REDUCING ENERGY CONSUMPTION AND PEAK POWER IN BELGIUM

WWF | GREENPEACE | Bond Beter Leefmilieu Vlaanderen | fédération INTER-ENVIRONNEMENT WALLONIE

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PRESENTATION CONTENT
Outline

- Objective
- Background
- Energy efficiency: examples in 3 sectors
  - Residential: electric heating
  - Tertiary: lighting
  - Industry: electric pumps
- Summary
- Policy recommendations
- Conclusion

OBJECTIVE

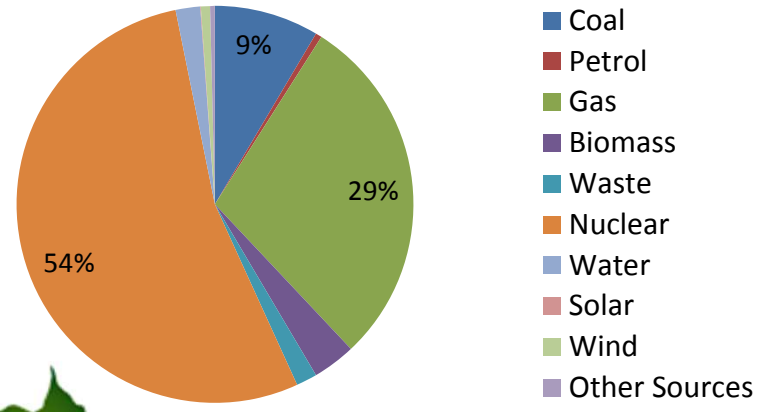
- Nuclear phase-out is planned to start in 2015
- Study wants to highlight the potential of energy efficiency to help achieving this decision while maintaining security of supply.

→ High-level analysis for three concrete examples provide proof and concrete basis for action
  - Quantitative analysis of energy reduction potential (over the year)
  - Quantitative analysis of power reduction potential (during peak moments)

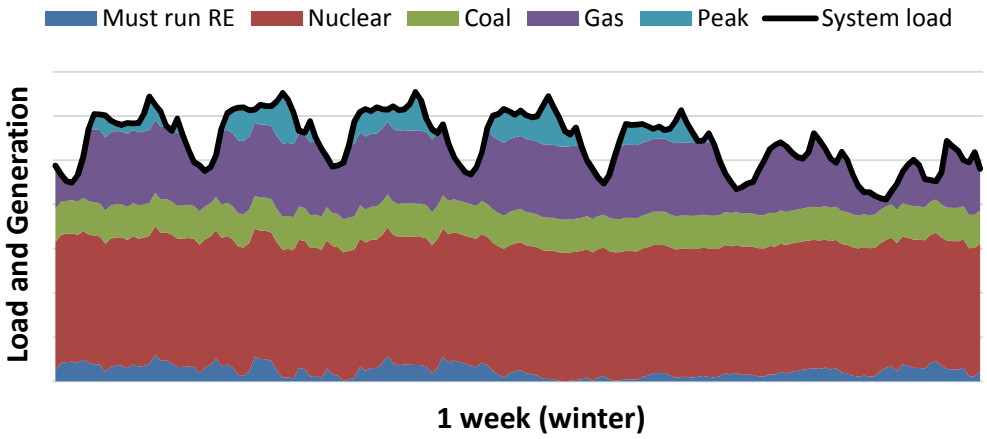
BACKGROUND

- Basic rule: generation must equal demand at all times
- Different types of generation:
  - Base load plants (e.g. nuclear, cheap coal…)
  - Flexible semi-baseload plants (e.g. gas)
  - Peak plants (e.g. diesel generators)
  - Must-run plants (e.g. wind)

Electricity production in Belgium per energy source [2009]

