



# **Integrating Installations into a zero-energy renovation**

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Rosanne Berkhout - 4529863

# CONTENTS

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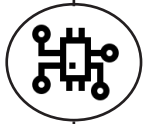
Background



Regulations and Energy Label



Problem statement and reseach question



Current state of innovation



Design Proposal



Conclusion

# BACKGROUND

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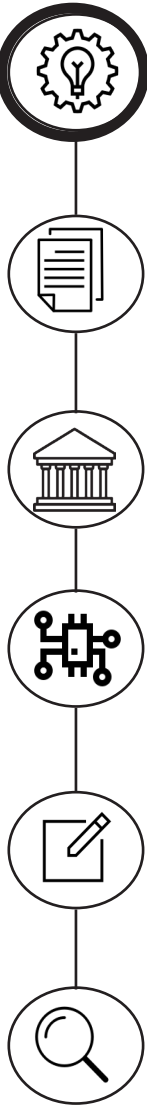
- 2ndskin
- Vlaardingen, 12 porch houses (portiek woningen)
- cupboard backside house
- Potential improvement



*2ndskin demonstrator back side house -  
Before*



*2ndskin demonstrator back side house -  
After*



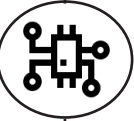
# PROBLEM STATEMENT

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The installations needed to renovate a post-war porch house in accordance with the 2ndskin approach are too heavy and take up a lot of valuable space.



*2ndskin demonstrator back side house -  
After*



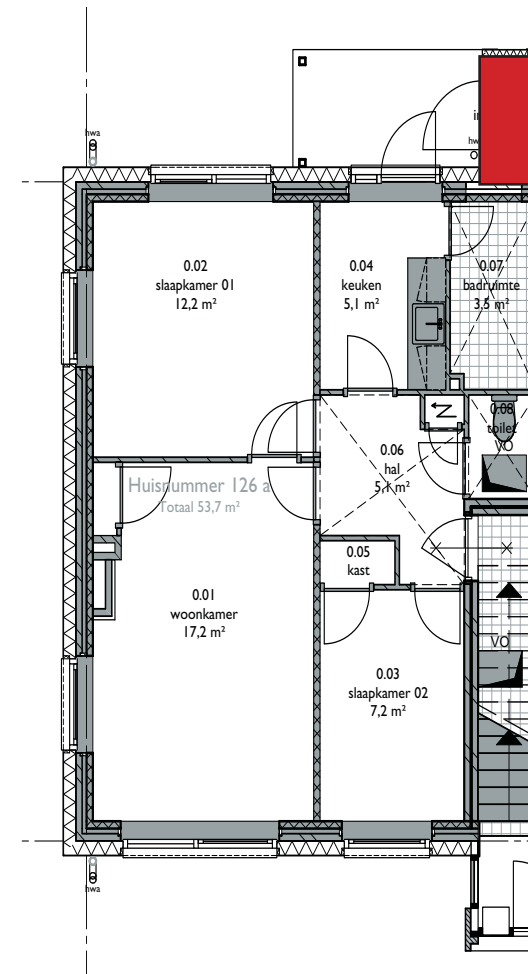
# PROBLEM STATEMENT

The **installations** needed to renovate a post-war porch house in accordance with the 2ndskin approach are **too heavy and take up a lot of valuable space**.

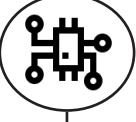


*2ndskin demonstrator back facade with installation cupboard*

- Based Evaluation
- 8,3 m x 1,8m x 0,9 m
- Extra foundation needed



*2ndskin demonstrator floor plan*

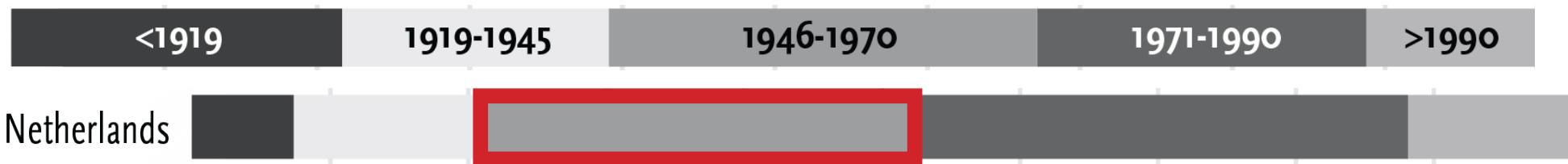
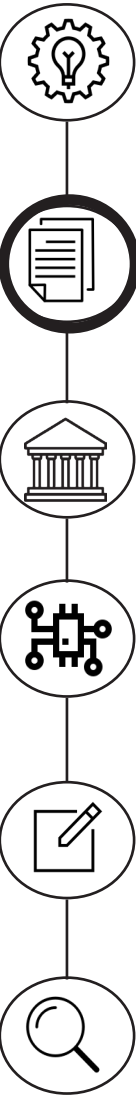


# PROBLEM STATEMENT

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The installations needed **to renovate a post-war** porch house in accordance with the 2ndskin approach are too heavy and take up a lot of valuable space.

- 7.7 million
- 1/3 built between 1946 and 1970
- Social housing
- High energy use
- D- Label or lower.



*Building time current building stock (Itard, L. 2008)*

# PROBLEM STATEMENT

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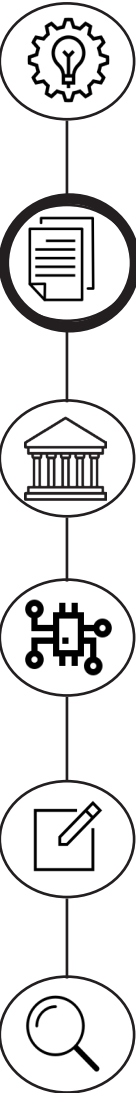
The installations needed to renovate a post-war **porch house** in accordance with the 2ndskin approach are too heavy and take up a lot of valuable space.

House type	1946 - 1974
Terraced houses	1084000
Porch houses	379000
Detached houses	344000
Semi-Detached houses	287000
Gallery houses	238000
Apartment Buildings	175000
Maisonette	135000

*Housing types build. (Platform31, 2013)*



- Second most build
- Upscaled to bigger houses
- Attic, garage or technical room



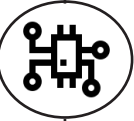
# PROBLEM STATEMENT

---

The installations needed to renovate a post-war porch house **in accordance with the 2ndskin approach** are too heavy and take up a lot of valuable space.

## 2ndskin aims:

- User acceptance
  - Stay during renovation
  - Short Building time
  - Limited work inside
  - Maintenance of the installation on the outside as much as possible
- Financing, EPV (Energieprestatie vergoeding)
    - Maximum
    - Requirements:
      - Well insulated
      - Heat demand:  $< 50 \text{ kWh/m}^2/\text{yr}$ .
      - Tap water:  $> 15 \text{ kWh/m}^2$
      - Energy: energy for installations +  $26 \text{ kWh/m}^2$  for the resident
        - Min 1800 kWh, Max 2600 kWh
    - Individual monitoring system





# AIM & RESEACH QUESTION

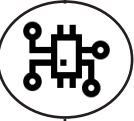
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## **Aim:**

To make a design proposal on how the installations can be more efficiently integrated into the 2ndskin renovation of a porch house.

## **Research question:**

How can the installations be more efficiently integrated into an 2ndskin porch house renovation?



# REGULATIONS

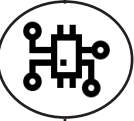
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- European regulations
- Dutch regulations
- Changing
- Installations need an Energy certificate

## DUTCH REGULATIONS

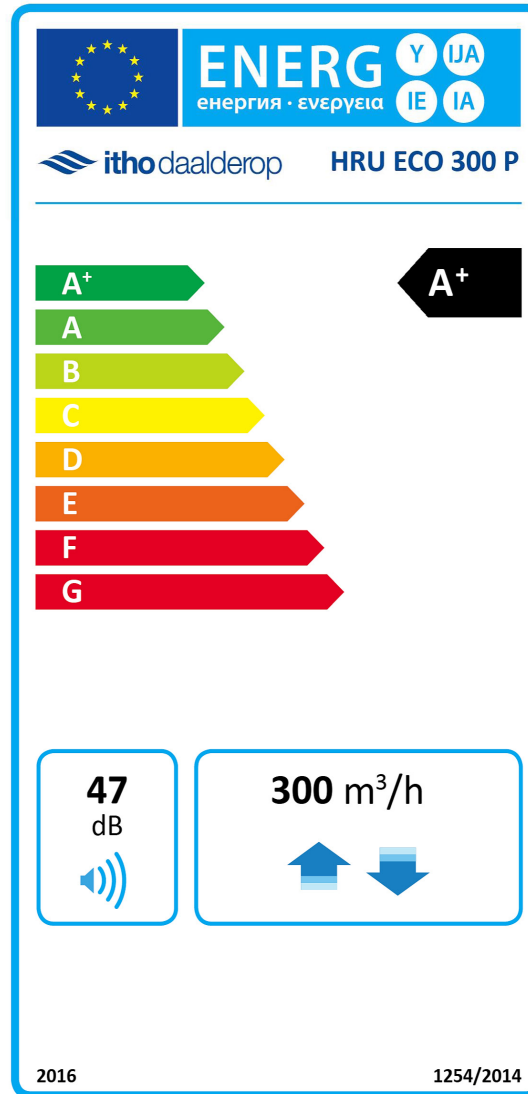
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EPN	->	EPG	->	BENG
↓		↓		↓
1995		2012		2020
EPC		EPA		BENG 1
EPU		EPBD		BENG 2
EPW		Energy Label		BENG 3
Saldering				

