Ebus experience – from feasibility study to procurement

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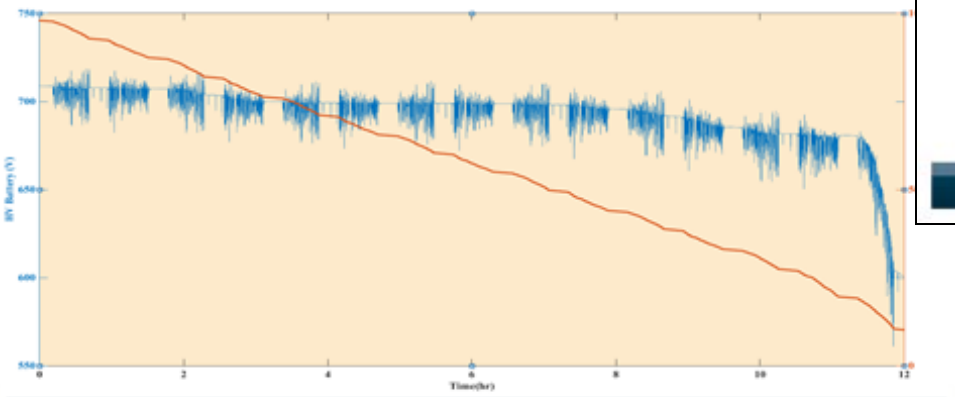
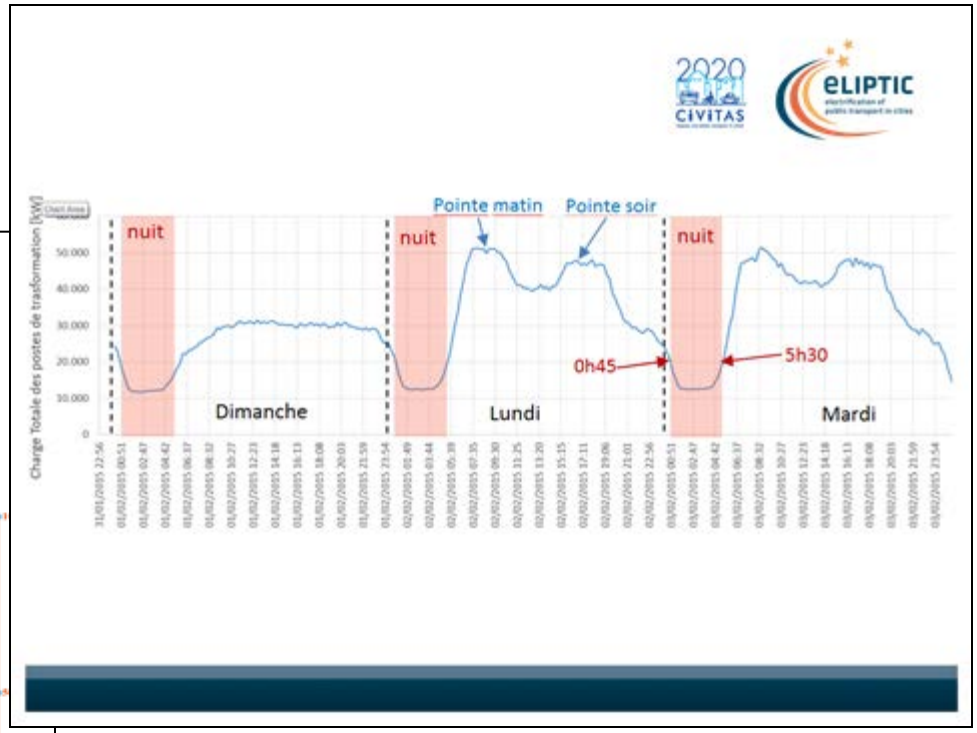
Feasibility Study STIB – VUB
Pillar A

→ LFP battery → 45Ah

- **Ebus Operation =12 hours**
- Min. SoC ~ 10%
- Total Battery Energy= **175.25 kWh** , Required Energy= **163.1 kWh**
- Estimated Distance ~ **103 km**
- BS Design: **213 cells x 6 strings** → total cells=**1278**