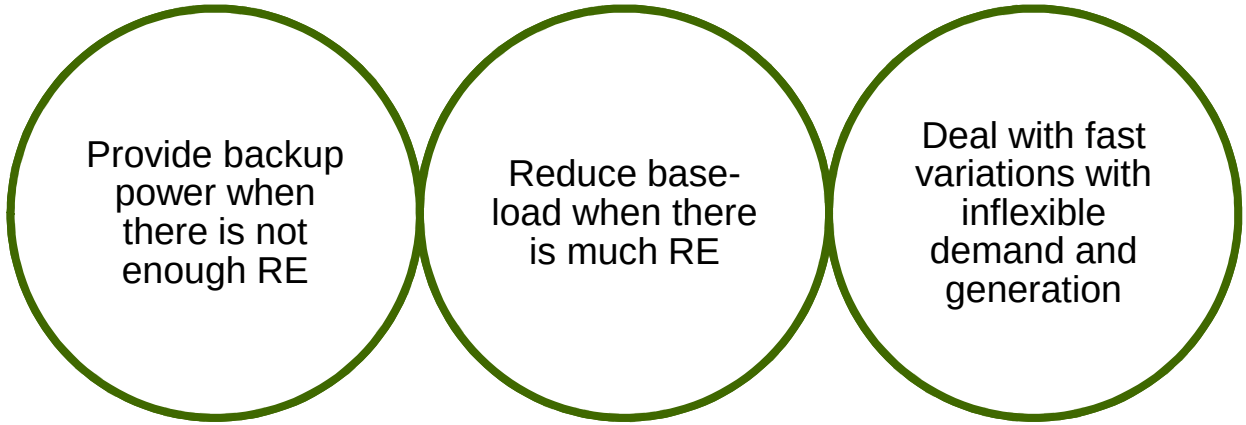


Indication of power generation with different sources in Belgium

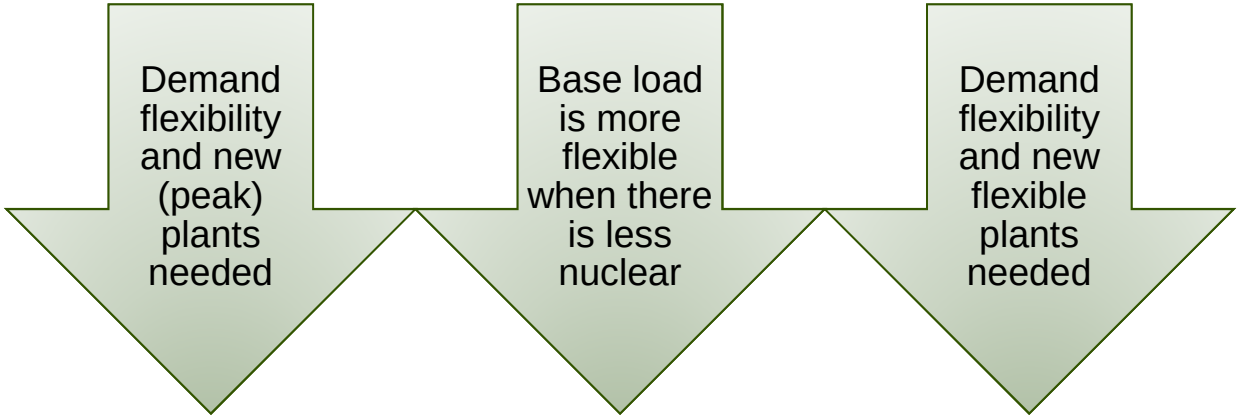


BACKGROUND

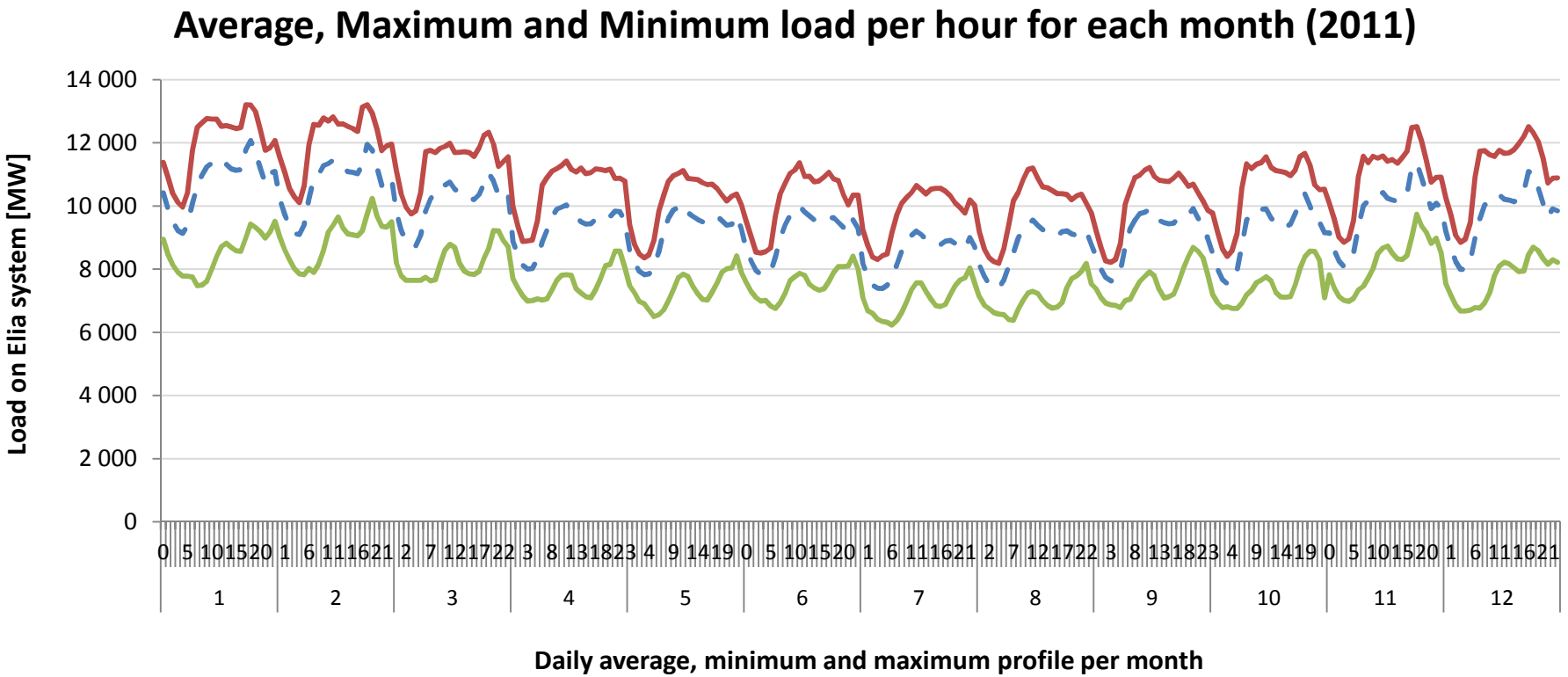
Main problems in current and future power system:



Consequences of nuclear phase-out:



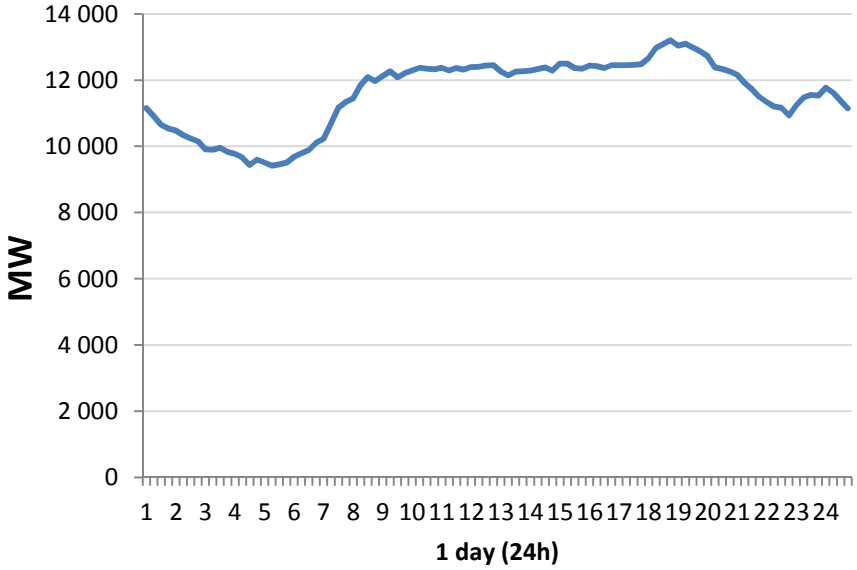
BACKGROUND



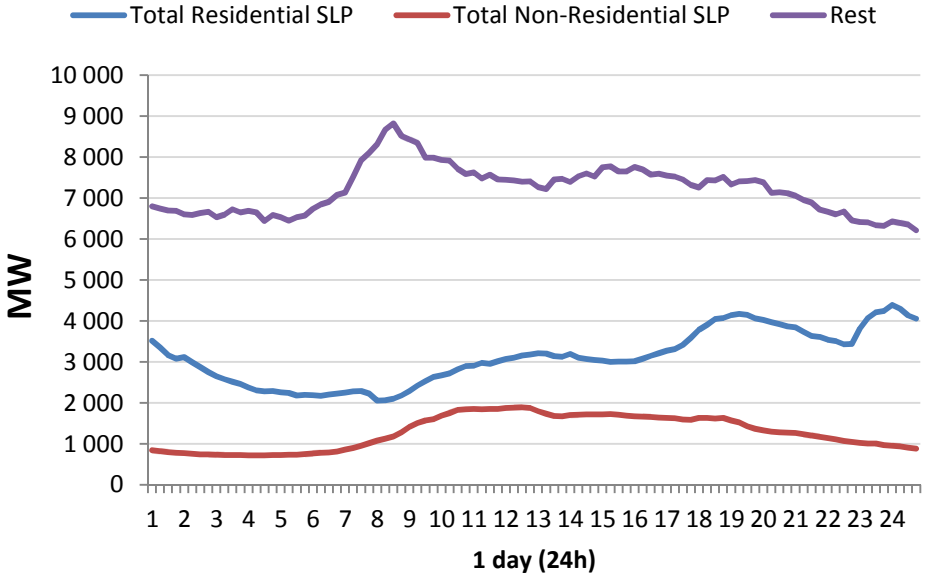
- Summer peak: during morning
- Winter peak: during evening and much more important

BACKGROUND

Day with Maximum load (January 11, 2011)



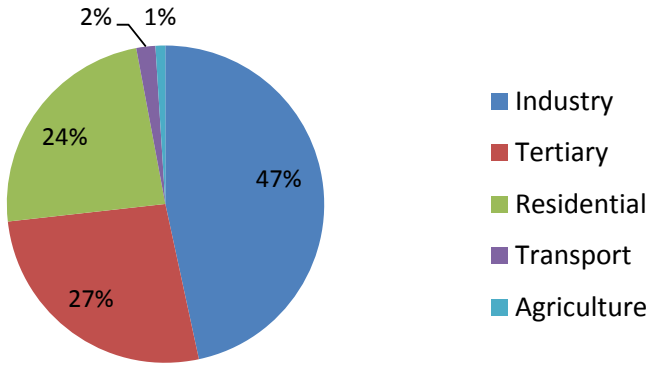
Breakdown of load profile 11/01/2011 (SLP RES, SLP non-RES and rest)



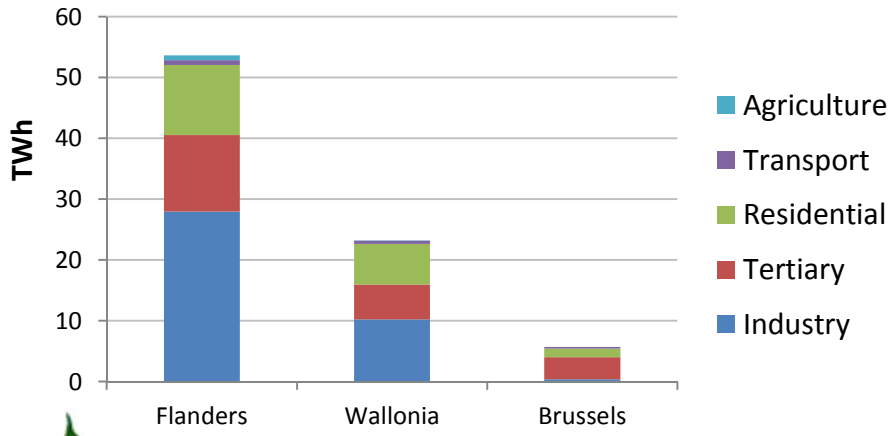
- Peak load in 2011 was on January 11 (13.2 GW on Elia grid)
- Evening peak (~18h) mainly comes from residential customers, but can be reduced in any sector

ENERGY EFFICIENCY: EXAMPLES IN 3 SECTORS

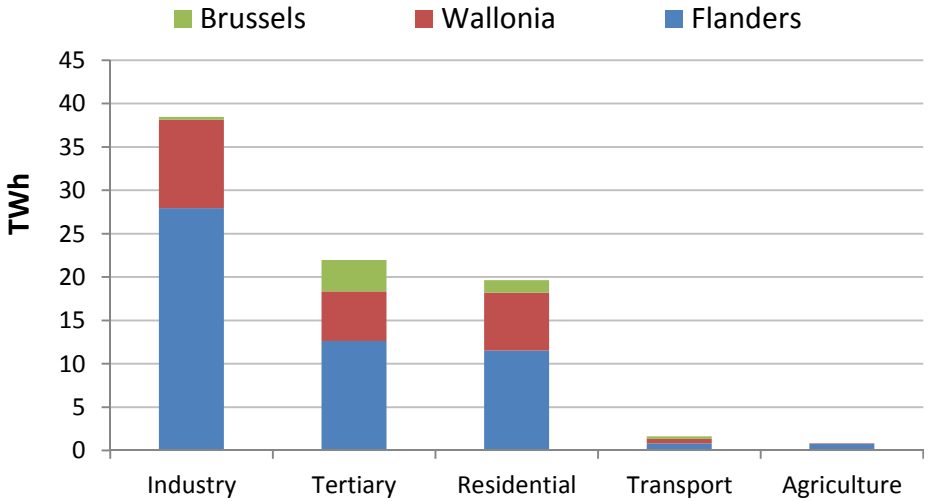
Electric consumption share (Energy balances 2009)



Annual electricity consumption per region



Annual electricity consumption per sector



RESIDENTIAL SECTOR:

ELECTRIC HEATING

RESIDENTIAL SECTOR: ELECTRIC HEATING

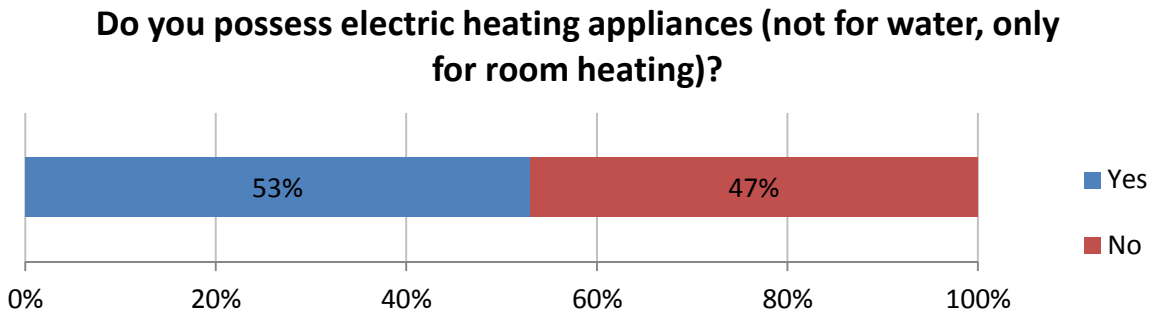
Looking at:

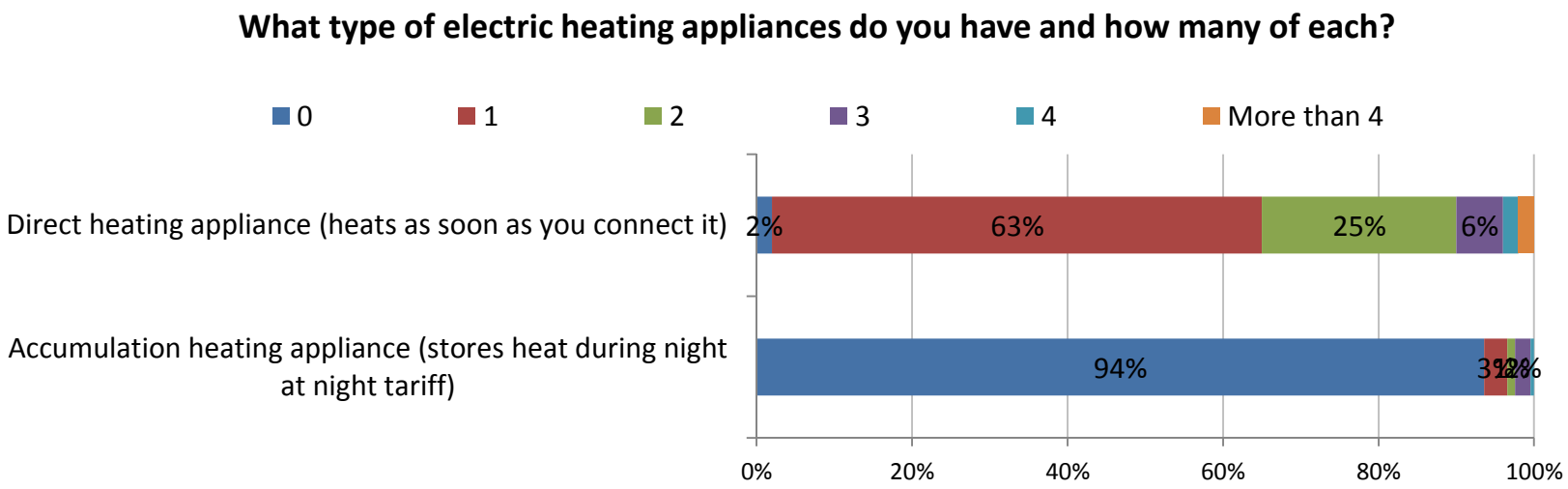
- Accumulation heating
- Direct complementary heating

Enquete performed by IPSOS:

- 1018 households
- Spread over Flanders (58%), Brussels (10%), Wallonia (32%)
- Well distributed over age, gender, income level…

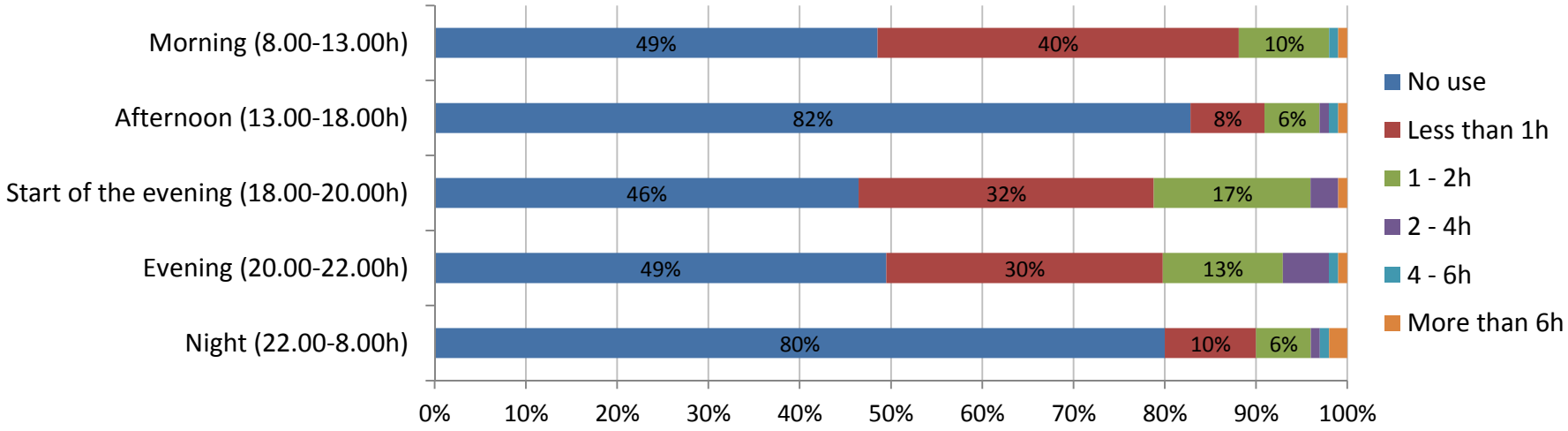
RESIDENTIAL SECTOR: ELECTRIC HEATING



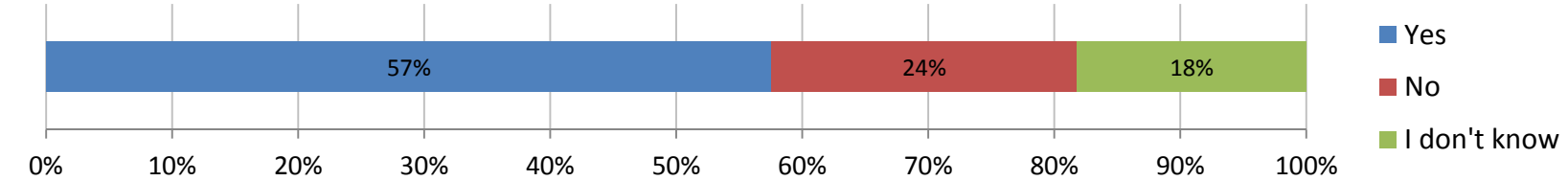


RESIDENTIAL SECTOR: ELECTRIC HEATING

Specifically for the direct heating appliances as complementary heating: How many hours per day do you use them during winter days when it's freezing (e.g. if during the morning you use 2 devices during 2 hours, then the answer is 4)



Would you be willing to stop using your device (or use it less) between 18h and 20h?



