 550	0.75	0.75	0.56	1.07	0.75	1.34	1.34	1.00	1.91	1.34	
Without Free Cooling	ACRC 150	0.96	0.96	2.05	1.03	0.96	0.47	0.47	1.00	0.50	0.47
	ACRC 165	0.93	0.93	1.83	1.03	0.93	0.51	0.51	1.00	0.56	0.51
	ACRC 180	0.88	0.88	1.70	1.04	0.88	0.52	0.52	1.00	0.61	0.52
	ACRC 200	0.87	0.87	1.53	1.03	0.87	0.57	0.57	1.00	0.67	0.57
	ACRC 225	0.81	0.81	1.31	1.01	0.81	0.62	0.62	1.00	0.77	0.62
	ACRC 250	0.77	0.77	1.21	1.02	0.77	0.63	0.63	1.00	0.84	0.63
	ACRC 275	0.75	0.75	1.11	1.00	0.75	0.68	0.68	1.00	0.90	0.68
	ACRC 300	0.72	0.72	1.00	1.00	0.72	0.72	0.72	1.00	1.00	0.72
	ACRC 330	0.68	0.68	0.92	1.00	0.68	0.74	0.74	1.00	1.09	0.74
	ACRC 375	0.79	0.79	0.80	1.04	0.79	0.99	0.99	1.00	1.30	0.99
	ACRC 380	0.77	0.77	0.78	1.02	0.77	0.98	0.98	1.00	1.30	0.98

	ACRC 440	0.70	0.70	0.71	1.06	0.70	0.99	0.99	1.00	1.50	0.99
	ACRC 450	0.68	0.68	0.69	1.03	0.68	0.98	0.98	1.00	1.49	0.98
	ACRC 500	0.67	0.67	0.63	1.05	0.67	1.07	1.07	1.00	1.66	1.07
	ACRC 550	0.60	0.60	0.56	1.07	0.60	1.07	1.07	1.00	1.91	1.07

Comparability

EPDs published within the same product category, though originating from different programs, may not be comparable. Full conformance with a PCR allows PEP comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible.

References

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