

STUDY

COMPARISON - BUILDING AUTOMATION WITH AND
WITHOUT WIRELESS TECHNOLOGY

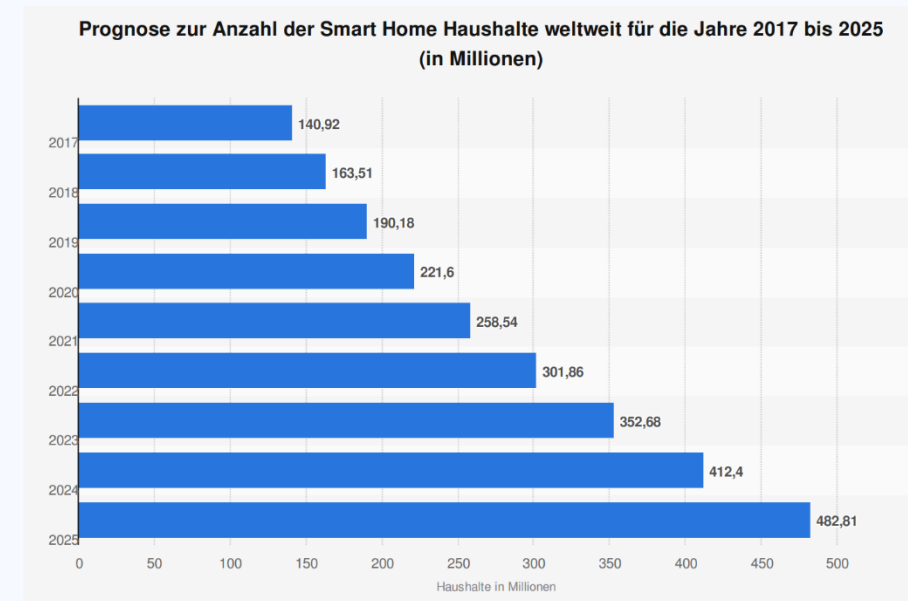
STRUCTURE

1. Goals of the Study
2. Key data
3. Procedure
4. Summary

WHY?

We spend 90% of our lives inside buildings

Building Automation / Smart Home is becoming an ever-increasingly important topic



GOALS

- To highlight **the advantages of building automation** compared to conventional installation methods
- To compare different types of installation technologies in the area of **decentralized building automation (with and without wireless technology)** and to highlight the **advantages and disadvantages** thereof

EQUIPMENT TECHNOLOGIES

1. Conventional installation

- 1. (Orientation value)



“dumb” building



2. Building automation without wireless

- KNX as a representative standard



3. Building automation with wireless

- EnOcean as a representative standard



"Intelligent" building



COMPARISON FACTORS



Cost



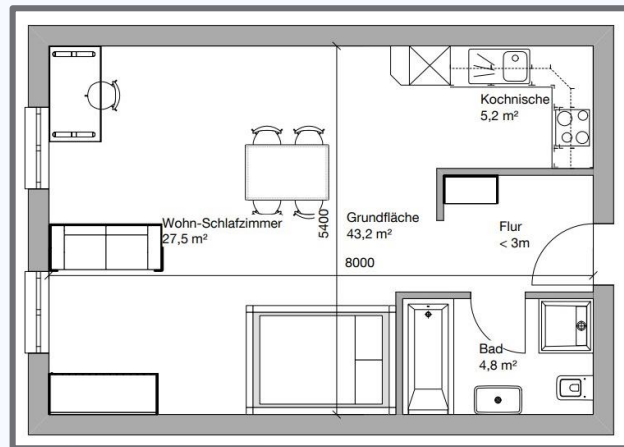
Ecology & Environment



Health & Wellness

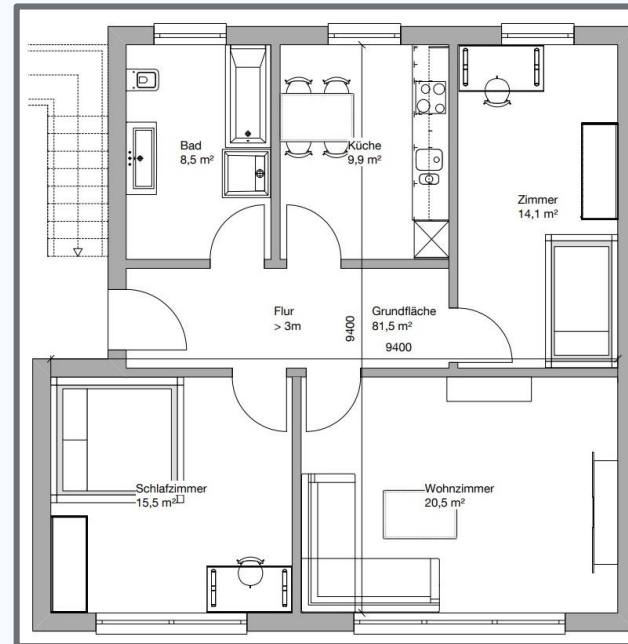
FLOOR PLANS

43,3 m²



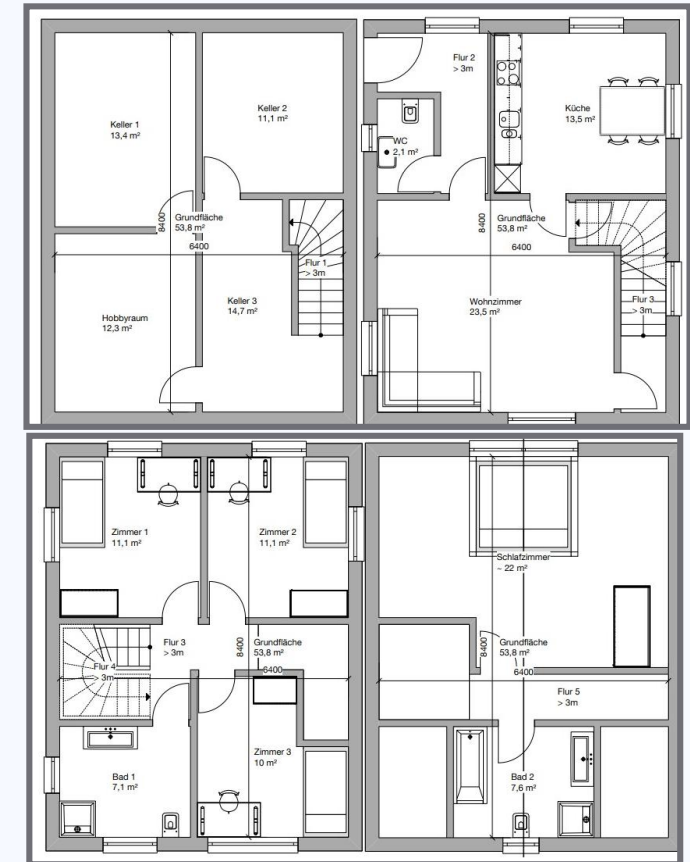
ONE-ROOM APARTMENT

81,5 m²



THREE-ROOM APARTMENT

215,2 m²



DETACHED HOUSE

EQUIPMENT VARIANTS

- **Basic Smart Building equipped**

- Partly "intelligent" building
- Entry point into building automation



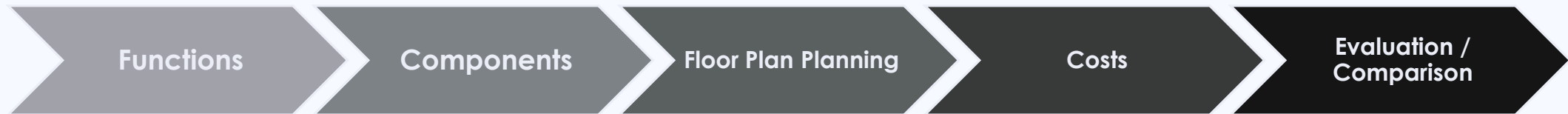
- **Fully Smart Building equipped**

- Fully "intelligent" building
- Comfort variation of building automation



ACTION

- For every floor plan
- In both equipment variants (basic and fully equipped)
- For all three equipment technologies (conventional, KNX and EnOcean)



Determination of the functions required for the respective equipment variant



Determination of the products required

Graphic floor plan planning
➤ Generating parts lists)

Complete parts lists with manufacturer prices

Interpretation and comparison of the different technologies

EQUIPMENT SPECIFICATION



| | Conventional |  |  |
|------------------------|--|--|--|
| Basic Equipment | DIN18015- RAL-RG678 "★★★★" - Comfort equipment | <ul style="list-style-type: none"> - Checklist for identification of user requirements * - Results of other university studies * | <ul style="list-style-type: none"> - Checklist for identification of user requirements * - Results of other university studies * |
| Full Equipment | | <ul style="list-style-type: none"> - Checklist for identification of user requirements * - Results of other university studies * | <ul style="list-style-type: none"> - Checklist for identification of user requirements * - Results of other university studies * |

* Checkliste zur Ermittlung der Nutzeranforderungen: Prof.Dr.Krödel,Michael: Technische Hochschule Rosenheim, Vorlesung für Gebäudeautomation

** Kos, Monika: Vergleich von „Smart-Home“ Gebäudeautomationssystemen und eine darauf basierende Entwicklung von Ausstattungsvarianten am Beispiel Hanse-Haus GmbH Oberleichtersbach. Rosenheim, Technische Hochschule Rosenheim, Fakultät für Holztechnik und Bau, Bachelorarbeit, 2013

Mattausch,Kay: Einsatz von Gebäudeautomation zur Unterstützung für altersgerechtes Wohnen. Rosenheim, Technische Hochschule Rosenheim, Fakultät für Holztechnik und Bau, Diplomarbeit, 2011

COSTS

| | Variant | Manufacturer | Source |
|----------------------------|---|---|--|
| Products | Conventional | Data from different manufacturers: Central Association of German Electrical and Information Technology Trades (ZVEH) | Calculation aid for electrical and information technology Trades (KFE), as of 2020 |
| Products |  | Hager Vertriebsgesellschaft mbH & Co. KG | 2021 Catalogue excerpts |
| Products |  | Eltako GmbH | 2021 Product Catalogue |
| Wiring, Installation Costs | | Data from various manufacturers: Central Association of German Electrical and Information Technology Trades (ZVEH) | Calculation aid for Electrical and Information Technology Trades (KFE), as of 2020 |

COST DETERMINATION

Conventional Wiring:

Material (Products and Wiring): **KFE**

+ 19% VAT

Installation (Komponente und Verkabelung): **KFE**

+ 19% VAT



Surcharge Factor 1,19

COST DETERMINATION

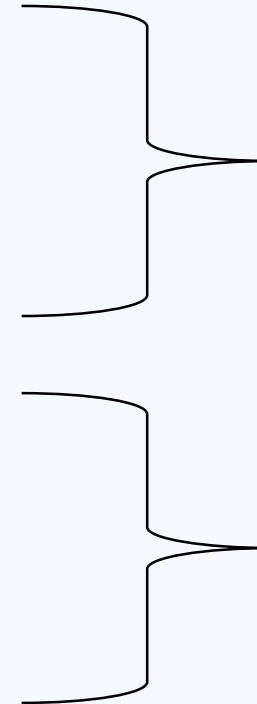
KNX und EnOcean :

Material (Products): **Official Suppliers' List Pricing**

- + 19 % VAT
- Discount for System Integrator
- + 30% Adder for the Installer Company (Margin)

Material (Wiring) and Installation: **KFE**

- + 19% VAT



Surcharge Factor 1,5

Surcharge Factor 1,19

BUILDING AUTOMATION AREAS



Security

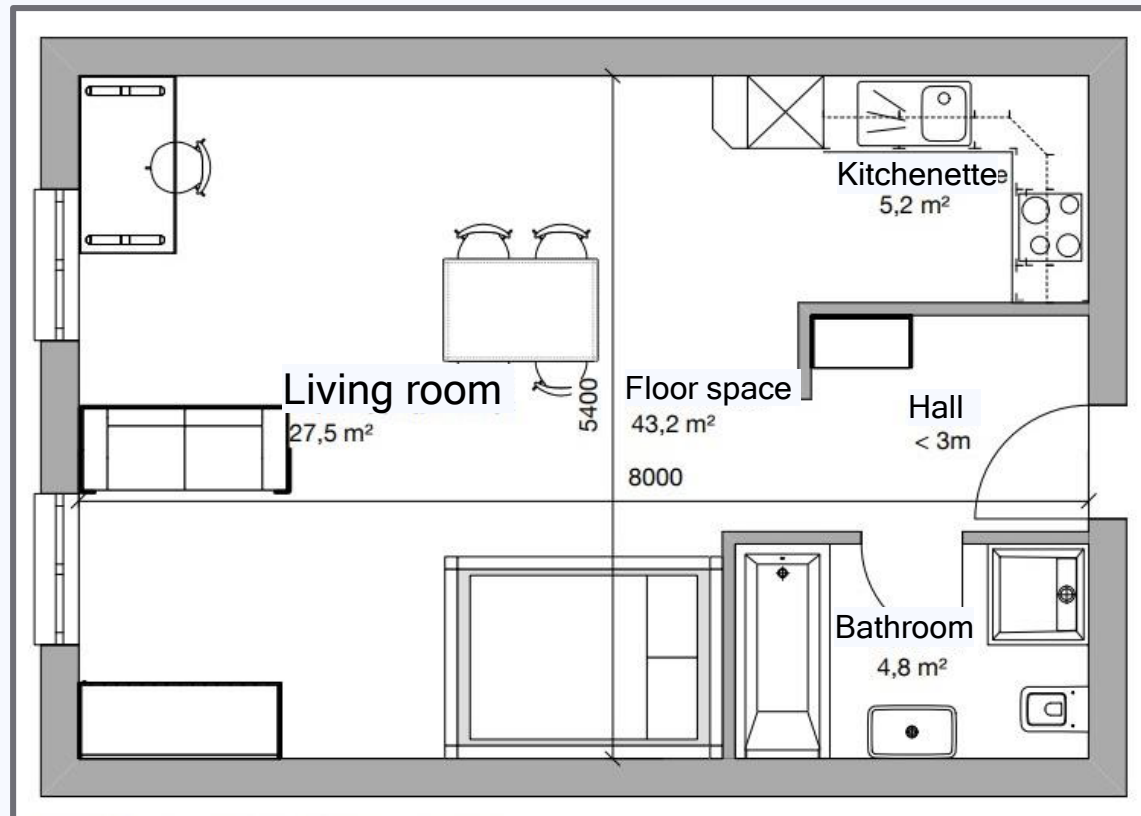


Comfort



Energy

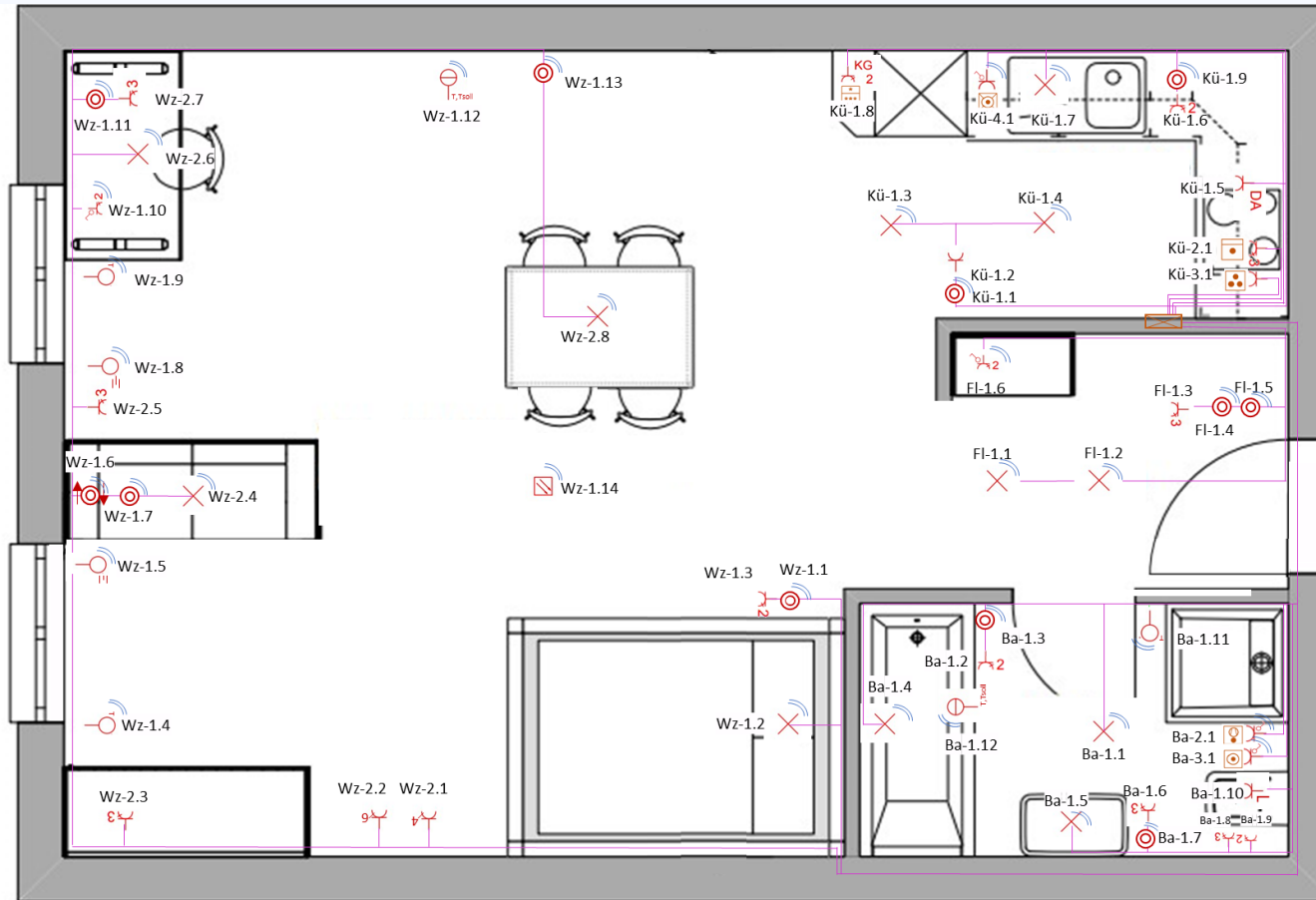
One-room apartment - **basic equipment**



Equipment component:

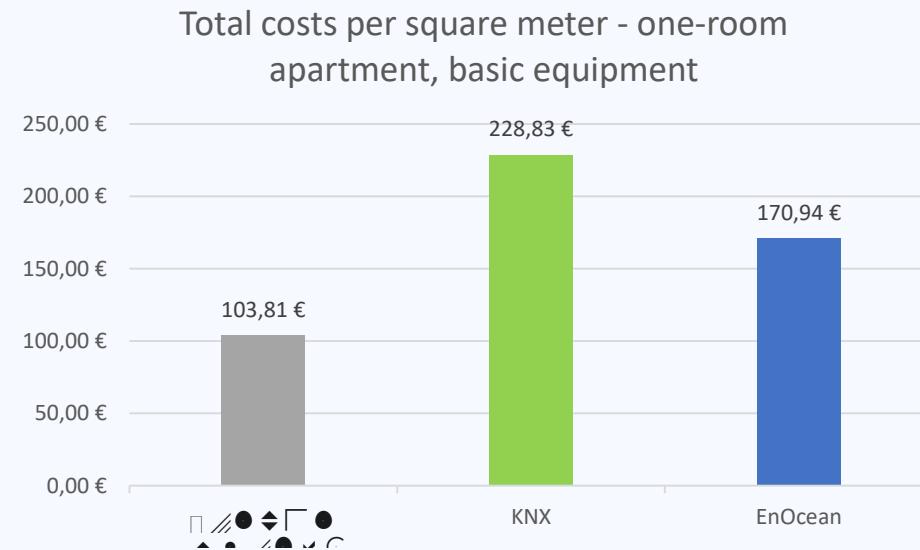
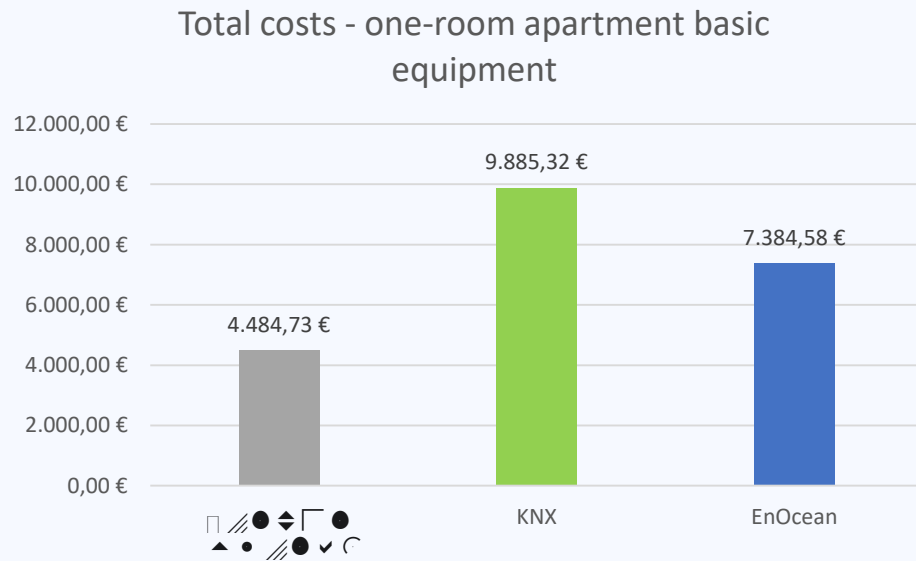
| One-room apartment basic equipment | | |
|------------------------------------|------------------------------------|-----------|
| Area | Product | Units |
| Comfort | Blind actuator | 2 |
| Comfort | Shutter switch | 2 |
| Comfort | Dimming actuator | 11 |
| Comfort | 2 Rocker light switch | 9 |
| Energy | Room temperature sensor with input | 2 |
| Energy | Radiator valve actuator | 3 |
| Energy | Switch actuator flush mounting | 2 |
| Energy | Central switch | 1 |
| Security | Smoke detector | 1 |
| Total | | 33 |