RESIDENTIAL SECTOR: ELECTRIC HEATING

Results of enquete

- 53% of all belgians has one or more electric heating devices at home.
- Only 6% of the these possesses accumulation heating. 98% says to possess one or more direct electric heating devices.
- Direct heating devices are mostly used in the beginning of the evening (between 18h and 20h), in the morning and between 20h and 22h.
- 57% of the respondents is willing to reduce consumption or unplug the direct electric complementary heating during the period 18-20h. One out of 4 respondents is not willing to do this, while 18% does not know.

RESIDENTIAL SECTOR: ELECTRIC HEATING

Results direct heating:

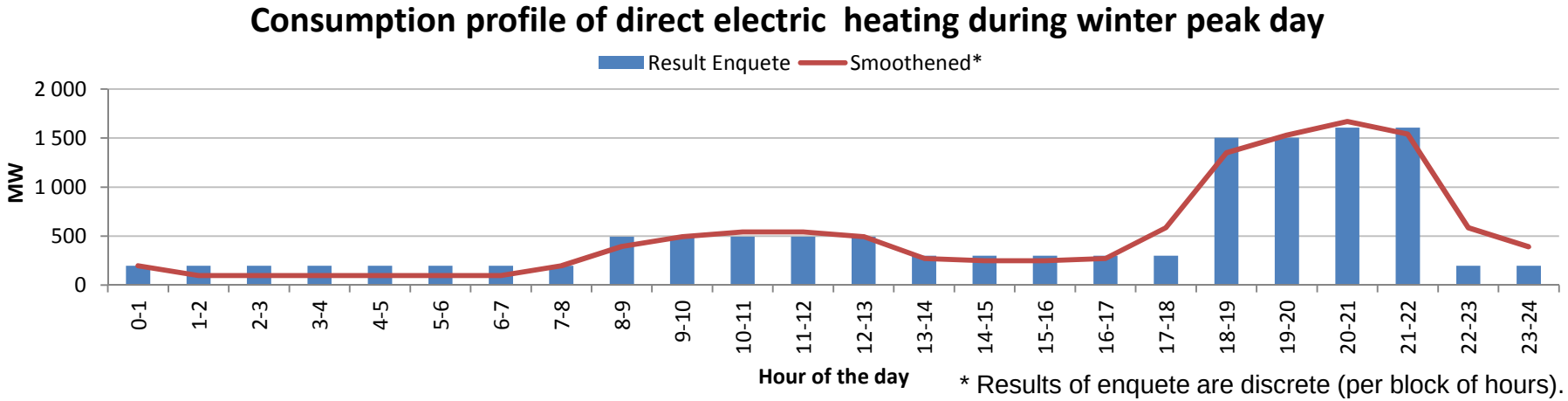
• Number of Belgian households (2008):	4 575 950
• Households with direct electric heating:	52 % (=53%*98%)
• Average number of devices:	1.5
• Average electric power:	1.5 kW
→ Number of devices in Belgium:	3 573 433
→ Total installed power electric compl. heating:	**5.36 GW**

Results accumulation heating:

• Number of Belgian households (2008):	4 575 950
• Households with accumulation heating:	3 % (=53%*6%)
• Average consumption (VREG):	12 500 kWh
• Average installed power (100 m², 100 W/m²):	10 kW
→ Number of accumulation heating systems:	137 279
→ Total installed power accumulation heating:	**1.37 GW**

RESIDENTIAL SECTOR: ELECTRIC HEATING

Direct complementary heating



* Results of enquete are discrete (per block of hours). Therefore, the curve has been smoothened to represent a more realistic profile.

Assumption**:

	number of days (during day)	Use of devices
<0°C	30	75%
<5°C	132	30%
<10°C	212	15%
<15°C	319	0%

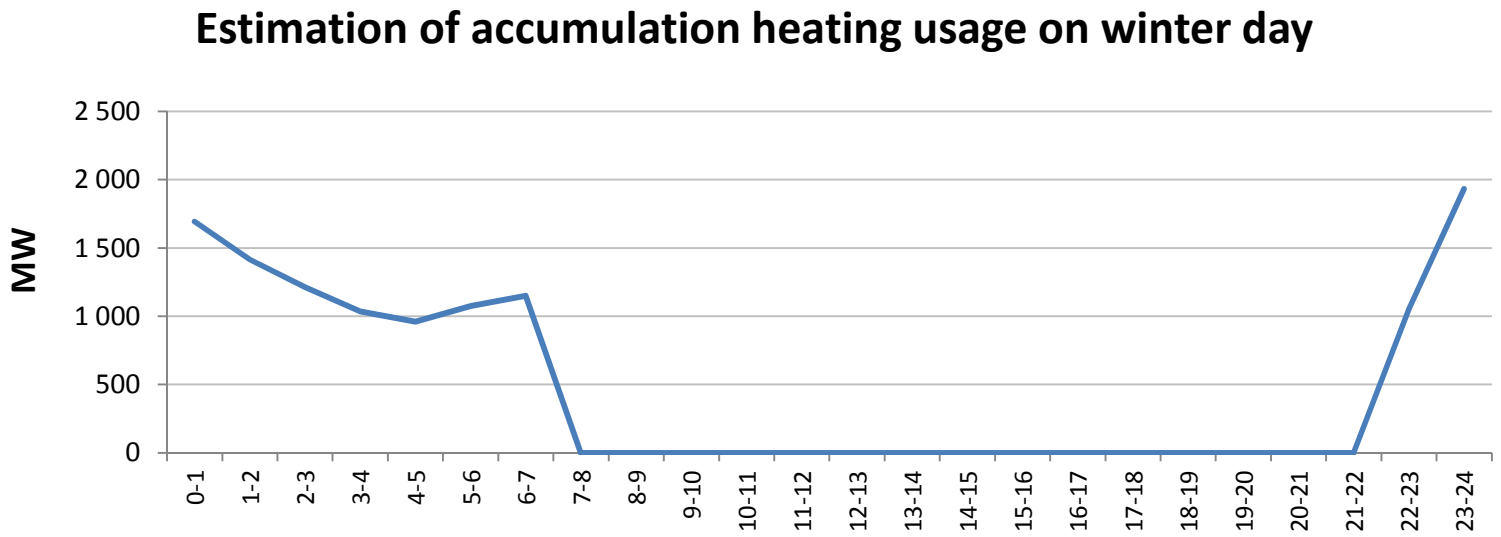
** This assumption is needed to transform the results of the enquete (in power consumption) to a total energy consumption over the year.

