

# An Energy Crisis



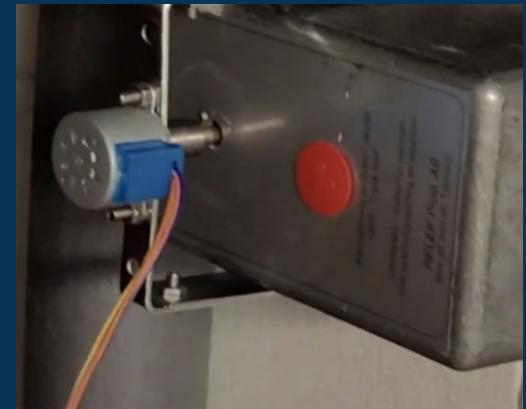
- Sweden is facing an energy crisis that can cripple its economy
  - Workplaces from small shops to large factories are struggling to afford energy costs.
  - Workplaces require **immediately** a new way to save energy costs
- All businesses are different
  - Each workplace has its unique goals, equipment, and challenges
  - The “one-size-fit-all” approach used in home automation **will not scale.**



# A new approach required



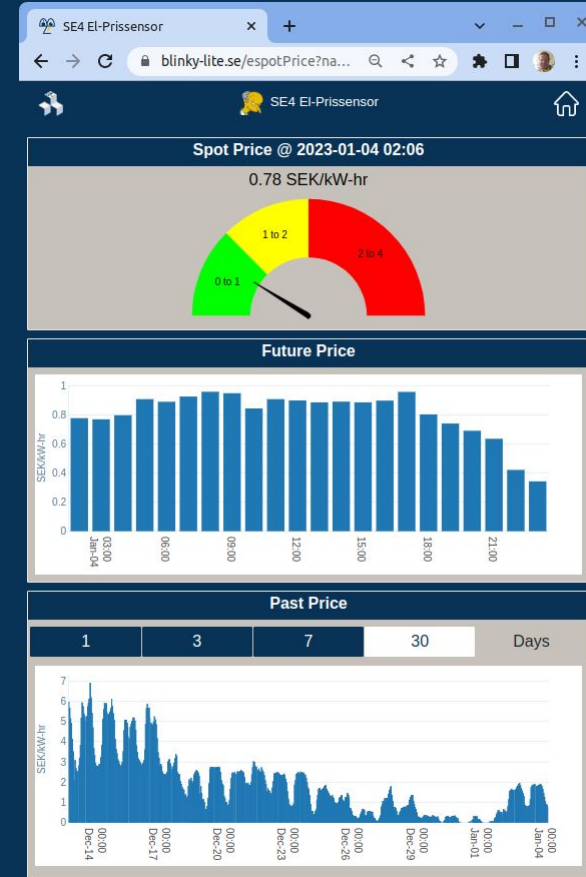
- **Businesses require a sustainable** (i.e affordable) **approach**
  - Businesses cannot just throw out old equipment or disrupt their operations while the latest shiny new “gizmo” is being installed.
- **The solution must be customizable**
  - To handle different business needs
  - Without costing a fortune
- **An integrated solution is required**
  - Software platforms are only 50% of the job
    - The hardware does most of the heavy lifting
  - Hardware solutions that require singleton software apps are not scalable
- **Integrated solutions must be on the *Edge***
  - Businesses cannot afford to maintain static, complex, in-house infrastructure



# Electricity Spot Price



- In Sweden and many other countries, you can choose to be charged your electric usage by the hour.
- We have implemented 39 different european electric zones into Blinky-Lite as virtual electric price devices
  - We get look-ahead prices 36 hours in advance at 2pm daily
  - We use local currencies updated daily
- This give the user the possibility to **automatically** tailor their electric usage to the lowest possible price



