Connected heat pumps in the Netherlands – update 2023

Market insight on flexible connected heat pumps

FLEXIBLEPOWER ALLIANCE NETWORK

TKI URBAN ENERGY
Topsector Energie

LCPDelta

This report was commissioned by the Flexiblepower Alliance Network and Netherlands Enterprise Agency (RVO) for the Energy top sector at the request of TKI Urban Energy.

Research was carried out by LCP Delta, reviewed and supported by Flexiblepower Alliance Network (FAN)

Connected heat pumps in the Netherlands – Update 2023

February 2023

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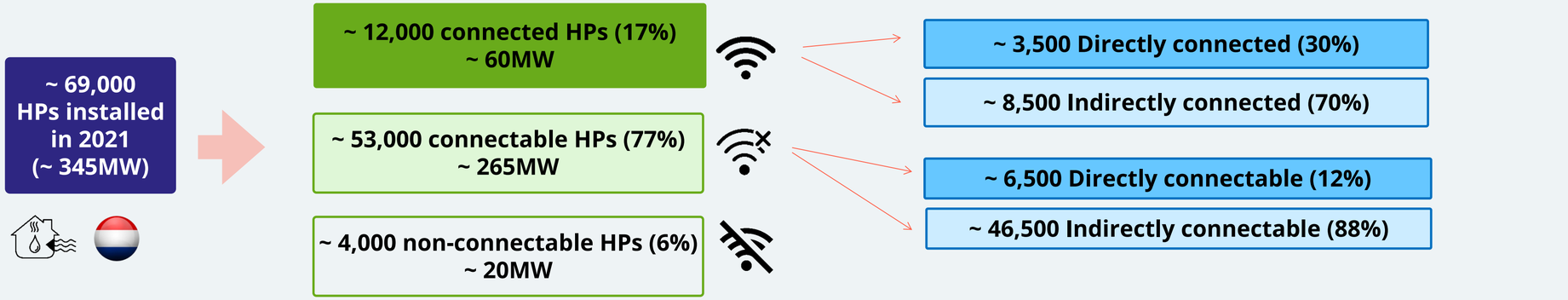
Executive summary (1/2)



- Heat pump (HP) sales in the Netherlands in **2021** were around **69,000** units, which is equivalent to approximately **345MW** of potential capacity.
- We estimate the number of connected* heat pumps to be 17% of all sold heat pumps in 2021, which has decreased since 2018. Only about **6%** of the heat pumps sold in 2021 were **non-connectable***.
- The split between **directly connected and indirectly connected*** heat pumps was **30:70** and there is no evidence from the OEMs that this will change in favour of directly connected heat pumps in the coming years.
- The top 4 OEMs* were **Itho Daalderop, Mitsubishi Alklima, Daikin** and **Nibe**. Together they accounted for **80% of the market share** of all heat pumps sold in the Netherlands in 2021.
- Heat pumps can be connected via **a variety of communication protocols** depending on the OEM (proprietary, OpenTherm, KNX, Modbus etc.).
- The variety of communication protocols implies **extra costs** for parties that want to develop and implement energy management functionality.
- The vast majority of OEMs also allow their heat pumps to be controlled by a smart thermostat (OEM's or 3rd party).

*Please refer to Glossary for definitions (page 20)

Executive summary 2/2

Interoperability remains a major challenge.

FAN and LCP Delta see a broad range of protocols and techniques for remotely accessing new built heat pumps. There is still a long way to go to a situation with only 1 or 2 standard protocols to operate the majority of all heat pumps. At the moment, energy service providers that want to use heat pumps for energy management are forced to invest heavily in different technologies that basically fulfil the same thing, due to the broad range of protocols that are being used today.

In FAN's view, this is an important barrier for large scale application of heat pump energy management*. We know the industry is aware of the value of connectivity and many OEM's are working on this topic. Yet, it seems hard to find common ground in a shared approach.

As FAN, we understand the reluctance from OEM's to give full access and control of their products to third parties. Therefore, we call upon OEM's to work together on a standard for energy management functionality. FAN strives to a situation where 80% of the market volume uses such an open standard by the end of 2024.

* The other one is the absence of incentives, which is outside the scope of this research.

Heat pumps in The Netherlands

In its report (in Dutch) based on 2020 figures, Dutch TSO Tennet states that the electricity consumption of heat pumps in the Netherlands can grow to 5 GW in 2030. With flexible control, heat pumps can contribute significantly to absorbing peaks and off-peak in sustainable generation.

