

The Energy Grid Needs Smart Heatpumps

Market insight on flexible connected devices

October 2019



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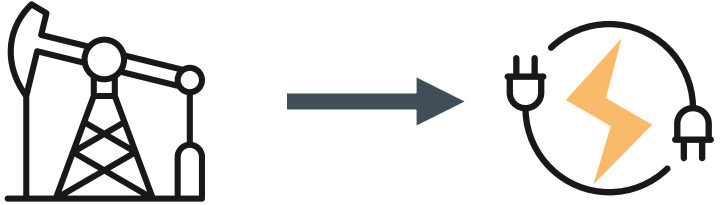
Product portfolio
Communication protocols
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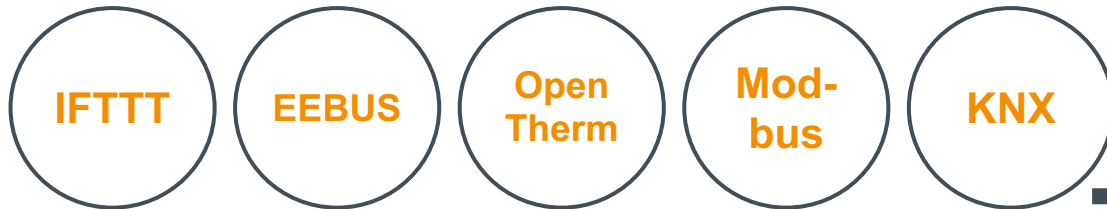
Customer attitudes and opinion of demand
side response

Glossary **23**

GOAL: Evaluate residential heat pumps potential in demand response services.



A shift in residential heating:
From fossil fuels to electricity.

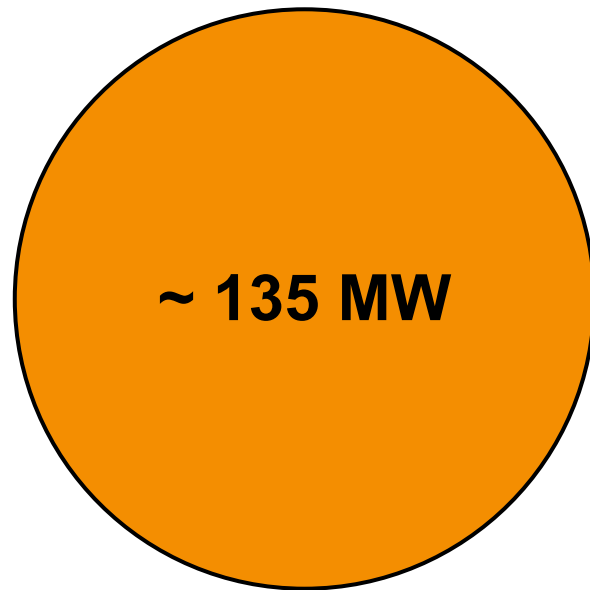


Many technologies and frameworks
for connecting electricity devices.



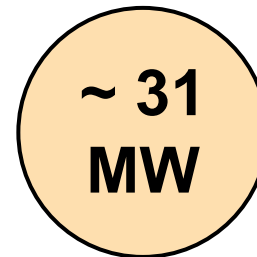
Need for insight in developments in
residential HP & HHP, and how it fits
future energy demand.