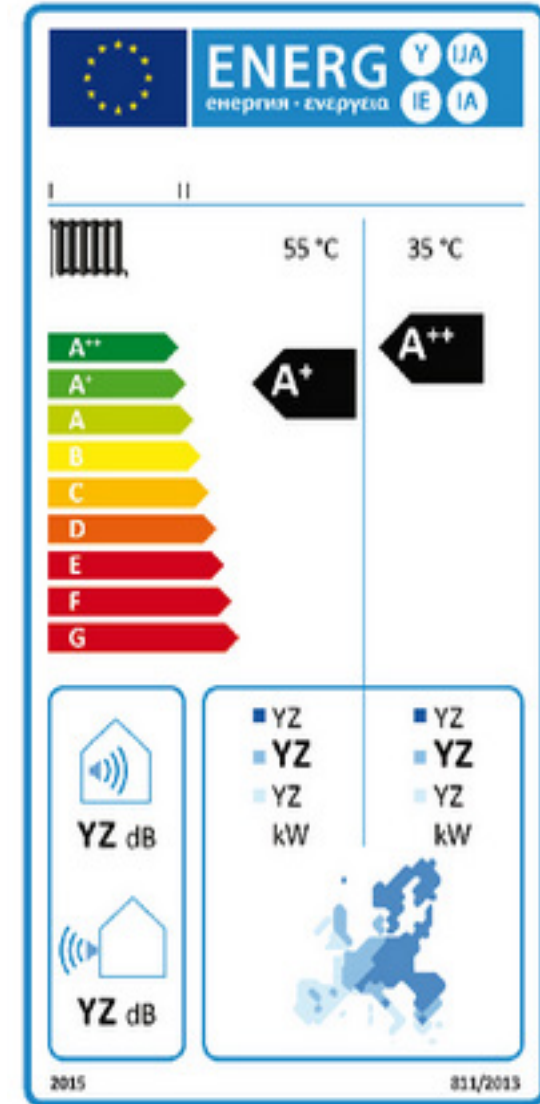


# ENERGY LABEL

- Electrical installations
- Usefull
  - Different numbers for different installations
  - Energy efficiency - SCOP



Energy label Heat recovery ventilation

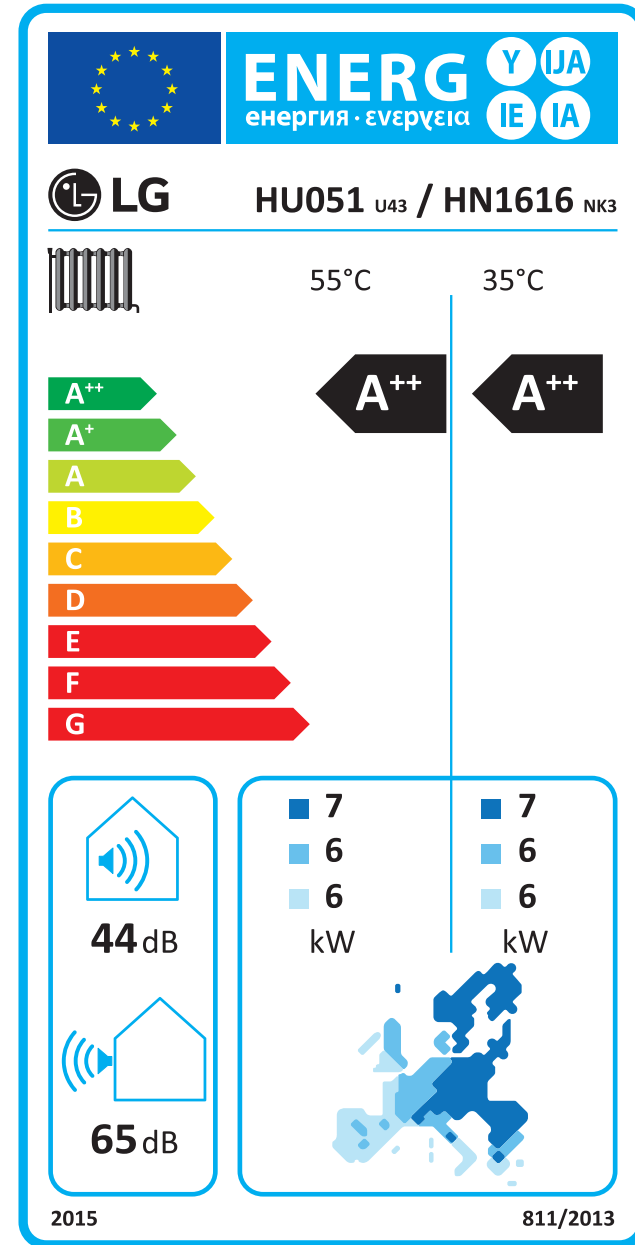


Energy label heat pump



# ENERGY LABEL

- SCOP is climate specific COP
- SCOP more accurate? Only if numbers where correct



MF766488627



# COP VS. SCOP

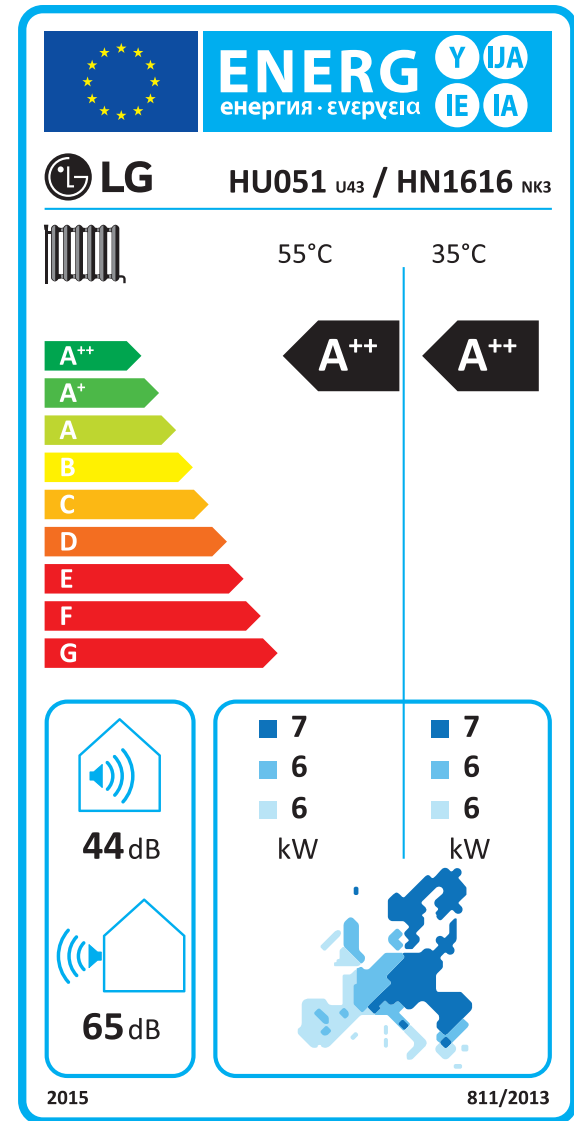
- COP (A7/W35): 4,68
- SCOP 4,36
- Majority Energy labels not correct.
- Quality reports are correct
- TNO, Eurovent and Kiwa



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## PRODUCT PERFORMANCE REPORT

FEATURE	VALUE	UNIT
Type	Split	
<b>Seasonal Efficiency Average W35</b>		
Pdesignh	5.9	kW
SCOPnet	4.37	
SCOP	4.36	
?s	171.0	%
<b>Seasonal Efficiency Average W55</b>		
Pdesignh	5.0	kW
SCOPnet	2.95	
SCOP	2.94	
?s	115.0	%



# CASE STUDIES

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Has installed sustainable installations in the Netherlands before?

113  
Companies

Clear product properties on their website

57  
Companies

Has an clear zero energy installation concept

4  
Companies

*Choice of companies*



LG Energy  
module



Nefit Energy  
Bar



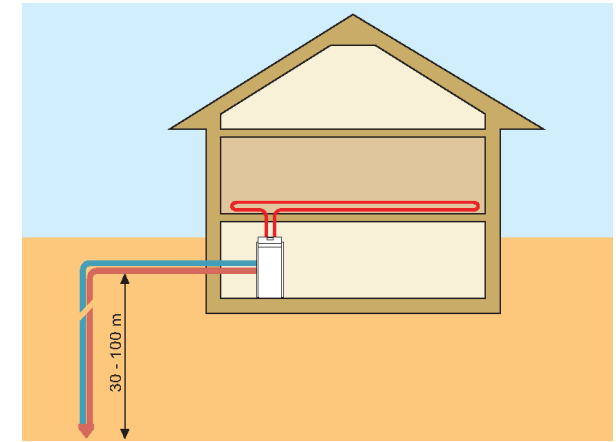
Stiebel Eltron  
LWZ 304 Trend



Brabant houses  
by Archiservice



# CASE STUDIES - 2NDSKIN DEMONSTRATOR



Heat recovery ventilation unit

Buffer Boiler

Ground Heat pump

2ndskin cupboard ground floor  
(Boess, S. 2017)



Heat recovery ventilation unit

Buffer Boiler

Heat pump booster

2ndskin cupboard First floor  
(Boess, S. 2017)



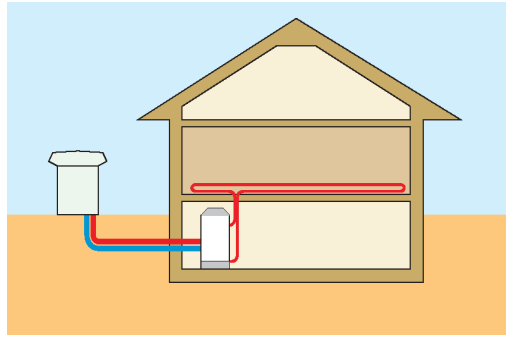
Heat recovery ventilation unit

Buffer Boiler

2ndskin cupboard second floor  
(Boess, S. 2017)