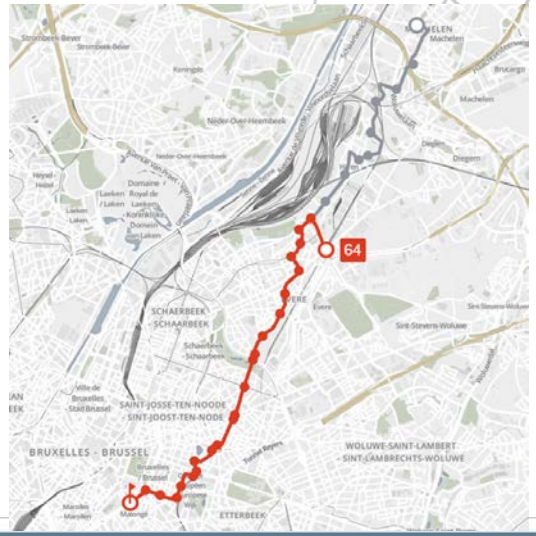


16/04/2016 : GO for tender procedures

- Line 33 (Cityline) operate with 7 Overnight Charging 9m Midibuses

- 5 standard 12m overnight charging buses (line 37 & 13)

- Line 64 operate with 25 articulated 18m buses opportunity charging at terminal stops



Overnight

Brel depot : Electrification & Adaption

5 STD 12m

5 Buses + Charging Point (from 400VAC) *

7 Midi 9m

7 Buses + Charging Point (from 400VAC) *

Opportunity

Haren & Porte de Namur Terminal, Haren depot : Electrification & Adaption

25 Articulated 18m

25 Buses + Charging system (from 11.000V) *

IT Tool : Fleet management

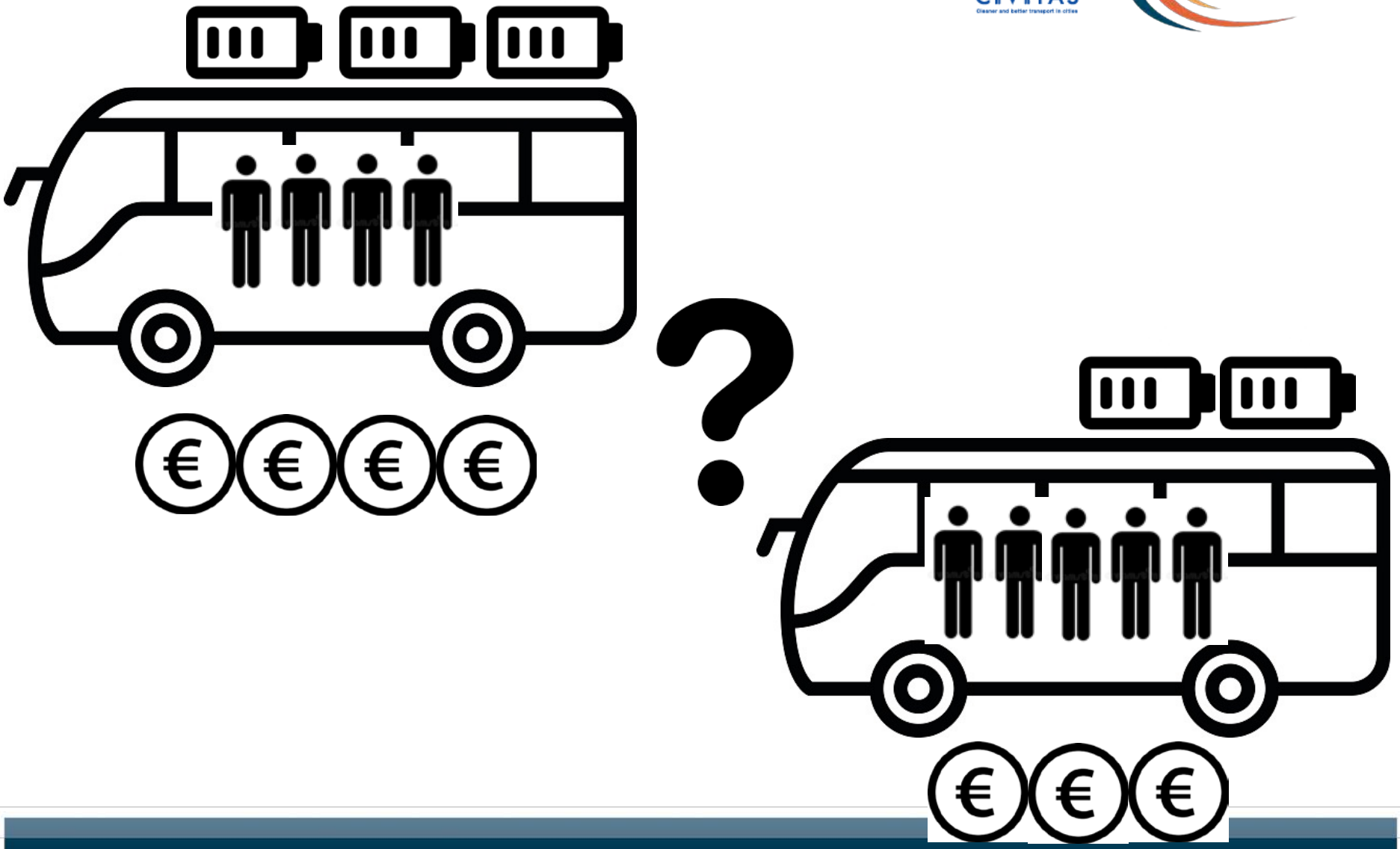
* Maintenance contract included for traction chain, charging system & batteries (15 years)