- Total energy consumption direct electric heating: 0.82 TWh
  - → 1.0% of Belgian electricity consumption
  - → 4.2% of residential electricity consumption
  - → 159 M€ electricity cost annually
    (calculated with 15/20 c€/kWh for day/night)
- Total consumption during winter peak: 610 MW

RESIDENTIAL SECTOR: ELECTRIC HEATING

Accumulation heating

From SLP profiles winter peak day (difference between S21 and S22):

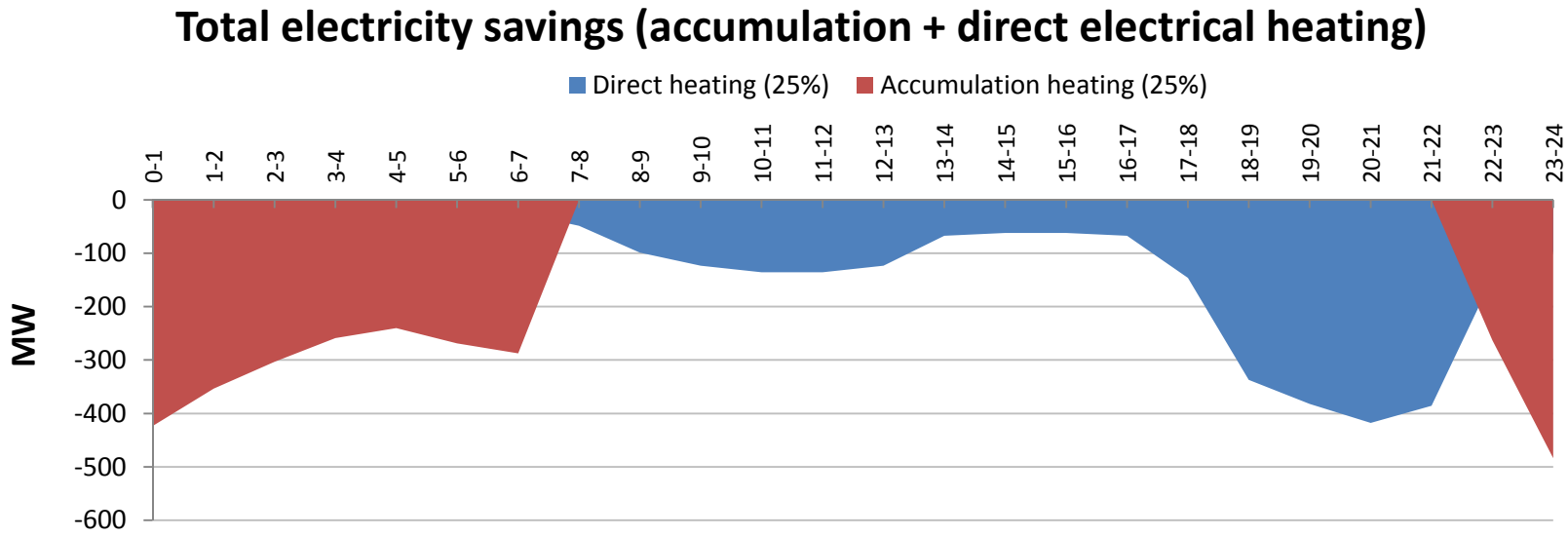


- Total energy consumption accumulation heating: 1.72 TWh
  - → 2.1% of Belgian electricity consumption
  - → 8.7% of residential electricity consumption
  - → 257 M€ electricity costs annually
    (calculated with 15 c€/kWh for night)
- Total consumption during winter peak: 0 MW (→ works at night)

RESIDENTIAL SECTOR: ELECTRIC HEATING

Assumed conversions possible: 25%

→ Total savings on peak day:

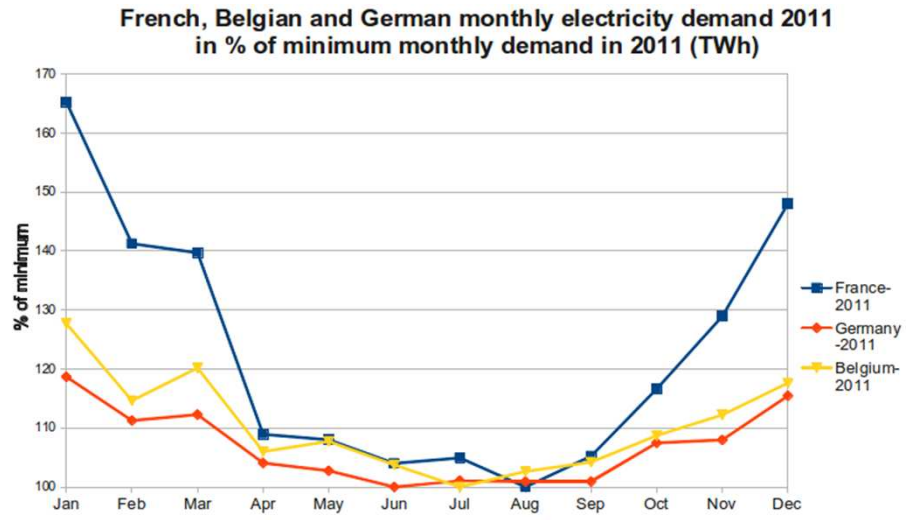


- Total energy savings: **0.64 TWh** (3.2% of residential consumption)
- Peak reduction: **152 MW** (1.15% of winter load peak)
- Annual electricity costs savings: **106 M€**

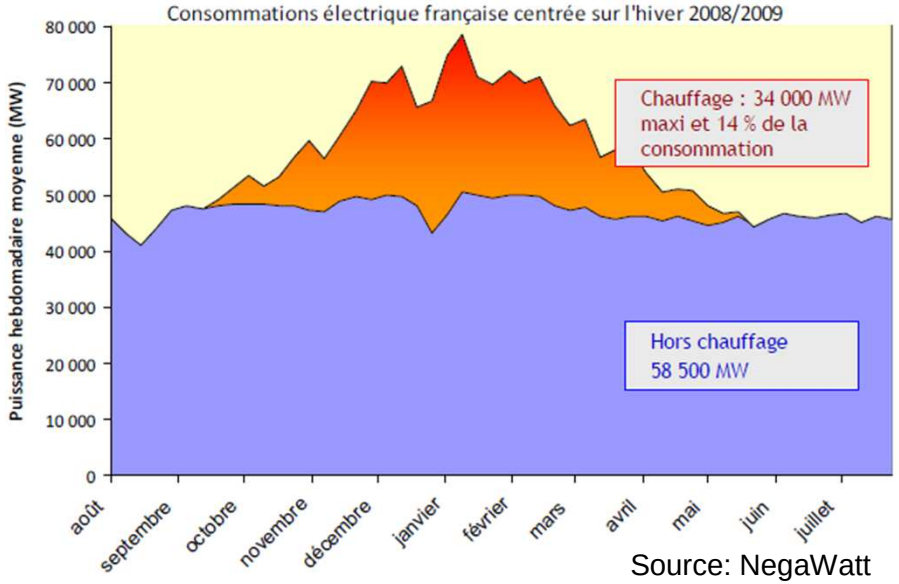
RESIDENTIAL SECTOR: ELECTRIC HEATING

Serious point of attention, and not only in Belgium!