Since 2020, we have only seen growth in the estimates of heat pump installations in The Netherlands towards 2030, due to new government policies and the rapidly changing energy world. The need to control heat pumps in a smart way is only increasing.

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Introduction & Scope

Background

Flexiblepower Alliance Network (FAN) and TKI Urban Energy (TKI UE) believe that Home Energy Management is a key factor for a successful energy transition in consumer households.

FAN and TKI Urban Energy partnered in the effort to understand the current state of affairs within connected heat pumps in the Netherlands.

Our collaboration

FAN used data and information from LCP Delta to develop this report. Research was carried out by LCP Delta, reviewed and supported by Flexiblepower Alliance Network (FAN).

The research was carried out in January- February 2023. It follows on from a previous research report delivered by FAN and LCP Delta from 2019.

Scope

The scope of work encompassed characterising the opportunities and challenges for connected heat pumps and hybrid heat pumps in the Netherlands. The two main topics covered in this report are:

- ✓ 1. Dutch heat pump market – market size, key manufacturers, how connectivity is achieved, using heat pumps for flexibility
- ✓ 2. Heat pump OEM overview – product portfolio, communication protocols and product connectivity

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Key definitions

A connected heat pump is able to send and receive data over the internet, allowing remote control, data visualisation and smart energy services, by end-users or professional service providers.

Key definitions

Connectivity can be achieved in one of two ways:

- **Directly connected heat pump with embedded connectivity:** the required hardware for connectivity is part of the heat pump.
- **Indirectly connected heat pump with an add-on control:** an additional physical module(s) is required in order to connect the heat pump, supplied either by OEM or 3rd party.

In both cases, the end-user or service provider usually needs to activate the connectivity, to access the functionality provided and make the heat pump 'connected'.

Connectivity can be part of a new heat pump install, or retrofitted:

- **For new heat pump installs**, connectivity can be achieved through the activation of the embedded connectivity in the heat pump unit, or through add-on controls being installed (and activated) at the same time as the heat pump.
- **For existing systems**, add-on controls are fitted (and activated) at a later date.

3rd party companies produce **add-on** controls. Such companies include controls specialists, Home Energy Management solutions providers, Smart Connected Thermostats and some aggregators.

Even though a large percentage of heat pumps in the Netherlands can be connected, a much smaller percentage are connected in reality. In this report we differentiate between them based on following definitions:

- **Connected heat pumps:** Heat pumps that *have the ability* and *are connected* to the internet (with either built-in or retrofit connectivity) and can be monitored or controlled remotely.
- **Connectable heat pumps:** Heat pumps that *have the ability* to be connected to the internet, either directly or mediated by smart thermostats/controllers.
- **Non-connectable heat pumps** *do not have the ability* to be connected to the internet.