New heat pump capacity – Sales 2018



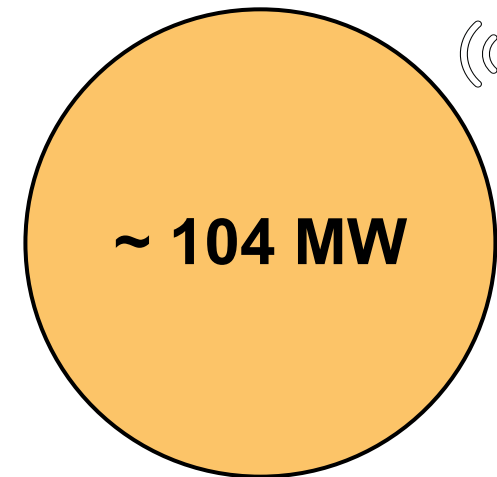
~ 135 MW

33700 units
Sold in 2018



**~ 31
MW**

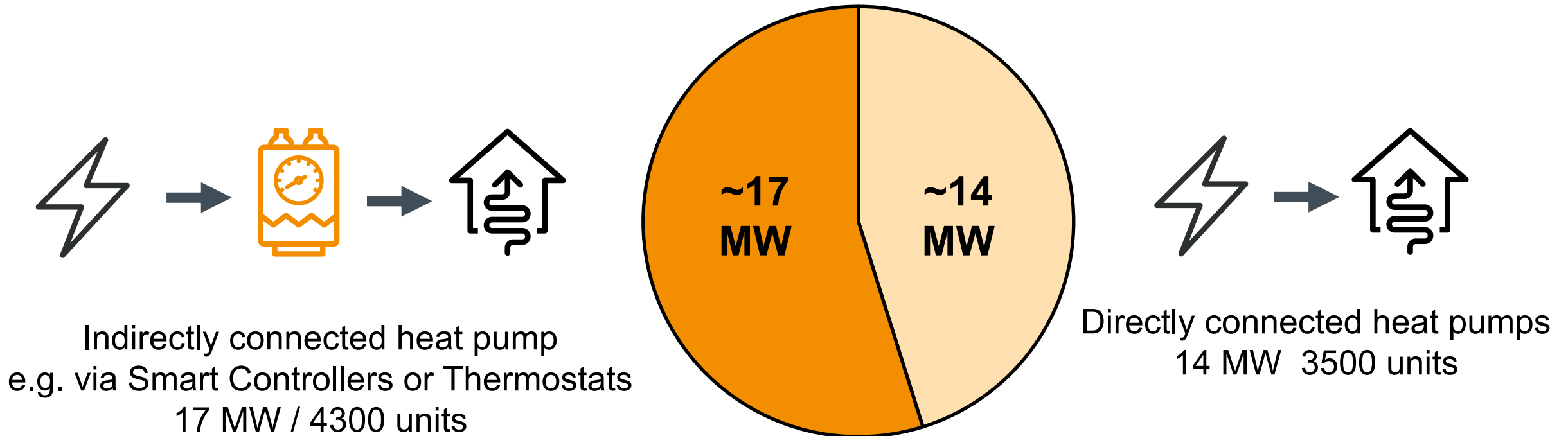
7800 units / 23 %
Connected Heatpumps



~ 104 MW

25900 units / 77 %
Unconnected Heatpumps

2018 heatpump sales Indirect vs direct connected heatpumps

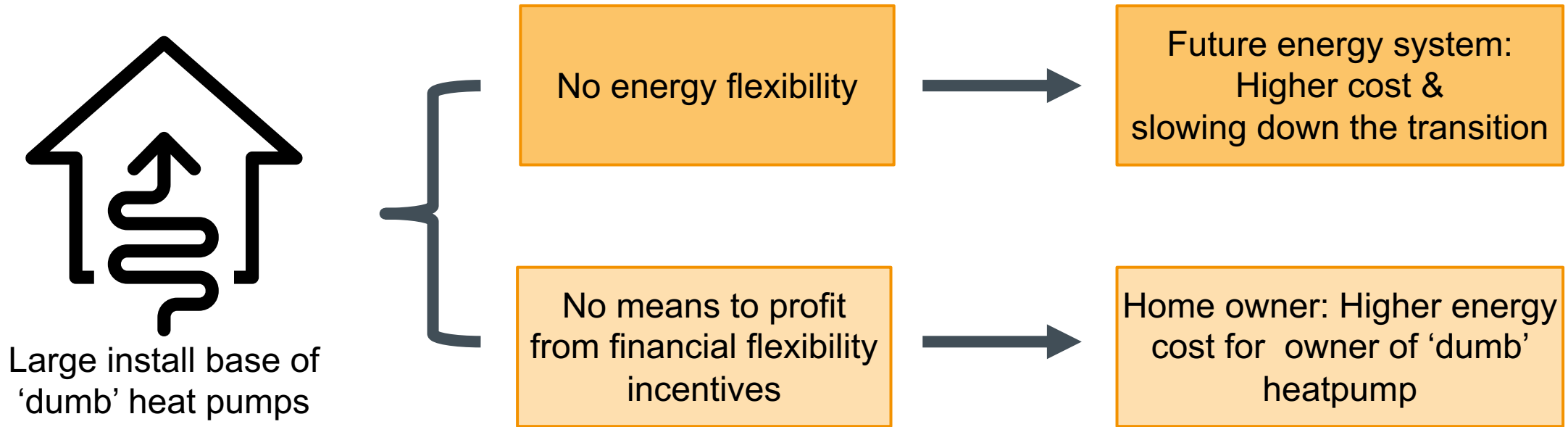


Note: Connectivity is related with the ability to connect to internet. It does **not** mean that these heat pumps are immediately available for flexibility services.