# CASE STUDIES - LG CLIMATE ENERGY MODULE



Air heat pump inside unit

Heat recovery ventilation unit

Air heat pump outside unit

Control panel

Buffer Tank

PV converter





# CASE STUDIES - *NEFIT ENERGY BAR*

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Air heat pump  
outside unit

Heat recovery  
ventilation unit

Air heat pump  
inside unit with  
integrated buffer  
tank

- 1 unit
- Compact
- Integrated buffer and secondary heater
- Only prototype
- Plug and Play

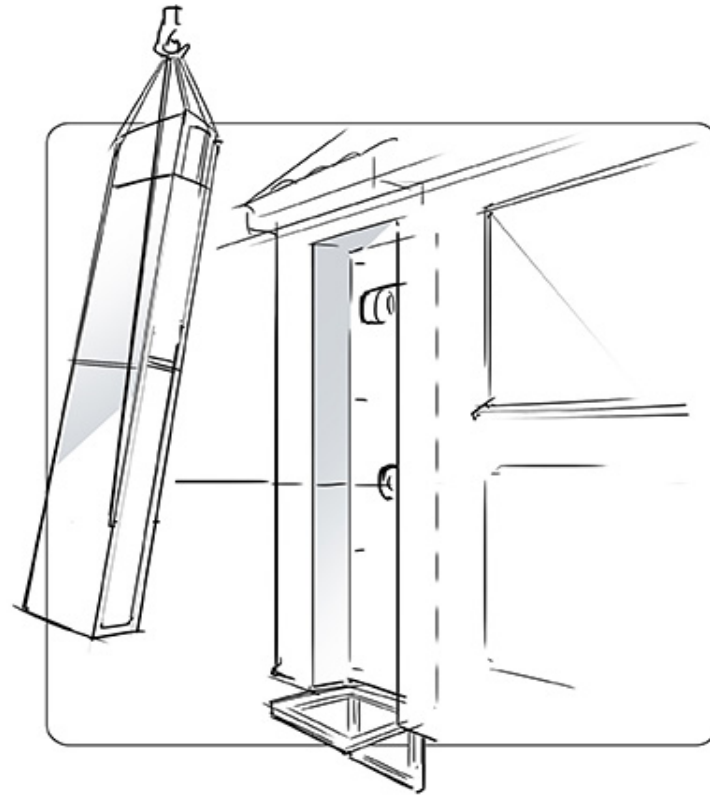


# CASE STUDIES - *NEFIT ENERGY BAR*

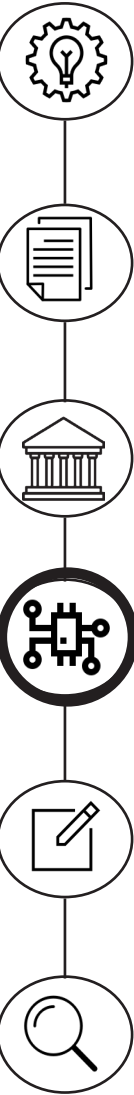
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- In the facade
- Openings on inside
- Connect after placement

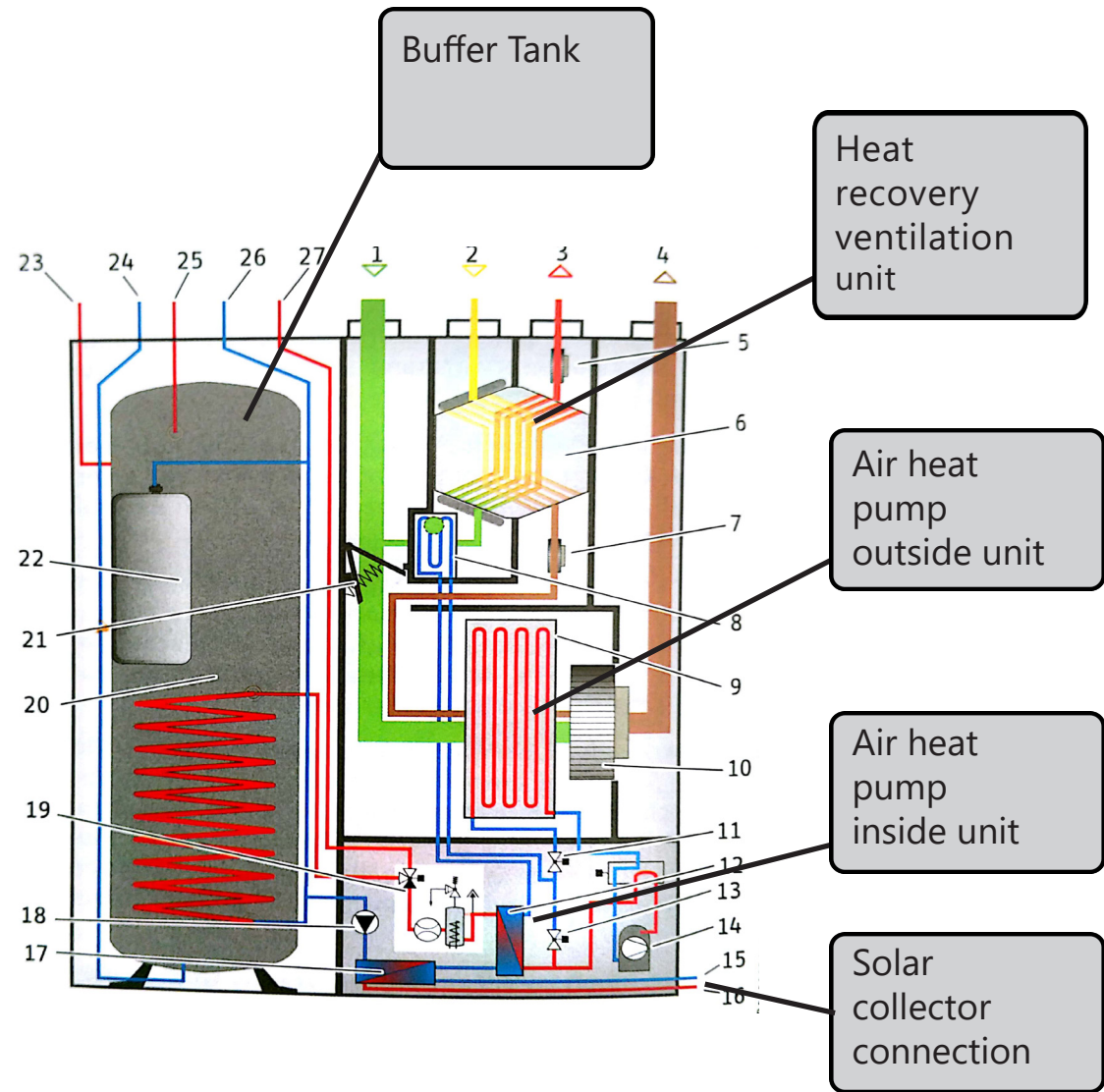


Placement



# CASE STUDIES - STIEBEL ELTRON

- All integrated
- Transport in 2 parts
- Placement inside
- Ventilation re-tour into Air heat pump



# CASE STUDIES - *BRABANT HOUSES*

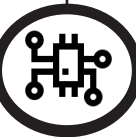
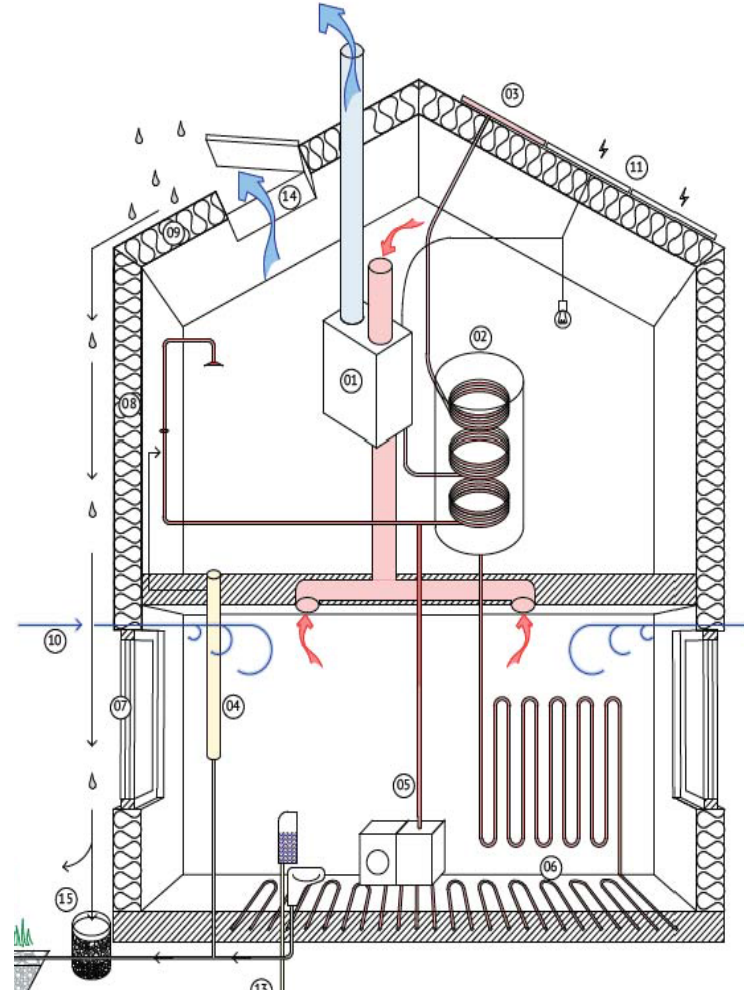


Flow heater

Air ventilation  
heat pump

Solar Buffer  
Tank

- Solar collector
- Inside above stairs
- Separate installations
- Natural ventilation
- No ventilation unit
- Zero energy



