

Hacking the Smart Home

Integrating KNX, Home Assistant, and Dynamic Energy Pricing

Johannes Sappl · Engineering Kiosk Alps · 2026-04-16

Motivation

Why not just buy "smart" devices?





The trap:

- Every vendor has their own app
- Difficult cross-device automation
- Cloud goes down → lights don't work
- Data leaves your home

The goal:

- Full local control
 - Cross-system automation
 - Energy-aware decisions
 - No subscription required
- “ Smart *isn't* cloud-connected — it's locally controlled, interoperable, and failure-resistant. ”

System Overview

Layer	Components
Field Layer 	KNX (MDT actuators, Berker)
Integration 	Home Assistant (Docker/NAS)
Messaging 	MQTT (Mosquitto)
Energy Layer 	PV · EV · EPEX Spot pricing

“ Key idea: **decouple hardware from logic.** ”

Field Layer



KNX — The Physical Bus

KNX Backbone

The reliable physical layer

Hardware:

- MDT actuators (heating, blinds, lights)
- Gira X1/S1 for app/remote access
- Berker switches & sensors
- Configured via ETS5
- Bus-powered, twisted pair

Why KNX?

- Deterministic timing
- Real-time response (~50ms)
- Works without any server
- 30-year standard → parts available

Limitations KNX alone can't solve:

- Static logic baked into ETS
- No external data (prices, weather, grid)
- No cross-room optimization

Integration Layer

Home Assistant — Logic & Orchestration

Home Assistant — The Brain

Why HA over alternatives (OpenHAB, Domoticz, ioBroker)?

What sold me:

- Open source
- puts local control and privacy first
- active community of tinkerers and DIY enthusiasts
- Huge integration ecosystem (3000+)

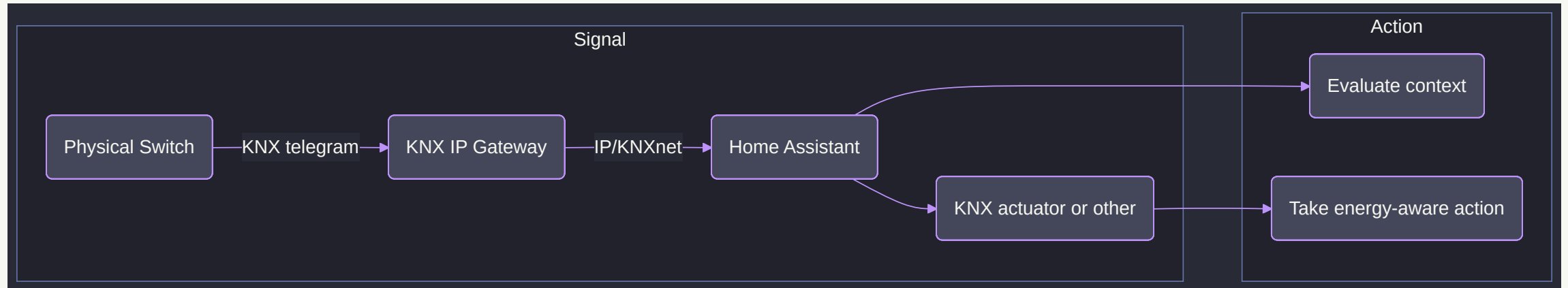
Setup:

- Docker container on QNAP NAS
- Persistent volume → trivial backups
- Exposed via Tailscale (no port forwarding)

```
# docker-compose snippet
services:
  homeassistant:
    image: lscr.io/linuxserver/homeassistant:latest
    network_mode: host
    volumes:
      - /share/docker/homeassistant/config:/config
    restart: unless-stopped
    depends_on:
      - mosquitto
```

KNX ↔ Home Assistant

Hybrid architecture: each layer does what it's best at



Example: Blind switch pressed → HA checks weather forecast & sun position → decides angle, not just open/close.

Messaging Layer

MQTT & Serial Bridges

Communication

MQTT as the universal glue

Mosquitto broker (Docker):

- Many DIY non-KNX devices publish here
- HA subscribes via MQTT integration
- Topics namespaced by device type

Why MQTT?

- Publish/subscribe → loose coupling
- Works on any network
- Countless devices natively support it

Serial → IP bridge: Elfin EW11

- RS485/UART device → WiFi TCP/UDP
- ~€25, no custom firmware needed
- Used for: inverter, smart meter

“ **Insight:** if a device speaks serial, it can be integrated. Most industrial hardware does. ”

Solar Inverter Integration

Huawei SUN2000 → no cloud required



- Real-time PV production (W)
- Daily/lifetime yield
- Optional: Battery SOC and charge/discharge rate