ONE-ROOM APARTMENT - BASIC EQUIPMENT



Example of the layout
in the EnOcean variant

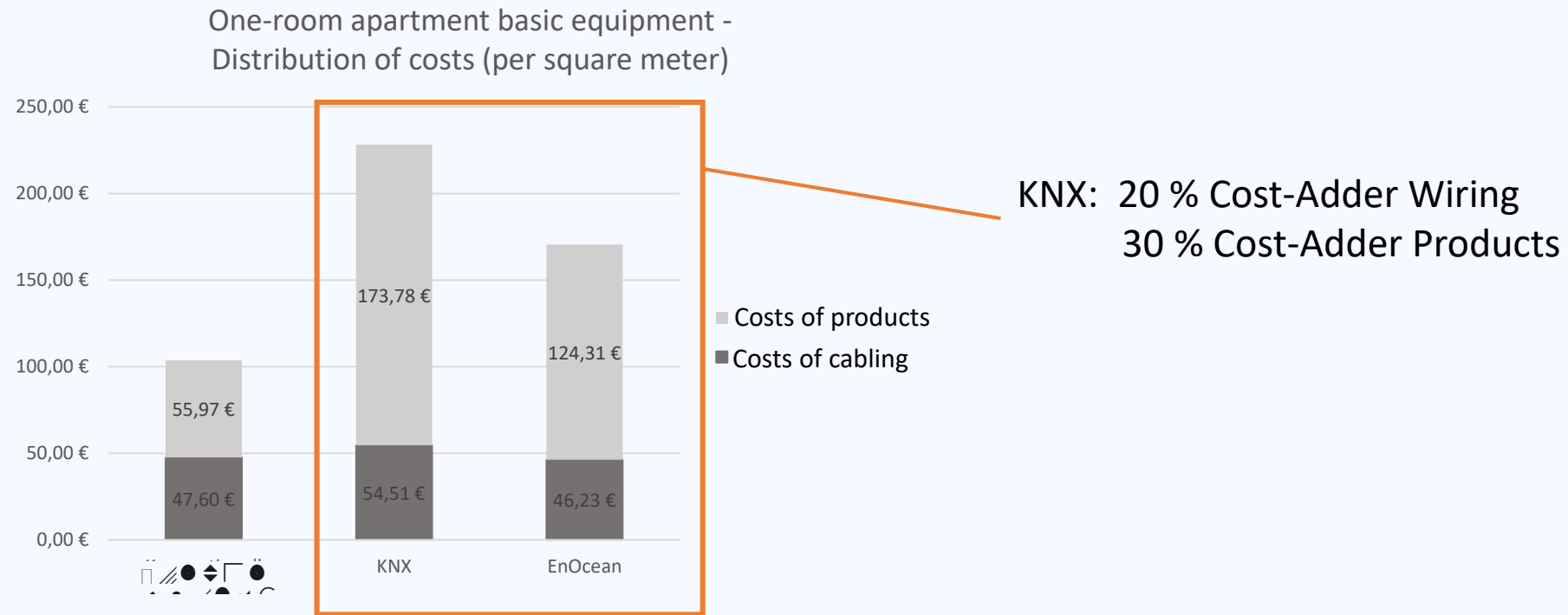
One-room apartment - basic equipment



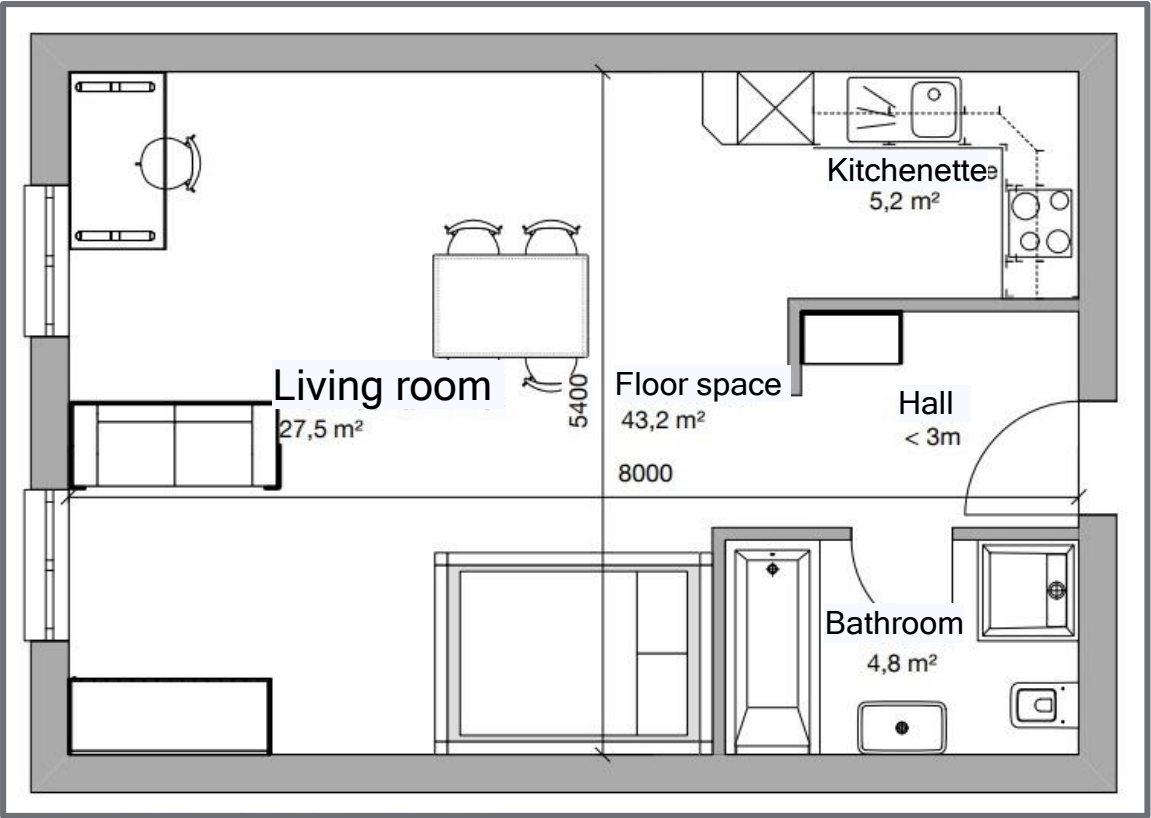
* The following costs were not taken into account for the KNX technology:

- Costs for the ETS tool (average flat rate is determined by the respective installer)
- License per construction site (between € 200 - € 400)

One-room apartment - basic equipment



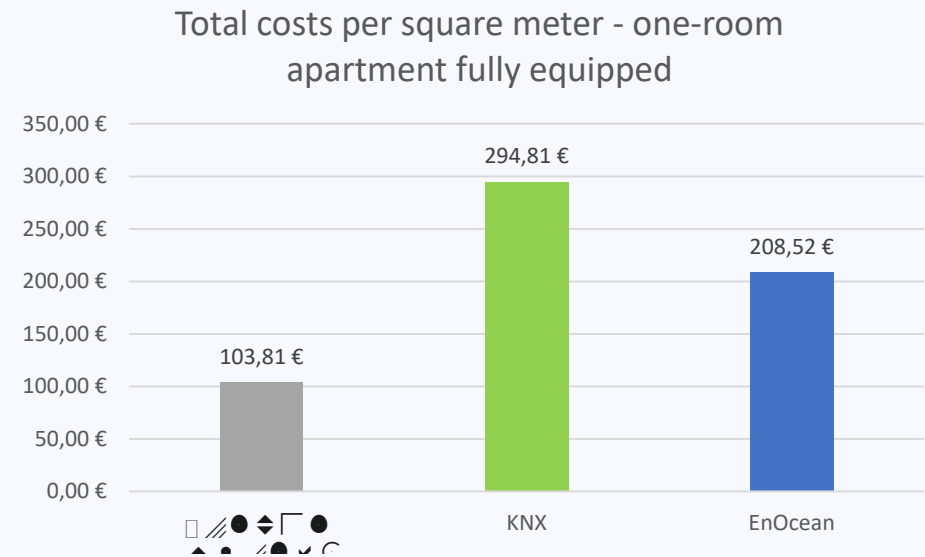
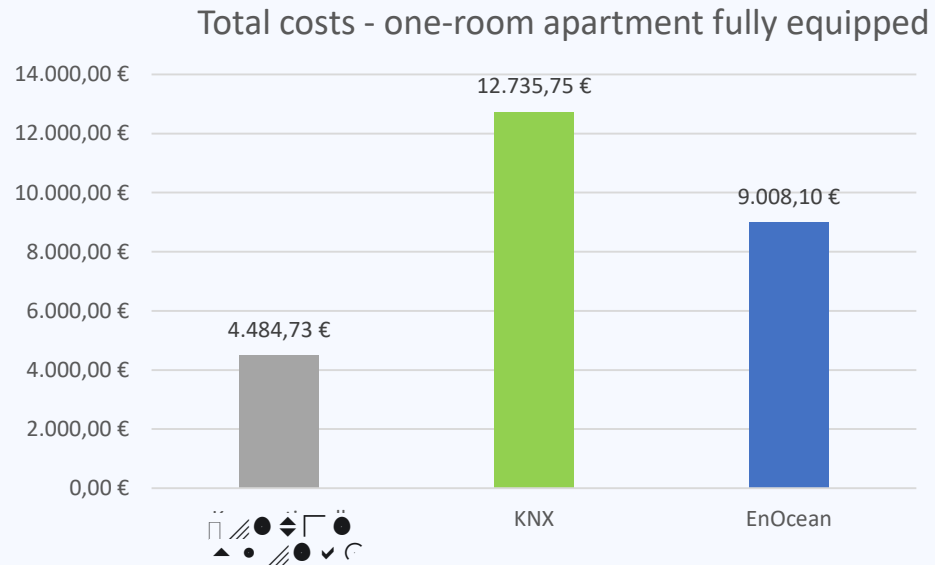
One-room apartment - fully equipped