# SYSTEM COMPARISON

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- Aim: determine what the possibilities are for integration, decreasing size and weight.
- Size
- Empty spaces
- Connections
- Weight
- Noise
- Sound Insulation
- Energy efficiency

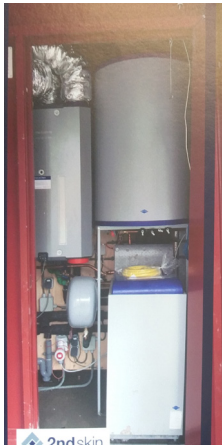
-- Bad

-

0 Average

+

++ Good



# SYSTEM COMPARISON - *Size*

- Height
- Volume
- Individual installations
- Integrated



**2ndskin**



**LG Energy module**



**Nefit Energy Bar**



**Stiebel Eltron LWZ 304**



**Brabant houses**

**Height**  
**Length**  
**Depth**  
**Total volume**

(m)	2,60	2,41	6,0	1,89	2,50
(m)	0,95	1,50	0,90	1,43	1,00
(m)	1,80	0,98	0,50	0,7	1,20
(m <sup>3</sup> )	4,5	3,5	2,7	2,0	3,0

**Score**

-                      0                      +                      ++                      0



# SYSTEM COMPARISON - *Size*

- >5,0 m<sup>3</sup>
- >4,0 m<sup>3</sup>
- 0 > 3,0 m<sup>3</sup>
- + >2,0 m<sup>3</sup>
- ++ <2,0 m<sup>3</sup>



**2ndskin**



**LG Energy module**



**Nefit Energy Bar**



**Stiebel Eltron LWZ 304**



**Brabant houses**

**Height**  
**Length**  
**Depth**  
**Total volume**

(m)	2,60	2,41	6,0	1,89	2,50
(m)	0,95	1,50	0,90	1,43	1,00
(m)	1,80	0,98	0,50	0,7	1,20
(m <sup>3</sup> )	4,5	3,5	2,7	2,0	3,0

**Volume installations**

(m <sup>3</sup> )	1,1	0,7	0,7	0,7	0,7
-------------------	-----	-----	-----	-----	-----

**Score**

-	0	+	++	0
---	---	---	----	---



# SYSTEM COMPARISON - *Empty space*



**2ndskin**



**LG Energy module**



**Brabant houses**

- > 0,4 m
- > 0,2 m
- 0 > 0,1 m
- + > 0,05 m
- ++ < 0,05 m



	2ndskin	LG Energy module	Nefit Energy Bar	Stiebel Eltron LWZ 304	Brabant houses
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**Empty spaces**

--                      -                      +                      ++                      0



# SYSTEM COMPARISON - *Empty space*



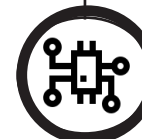
**Nefit Energy Bar**



**Stiebel Eltron LWZ 304**



- > 0,4 m
- > 0,2 m
- 0 > 0,1 m
- + > 0,05 m
- ++ < 0,05 m



	2ndskin	LG Energy module	Nefit Energy Bar	Stiebel Eltron LWZ 304	Brabant houses
<b>Empty spaces</b>	--	-	+	++	0

# SYSTEM COMPARISON - *Connections*

- 5 sides
- 4 sides
- 0 3 sides
- + 2 sides
- ++ 1 side



**2ndskin**



**LG Energy module**



**Nefit Energy Bar**



**Stiebel Eltron LWZ 304**



**Brabant houses**

Score

++

+

++

0

+



# SYSTEM COMPARISON - *Weight*

.. >1000 kg

- >800 kg

0 > 600 kg

+ >400 kg

++ <400 kg



**2ndskin**



**LG Energy module**



**Nefit Energy Bar**



**Stiebel Eltron LWZ 304**



**Brabant houses**

**Total installations**  
**Total unit**

(Kg)

(Kg)

341  
870

395  
780

390  
600 - 1000

-  
610

431  
-

**Score**

-

0

X

0

X



# SYSTEM COMPARISON - Noise



**2ndskin**



**LG Energy module**



**Nefit Energy Bar**



**Stiebel Eltron LWZ 304**



**Brabant houses**

**Total inside noise**

(db)

50

51

36

59

51

**Heat pump Outside**

(db)

64

65

59

47

**60 db**



# SYSTEM COMPARISON - *Sound insulation*

- Connection sound
- Airborne sound
- Insulation



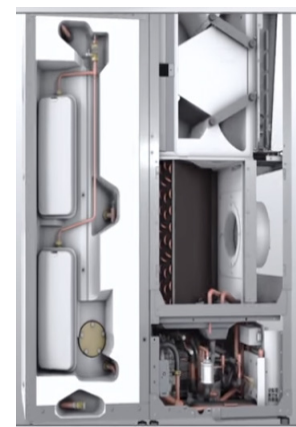
**2ndskin**



**LG Energy module**



**Nefit Energy Bar**



**Stiebel Eltron LWZ 304**



**Brabant houses**

Score

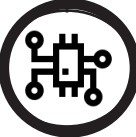
0

-

0

++

--



# SYSTEM COMPARISON - *Energy efficiency*



## Capacity

**2ndskin**

**LG Energy module**

**Nefit Energy Bar**

**Stiebel Eltron 304**

**Brabant houses**

**Heat pump (kW)**

5,4

5,9

7,0

7,8

5,3

1,4

## COP

**Temperature source for COP**

14°C

7°C

7°C

7°C

7°C

7°C 20°C

**Average**

**6,19**

**3,49**

**3,42**

**4,58**

**4,26**

**1,43 5,81**

**Score**

**++**

**-**

**0**

**0**

**+**



# SYSTEM COMPARISON - Conclusion



**2ndskin**



**LG Energy module**



**Nefit Energy Bar**



**Stiebel Eltron LWZ 304**



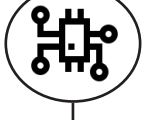
**Brabant houses**

	2ndskin	LG Energy module	Nefit Energy Bar	Stiebel Eltron LWZ 304	Brabant houses
Size	-	0	+	++	0
Empty spaces	--	-	+	++	0
Connections pipes	++	+	++	0	+
Sound insulation	0	-	0	++	--
Weight	-	0	X	0	X
Efficiency	++	-	0	0	+
Average	0	-/0	0/+	+	0
Ranking	<b>3</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>3</b>



# DESIGN PROPOSAL

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# DESIGN PROPOSAL - *The heat pump*



**Ground heat pump**



**VS.**

- Installation on site
- Reduce building time

**1 house**

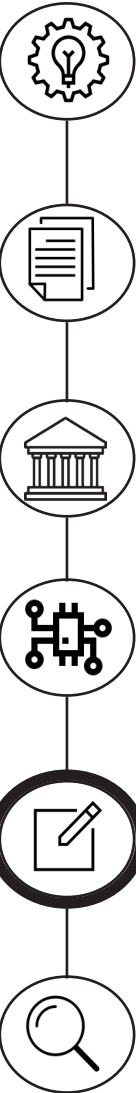
- 0,8 kW heating
- 1,1 kW Cooling

**3 house**

- 2,4 kW heating
- 3,3 kW Cooling



**Air ventilation heat pump**



# DESIGN PROPOSAL - *Ventilation*

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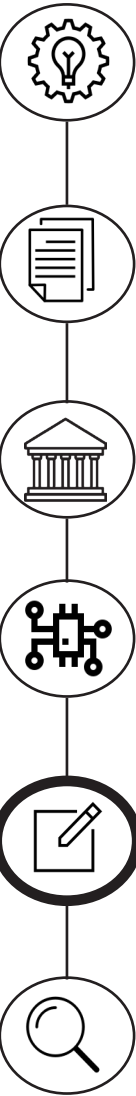
**Heat recovery ventilation system**    **1 house**  
• 150 m<sup>3</sup>/s

**vs.**

**3 house**  
• 450 m<sup>3</sup>/s



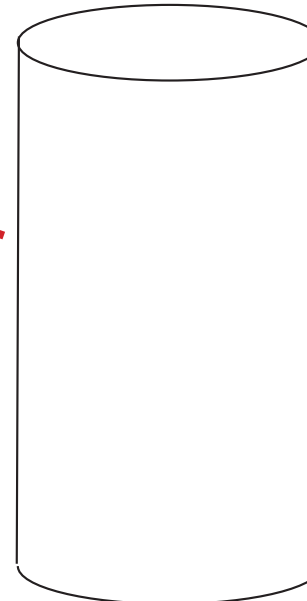
**Natural Ventilation**



# DESIGN PROPOSAL - *Water*



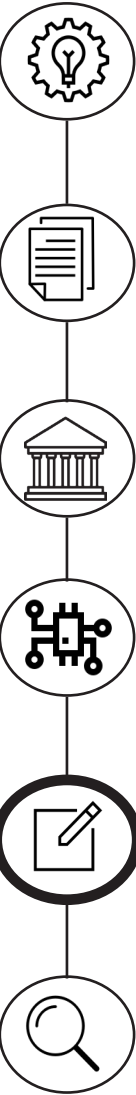
**VS.**



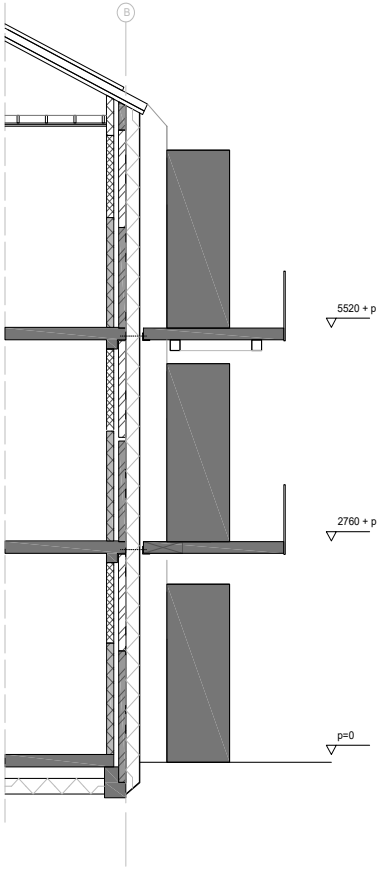
- Size and weight
- Length pipes
- Individual monitoring
- Difference in use