- Situation in France is even worse due to electric heating:
  - In winter, demand is 65% higher than in summer, while for Belgium this is 'only' 30%
  - Electric heating in France consumes 34% of the winter peak
  - Demand sensitivity per degree °C:
    - France: 2300 MW (=~2.3 % of peak power per °C)
    - Belgium: 80 MW (=~0.6 % of peak power per °C)



Source: Greenpeace

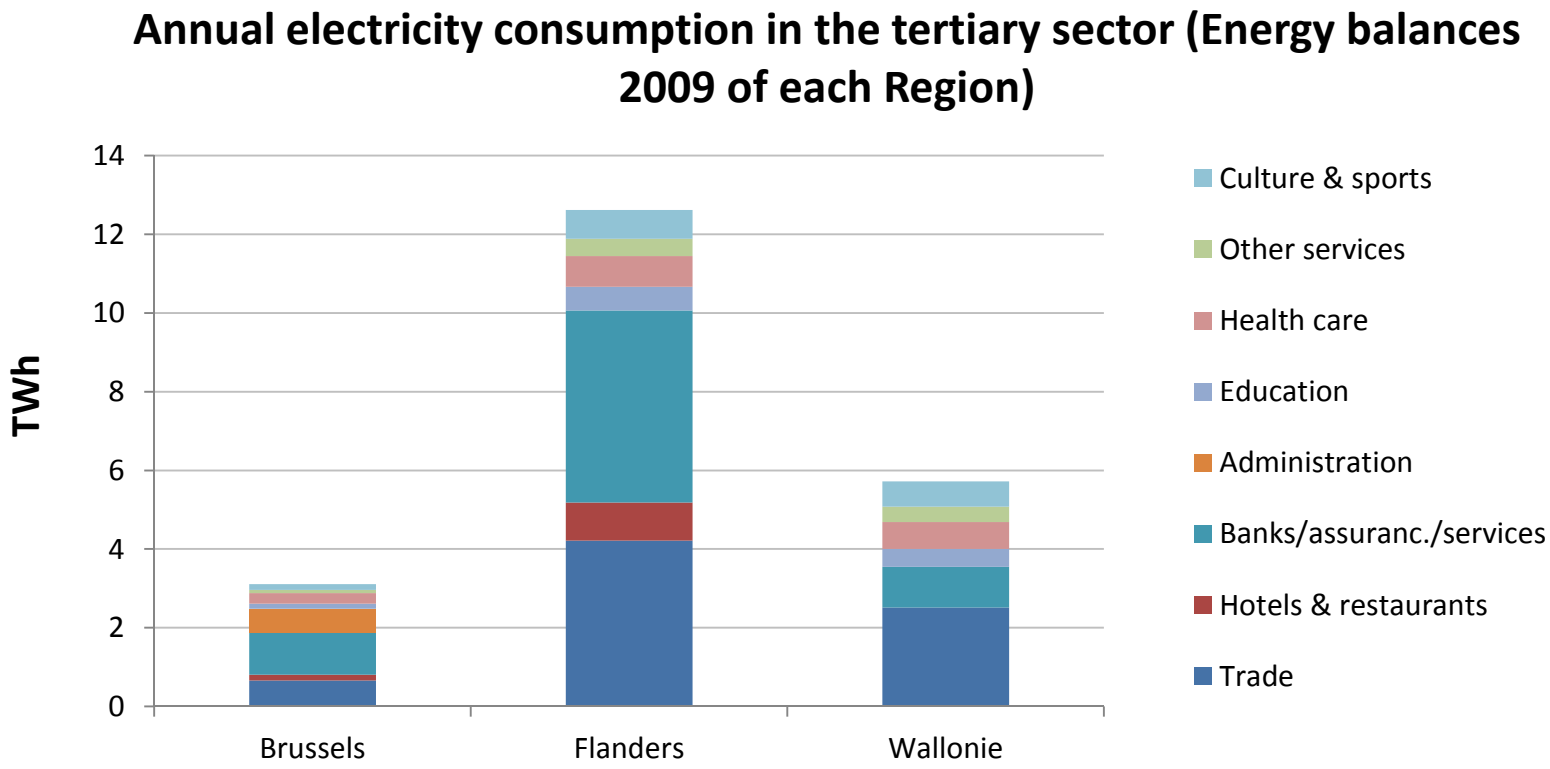


Source: NegaWatt