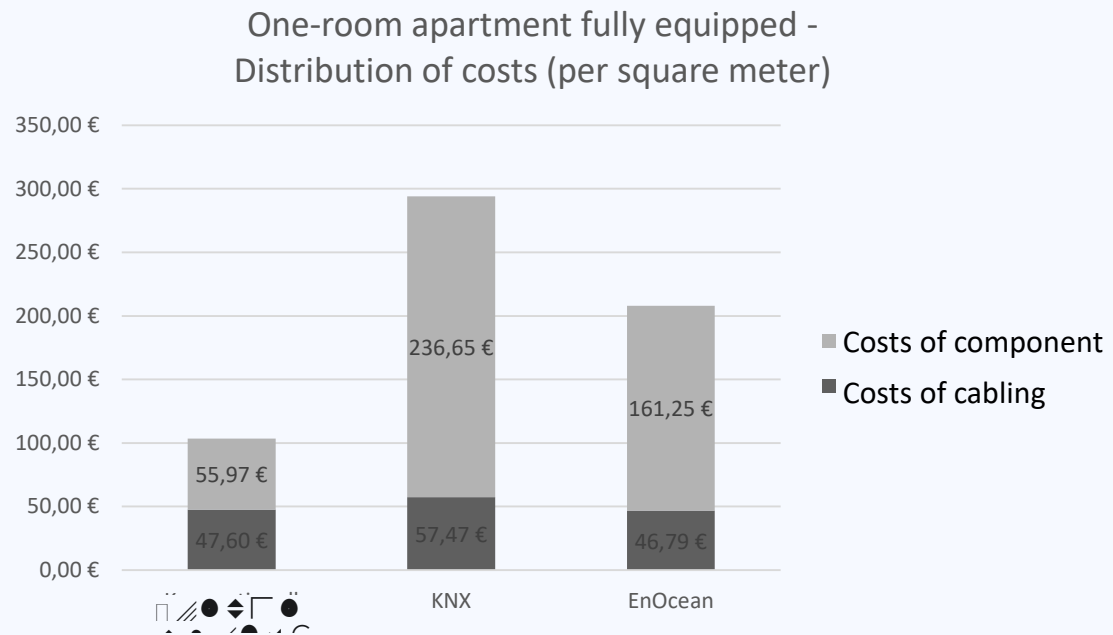
Equipment component:

| One-room apartment fully equipped | | |
|-----------------------------------|------------------------------------|-------|
| Area | Product | Units |
| Comfort | Blind actuator | 2 |
| Comfort | Shutter switch | 2 |
| Comfort | Dimming actuator | 11 |
| Comfort | 2 Rocker light switch | 11 |
| Energy / Comfort | Brightness and presence detectors | 4 |
| Energy | Room temperature sensor with input | 2 |
| Energy | Radiator valve actuator | 3 |
| Energy | Switch actuator flush mounting | 2 |
| Energy | Central switch | 1 |
| Security | Smoke detector | 1 |
| Security | Weather station | 1 |
| Security | Window contact | 2 |
| Total | | 42 |

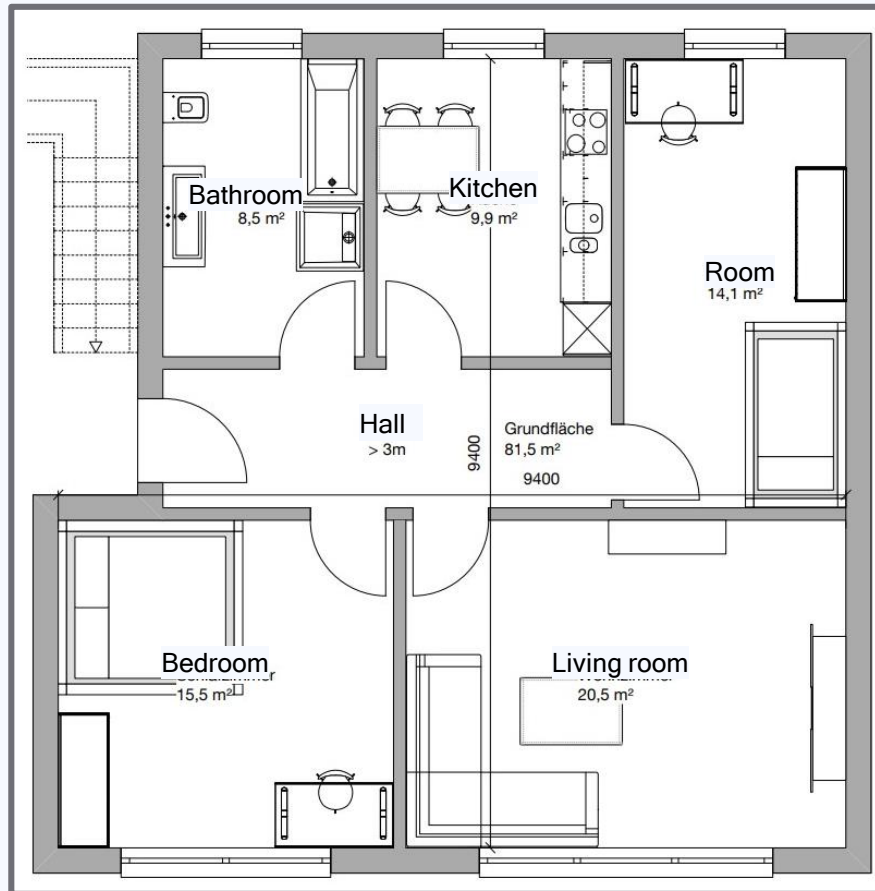
One-room apartment - fully equipped



One-room apartment - fully equipped



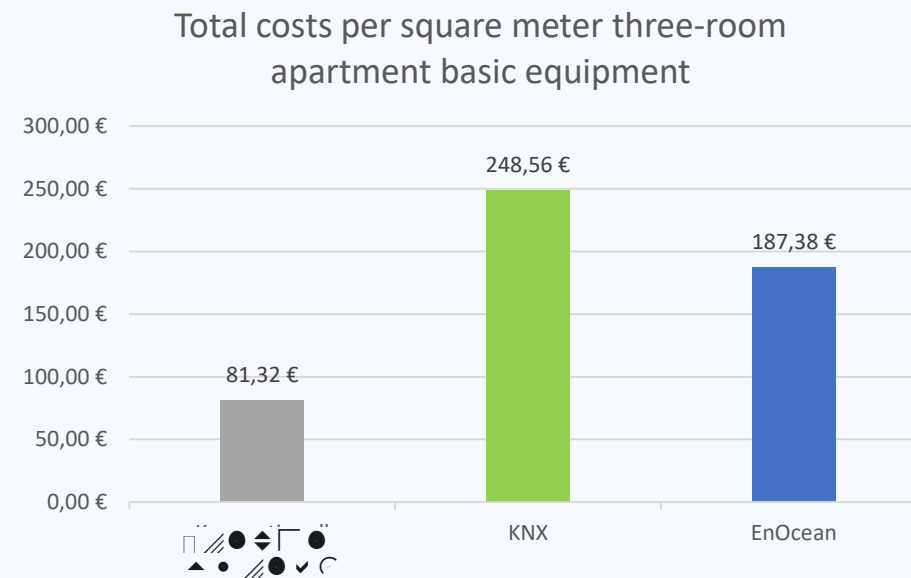
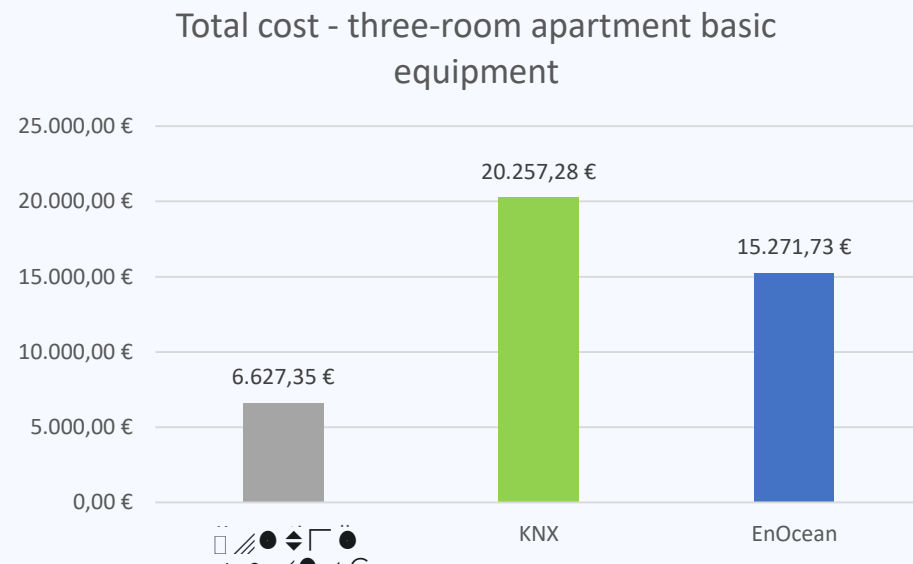
Three-room apartment - basic equipment



Equipment component:

| Three-room apartment basic equipment | | |
|--------------------------------------|------------------------------------|-------|
| Area | Product | Units |
| Comfort | Blind actuator | 8 |
| Comfort | Shutter switch | 5 |
| Comfort | Dimming actuator | 18 |
| Comfort | 2 Rocker light switch | 15 |
| Energy | Room temperature sensor with input | 5 |
| Energy | Radiator valve actuator | 6 |
| Energy | Switch actuator flush mounting | 9 |
| Security | Smoke detector | 4 |
| Total | | 70 |