**1 house**  
• 150 L

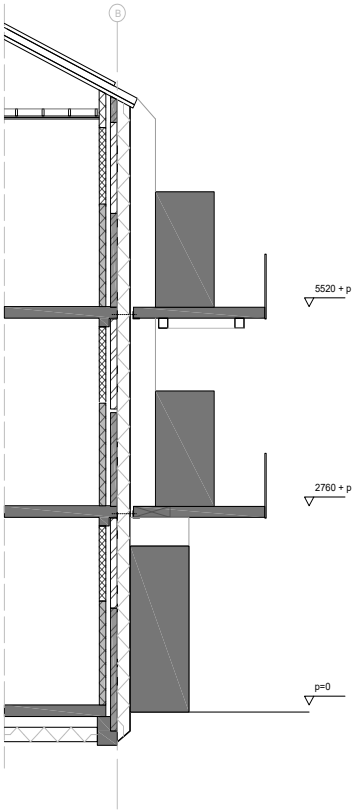
**3 house**  
• 450 L



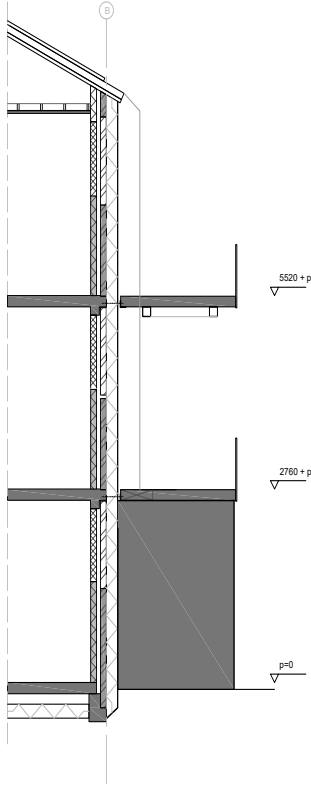
# DESIGN PROPOSAL - 3 concepts



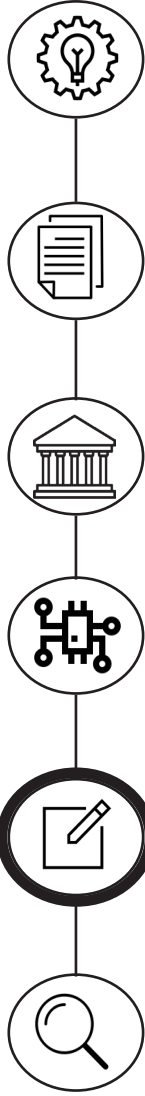
All - individual



Hybrid

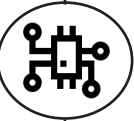
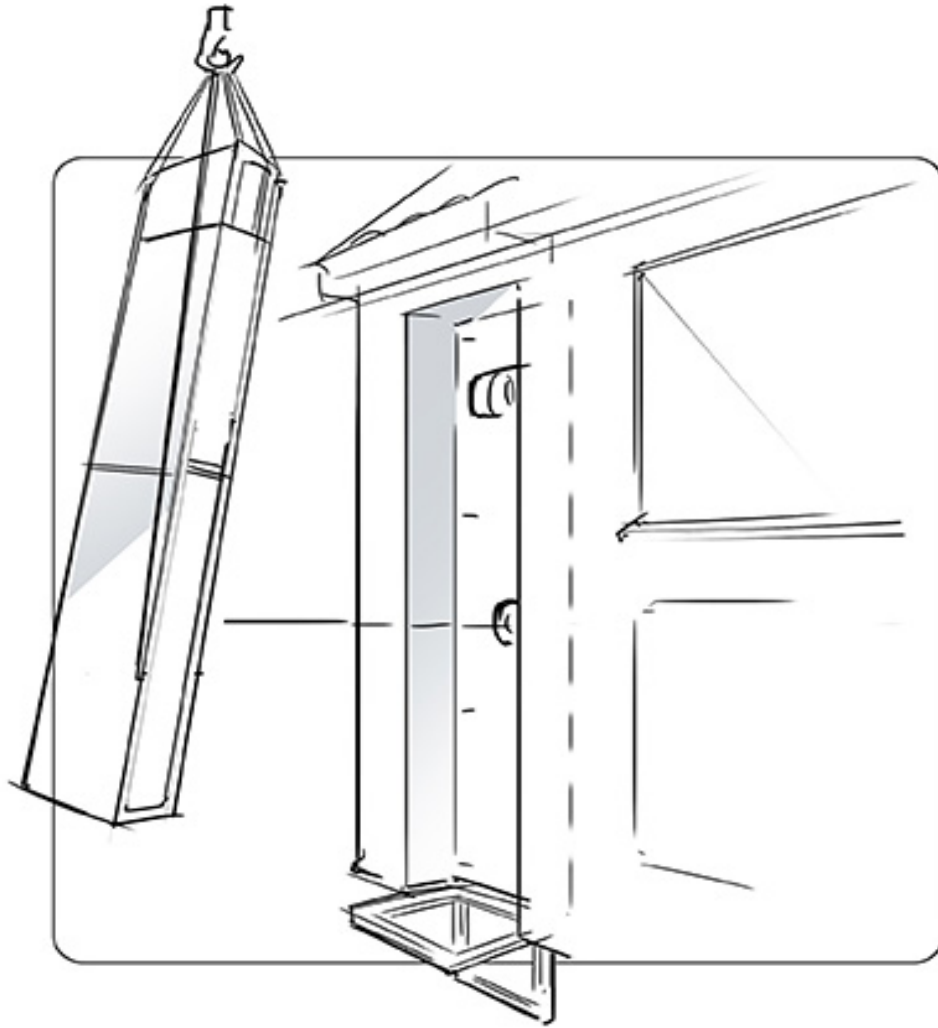


All - in - one



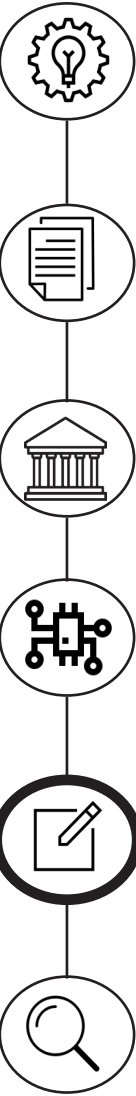
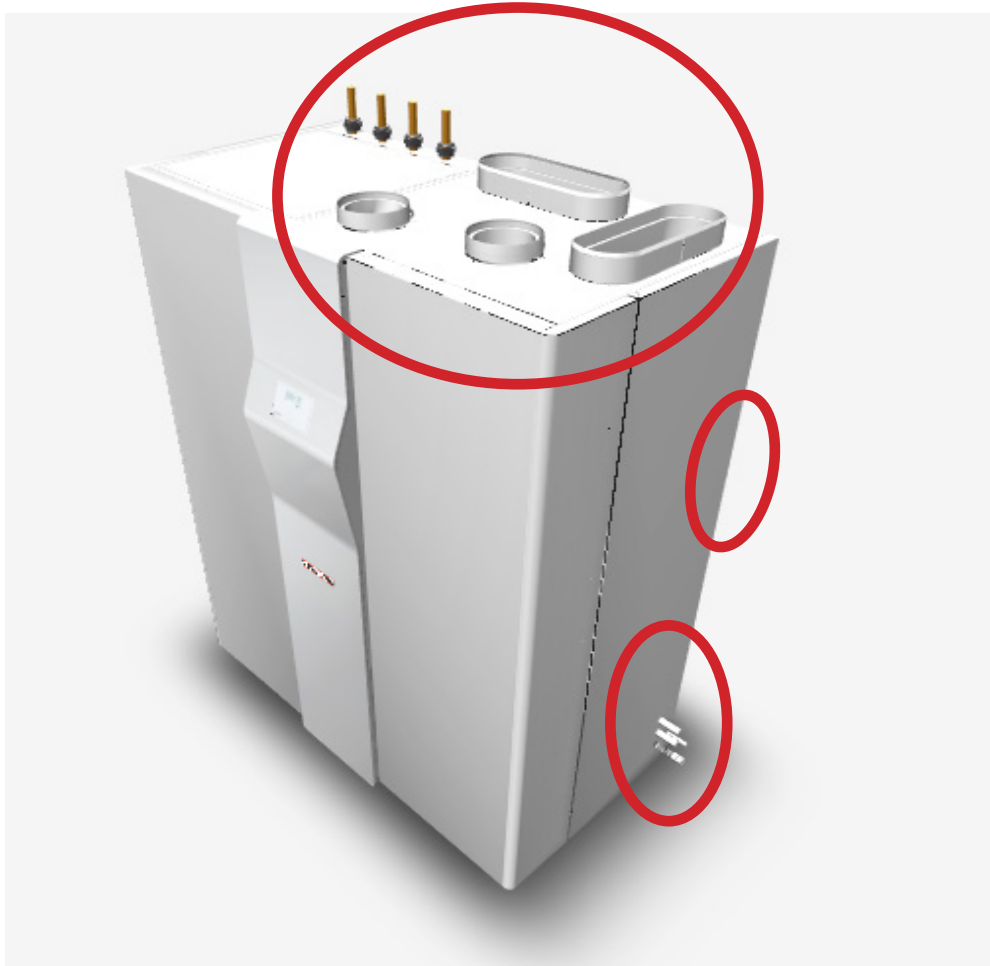
# DESIGN PROPOSAL - *Facade integration*