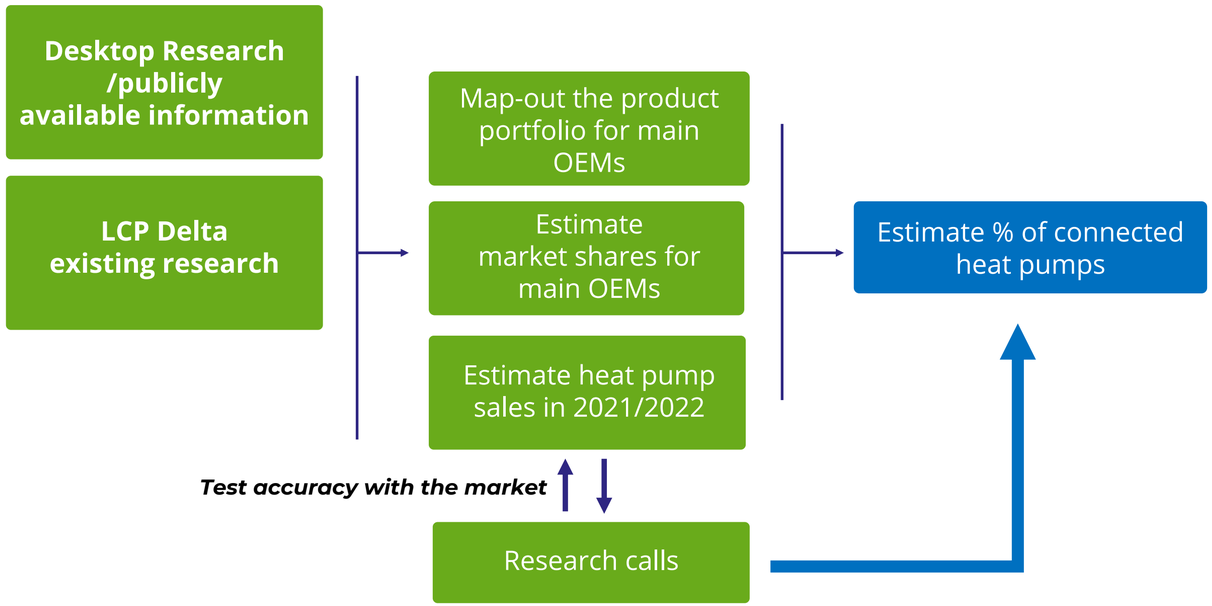
Methodology

Our approach & sources

The focus of this report is the opportunities and challenges for connected heat pumps and hybrid heat pumps in the Netherlands. This scope of this is:

- **The market estimates are based on new sales figures from 2021/2022:** this is because the heat pump market has started growing very rapidly over the last few years. As the research was undertaken in early 2023, up-to-date sales figures from 2022 were not fully available.
- The technologies considered are **air-to-water, ground-source and hybrid heat pumps** (i.e., air-to-air units are excluded from the analysis). See the glossary for heat pump definitions.

Based on some key assumptions from our deep understanding of the market for residential heat pumps, as well as flexibility potential, we have updated our views regarding the short term forecast of market potential. We have also carried out new desk research, backed up by interviews with key industry contacts to gather the latest insights:



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Dutch heat pump market

- Market size and key manufacturers (2021)
- Connected heat pumps in the Netherlands (2021)
- How is the connection achieved?
- Using heat pumps for grid flexibility in the Netherlands

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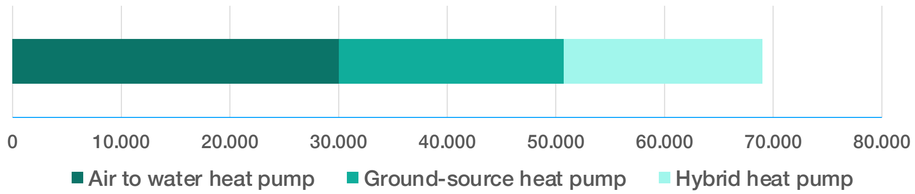
Market size and key manufacturers (2021)

The Dutch residential heat pump market is on the rise with around 69,000 new units installed in 2021. 80% of the market share consists of just 4 manufacturers.

Heat pump sales in 2021

In 2021 there were approximately **69,000** residential heat pumps sales in the Netherlands, with air-to-water units having the largest share. Total installed base is **~313k**, which shows how fast the market is growing.

Heat pump sales in 2021 (number of units installed)



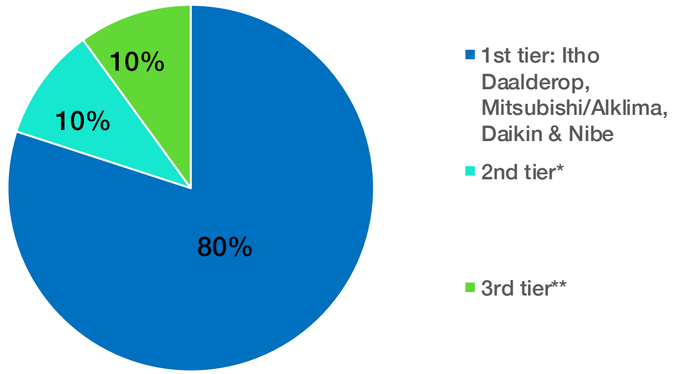
(Air-to-air units are outside the project's scope.) See slide 20 for a glossary of heat pump terms.

The equivalent electrical capacity of these installations is approximately **345MW**.

Key manufacturers in the Dutch market

In the Netherlands, Itho Daalderop, Mitsubishi Electric (Aklima), Daikin and Nibe group are the leading manufacturers. This 1st tier of manufacturers account for 80% of the market share. 2nd tiers* and 3rd tiers** equally hold 10% of the shares each.