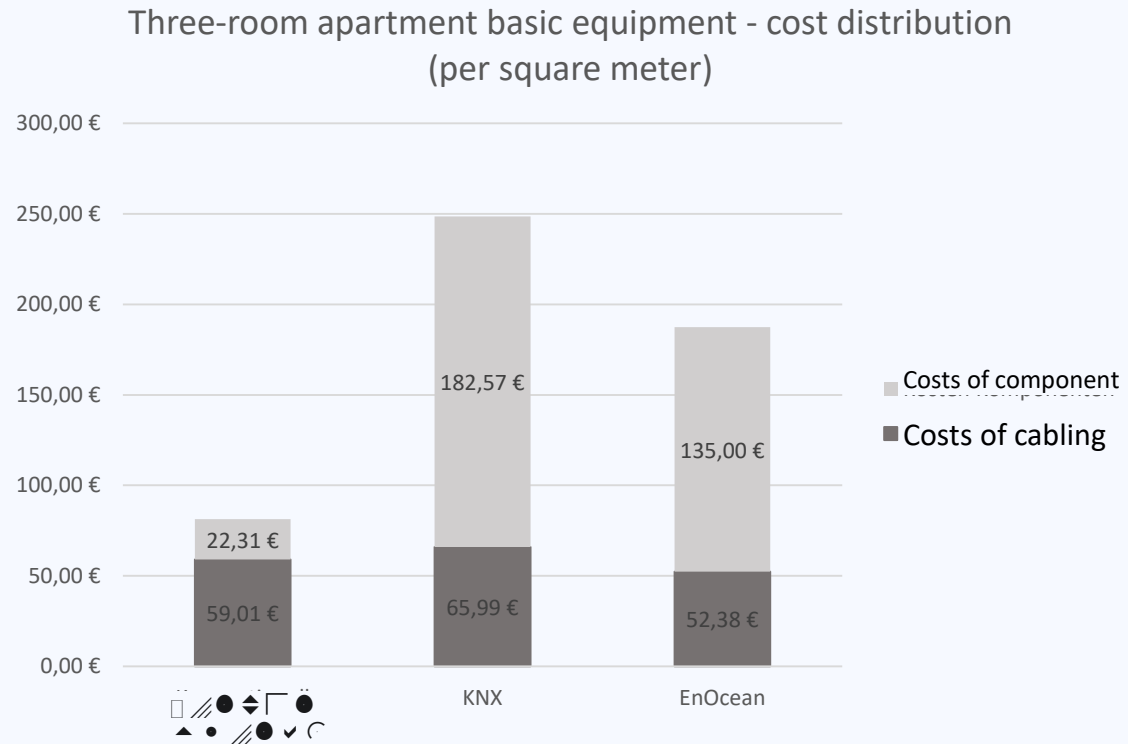
Three-room apartment - basic equipment



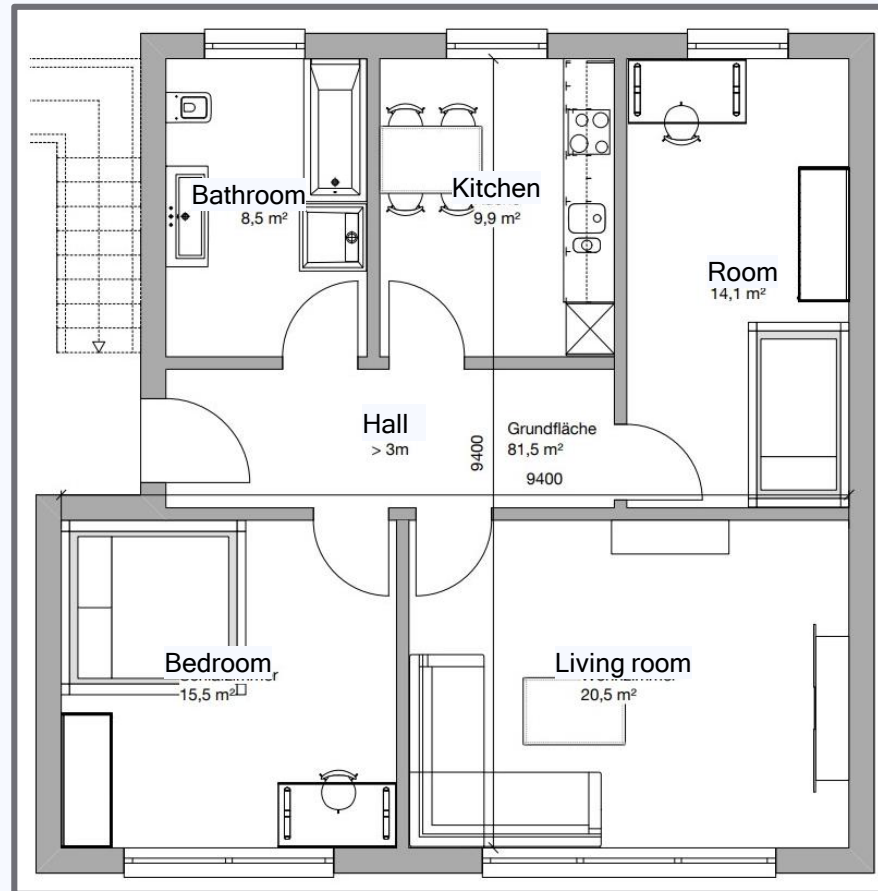
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Three-room apartment - basic equipment



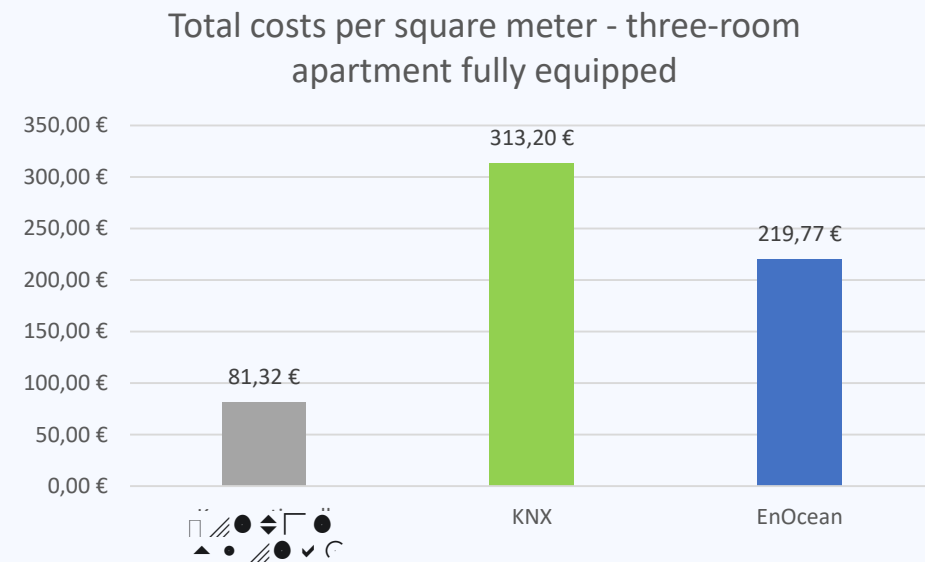
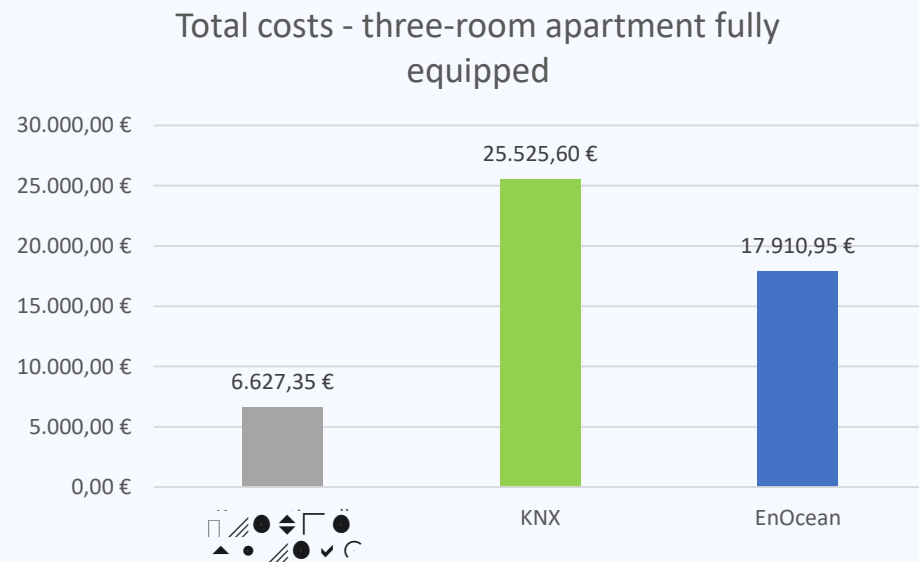
Three-room apartment - fully equipped



Equipment component:

| Three-room apartment - fully equipped | | |
|---------------------------------------|------------------------------------|-------|
| Area | Product | Units |
| Comfort | Blind actuator | 8 |
| Comfort | Shutter switch | 8 |
| Comfort | Dimming actuator | 18 |
| Comfort | 2 Rocker light switch | 15 |
| Energy / Comfort | Brightness and presence detectors | 6 |
| Energy | Room temperature sensor with input | 5 |
| Energy | Actuator | 6 |
| Energy | Switch actuator flush mounting | 9 |
| Energy | Central button | 1 |
| Security | Smoke detector | 4 |
| Security | Weather station | 1 |
| Security | Window contact | 8 |
| Total | | 89 |