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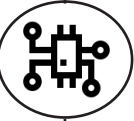
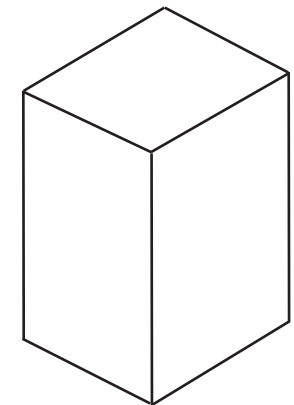
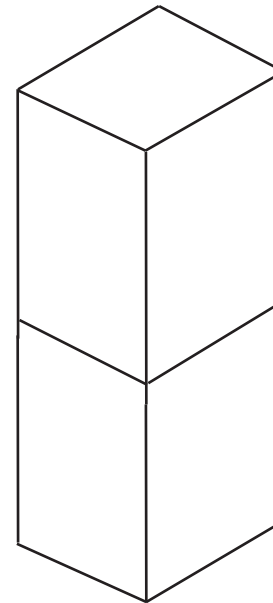
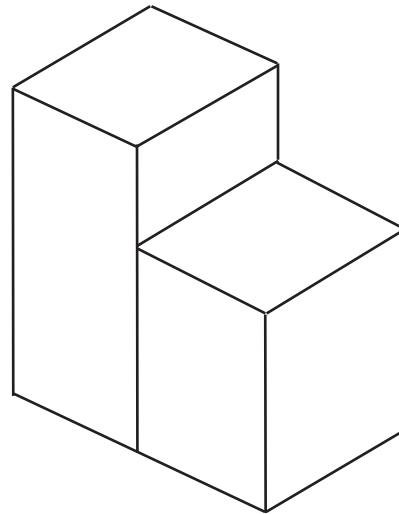
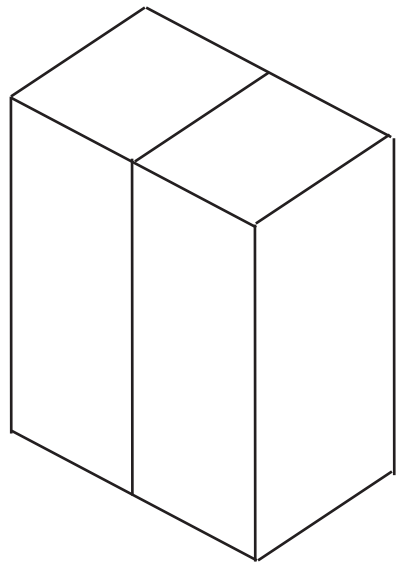
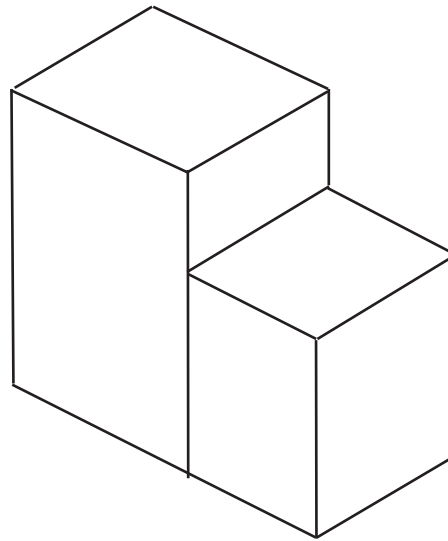
# DESIGN PROPOSAL - *Connections*

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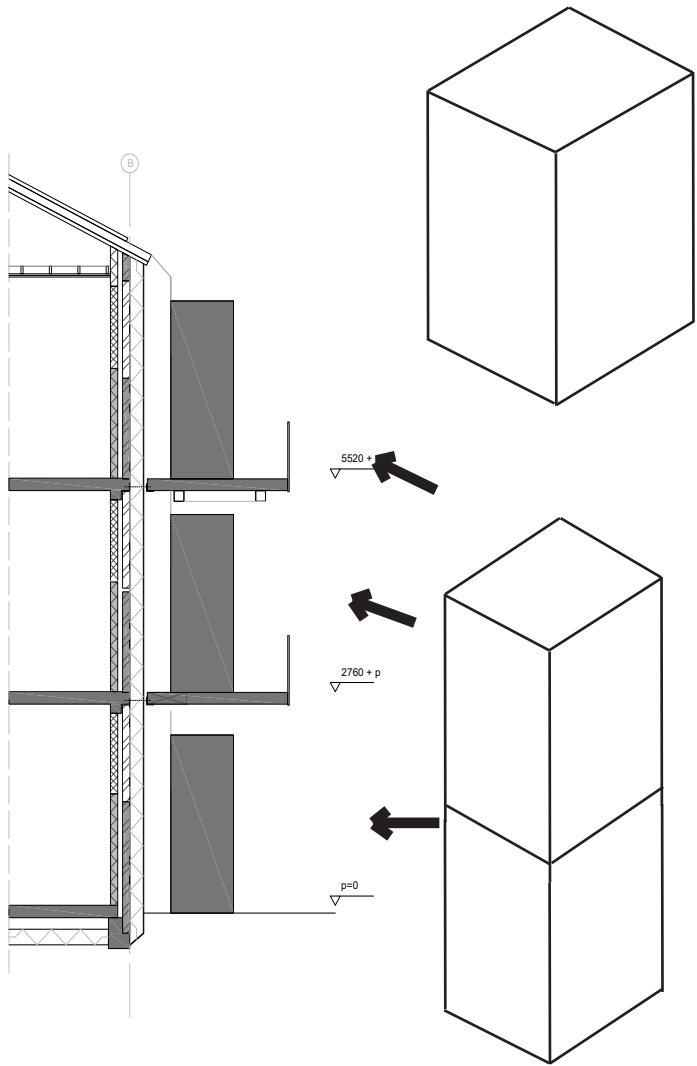


# DESIGN PROPOSAL - *Space*

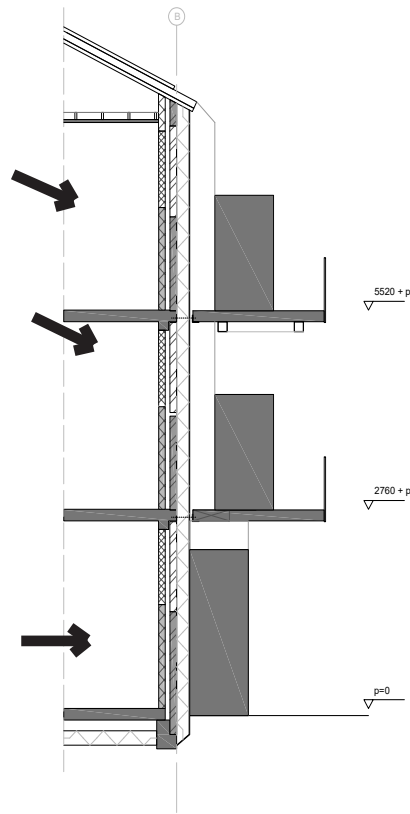
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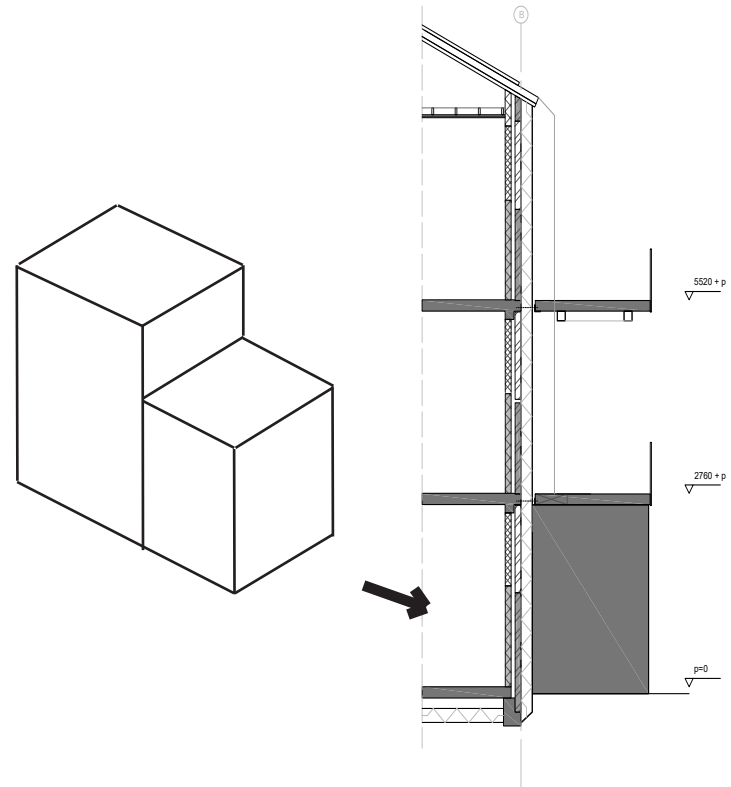
# DESIGN PROPOSAL - *placement*