Challenges

- Currently residential HPs not used for flexibility services. Activity is limited to pilot projects or monitoring purposes
- Scattered market shares: Not 1 platform to address a significant part of the market
- Hence, a variety of protocols being used by different OEMs
- Low willingness from OEMs to give full access and control of their products to 3rd parties.

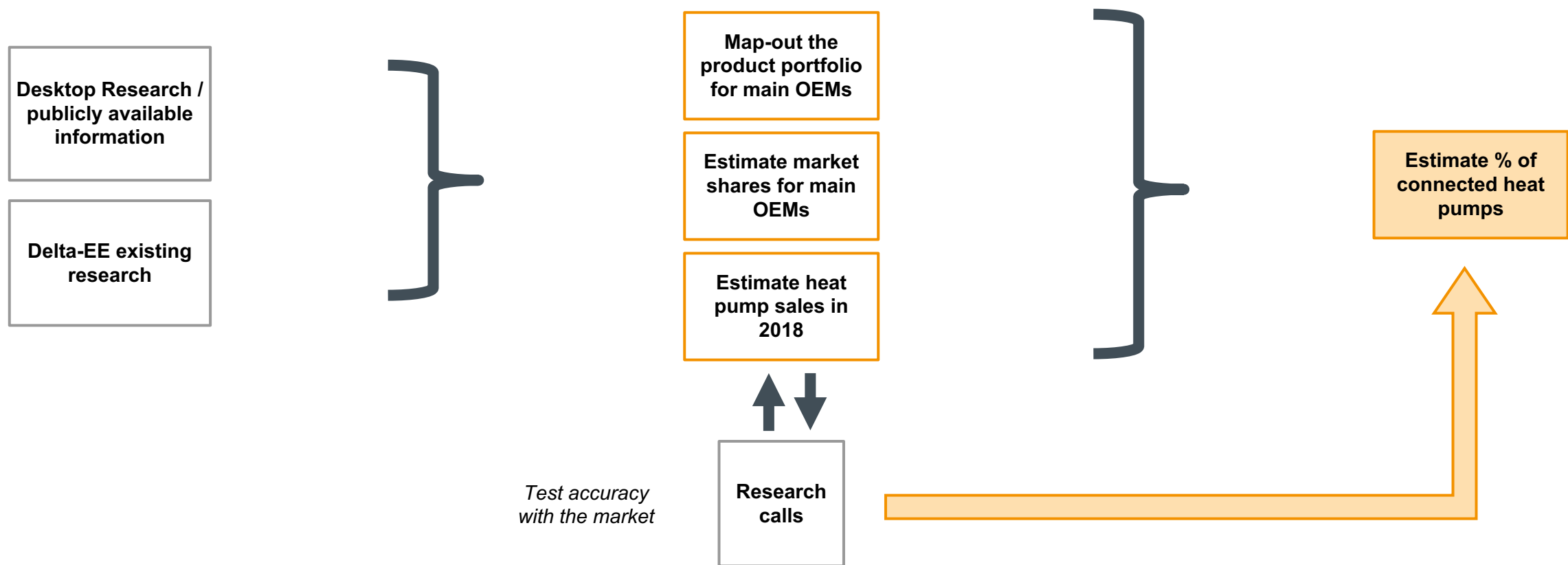
We risk to create tomorrow problems



Scope of the research:

- **The market estimates are based on new sales figures from 2018 :** this is because the market for flexible heat pumps is just gaining momentum and the heat pump market has started growing very rapidly over the last year.
- The technologies considered are **air-to-water , ground-source and hybrid heat pumps** (i.e. air-to-air units are excluded from the analysis)

Methodology: The graph below shows how we reached to the results seen on the report, and the different types of sources used to collect the information



Assumptions and key definitions

Assumptions

For the calculation of connected heat pumps capacity the following assumptions were made :

- The *average* nominal electrical capacity of a heat pump in the Netherlands is 4kW.
- 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 am)
- With regards to heat pumps that are connectable with the addition of a special control unit, thermostat etc, we assumed that about 15% of them have such an add-on.
- In some cases, we had specific estimates from research calls with OEMs, in which case an OEM specific % was applied.