Heat pump market shares



*Intergas, LG, Panasonic, Nefit (Bosch), Vaillant/AWB, Samsung
**Duco, Groupe Atlantic, ATAG/Ariston in here along with many, many others

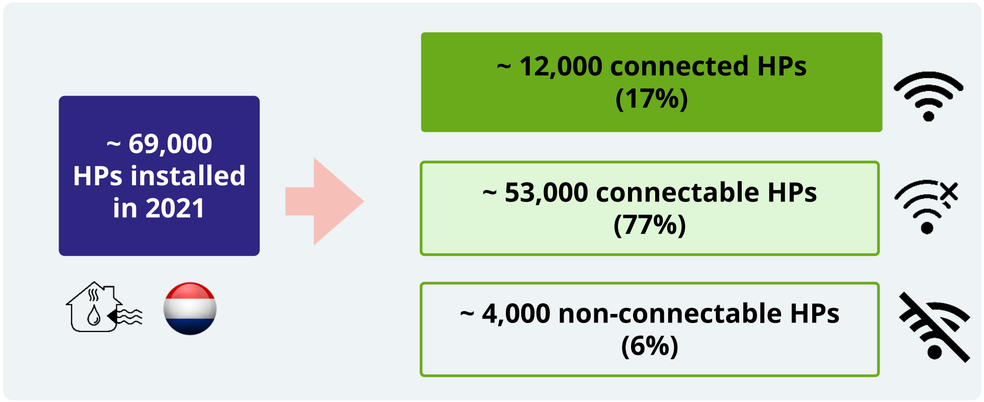
Both graphs were sourced from LCP Delta Heat team.

Connected heat pumps in NL - new installs 2021

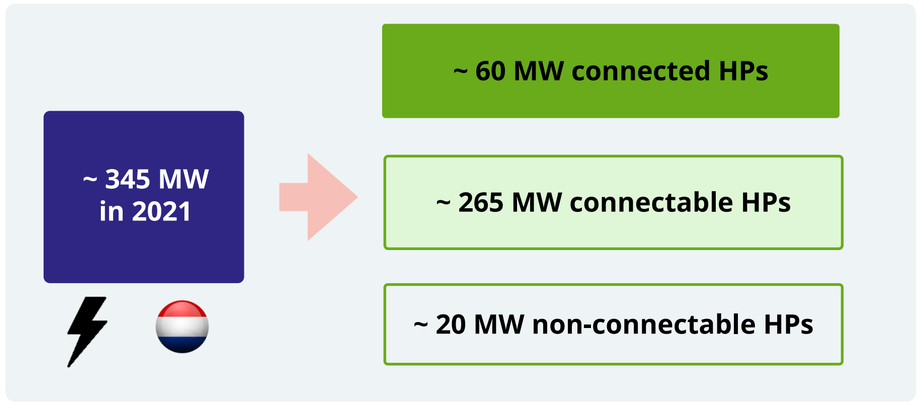
We estimate that about 12,000 connected heat pumps were installed in 2021, which is an equivalent of approximately 60 MW electrical capacity.

The diagram below shows the breakdown of 2021 heat pump sales, according to the number of units that are connected, connectable and non-connectable (see slide 7 for definitions). Although most OEMs offer connectable heat pumps, they do not have a clear picture over how many are eventually connected once installed. To the best of their knowledge, this number is around 15-20%. This aligns with LCP's internal data which is based on other industry interactions and so we estimate this number to be **17%.**

Heat pump units sales by connectivity in 2021



Equivalent (electrical) capacity of heat pumps by connectivity in 2021

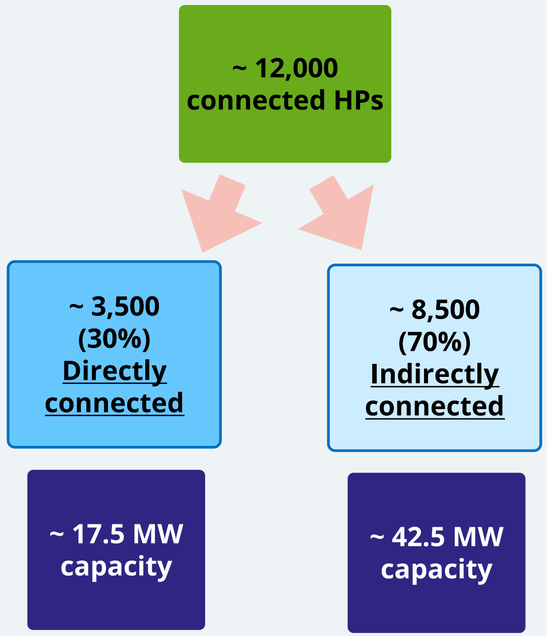


Assumption based on industry calls**: Average nominal electrical capacity of a heat pump in the Netherlands is **5kW*.