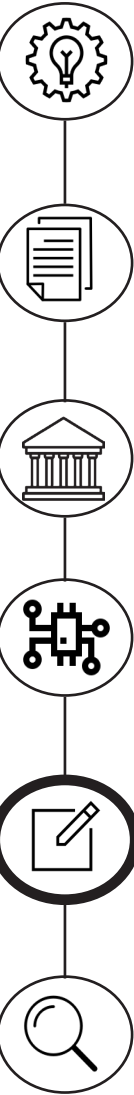
**All - individual**



**Hybrid**



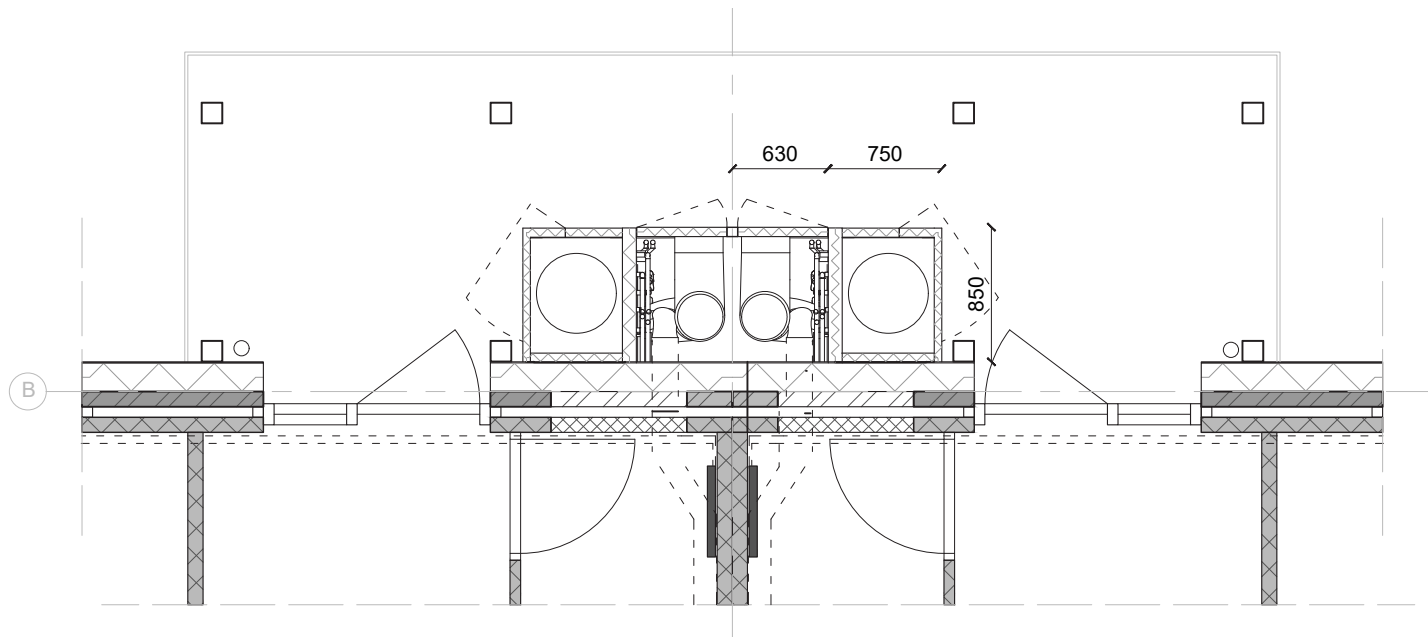
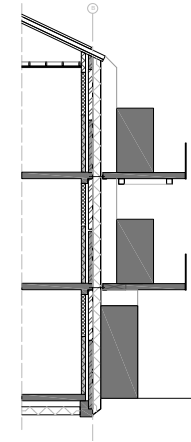
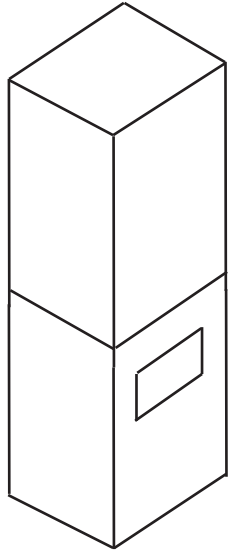
**All - in - one**



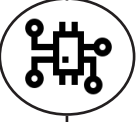


# DESIGN PROPOSAL - *placement*

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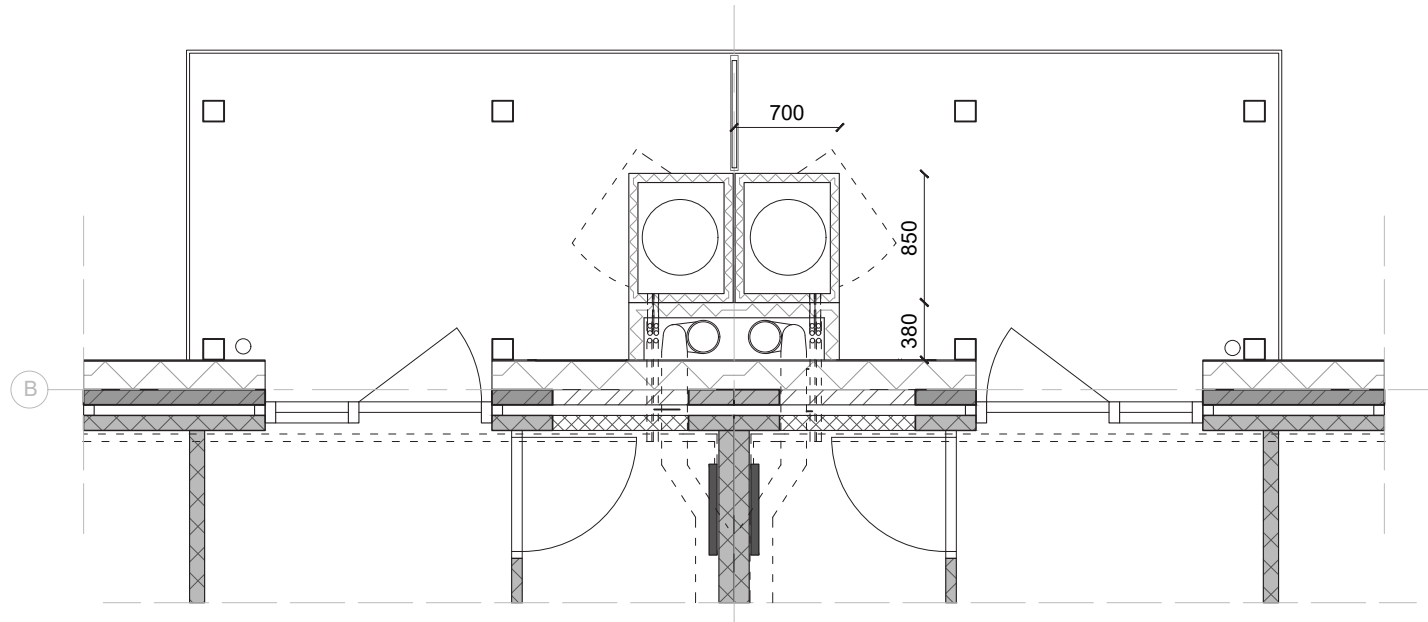
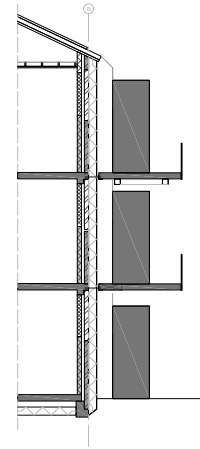
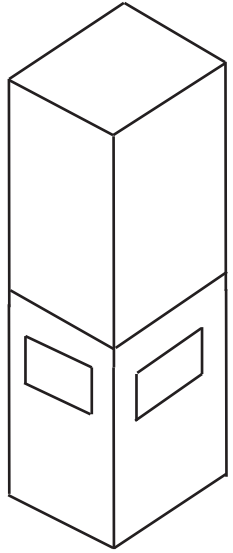


**Hybrid - Ground Floor**

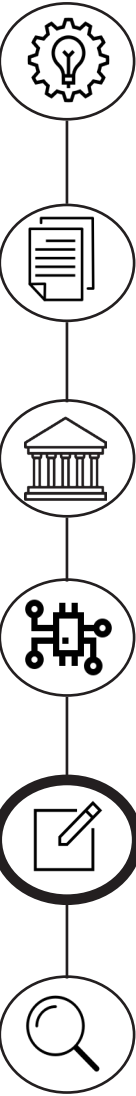


# DESIGN PROPOSAL - *placement*

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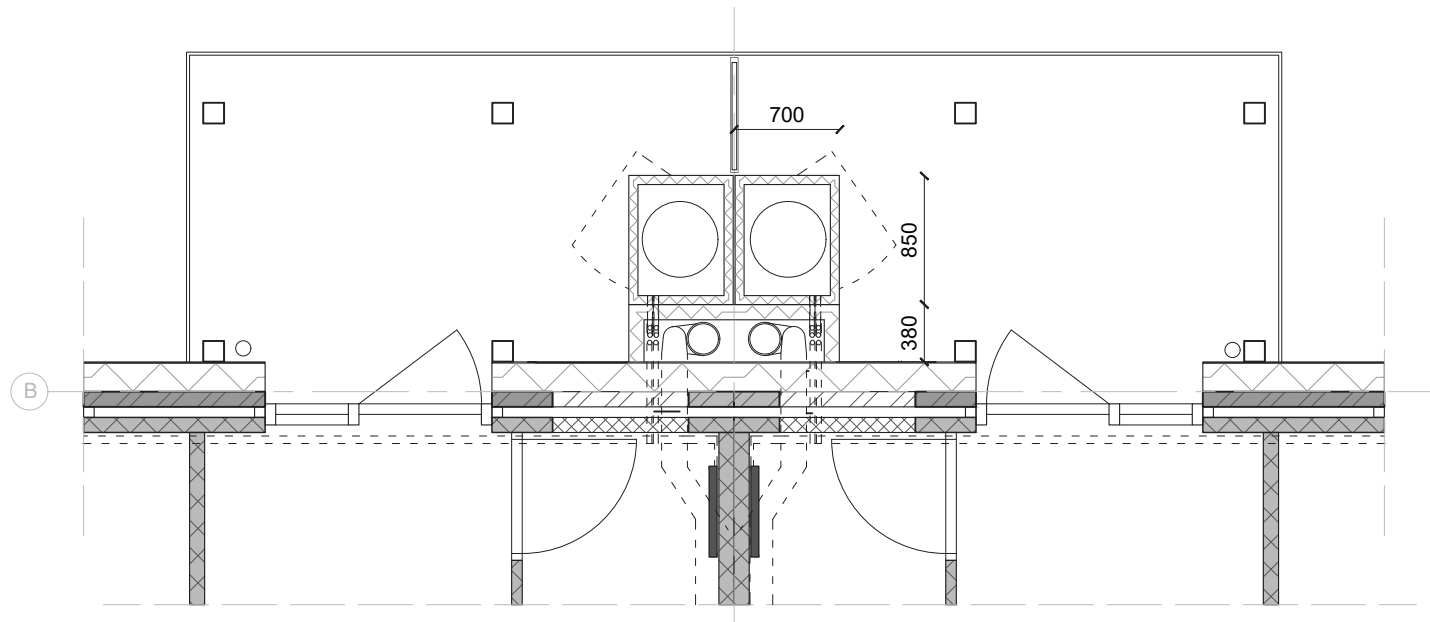
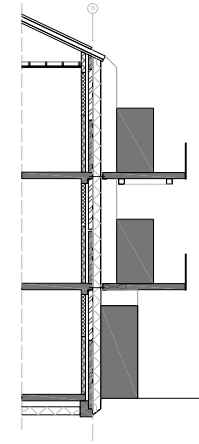
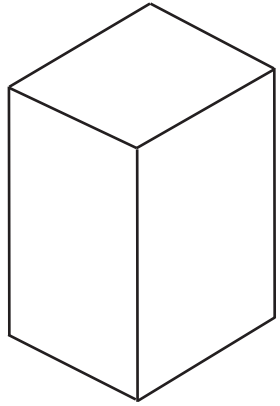