Key definitions

- *Connected heat pump* : Heat pumps that are connected to the internet (with either direct or indirect connectivity) and can be monitored or controlled remotely.
- *Connectable heat pump* : Heat pumps that have *the ability* to be connected to the internet, either directly or mediated by smart thermostats/controllers

More definitions can be found at the end of the report in the “Glossary” section.

- > **Market size and manufacturers (2018)**
- > **Connected heat pumps in the Netherlands (2018)**
- > **How is the connection achieved?**
- > **Challenges in using heat pumps for flexibility services**

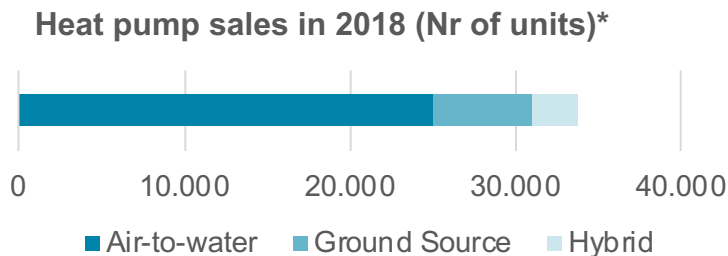
Dutch heat pump market



Market size and key manufacturers (2018)

Heat pump sales in 2018

- new sales 2018: approximately **33,700 in NL** Majority air-to-water units. *
- 2019 sales figures will be higher (some OEMs reported early numbers show a potential doubling of their sales figures).
- Total installed base is **~140k**, which shows how fast the market is growing.



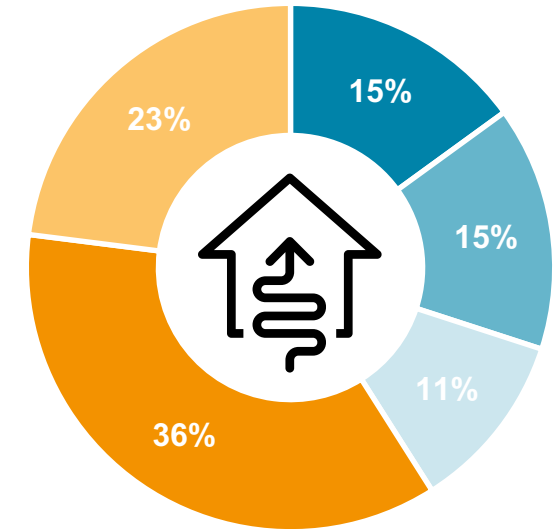
~135 MW. Electrical capacity of these installations

** Air-to-air units (>30k units sales in 2018) are outside the project's scope, see 'Scope & methodology'.*

Dutch heatpump market fragmented (2018)

Key manufacturers in the Dutch market

- Leading manufacturers: 11 % - 15% market shares each.
- 2nd tier manufacturers: ~ 5% market share each.
- Other market players: ~ 23% in total.