# Electricity Spot Price Devices



🏠
Rheostat
🏠

**Control** -

Device: Hot Water Control

Timestamp: 2023-01-04 02:12:12

Watchdog: 4651

Temp Reading: 21.125 C

Temp Setting: 4 C

Rheostat State: Off

Schedule Mode: Cost

Start Time: 5 hr

Stop Time: 7 hr

Max Spot Price: 1.5 SEK/kW-hr

**Archive** -

2 4 8 24 72 168 Hours

**Expert Settings** -

Watchdog: 4651

Rheostat Off: 4 C

Rheostat On: 69 C

Location: 66

Move: Off

No. Steps: 434

Forward: Off

Step Delay: 2000 uS

Delay After Rotation: 100 mS

Resolution: 0

Stay Awake: Off

Reset Location Reading: Off

🏠
Blinky Power Relay
🏠

**Control** -

Watchdog: 4518

Power: 3.4 Watts

Set Relay: Off

Schedule Mode: Schedule

Start Time: 2 hr

Stop Time: 3 hr

Max Spot Price: 1.5 SEK/kW-hr

**Time Plot** +

Archive -

2 4 8 24 72 168 Hours

**Expert Settings** +

**User** -

User: dmccginnis427

Time left: 05:46:42

Renew
Logout

🏠
IVT Heat Pump
🏠

**Control** -

Device: Plommonhuset Heat Pump

Timestamp: 2023-01-04 02:16:59

Watchdog: 6856

Temperature: 16.08 C

Pump State: On

Set Temp: 20 C

Schedule Mode: Cost

Start Time: 0 hr

Stop Time: 21 hr

Max Spot Price: 3 SEK/kW-hr

**Archive** -

2 4 8 24 72 168 Hours

**Expert Settings** +

**User** -

User: sjulen

Time left: 07:58:52

Renew
Logout

# Simrishamn Autoseum



- **The Autoseum is a non-profit museum**
  - that has a showcase of over 200 antique cars including 15 Rolls Royces
  - with an estimated worth of 100-200 MSEK
  - displayed in a 5000 sqm showroom.





# Hybrid heating system



- The Autoseum is heated with a 80 kW air to water heat pump made by Qvantum AB.
- The system has been customized to be supplemented by Simrishamn district heating when the heat pump cannot keep up with the heating load.

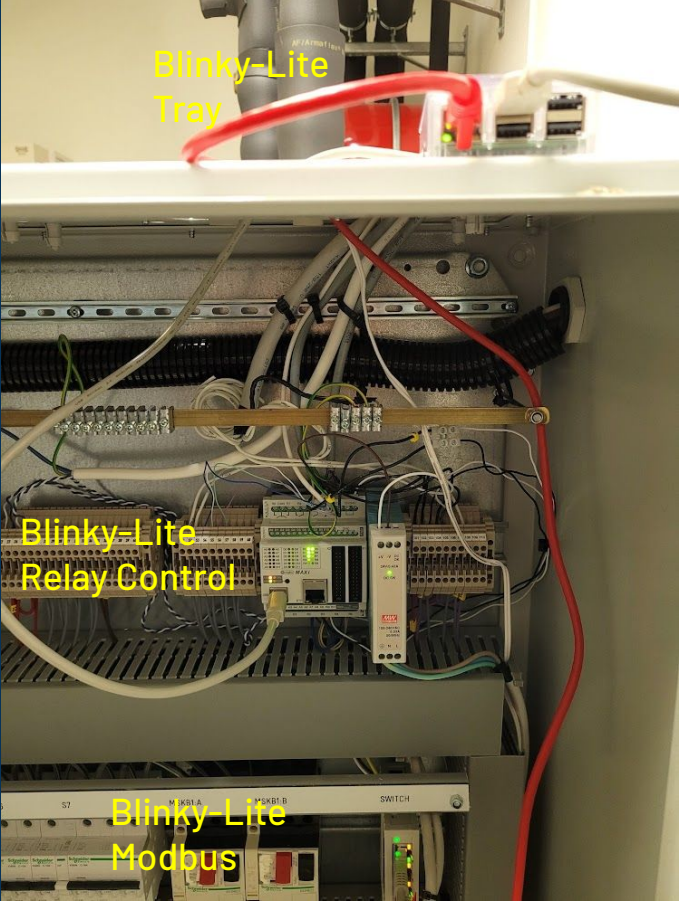
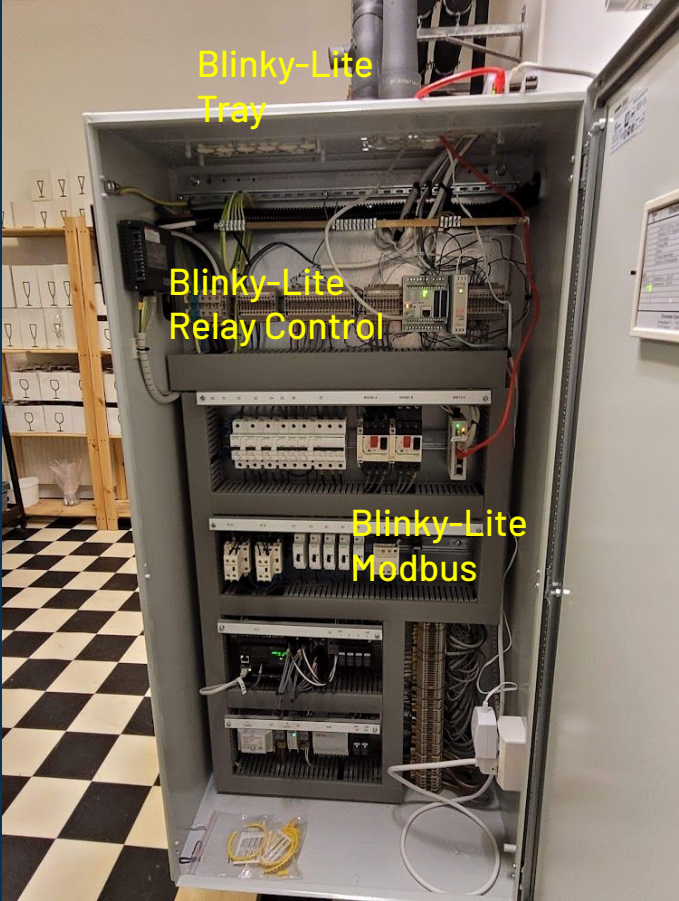