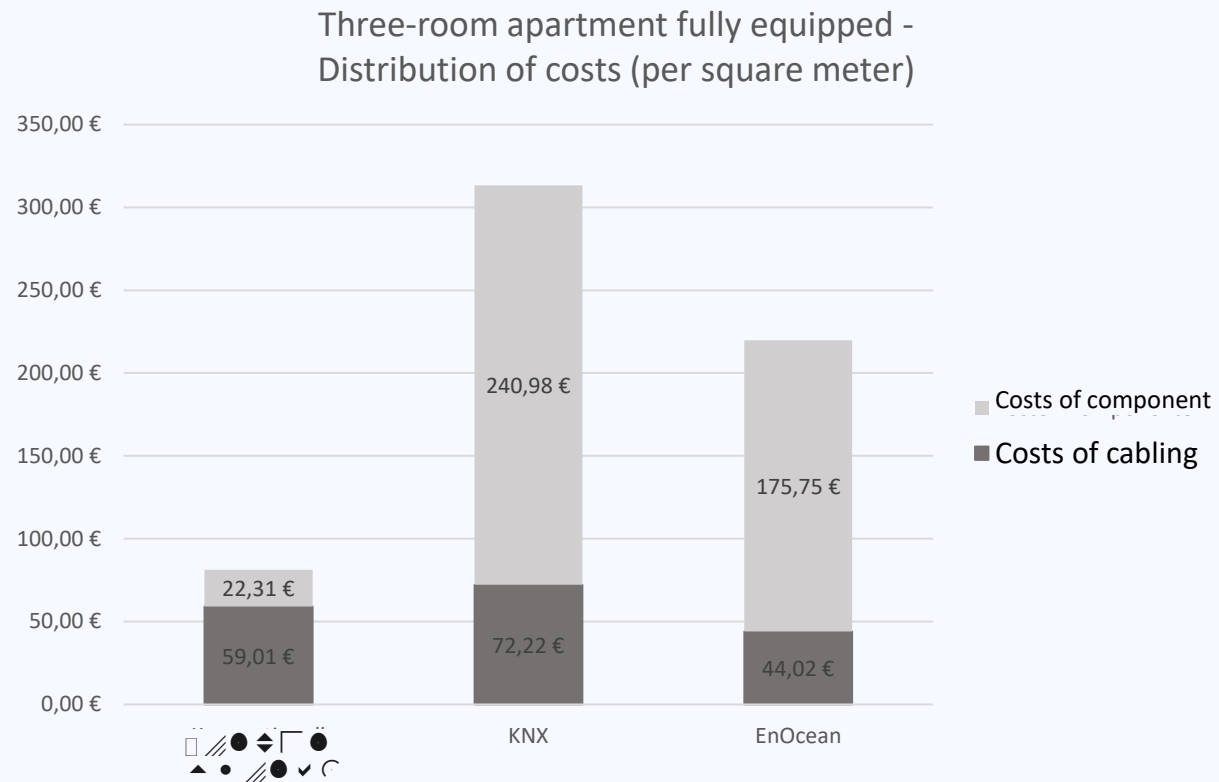
Three-room apartment - fully equipped



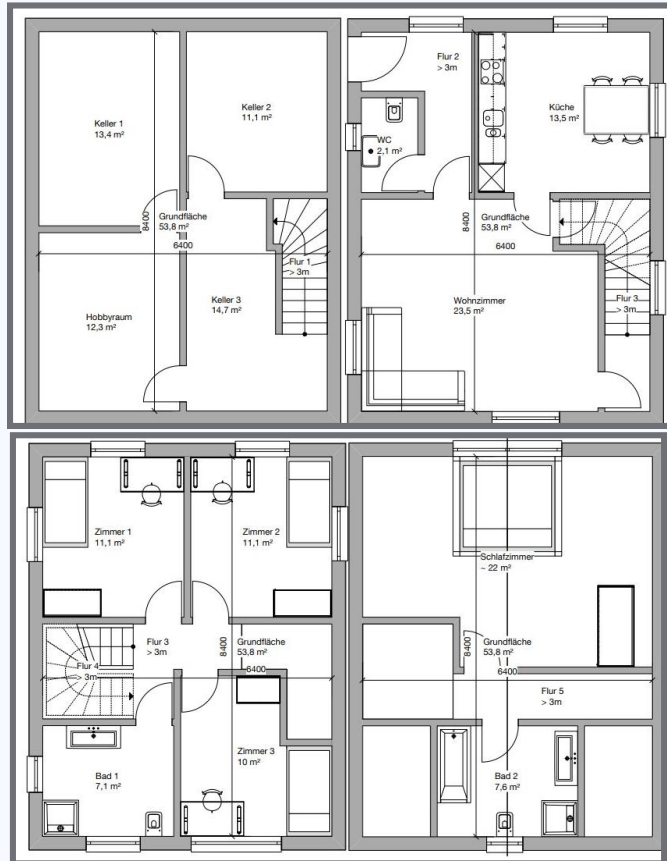
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Three-room apartment - fully equipped



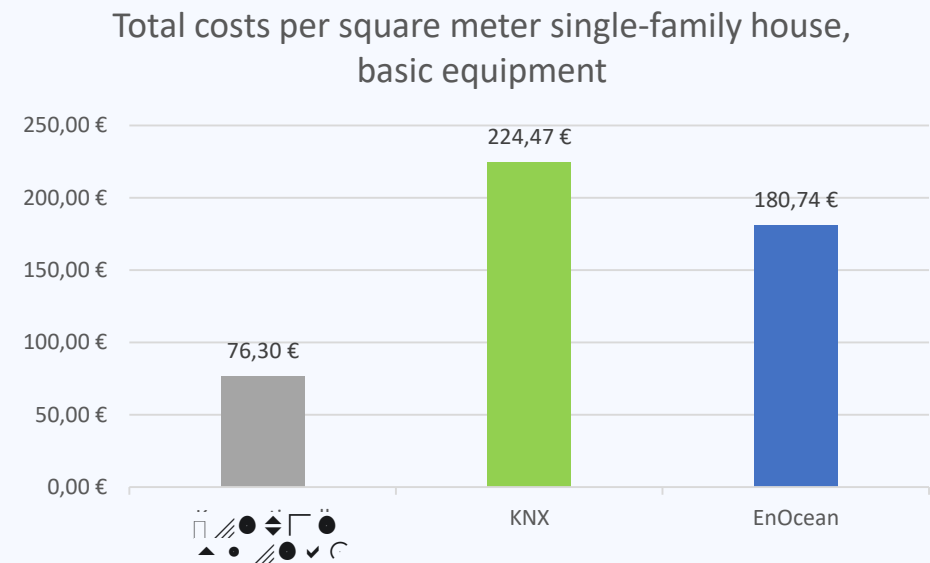
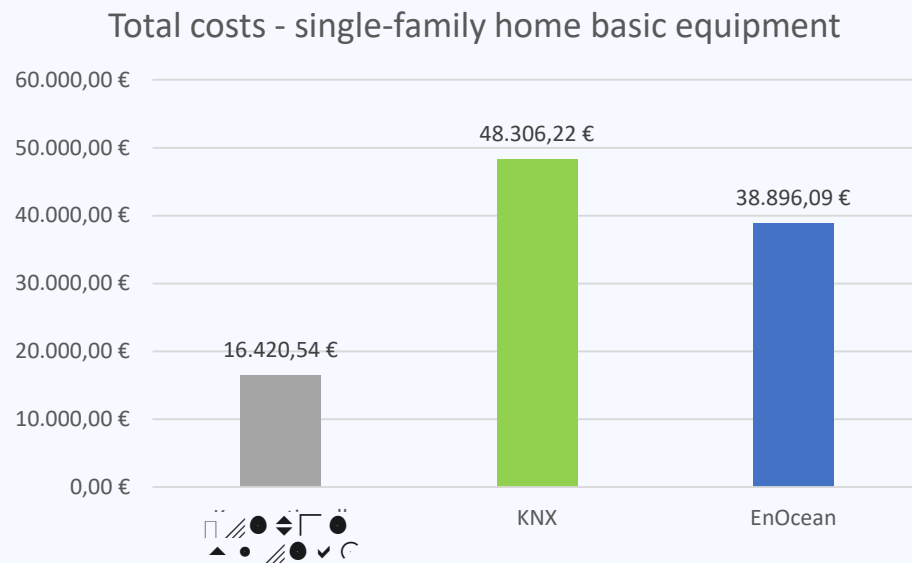
Single-family house - basic equipment



Equipment component:

| Single-family house - basic equipment | | |
|---------------------------------------|------------------------------------|-------|
| Area | Product | Units |
| Comfort | Blind actuator | 16 |
| Comfort | Shutter switch | 12 |
| Comfort | Dimming actuator | 45 |
| Comfort | 2 rocker light switch | 33 |
| Energy | Room temperature sensor with input | 10 |
| Energy | Radiator valve actuator | 7 |
| Energy | Switch actuator flush mounting | 14 |
| Security | Smoke detector | 7 |
| Security | Weather station | 1 |
| Security | Window contact | 17 |
| Total | | 162 |