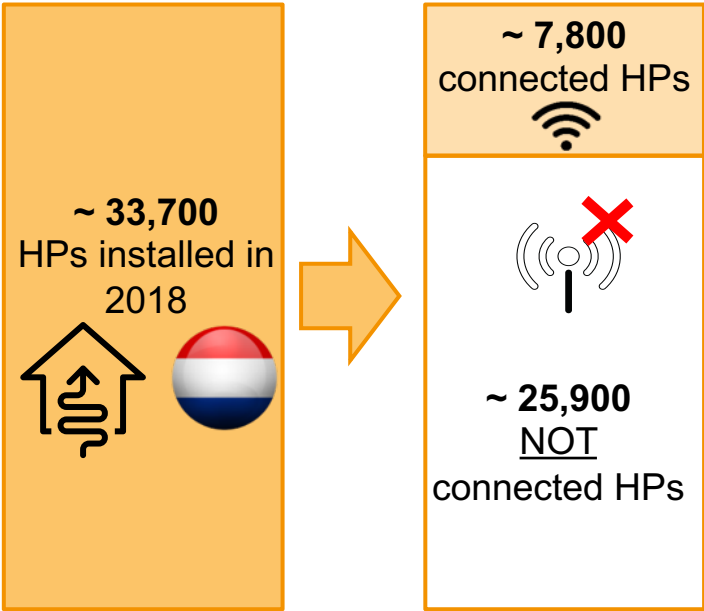
Heat pump market shares

Connected heat pumps in the Netherlands (2018)

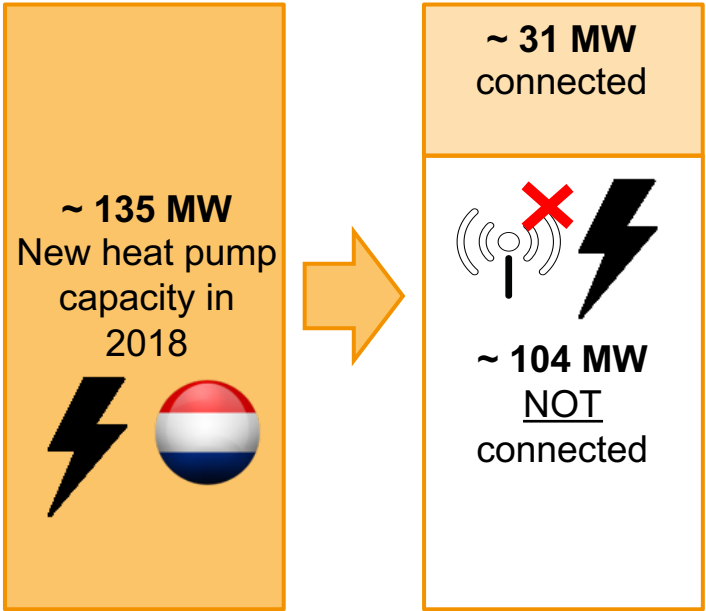
We estimate that about 7,800 connected heat pumps were installed in 2018, which is an equivalent 31 MW.

Since connectivity is usually an optional add-on to heat pumps that comes at an extra cost, only a small percentage of customers choose to select it. - *Of course this may be counter-acted if offered combined with an additional savings route, such as flexibility services.*

Heat pump units sales by connectivity in 2018



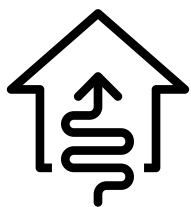
Equivalent capacity (electrical) of heat pumps by connectivity in 2018



Built-in versus mediation by smart controllers or thermostat.

Directly connected heat pumps, i.e. with built-in connectivity

We estimate that about 3,500 heat pumps are directly connected by OEM



~ 3,500
Directly
connected
HPs

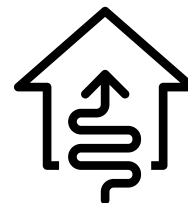


~ 14 MW
Capacity of
directly
connected
heat pumps

Indirectly connected heat pumps, i.e. mediated by smart controllers or thermostats

As of 2019, all heat pumps can connect either through either own OEM or 3rd party hardware / smart controller / smart thermostat.

The number of customers who choose connect their heat pumps this way, represents 10 – 20% of annual sales.



~ 4,300
Indirectly
connected
HPs



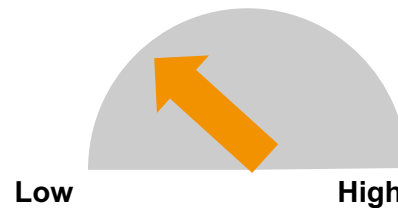
~ 17 MW
Capacity of
indirectly
connected
heat pumps

Challenges - continued

Difficulty to create a single platform to address the heat pump market

- A variety of different protocols for HPs
- Impossible for a single platform to being able to communicate with all of them.
- The fragmentation of the HP market. For example the top-5 brands in the French market represent about 80% of sales, versus only 52% in the Netherlands

Current OEM awareness / openness to the use of heat pumps for flexibility services



Heat pump manufacturer concerns


- Frequent starts & stops will impact the compressor's lifetime – a key part (and expensive) of a HP system.
- Even manufacturers that use open protocols, won't give full access to the heat pump, as some features will be locked to external parties.
- Nonetheless, awareness is increasing; some OEMs have reported plans to include open APIs for their HPs with a view to address flex markets.