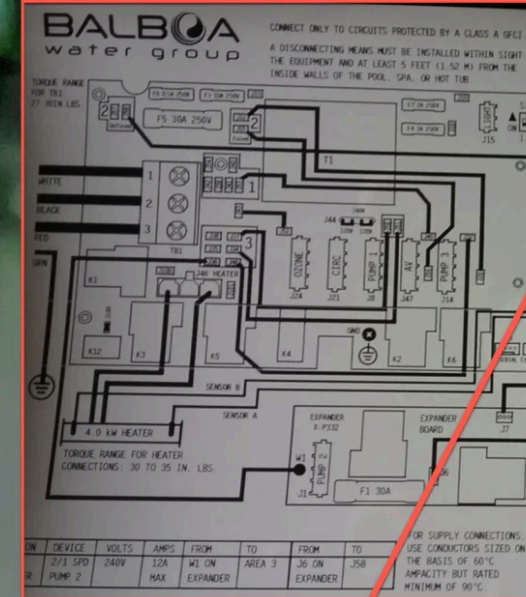
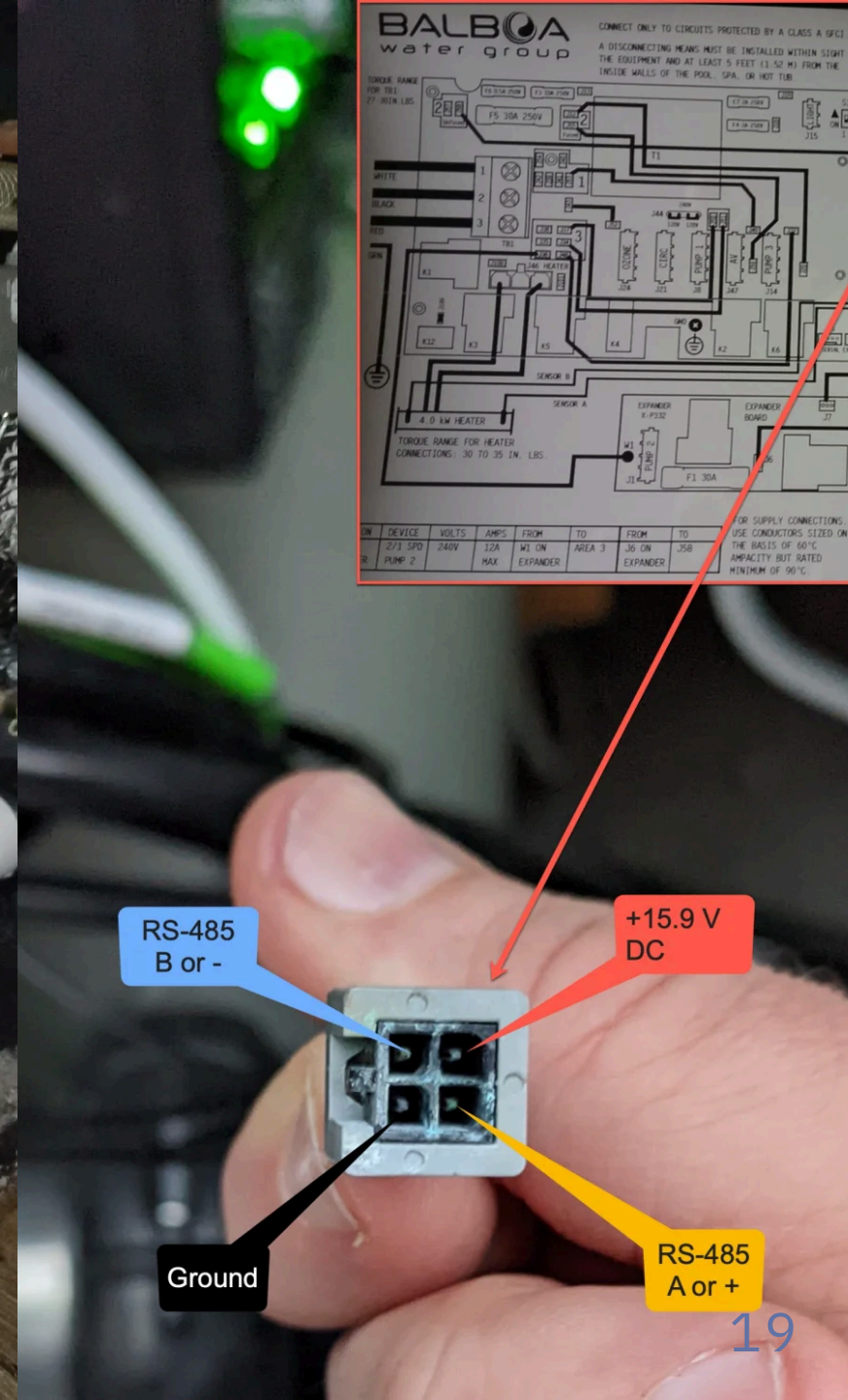