*In reality the systems have higher / lower capacity than this average value depending on the heating needs of the house. Furthermore, the load is not constant but will vary from close to full capacity (e.g. afternoon) to close to zero (e.g. between 10-12).

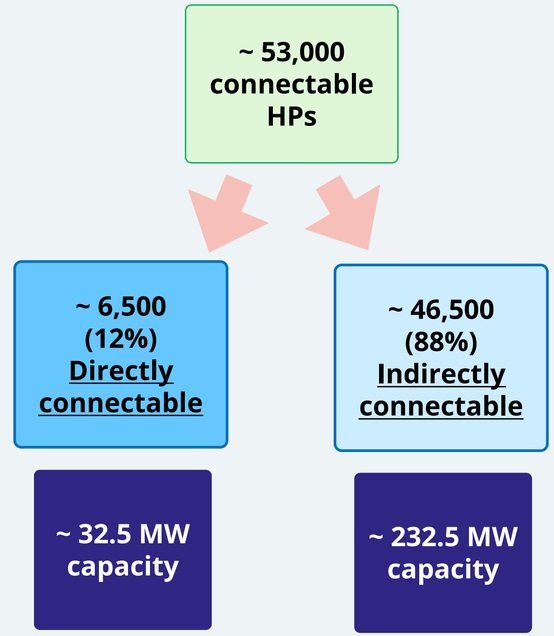
How is the connection achieved?

In 2021, the majority of heat pumps are still indirectly connected and connectable. There is no clear indication from the OEMs if the number of directly connected heat pumps will increase in the future. Nibe is the only OEM offering solely directly connected heat pumps.



Directly connected and connectable heat pumps still represent the lower proportion with 30% and 12% respectively. The main OEM offering directly connectable heat pumps is Nibe. All ground-source heat pumps from Itho Daalderop are directly connectable.

The majority of heat pumps in the Netherlands are **indirectly connected/connectable.** Some OEMs only sell indirectly connectable heat pumps. Others offer both directly and indirectly connectable heat pumps.



Grid flexibility & heat pumps in the Netherlands (1/2)

There has been some progress with key challenges for flexibility services since 2019 and there are case studies highlighting this progress.

Key challenges for flexibility services:

The difficulty to create a single platform to that would help to enable flexibility in the heat pump market has lessened slightly since 2018:

- Manufacturers still use a variety of different protocols for their HPs. However, some key manufacturers (Mitsubishi, Nibe, Remeha, Daikin) have moved from using only proprietary protocols to more widely applicable protocols.
- The market has become less fragmented since 2018. In 2021, 80% of the market was shared by only 4 top OEMs (slide 10).

Customer engagement:

- Customers still seem to be reluctant to connect their HPs to home energy management. This might be due to customer concerns over data protection or not being familiar enough with the benefits of the connectivity after installation.

Potential impacts of using heat pumps for flexibility:

- Most manufacturers realise that energy management is a great opportunity.
- The general opinion is that using heat pumps for grid flexibility usually does not impact the wear and tear of heat pumps.
- Frequent start and stop is not advised as it reduces coefficient (COP) of performance of heat pumps.

Some of the options for shifting the times heat pumps use electricity from the grid are:

- *Hybrid heating systems:* hybrid heat pumps can switch to gas during times when grid is most constrained.
- *Water storage:* a fully utilised 200-250l water tank could potentially shift up to 1-2 hrs of space heating demand out of the peak grid demand periods.
- *Electrical storage*: a heat pump can generate 2-4 kWh of heat for every kWh of electricity stored.

Grid flexibility & heat pumps in the Netherlands (2/2)

There has been some progress with key challenges for flexibility services since 2019 and there are case studies highlighting this progress.

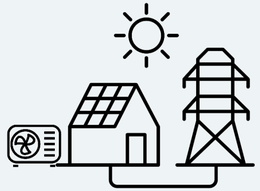
Case study: Flexibility deployment of a heating system with heat pumps in residential towers (CLIMA 2022 & Royal BAM group)*

- This case study explored the potential of the available flexibility from heat pumps with intelligent control from two residential towers in the Netherlands.
- Two models were developed (building performance and financial model) to assess the potential energy flexibility; with key performance indicators being total heat demand, shifted load, the comfort and saved costs when deploying flexibility. Energy prices from 2019 were used.