Challenges in customer engagement

Currently residential HPs are not used for flexibility services. Activity is limited to pilot projects or monitoring purposes.

Customer engagement

- Customer engagement is a concern from a service provider perspective on the willingness of residential customers to participate in flex service with their HPs.
- Unwillingness to hand over control of their from fear that operating a heat pump flexibly may result in a colder home.
- Technically, customers may also need to invest extra for a storage tank.
- Therefore, it is possible that the proposition may not be attractive to the customer, especially when compared with more straightforward flexibility solutions, such as flexible hot water tanks.

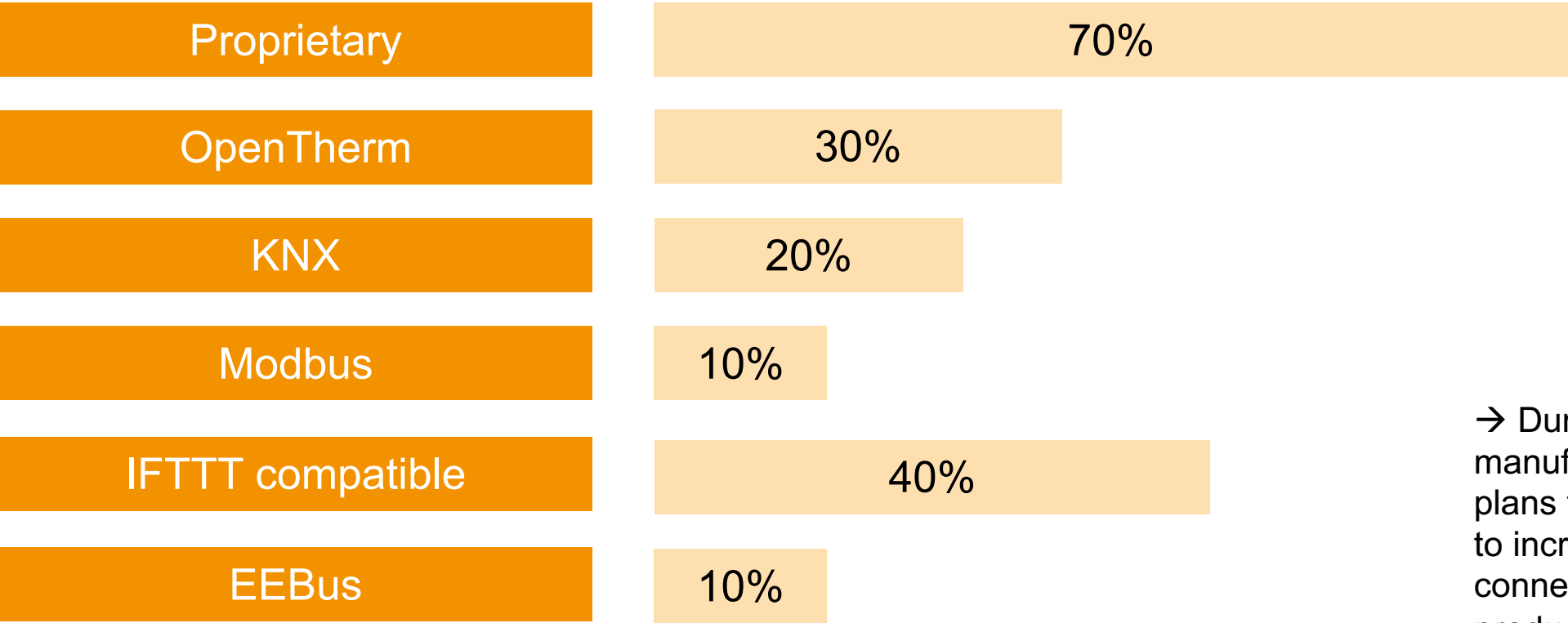
A modern interior scene featuring a bright orange sofa with two red cushions. To the left, a red cylindrical lamp hangs from a curved metal arm. In front of the sofa, a stack of white books holds two vases with red flowers. To the right, a tall, thin black sculpture stands on a dark circular base. The floor is dark wood, and the wall is light gray.