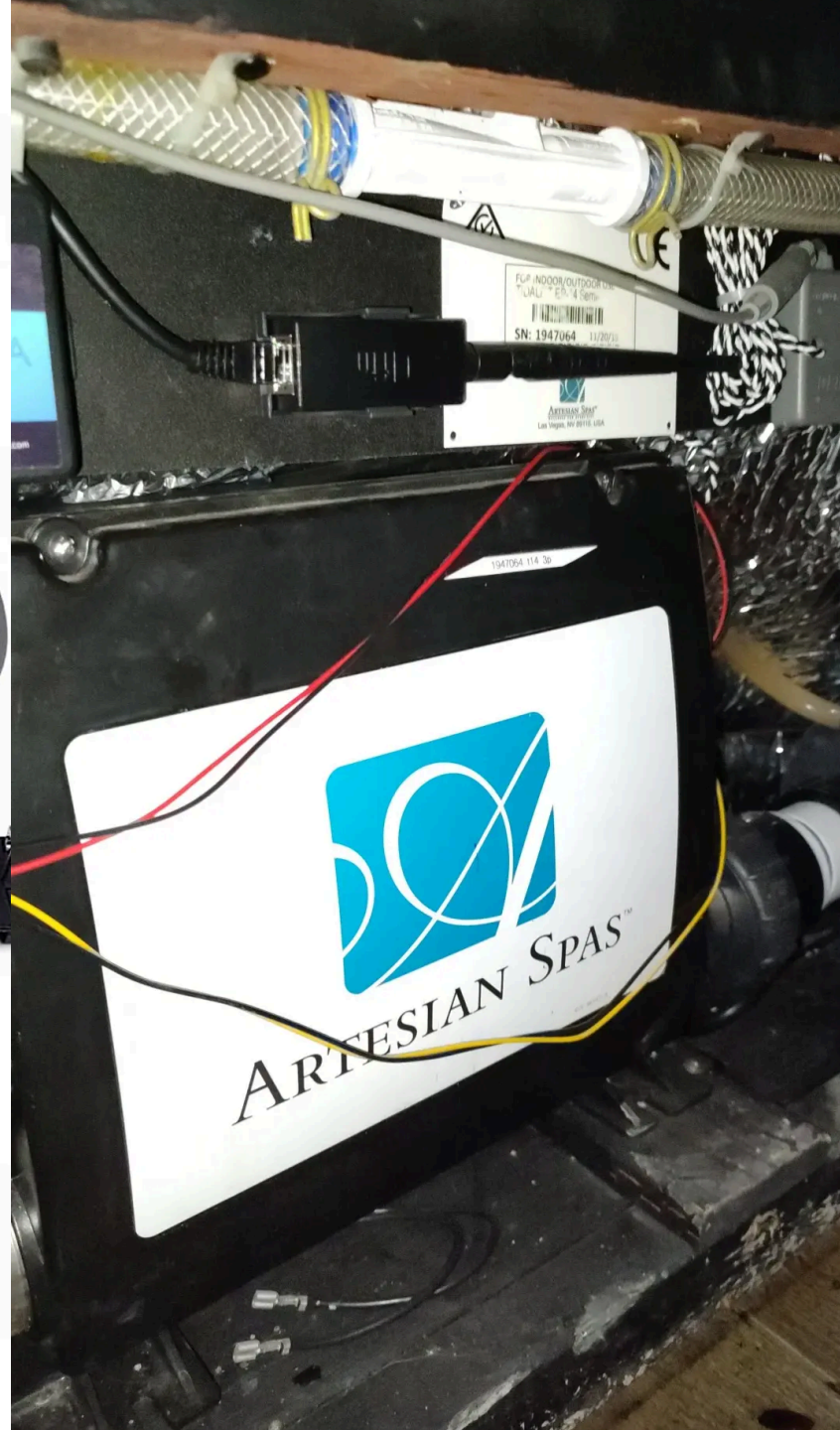