Results:

- Load shifting proved to save a significant part of electricity costs. With higher electricity prices, the potential for flexibility deployment can become even more significant this decade.
- The study showed that more than 50% of the electricity demand from buildings can be shifted under certain conditions. Also, there is a potential to save at least 20% of the electricity purchase costs in 2030.

From 2026, it will be mandatory for homeowners to **install a hybrid heat pump or a sustainable alternative** when replacing their gas central heating system. The goal is to have 1M hybrid heat pumps installed by 2030**, with an intermediate goal of 125,000 additional hybrid heat pumps installed by 2024.*** This will increase the number of HPs available for flexibility in the Netherlands.



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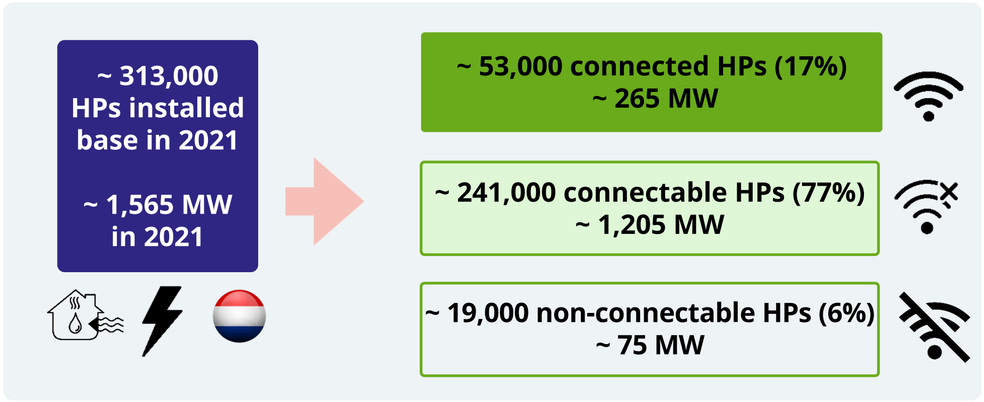
*CLIMA 2022: Flexibility deployment of a heating system with heat pump in residential towers
** Netherlands Enterprise Agency : https://www.rijksoverheid.nl/documenten/rapporten/2022/06/01/beleidsprogramma-versnelling-verduurzaming-gebouwde-omgeving (page 11)
*** Netherlands Enterprise Agency : https://www.rijksoverheid.nl/documenten/rapporten/2022/06/01/22235424bijlage-actieplan-hybride-warmtepompen (page 4)

Evaluating untapped flexibility potential of HPs

If the 2021 sales would represent the full 2021 installed base of 313,000 heat pumps, it would represent an equivalent of approximately 1,565 MW electrical capacity.

The diagram below shows the breakdown of 2021 installed base of heat pump sales, if the total installed base of heat pumps would reflect the 2021 sales for connected, connectable and non-connectable (see slide 8 for definitions). This exercise is solely to illustrate the untapped potential of using connectable HPs for flexibility in the Netherlands. In order to show more precise proportions of connected & (non)connectable heat pumps within the whole installed base, previous annual sales would have to be considered.

Calculated state of affairs if 2021 figures would represent the full install base:



When applying 2021 figures to installed base, it becomes apparent that **the Netherlands has a large untapped potential for using heat pumps for grid flexibility**. Our basic calculations show this to be **around 1.2 GW**.

The **number of hybrid heat pumps** is **to rise considerably from 2026** due to the new mandate of replacing gas central heating with hybrid heat pumps.

As a result, **the potential for using heat pumps for grid flexibility is only expected to increase** in the Netherlands, especially later this decade.

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Comparison between 2019 and 2021/2022

The table below provides a comparison of numbers between 2019, 2021 and 2022. Some data for 2022 is publicly available and some we have extrapolated based on the split of heat pump types in 2021. Based on the conversations with OEMs, we do not believe the proportions of connected, connectable and non-connectable HPs have changed a lot between 2021 and 2022.