SOLARIS
1-UDP-056

1 diesel bus to 1 electric bus

- Range needed to operate
  - Commercial speed
  - Temporal line amplitude
- Space at depot for infrastructure

Cost Vs. Range Vs. Passenger capacity



Passenger Capacity

- Technical passenger capacity : 8p/m² (R107)

  Axles weight limitation

- STIB Commercial passenger capacity : 4p/m²

  Ebus similar to Diesel

Cost Vs. Range on Line 37

Example : Manufacturer	A	B
Tender facts (example of a difference of 100k€ & 2h range between 2 vehicles) :		
Range	14h	16h
Cost for 1 bus (electric chain maintenance for 15 years included)	0,730 M€	0,830 M€
Consummation on selected line	2 kWh/km	2 kWh/km
15 years exploitation cost calculation on selected line :		
Number of buses needed for selected line (depend on range)	13	11
Acquisition cost for the fleet (incl. 15y electric chain maintenance)	8,760 M€	9,130 M€
Driver costs (15 years)	23,370 M€	23,370 M€
Energy costs (15 years)	1,160 M€	1,150 M€
Parking cost at depot	4,200 M€	3,850 M€
Maintenance cost (15 years, without electric chain maintenance)	6,670 M€	6,590 M€
Total exploitation cost (15 years)	44,160 M€	44,090 M€

Cost Vs. Range on Line 37

1h range ~ 50k€ per bus ~ 1,1 kWh/km

Financial Penalties

Test in real operation following the protocol

Same amount for financial penalties

1h range ~ 50k€ per bus ~ 1,1 kWh/km

The manufacturer knows his product.

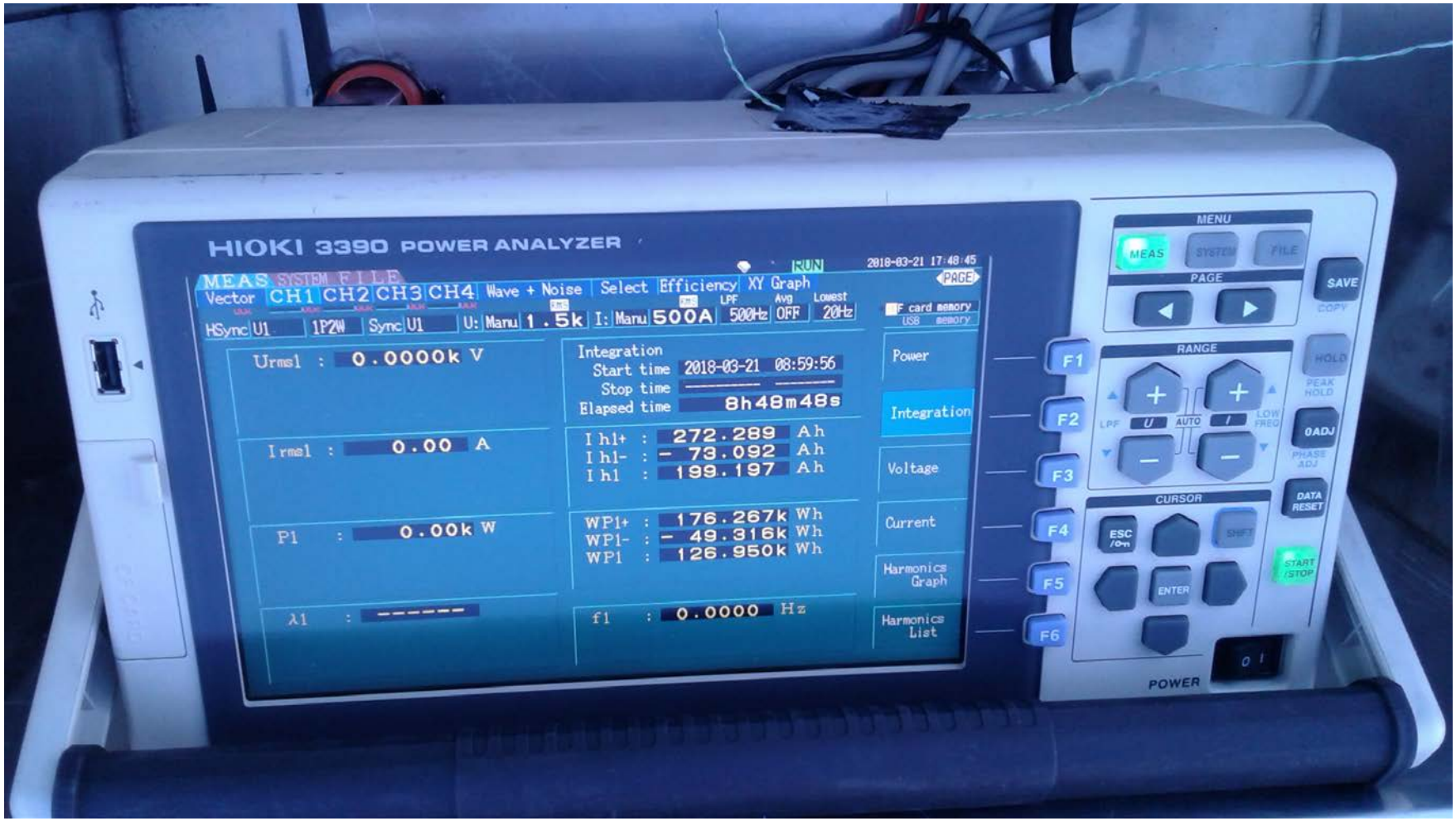
The risk need to be manage by the bus manufacturer.