# Cost Strategy



- It is cheaper to use only the Qvantum heat pump when the electric spot price is below 1.9 SEK/kw-hr
- Autoseum asked BL-MC if we could implement spot price control.
- **Within a period of less than 10 days we implemented**
  - A complete Modbus interface including web application to the Qvantum system accessing over 70 control parameters
  - A relay switch network using a Blinky-Lite PLC system that provides and on-demand and price-controlled switch between district heating and heat-pump

# Hardware Installation



12:39 [status icons] 78%

Quantum Bypass

### Control

Device	Autoseum	-
Timestamp	2022-12-08	
WatchDog	12:39:33	
Bypass	9498	<input checked="" type="checkbox"/>
Schedule Mode	On	<input checked="" type="checkbox"/>
Start Time	Cost	<input checked="" type="checkbox"/>
Stop Time	5	hr <input checked="" type="checkbox"/>
Max Spot Price	7	hr <input checked="" type="checkbox"/>
	3.3	SEK/kW-hr <input checked="" type="checkbox"/>

### Archive

+ -

### Bypass Switch Tree Schematic

The schematic diagram shows a bypass switch tree with nodes 21, 22, 23, 24, 103, 106, SV1:A, and SV1:B. It includes a legend for Bypass\_OFF and Bypass\_ON states.

Node	Bypass_OFF	Bypass_ON
R0	X	O
R1	X	O
R2	X	O
R3	X	O
R4	X	O
R5	O	X

### Expert Settings

+ -



# Heat Pump Web Application

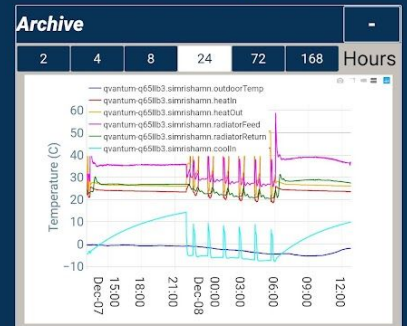


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**Quantum Q65LB3**

### Summary

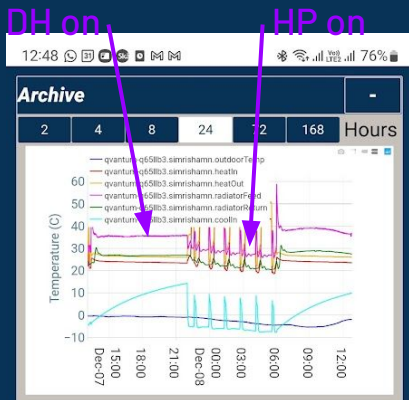
Device: Autoseum  
 Timestamp: 2022-12-08 12:48:23  
 WatchDog: 17036  
 Utomhus temp.: -1.9 C  
 Börvärde från kurva: 36.4  
 Radiator, Framledning: 36.5 C  
 Radiator, Retur: 27.3 C  
 A Alarm:   
 B Alarm:



**Temperaturer** +

**Driftindikeringar** +

**Analoga ut** +



### Temperaturer

Avfrostningstank	9.6	C	
Köldbäare IN, Värmepump	10	C	
Köldbäare UT, Värmepump	12	C	
Värmebäare IN, Värmepump	23.5	C	
Värmebäare UT, Värmepump	26	C	
Hetgas, Värmepump	23.3	C	
Radiator, Framledning	36.6	C	
Utomhus temp.	-1.9	C	
Radiator, Retur	27.4	C	
Sug gas temp.	19.9	C	
Lågtryck	6.2	bar	
Förångnings temp.	13.2	C	