Pool Integration

Balboa Water Group

https://github.com/ccutrer/balboa_worldwide_app

- Ruby library
- interacting with Wi-Fi spa controllers
- reverse engineered from communication bus



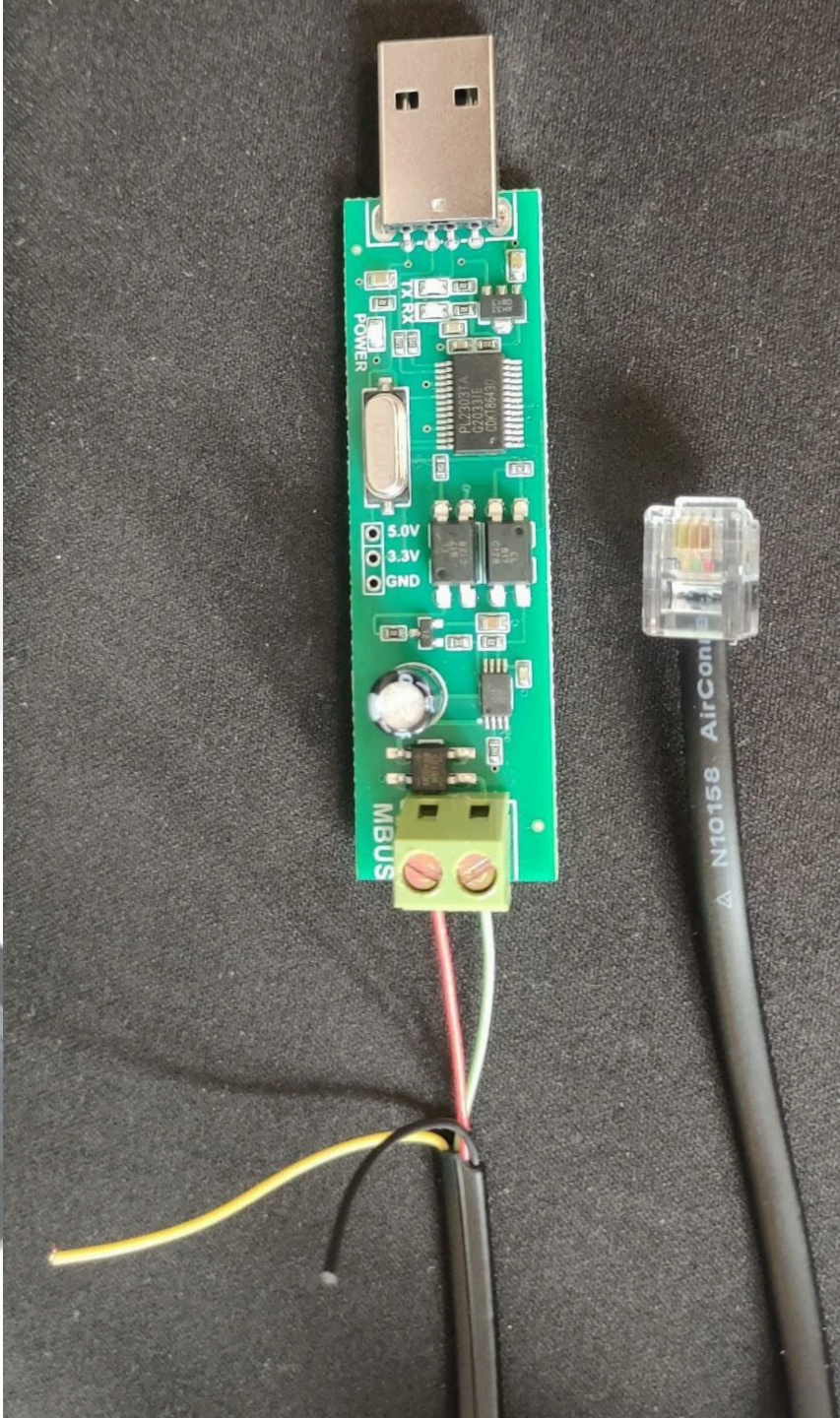
Smart Meter Integration

TINETZ Kaifa MA309 → local readout, no cloud

- Grid operator provides decryption key on request
- RJ-12 into **Kundenschnittstelle**
- Raspberry Pi reads Modbus, publishes via MQTT → HA

Data available in HA:

- Current grid draw / feed-in (W)
- Cumulative consumption & production (kWh)
- Voltage, current, power factor per phase



Energy Layer



PV · EV · Dynamic Pricing

Dynamic Electricity Pricing

TIWAG flex privat: EPEX Spot AT + 1,44 ct/kWh

How it works:

- Day-ahead prices published at ~13:00
- HA fetches via Nord Pool / custom integration
- Prices available as time-series sensor
- Automations react to price thresholds

Price zones we use:

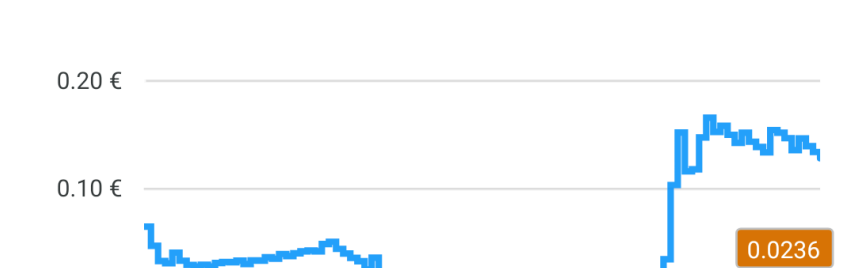
- ● Peak > 20 ct/kWh \rightarrow defer everything possible
- ● Meh $11.76-20$ ct/kWh \rightarrow standard behavior
- ● Cheap < 11.76 ct/kWh \rightarrow charge, run loads
- ● Insane < 0 ct/kWh \rightarrow turn on ALL the devices

Intervall: 15 Minuten 1 Stunde

Zeit Wien	Heute 6. Apr	Morgen 7. Apr
11:30 - 11:45	€-0.03208	
11:45 - 12:00	€-0.06122	
12:00 - 12:15	€-0.03600	
12:15 - 12:30	€-0.08206	
12:30 - 12:45	€-0.08668	
12:45 - 13:00	€-0.09850	
13:00 - 13:15	€-0.11578	
13:15 - 13:30	€-0.12701	
13:30 - 13:45	€-0.14615	
13:45 - 14:00	€-0.15809	
14:00 - 14:15	€-0.15362	
14:15 - 14:30	€-0.14306	
14:30 - 14:45	€-0.13795	
14:45 - 15:00	€-0.12023	
15:00 - 15:15	€-0.12298	
15:15 - 15:30	€-0.10084	
15:30 - 15:45	€-0.08342	
15:45 - 16:00	€-0.06641	
16:00 - 16:15	€-0.06204	
16:15 - 16:30	€-0.03456	
16:30 - 16:45	€-0.01633	
16:45 - 17:00	€-0.00694	
Durchschnitt 0.02360 €/kWh		Durchschnitt 0.00000 €/kWh