	2019	2021	2022
Heat pump sales	~33,700	~69,000	**~99,000***
Connected heat pumps	~7,800	~12,000	~17,000**
Connectable heat pumps	~25,900	~53,000	~76,000**
Non-connectable heat pumps		~4,000	~6,000**
Installed base	**~140,000**	**~313,000**	**~450,000***

*Dutch heat pump association report, 2023
**Numbers extrapolated based on percentages in 2021 (see slide 11)

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Heat pump OEM overview

Overview of the main players in the Dutch residential heat pump market:

- Product portfolio
- Communication protocols used by their products
- Product connectivity

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Product portfolio

This table provides an overview of heat pumps available in NL from key manufacturers.

OEM	Air-to-Water	Hybrid*	Ground Source	Comments
Itho Daalderop	Vincent HP-S	Vincent L/W heat pump	***	***N/A***
Mitsubishi Electric	Ecodan	Ecodan	*N/A*	Mitsubishi sells its HPs via its distributor Alklima in the Netherlands.
Daikin	Altherma 3	Altherma R Hybrid Altherma H Hybrid Monoblock-add-on	Altherma 3 Geo	***N/A***
Nibe	NIBE S2125	NIBE F2050/F2040/S2125/F2120/AMS10/AMS20	S1155, S1255, F1253	Nibe also offers an exhaust air heat pump** (F730)
Inventum		Optima Modul-AIR Aqua	*N/A*	Inventum offers exhaust air heat pumps**. Their electric-only models are: Modul Air (RED/BLUE). Their hybrid models combine an exhaust air heat pump and a gas boiler.
Nefit/Bosch	Nefit Enviline Bosch Compress	Hybrid 7000iAW	Compress 6000 & 7800i	Nefit/Bosch offers a new rooftop design heat pump (compress 5800i AWR)
Vaillant	aroTHERM plus (monobloc and split)	aroTHERM plus (monobloc and split)	flexoTHERM flexocompact geoTHERM	***N/A***
Remeha	Neptuna, Mercuria ,Eria Tower	Elga Ace	*N/A*	All three heat pumps are equipped with the integrated Remeha eSmart Inside platform (prepared for remote control and monitoring)
Intergas	Xource	Xtend	*N/A*	Daikin-Intergas hybrid available from early 2023

*Hybrid heat pumps combine a gas boiler with a heat pump in one system
**A heat pump that recovers energy from the ventilation air to heat the house – also referred to as a ventilation heat pump.
*** in previous versions of our report we misreported that the Itho WPU was discontinued. It is still available.

Communication protocols

This table provides an overview of communication protocols used in connectable heat pumps by key manufacturers (blue shaded cells).

OEM	Proprietary	OpenTherm	KNX	Modbus	Other
Itho Daalderop					
Mitsubishi Electric	(MELCloud)				
Daikin					iFTTT compatible
Nibe	(their own API)				iFTTT compatible
Inventum					
Nefit/Bosch					EMS-BUS
Vaillant	eBUS*	(only for boilers)			Smart Home API, EEBus
Remeha	eSmart inside platform				
Intergas					

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* eBUS is not to be confused with EEBus. eBus is a proprietary communication protocol for Vaillant: https://www.vaillant.co.uk/for-installers/products/controls-and-thermostats/why-vaillant-controls/

Connectability (1/2)

This table summarizes the connectability of the OEM's heat pumps, i.e. it shows the ways their heat pumps can be connected to the internet: via Wi-Fi that is integrated in the HP, via OEM specific hardware, via OEM Smart thermostat or 3rd party thermostat.

OEM	Wi-Fi integrated in HP	Via OEM hardware	Via OEM smart thermostat	Via 3rd party smart themostat	Comments
Itho Daalderop					▶ Spider WP Climate Thermostat are compatible with all models and available for an additional price. ▶ The Gateway has a wired connection to the WiFi router and smart meter. The thermostat has a wired connection to the HP and wireless connection to the gateway.
Mitsubishi Electric					▶ MELCloud app allows heat pump operation from any device (phone, tablet, PC). ▶ The WiFi interface uses wireless connection with the home router and wired connection with the HP. ▶ Any thermostat with on/off signal can be used with Ecodan.
Daikin					▶ Daikin Onecta app is available for all Altherma heating systems and air conditioning systems. Control is available via WLAN adapter either integrated, included as standard or optionally available. ▶ All new 3rd generation systems sold from 2020 are compatible with Onecta.
Nibe					▶ Online software platform (and app) NIBE myUplink specially developed for smart NIBE S series heat pumps. There is an option to choose between the WIFi connection or direct operation on heat pump touchscreen. ▶ Different levels/types of subscription allows different levels of control.