**All - individual - All floors**

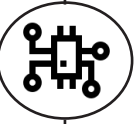


# DESIGN PROPOSAL - *placement*

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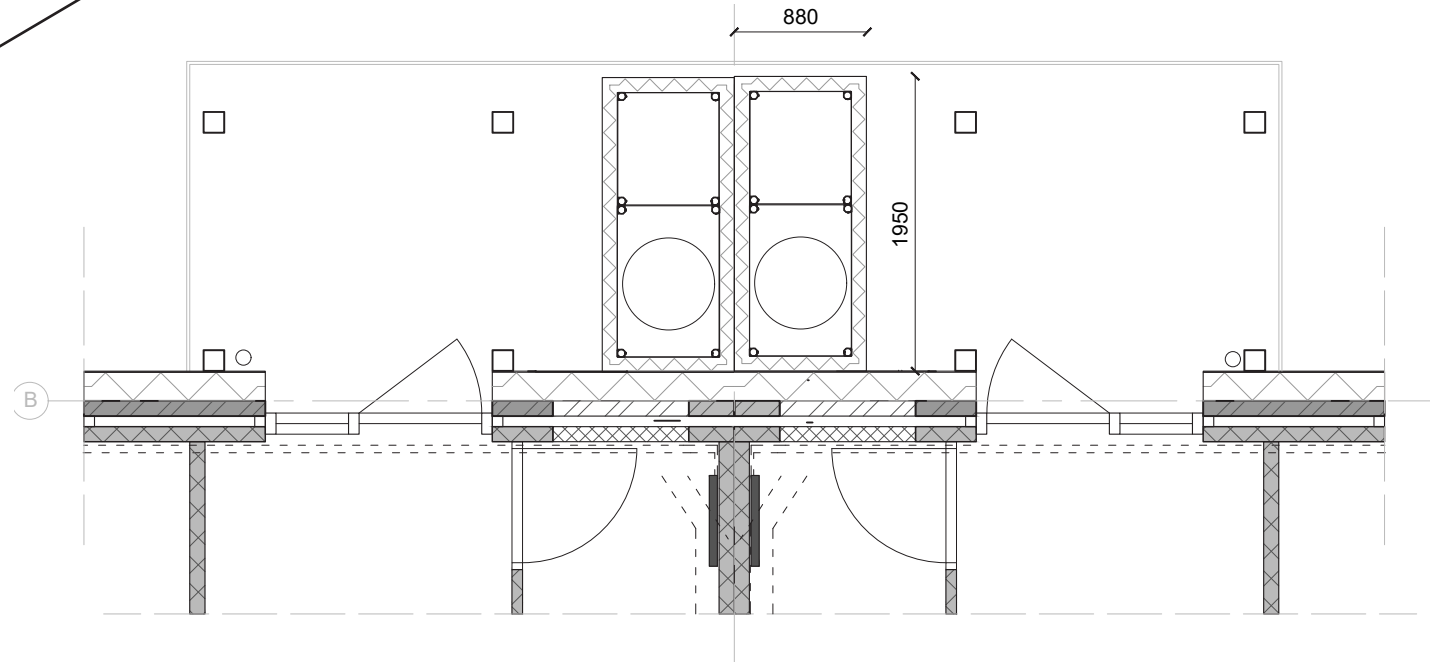
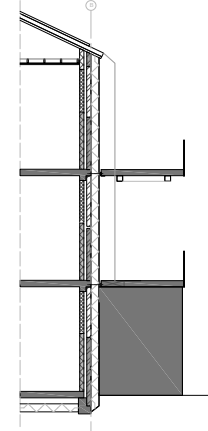
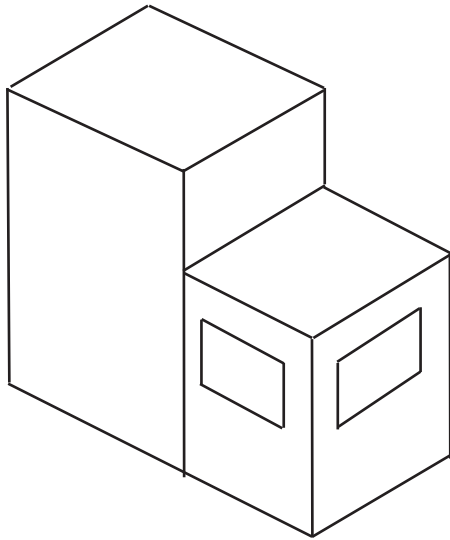


**Hybrid - First and Second floor**

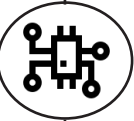


# DESIGN PROPOSAL - *placement*

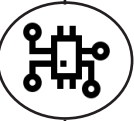
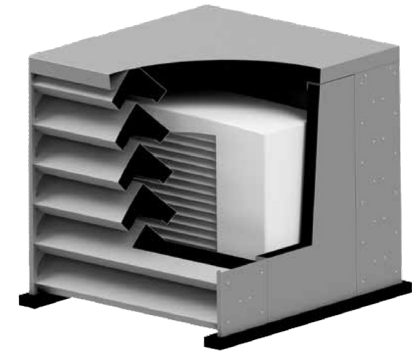
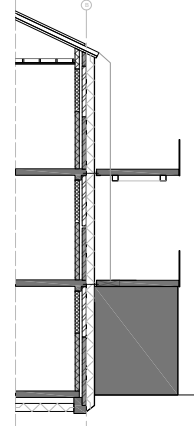
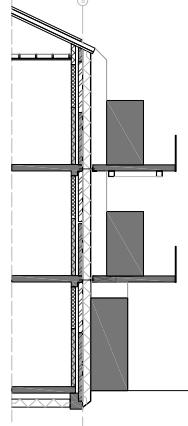
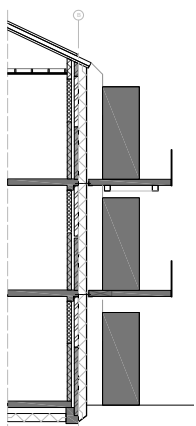
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**All - in - one**



# DESIGN PROPOSAL - *Covering*



**All - individual**

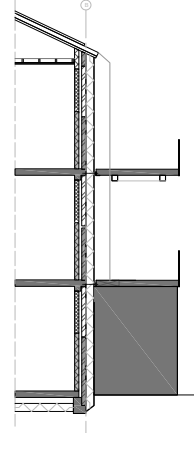
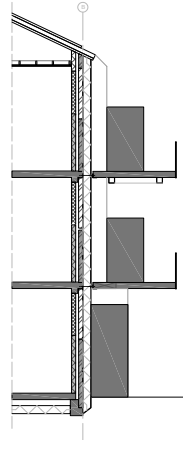
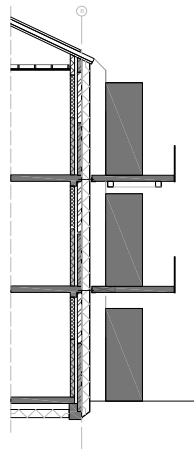


**Hybrid**

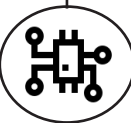


**All - in - one**

# DESIGN PROPOSAL - Comparison



	Individual	Hybrid	All-in-one	2ndskin
Size biggest unit	1,95 m <sup>3</sup> ++	2,69 m <sup>3</sup> +	5,0 m <sup>3</sup> --	4,5 m <sup>3</sup> -
Total size	5,85 m <sup>3</sup>	5,38 m <sup>3</sup>	5,20 m <sup>3</sup>	13,5 m <sup>3</sup>
Empty spaces	-	--	-	--
Connections pipes	++	++	+	++
Weight biggest unit	600 kg O	600 kg O	800 kg -	870 kg -
Individual monitoring	++	+	-	+



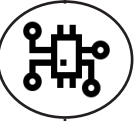
# DESIGN PROPOSAL - *Conclusion*

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## **Research question**

How can the installations be more efficiently integrated into an 2ndskin porch house renovation?

- Less Empty spaces
- Less Connection sides
- Less Installations
- Designing inside out.





# **Integrating Installations into a zero-energy renovation**

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Rosanne Berkhout - 4529863