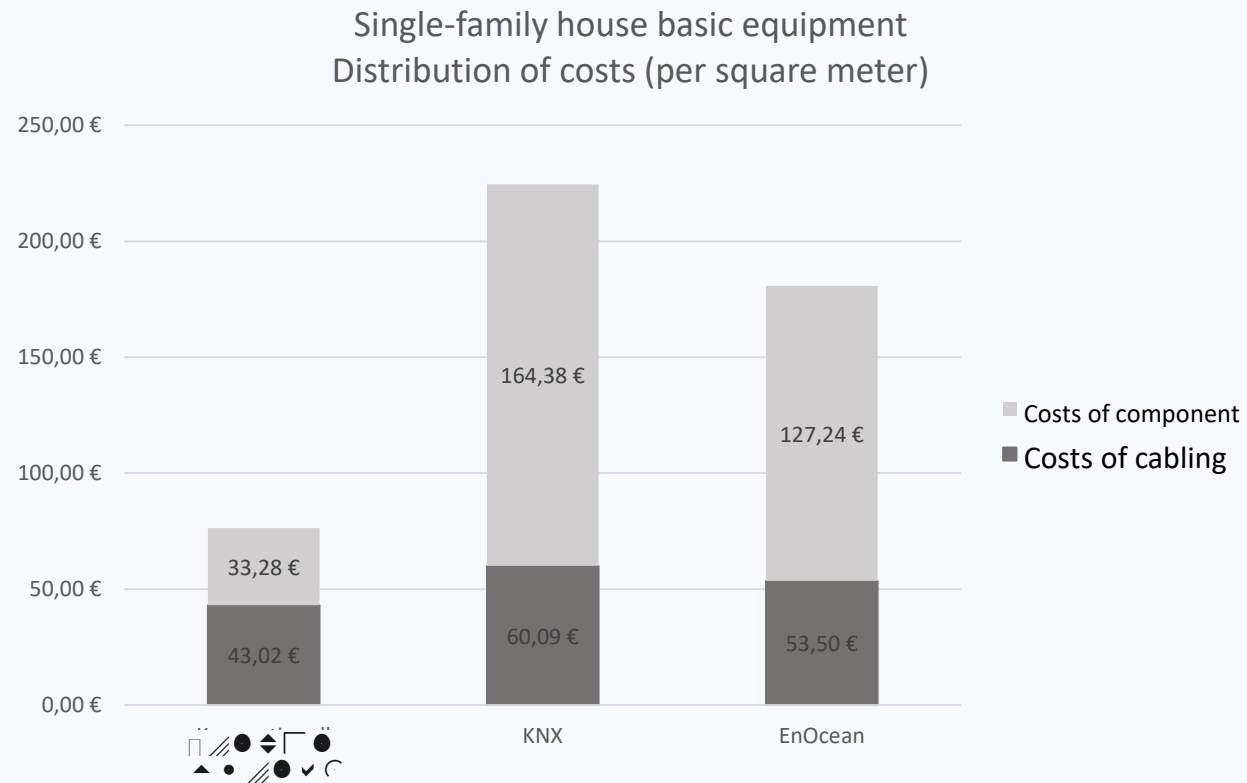
Single-family house - basic equipment



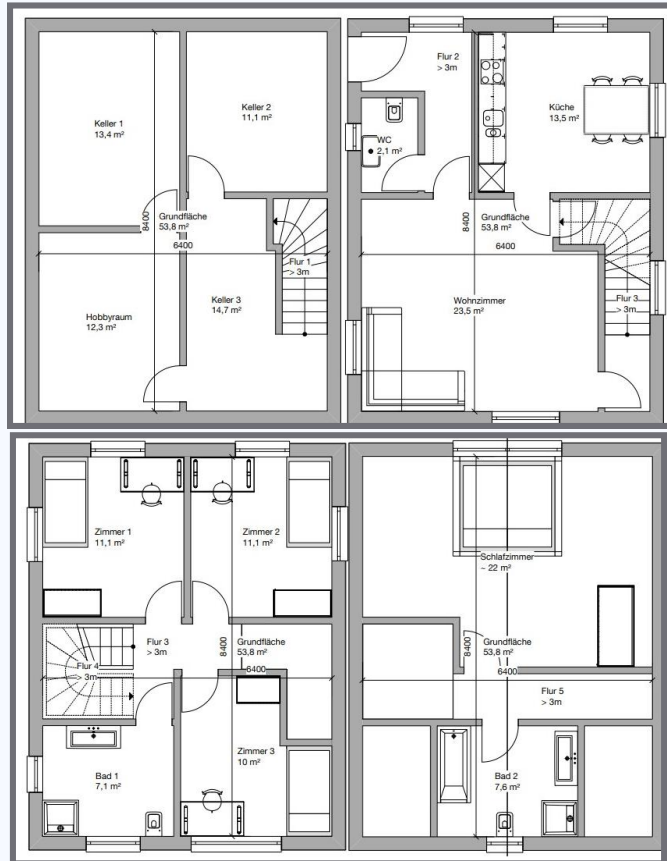
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Single-family house - basic equipment



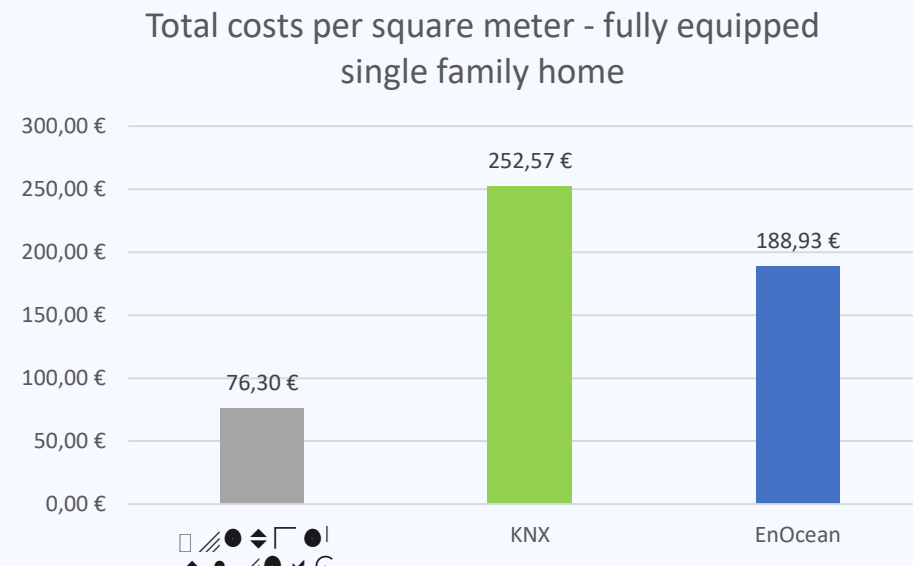
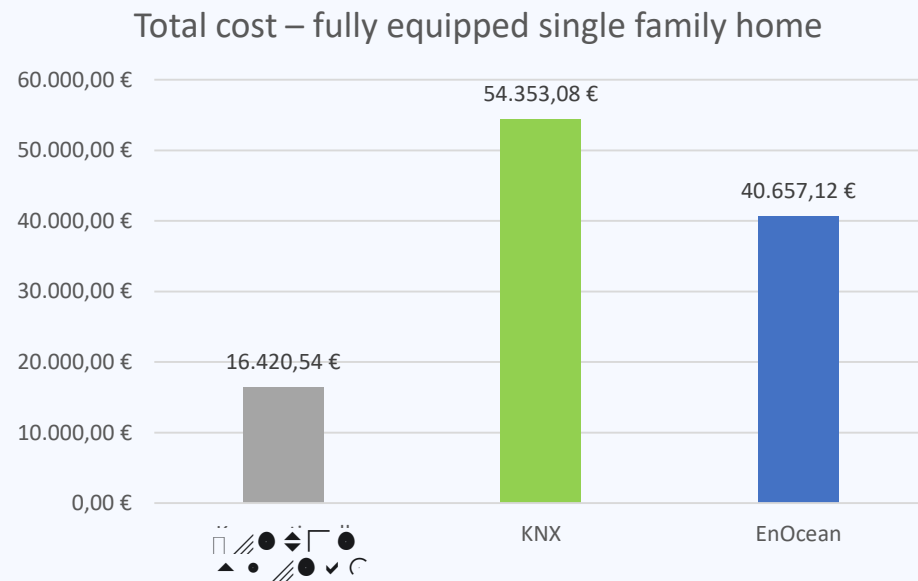
Single-family house - full equipment



Equipment component:

| Single-family house fully equipped | | |
|------------------------------------|------------------------------------|-------|
| Area | Product | Units |
| Comfort | Blind actuator | 16 |
| Comfort | Shutter switch | 12 |
| Comfort | Dimming actuator | 45 |
| Comfort | 2 rocker light switch | 33 |
| Energy / Comfort | Brightness and presence detectors | 15 |
| Energy | Room temperature sensor with input | 10 |
| Energy | Radiator valve actuator | 14 |
| Energy | Switch actuator flush mount | 14 |
| Energy | Central switch | 1 |
| Security | Smoke detector | 7 |
| Security | Weather station | 1 |
| Security | Radio siren | 1 |
| Security | Window contact | 17 |
| Total | | 186 |