Österreich Preisdiagramm

Heute Morgen

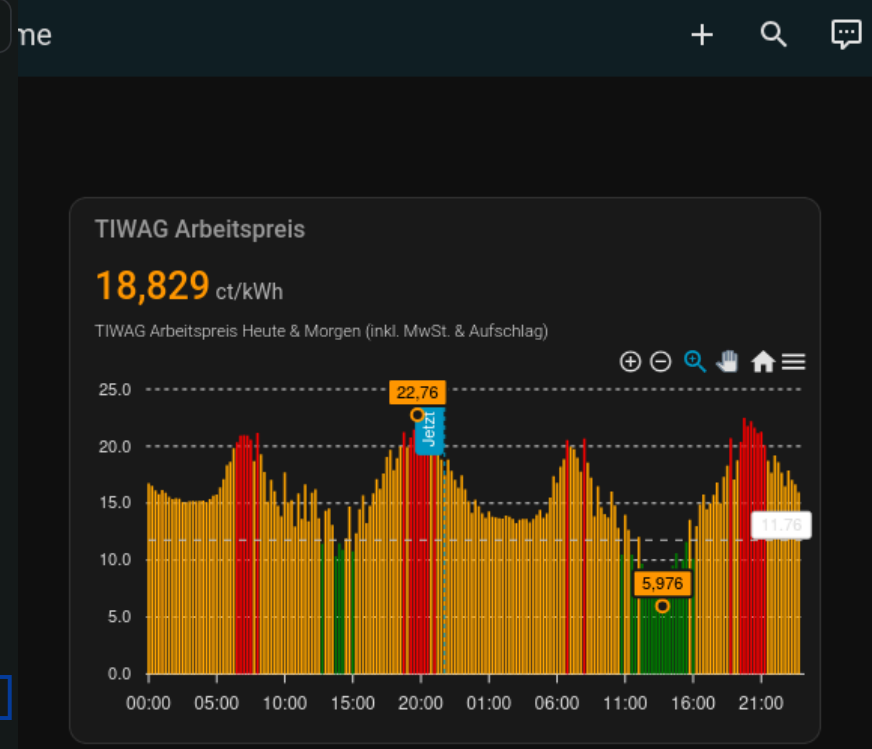
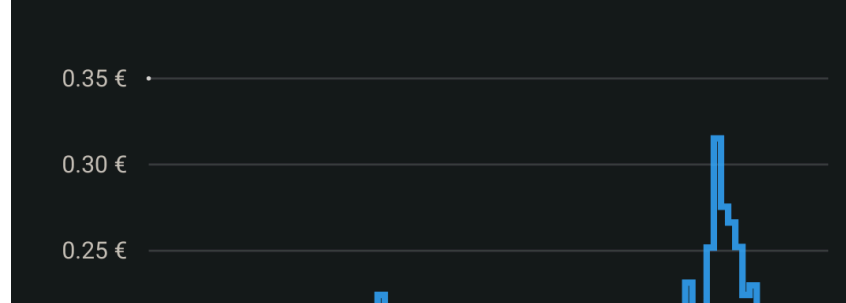


Intervall: 15 Minuten 1 Stunde

Zeit Wien	Heute 14. Apr	Morgen 15. Apr
17:30 - 17:45	€0.18990	€0.18299
17:45 - 18:00	€0.17165	€0.16464
18:00 - 18:15	€0.18535	€0.17533
18:15 - 18:30	€0.21101	€0.18530
18:30 - 18:45	€0.23154	€0.19800
18:45 - 19:00	€0.19238	€0.18474
19:00 - 19:15	€0.21499	€0.19333
19:15 - 19:30	€0.25178	€0.20032
19:30 - 19:45	€0.31523	€0.21320
19:45 - 20:00	€0.27553	€0.21062
20:00 - 20:15	€0.26639	€0.20308
20:15 - 20:30	€0.25216	€0.20496
20:30 - 20:45	€0.22434	€0.18269
20:45 - 21:00	€0.22987	€0.20236
21:00 - 21:15	€0.21156	€0.18173
21:15 - 21:30	€0.19231	€0.17389
21:30 - 21:45	€0.18436	€0.16003
21:45 - 22:00	€0.19973	€0.17388
22:00 - 22:15	€0.18865	€0.16408
22:15 - 22:30	€0.17774	€0.15596
22:30 - 22:45	€0.16201	€0.14921
22:45 - 23:00	€0.16201	€0.14921
Durchschnitt 0.16980 €/kWh		Durchschnitt 0.15230 €/kWh

Österreich Preisdiagramm

Heute Morgen



EV Charging

Polestar 2 + Tesla Wall Connector

The setup:

- Charge current: 6–32A adjustable
- Tesla Wall Connector Gen 3
- Monitored via official HA integration

Charging modes:

- **Manual** – always charge, full speed
 - **Solar** – charge only when PV surplus
 - **Smart** – optimize for price + solar
 - **Scheduled** – ready by departure time
- “ **EV largest flexible load** in the house (up to ~11 kW). Shifting charge can save €5–10 per session. ”

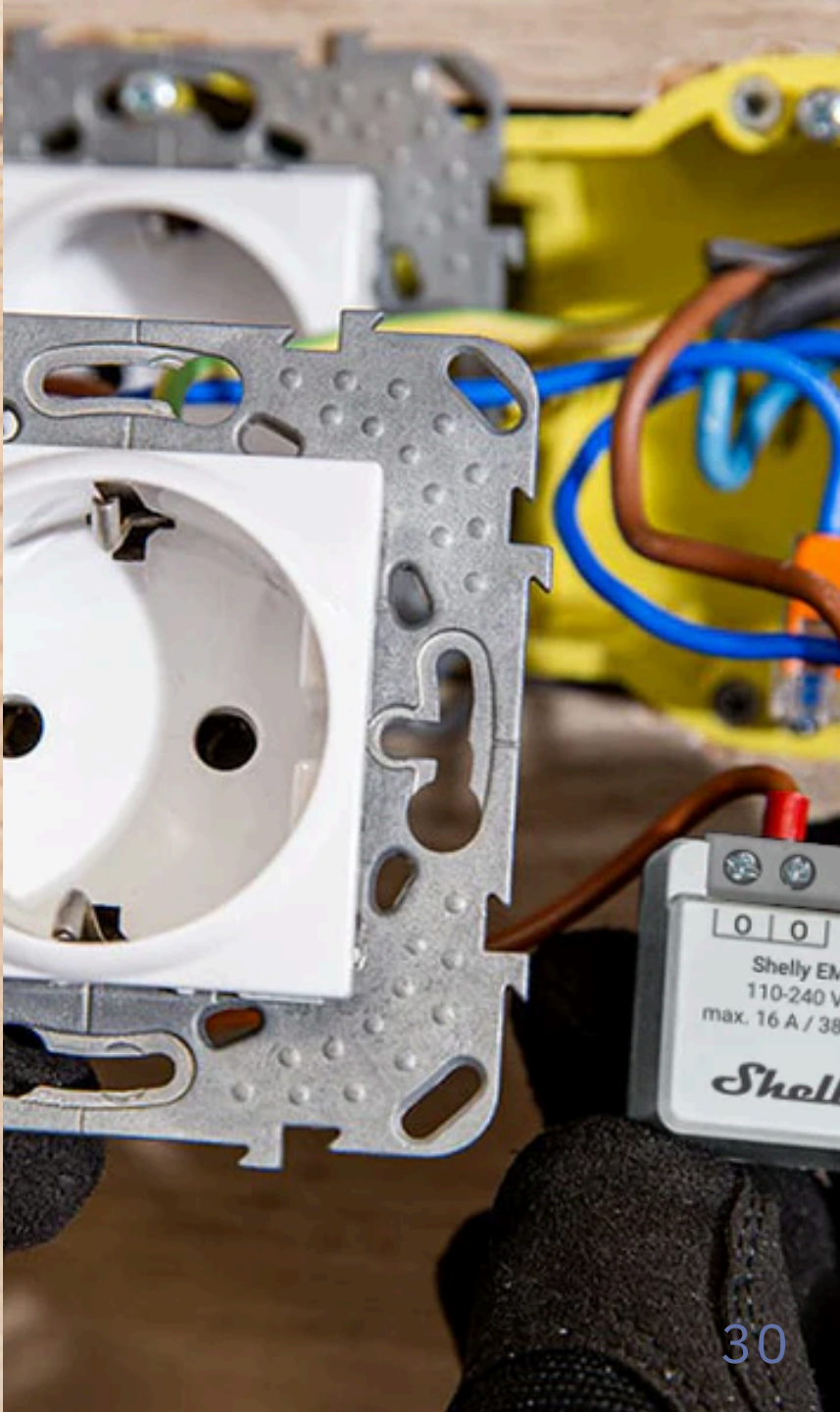
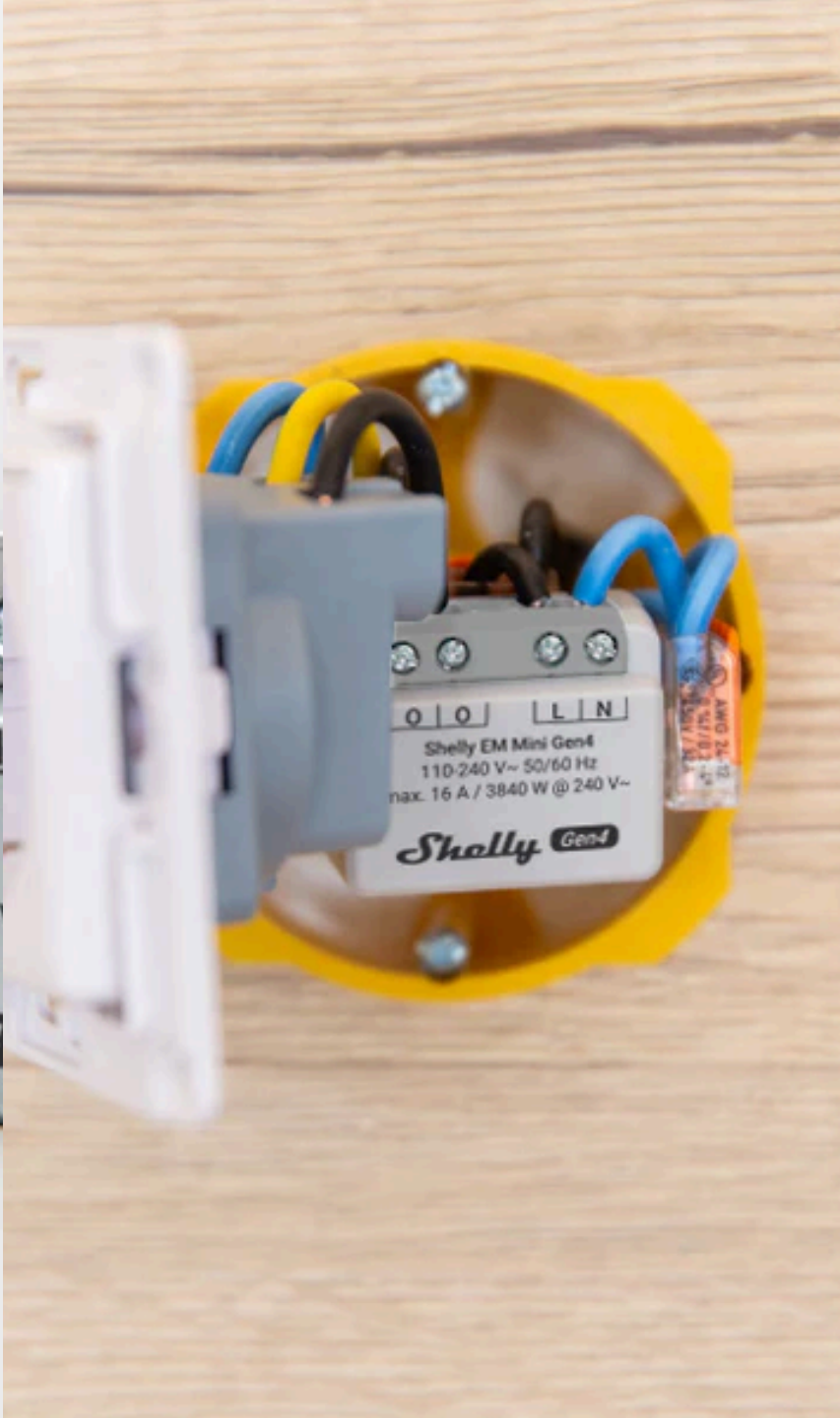
Smart Power Monitoring