**Driftindikeringar** +

**Analoga ut** +

**A Alarm Lista** +

12:49 76%

**A Alarm Lista** +

**B Alarm Lista** +

### Börvärden, Analog läs/skriv

Kurva, FL vid 0grC	35	C	
Kurva, FL vid 20grC	20	C	
Min. begr. Framledning	20	C	
Max begr. Framledning	60	C	
Sommarstopp temp.	18	C	
Sommarstopp startup delay	5	h	
Start temp. (Styrning på Värmebäare IN)	44	C	
Hysteres (Start temp. + Hysteres = Stopp temp)	5	K	
Start temp. Varmvatten	46	C	
Hysteres (Start temp. + Hysteres = Stopp temp)	4	K	
Start nivå Kompressor (Värmebalans)	60	Kmin	
Stoppnivå Kompressor (Värmebalans)	0	Kmin	
Startnivå Tillsats (Värmebalans)	200	Kmin	
Analog Komp. 0% (Värmebalans värde)	100	Kmin	
Analog komp. 100% (Värmebalans värde)	200	Kmin	
Extern Börvärde från överordnat system	0	C	
Extern Utetemp-givare från överordnat system	0	C	
Ext. blockering via Modbus (Obs! Bit i word.)	64		

**Börvärden, Analog läs** +

12:50 76%

**Parametrar** +

**Elektriskt schema** -

### Modbus Table

Symbol	English	Name	Table
Temperatur, Analog läs (Input register)	Temperature, Analog read	deltaTemp	Input
Avfrostningstank	Defrost tank	defrostTank	Input
Köldbäare IN, Värmepump	Coolant IN, Heat pump	coolIn	Input
Köldbäare UT, Värmepump	Coolant OUT, Heat pump	coolOut	Input
Värmebäare IN, Värmepump	Heat carrier IN, Heat pump	heatIn	Input
Värmebäare UT, Värmepump	Heat carrier OUT, Heat pump	heatOut	Input
Hetgas, Värmepump	Hot gas, Heat pump	hotGas	Input
Radiator, Framledning	Radiator, Heat line	radiatorFeed	Input
Radiator, Retur	Hot water radiator	radiatorRet	Input
Utomhus temp.	Outdoor temp.	outdoorTemp	Input
Radiator, Retur	Radiator, Return	radiatorRet	Input
Sug gas temp.	Suction gas temp.	suctionGas	Input
Lågtryck	Low pressure	lowPressure	Input
Förångnings temp.	Evaporation temp.	evapTemp	Input
Driftindikeringar: Digital läs (Input register, unmasked)	Operating indications, Digital read	operInd	Input
Spårlas	System	system	Input
Kompressor	Compressor	compressor	Input
Köldbäare pump	Coolant pump	coolantPump	Input
Avfrostningskyl	Defrost Anticool	defrostAnticool	Input
Värmepump	Heat carrier pump	heatCarrierPump	Input
Hörselbatteri med temperatur	Battery when not in use, battery	heatCarrierBatt	Input
Tillägsutrustning	Additional heat	addHeat	Input
Börvärde pump	Heat carrier pump	heatCarrierPump	Input
Analoga ut 0-10V (Digital register)	Analog output 0-10V	analogOut010V	Input
Startgrupp (SVT A), efter task	Start group (SVT A), after task	afterTaskSV	Input
Värmebäare (0-10000)	Evaporation (0-10000)	evap	Input
Driftindikeringar (0-10)	Indication when 0-10	operIndicative	Input
Startgrupp (SVT B), tillägs värme (System)	Start group (SVT B), Additional heat (Carrier boiler)	addHeatSV	Input

**Extra inställningar** +

# Cost Savings



- The calculated cross-over point to when it is more economical to run the heat pump is 1.9 SEK /kW-hr
- If the average electric spot price is 5 SEK /kW-hr
  - This is a before-tax savings of 3.1 SEK kW-hr
  - This is a after-tax savings of 4.3 SEK kW-hr
- The heat pump has a C.O.P of 3 and can provide 80 kW of heat power for an input power of 27 kW
- When it is cold (< 2C), the heat pump runs full out
  - The Blinky-Lite system provides a savings of 27 kW x 4.3 SEK kW-hr = 116 SEK /hour or 2800 SEK/day or 83500 SEK /month