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

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

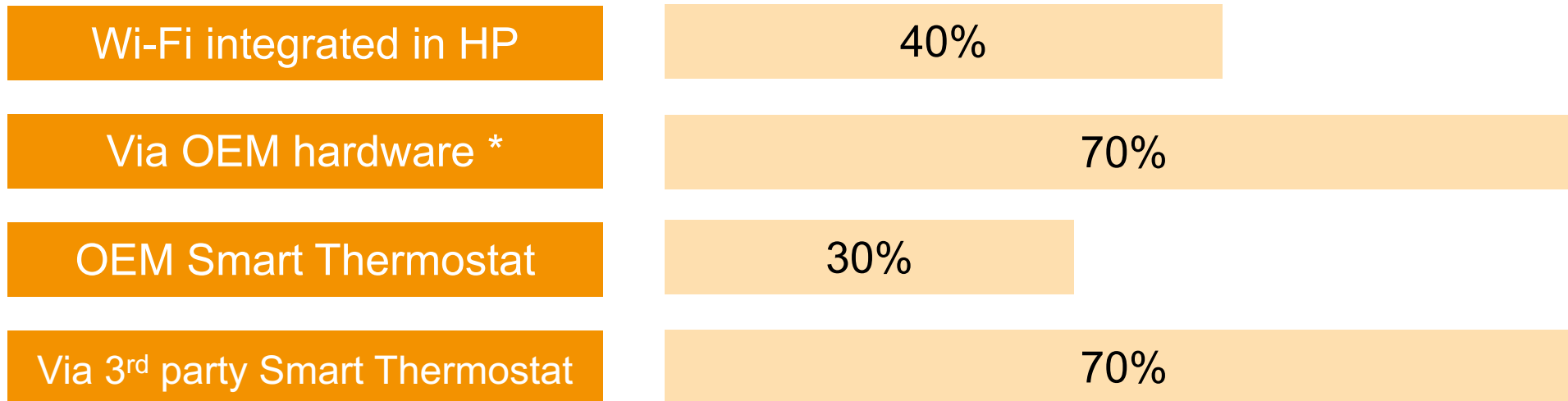
Heat pump protocol overview

Connection protocols used by 10 OEMs.



→ During interviews some manufacturers shared some plans to move to open API , to increase the connectability of their products with 3rd party hardware.

How can OEM heatpumps be connected to the internet?



* The difference between 'connected via Wi-Fi that is integrated in the HP' and connected via OEM specific hardware is that an additional hardware part or adapter is needed in the latter case.

Appendix

- > Customer attitudes and opinion of demand side response
– key findings from a Deta-EE UK focused report**

Customer attitudes towards demand side response

Key findings from a Delta-EE, UK focused customer research



Key focus	Key findings
Would customers trust to perform demand side response?	<ul style="list-style-type: none">• The biggest barrier: Customers need to feel confident to trust a third-party to control their device.• Customers have a strong requirement to maintain ultimate control over the system• Customers prefer a big brand name (like their energy company) to perform it.
What rewards and incentives (if any) might be required	<ul style="list-style-type: none">• Energy bill savings / financial reward

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 pump : Heat pumps that are connected to the internet (with either built-in or retrofit connectivity) and can be monitored or controlled remotely

Connectable heat pump : Heat pumps that have the ability to be connected to the internet, either directly or mediated by smart thermostats/controllers

EEBus : A standards-based communication interface that can use any device and platform, regardless of manufacturer and technology

EnOcean : Energy harvesting wireless technology used primarily in building automation systems

Ground source heat pumps : A heat pump that transfers heat from the ground

HP : Heat pump

Hybrid heat pumps : Hybrid heat pumps combine a gas boiler with a heat pump in one system

IFTTT : "If This Then That" is a free web--based service to create chains of simple conditional statements

KNX : An open standard for domestic automation, including heat pumps

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

Zigbee : A low-power, low data rate and low range wireless ad hoc network

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Coming up:

Flexibility & residential EV chargers, by FAN & Delta-EE. November 2019

FLEXCON2020: The smart energy conference. Spring 2020.