Connectability (2/2)

This table summarizes the connectability of the OEM's heat pumps, i.e. it shows the ways their heat pumps can be connected with the internet : via Wi-Fi that is integrated in the HP, via OEM specific hardware, via OEM Smart thermostat or 3rd party thermostat.

OEM	Wi-Fi integrated in HP	Via OEM hardware	OEM Smart Thermostat	Via 3rd party Smart Thermostat	Comments
Inventum			✓		▶ EVA smart thermostat (and app) ensure optimum operation of Inventum's heat pumps.
Bosch	✓	✓	✓	✓	▶ Bosch EasyRemote smart thermostat & app capable of remotely controlling ground source heat pump with an integrated gateway. ▶ HomeCom Easy app operates all Nefit Bosch heat pumps remotely. ▶ Bosch heat pumps can be used with all smart thermostat except for Nest.
Vaillant		✓	✓	✓	▶ Consumer apps: sensoApp & myVAILLANTapp (depending on gateway used). ▶ Installers use myVAILLANTapp for remote access maintenance. ▶ Unique to Vaillant: Smart Home API (used mostly by larger installer companies).
Remeha	✓		✓		▶ Smart Remeha eTwist or wireless eTwist RF thermostat and eTwist app can control (hybrid) heat pumps and boilers. ▶ Connectivity via MODBus gateway and remote connection network.
Intergas	✓	✓			▶ Smart thermostat app Incomfort & Comfort Touch thermostat only compatible with boilers for now.

4

Conclusion

Conclusion

The main conclusions are:

- **94% of the heat pumps** sold in the Netherlands in 2021 **have the ability to be connected,** either directly or indirectly.
- With regards to **connected heat pumps the progress since 2019 report is disappointing** as the number of connected heat pumps went from 23% in 2018 to 17% in 2021. Also, the proportion of directly to indirectly connected heat pumps stayed low (30:70).
- Our estimates show **approximately 1.2 GW of untapped flexibility potential for connectable HPs** in the Netherlands. This is also very likely to increase later this decade due to a mandate to replace gas central heating with hybrid heat pumps from 2026.
- There is still a large variety of protocols and techniques used by the OEMs to remote control heat pumps. This still poses as an **important barrier for large scale application of heat pumps in energy management.**

Glossary

***Air-to-water heat pumps**:* Heat pump that transfers heat from outside air to a water loop with the purpose of being used for space heating or domestic hot water.
***Connected heat pumps**:* Heat pumps that are connected to the internet (with either built-in or retrofit connectivity) and can be monitored or controlled remotely.
***Connectable heat pumps**:* Heat pumps that have the ability to be connected to the internet, either directly or mediated by smart thermostats/controllers.
Directly connected heat pumps: Heat pumps that have the required hardware for connectivity is part of the heat pump.
***EEBus**:* A standards-based communication interface that can use any device and platform, regardless of manufacturer and technology.
***Ground source heat pumps**:* A heat pump that transfers heat from the ground to a water loop with the purpose of being used for space heating or domestic hot water.
***HP**:* Heat pump.
***Hybrid heat pumps**:* Hybrid heat pumps combine a gas boiler with a heat pump in one system, and a controller managing the operation of both heat generators.
***IFTTT**:* "If This Then That" is a free web--based service to create chains of simple conditional statements.
Indirectly connected heat pumps: Heat pumps that need an additional physical module(s) is required in order to connect the heat pump, supplied either by OEM or 3rd party.
***KNX**:* An open standard for domestic automation, including heat pumps.
Matter: An IP-based connectivity protocol and standard for home automation aimed to reduce fragmentation across vendors.
***Modbus**:* A serial communications protocol, typical mean to connect electronic devices.
***OEM**:* Original Equipment Manufacturer.
***Open API**:* A publicly available application programming interface that provides developers with programmatic access to a proprietary software application.
***OpenTherm**:* A standard communications protocol (i.e. independent of any single manufacturer).
***Proprietary protocol**:* A protocol owned by a single organization or individual.
Exhaust-air/Ventilation heat pump: A heat pump that recovers energy from the ventilation air to heat the house.
***Zigbee**:* A low-power, low data rate and low range wireless ad hoc network.

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