Battery aging

The manufacturer knows his product.

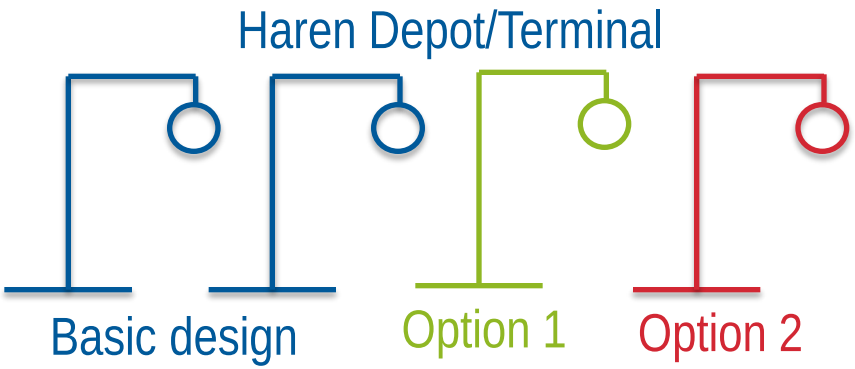
The risk need to be manage by the bus manufacturer.

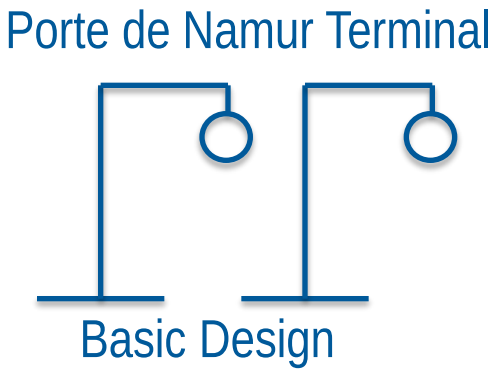
- Maintenance contract for 15 years including battery replacement
- 80% remaining battery capacity criteria
- Test protocol
  - Voltage & current measurement during driving
  - Power in & out of the battery
  - New battery & sample each year


HIOKI 3390 POWER ANALYZER
RUN
2018-03-21 17:48:45
MEAS SYSTEM FILE
Vector CH1 CH2 CH3 CH4 Wave + Noise Select Efficiency XY Graph
PAGE
HSync U1 1P2W Sync U1 U: Manu 1.5k I: Manu 500A LPF 500Hz Avg OFF Lowest 20Hz
F card memory
USB memory
Urms1 : 0.0000k V
Irms1 : 0.00 A
P1 : 0.00k W
λ1 : ------
Integration
Start time 2018-03-21 08:59:56
Stop time ---------- --------
Elapsed time 8h48m48s
Ih1+ : 272.289 Ah
Ih1- : - 73.092 Ah
Ih1 : 199.197 Ah
WP1+ : 176.267k Wh
WP1- : - 49.316k Wh
WP1 : 126.950k Wh
f1 : 0.0000 Hz
Power
Integration
Voltage
Current
Harmonics Graph
Harmonics List
F1
F2
F3
F4
F5
F6
MENU
MEAS
SYSTEM
FILE
PAGE
SAVE
COPY
RANGE
LPF
U
AUTO
I
LOW FREQ
HOLD
PEAK HOLD
0ADJ
PHASE ADJ
CURSOR
ESC /On
SHIFT
ENTER
DATA RESET
START /STOP
POWER
0 I