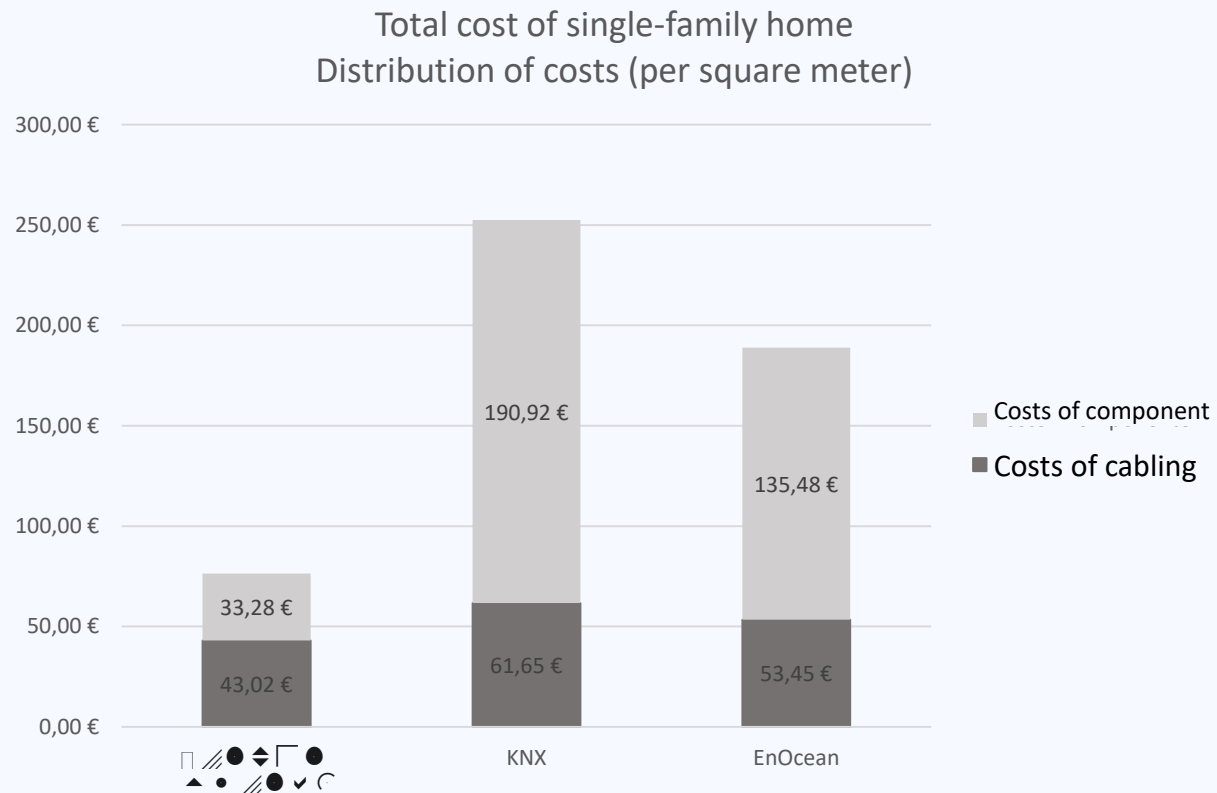
Single-family house - full equipment



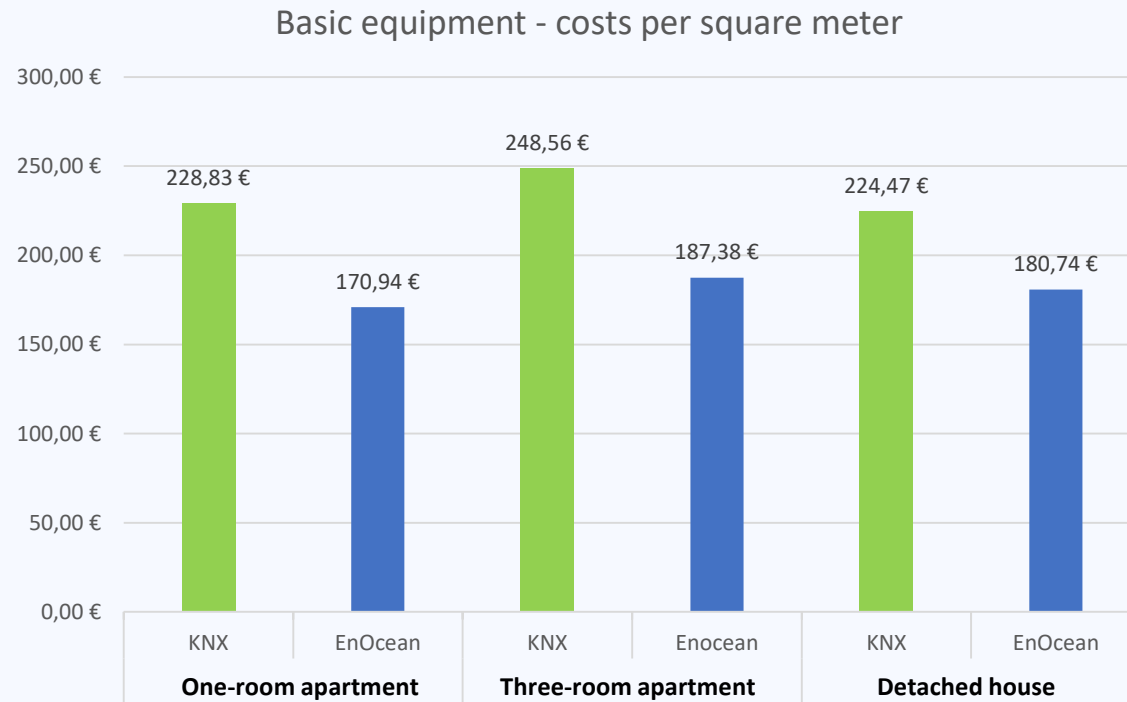
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Single-family house - full equipment



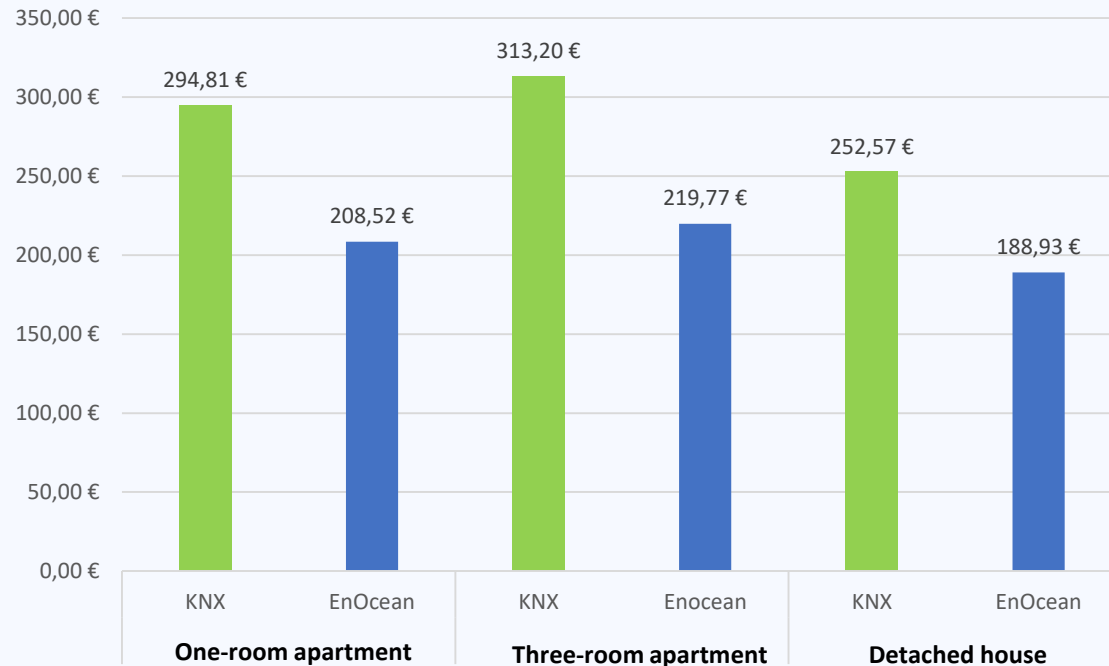
Summary - basic equipment



| Minimum equipment variant | One-room apartment | | Three-room apartment | | Detached house | |
|---------------------------|--------------------|------------|----------------------|-------------|----------------|-------------|
| | KNX | EnOcean | KNX | EnOcean | KNX | EnOcean |
| Total cost | 9.885,32 € | 7.384,58 € | 20.257,28 € | 15.271,73 € | 48.306,22 € | 38.896,09 € |
| Costs per square meter | 228,83 € | 170,94 € | 248,56 € | 187,38 € | 224,47 € | 180,74 € |

Summary - full equipment

Full equipment - costs per square meter



| Full equipment variant | One-room apartment | | Three-room apartment | | Detached house | |
|------------------------|--------------------|------------|----------------------|-------------|----------------|-------------|
| | KNX | EnOcean | KNX | EnOcean | KNX | EnOcean |
| Total cost | 12.735,75 € | 9.008,10 € | 25.525,60 € | 17.910,95 € | 54.353,08 € | 40.657,12 € |
| Costs per square meter | 294,81 € | 208,52 € | 313,20 € | 219,77 € | 252,57 € | 188,93 € |

HEALTH & WELLNESS



- **What effects does building automation have on health?**
- **Are there any health aspects that could speak for or against the respective equipment technology (KNX or EnOcean)?**

HEALTH & WELLNESS



- **Electrosmog** from wireless systems?

WLAN/Bluetooth



SAR-Value
(Specific
Absorption
Rate W/m²)

0,01

700 x

Mobile



12 - 42

1,6 Million x

EnOcean



0,000013



No disadvantage for EnOcean technology

HEALTH & WELLNESS



Indoor climate: effects on physical and mental health and productivity

Advantages of an "intelligent" building:

- **Creation of an optimized room climate, e.g. by**
 - CO2, temperature and humidity sensor
 - Brightness sensor
 - Dimming actuators



ECOLOGY AND ENVIRONMENT



- **Which effects on the environment result from a smart home?**
- **Are there differences in the respective technology (KNX and EnOcean)?**

ECOLOGY AND ENVIRONMENT



- Heating is responsible for around 60 percent of the total energy usage of private households
- Especially in winter, most homes are heated 24 hours a day
- **„Smart Heating“ – Reduction of 4-5 °C in room temperature (during the night or during non-occupancy)**
- **The implementation of smart heating valve actuators can save approximately 10% energy**

ECOLOGY AND ENVIRONMENT

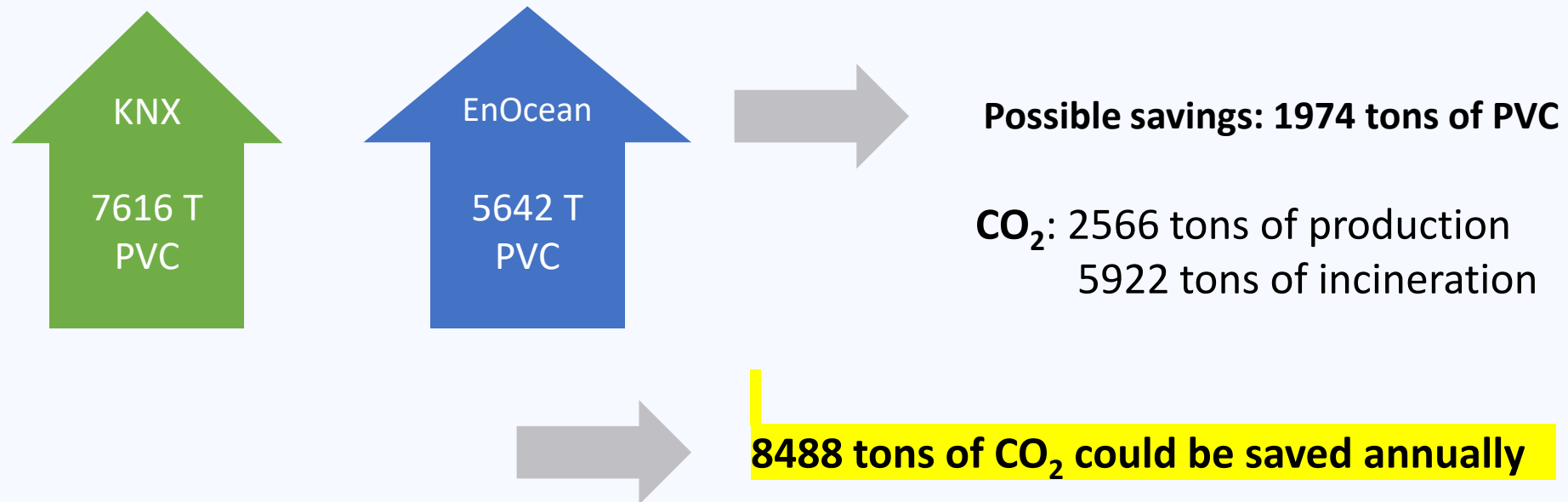


Facts:

- Production of 1 ton of plastic generates around 1.3 tons of CO₂
- Burning 1 ton of plastic produces around 3 tons of CO₂
- In Germany alone, around 150,000 tons of old cables are disposed every year during renovation and demolition
 - Main components: PVC and Copper
 - Consequence: Complex recycling process

ENVIRONMENTAL FACTOR

- **Per construction project:** Saving on average 8.5 kg of PVC
- Annual building permits (Germany): **232208**



SUMMARY ADVANTAGES AND DISADVANTAGES

Disadvantages of Smart Homes:

- High acquisition costs (especially for KNX)



SUMMARY ADVANTAGES AND DISADVANTAGES

Advantages of Smart Homes:

- + Improved room climate (KNX and EnOcean)
- + Security (KNX and EnOcean)
- + Energy (approx. 10% savings) (KNX and EnOcean)
- + Comfort (KNX and EnOcean)

Advantages of EnOcean:

- + Ecology - Energy Harvesting (EnOcean)
- + High flexibility (EnOcean)



CONTACT



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English translation by Marketa Sidlikova.

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