Shelly EM Mini Gen4 — circuit-level visibility

Circuit	Why it matters
Server rack (NAS, APs)	Baseline: always-on load ~80W
Freezer	Detects door-left-open anomaly
Washing machine	Detect cycle start/end for automation
Swim Spa	Largest 230V non-EV load, 3kW heater

Integration:

- Native HA integration, auto-discovery
- Data logged in HA → history available in UI
- Anomaly alerts via mobile notification



AI-on-the-Edge Metering

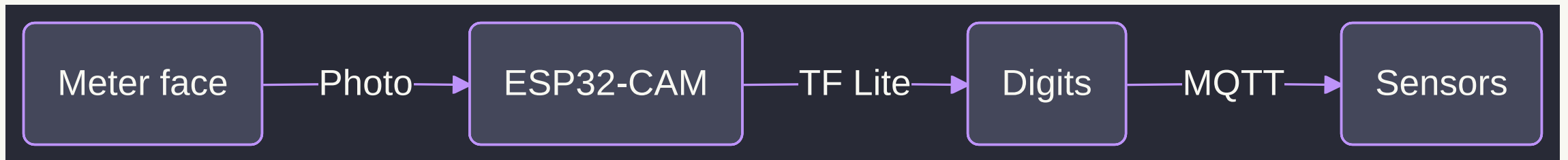
Reading legacy meters without modifying them

Problem:

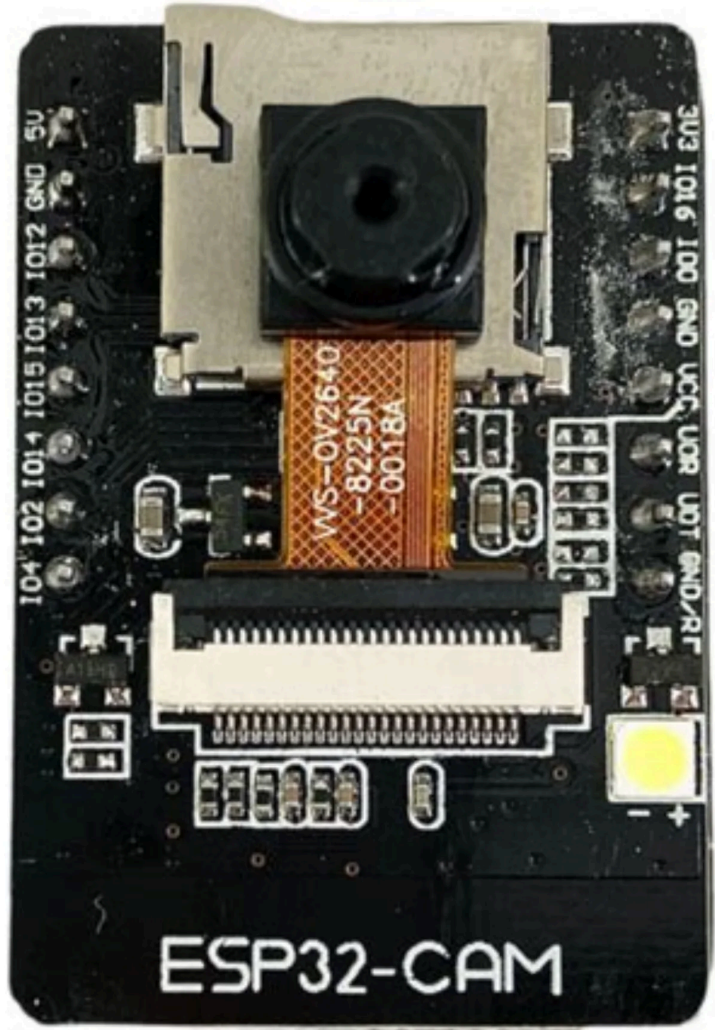
- Gas meter: analog rolling digits
- Water meter: analog dial
- No electrical interface
- Can't modify the meter (rental/legal)

Solution: ESP32-CAM + AI on the Edge

- Camera points at meter display
- On-device digit recognition (TensorFlow Lite)
- Publishes reading via MQTT
- Accuracy: ± 1 digit on last decimal



- `sensor.watermeter_value`
- `sensor.gasmeter_rate_per_time_unit`



Data Unification in HA

Source	Data
KNX	Room temps, blind positions, switch states
Shelly EM	Circuit-level power (W)
Inverter	PV production, battery SOC
EW11 + Modbus	Heat pump COP, flow temp
ESP32-CAM	Gas m ³ , water L
EPEX / Nord Pool	Spot price €/kWh
EV	EV SOC, charge rate

“ **Single source of truth** → automations can combine any of these. No API stitching at runtime. ”

Awaken your home

Open source home automation that puts local control and privacy first.
Powered by a worldwide community of tinkerers and DIY enthusiasts.

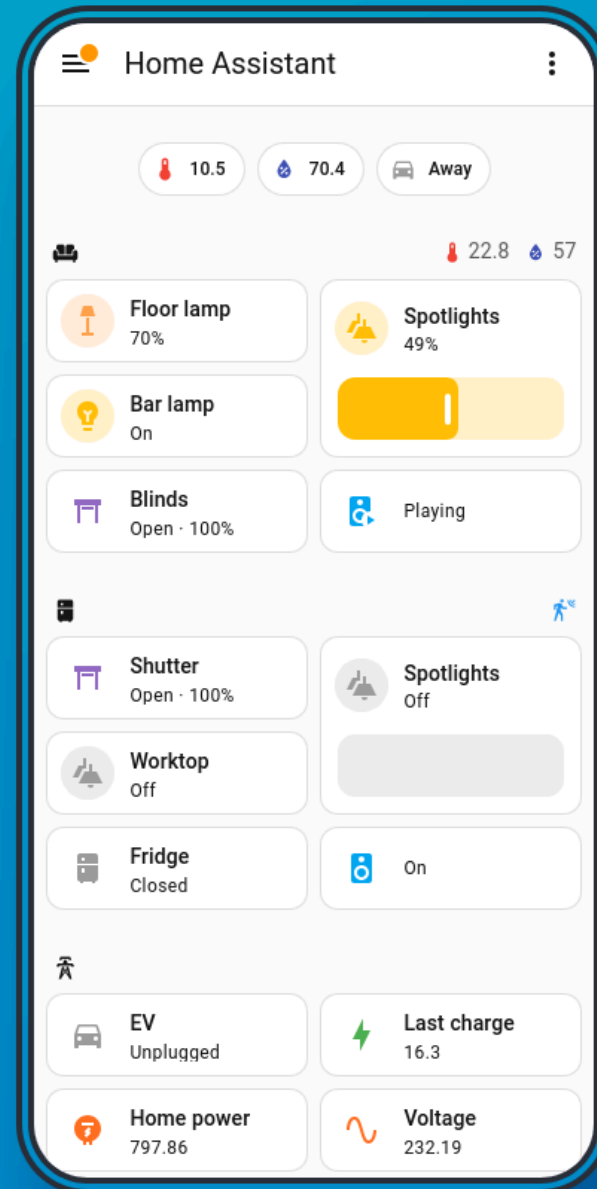
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by contributors in 2025



Final Thought

“ A smart home built on KNX with Home Assistant on top isn't just about automation—it's about owning your system end-to-end, so every watt, every rule, and every improvement actually makes sense to you. ”