Opportunity charging

- 25 articulated 18m buses
- 4 Fast charging positions at terminal stops
- 24 slow charging position at depot





Opportunity charging

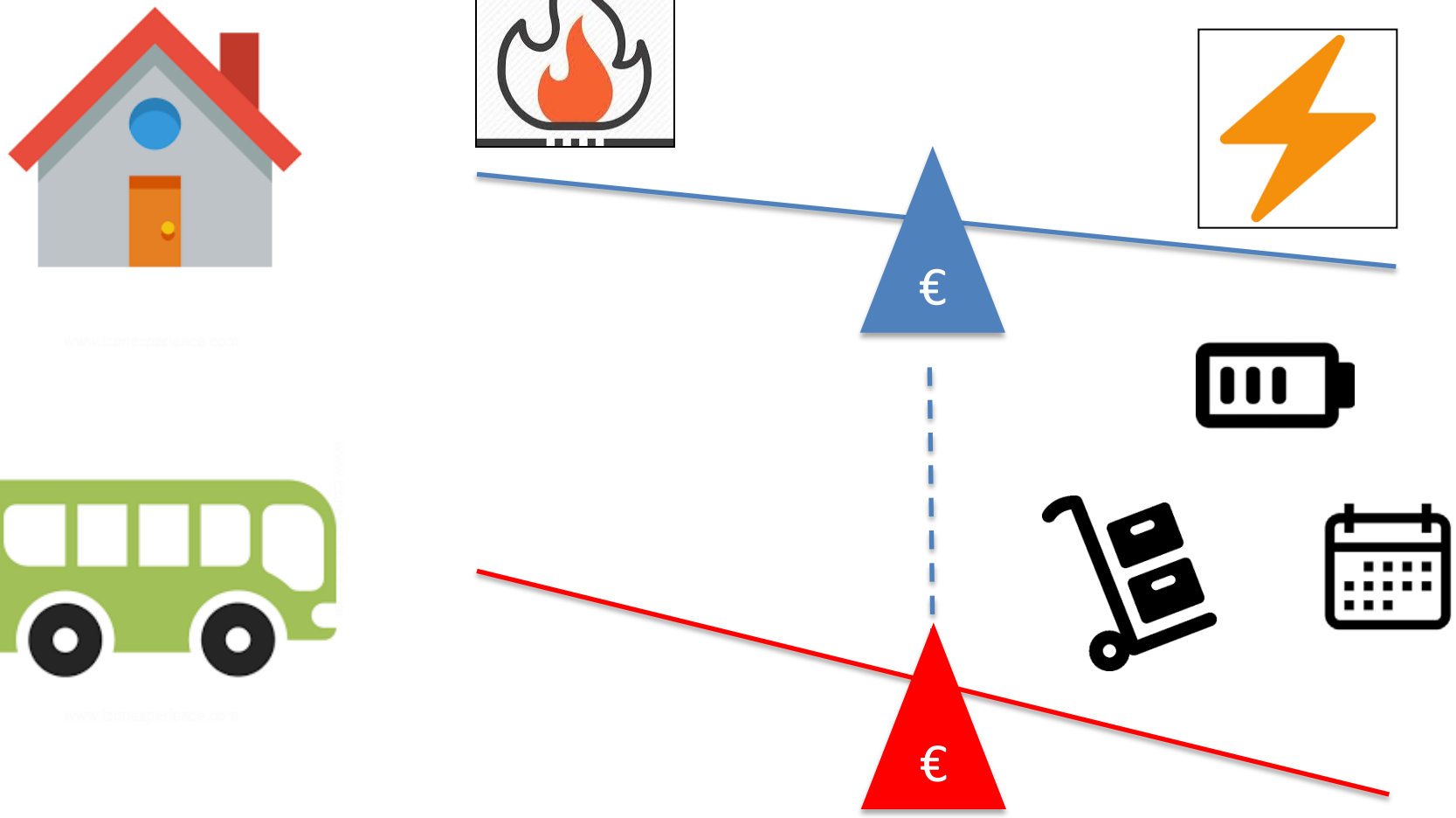
Charging time Vs. Cost

2 minutes for a round trip

~ 65k€ per bus

~ 2 kWh/km

Heating system



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Horizon 2020 Programme

This project has received funding from the European Union's Horizon 2020 research an innovation programme under grant agreement No 636012