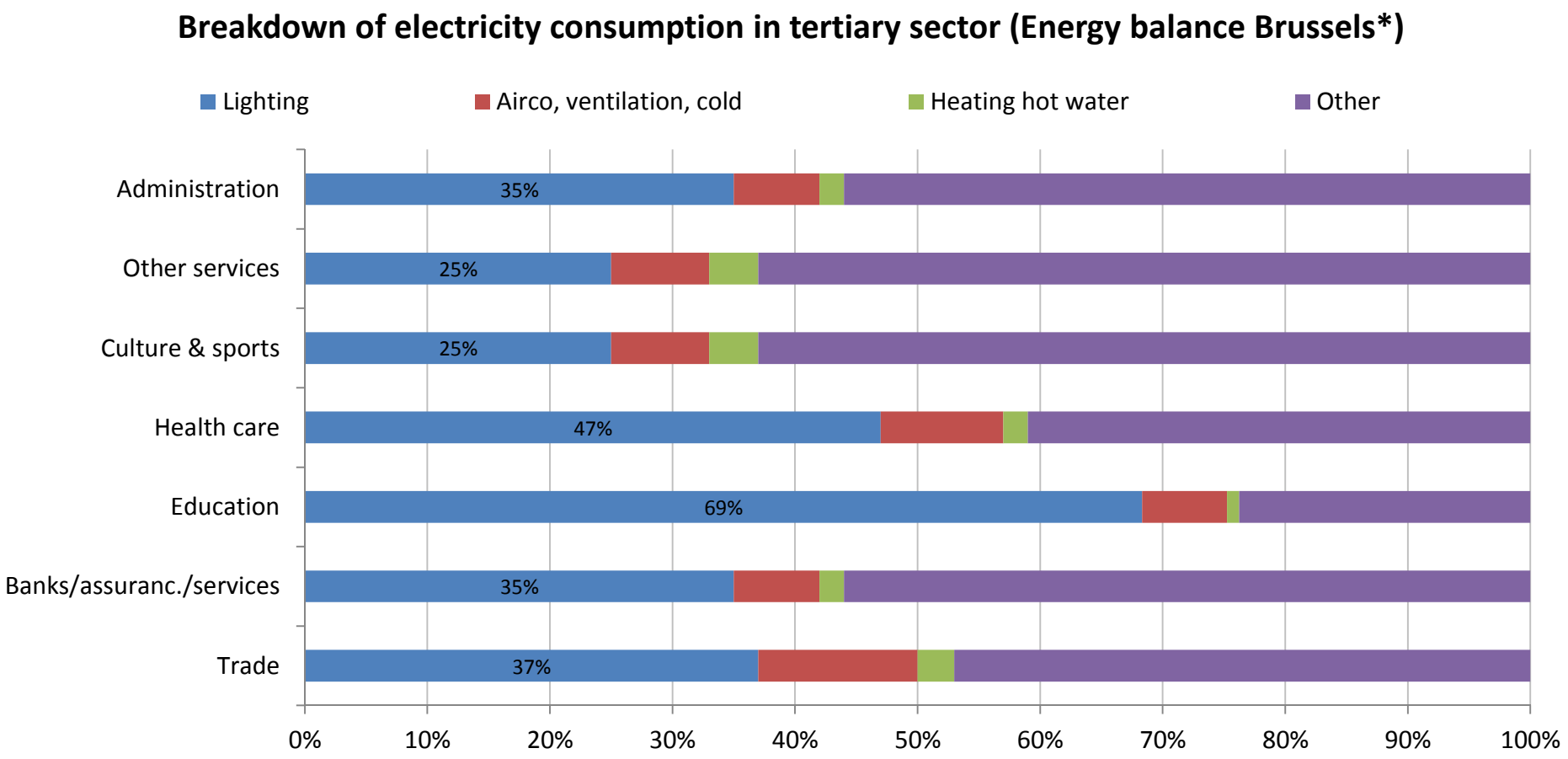
TERTIARY SECTOR:

LIGHTING

TERTIARY SECTOR: LIGHTING

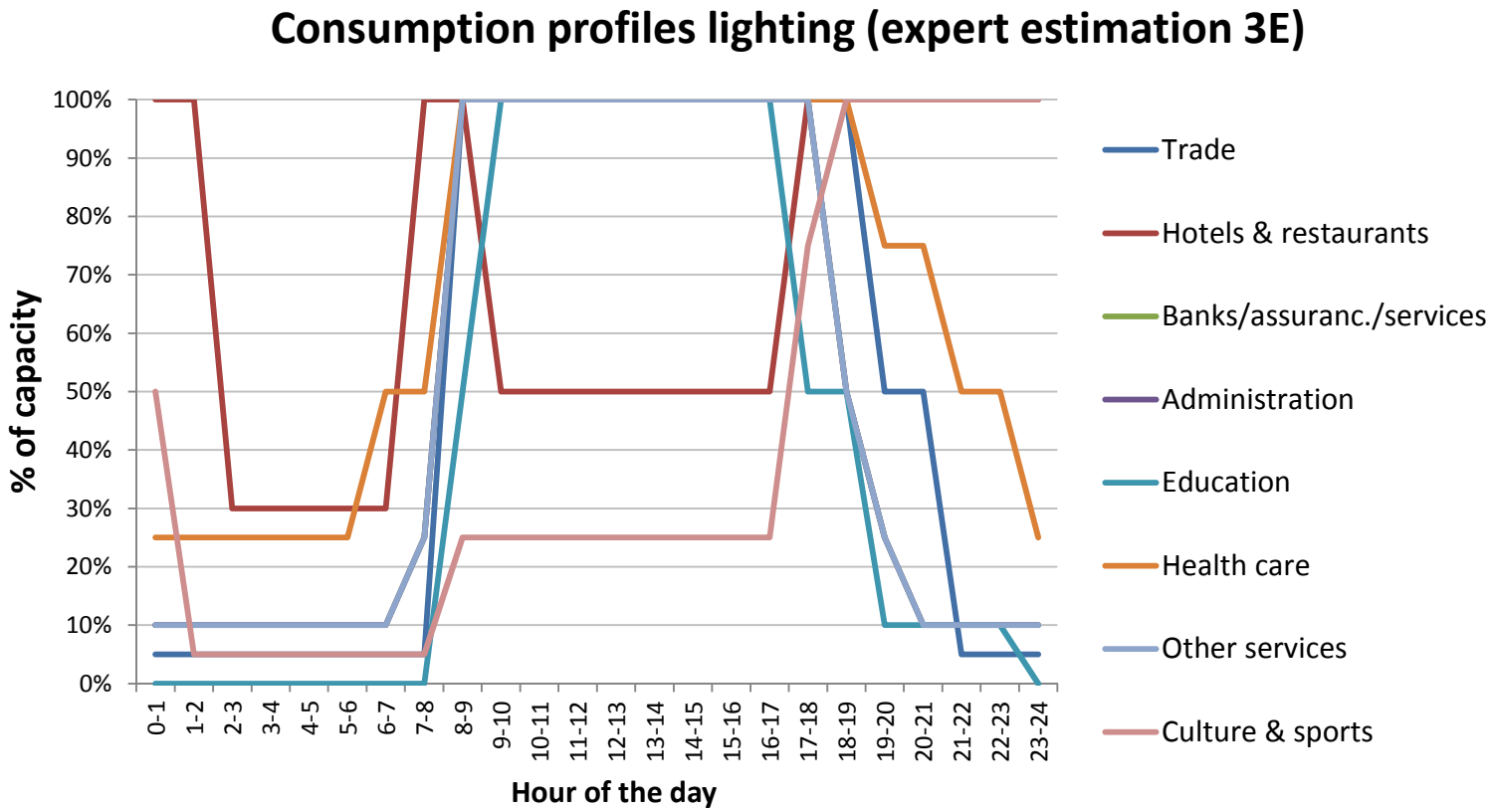


TERTIARY SECTOR: LIGHTING



* The Brussels Energy balance (2009) is the only one with details on the split of electricity consumption. It is assumed that the shares in the other regions are similar.

TERTIARY SECTOR: LIGHTING



TERTIARY SECTOR: LIGHTING

Working hours lighting [1]:

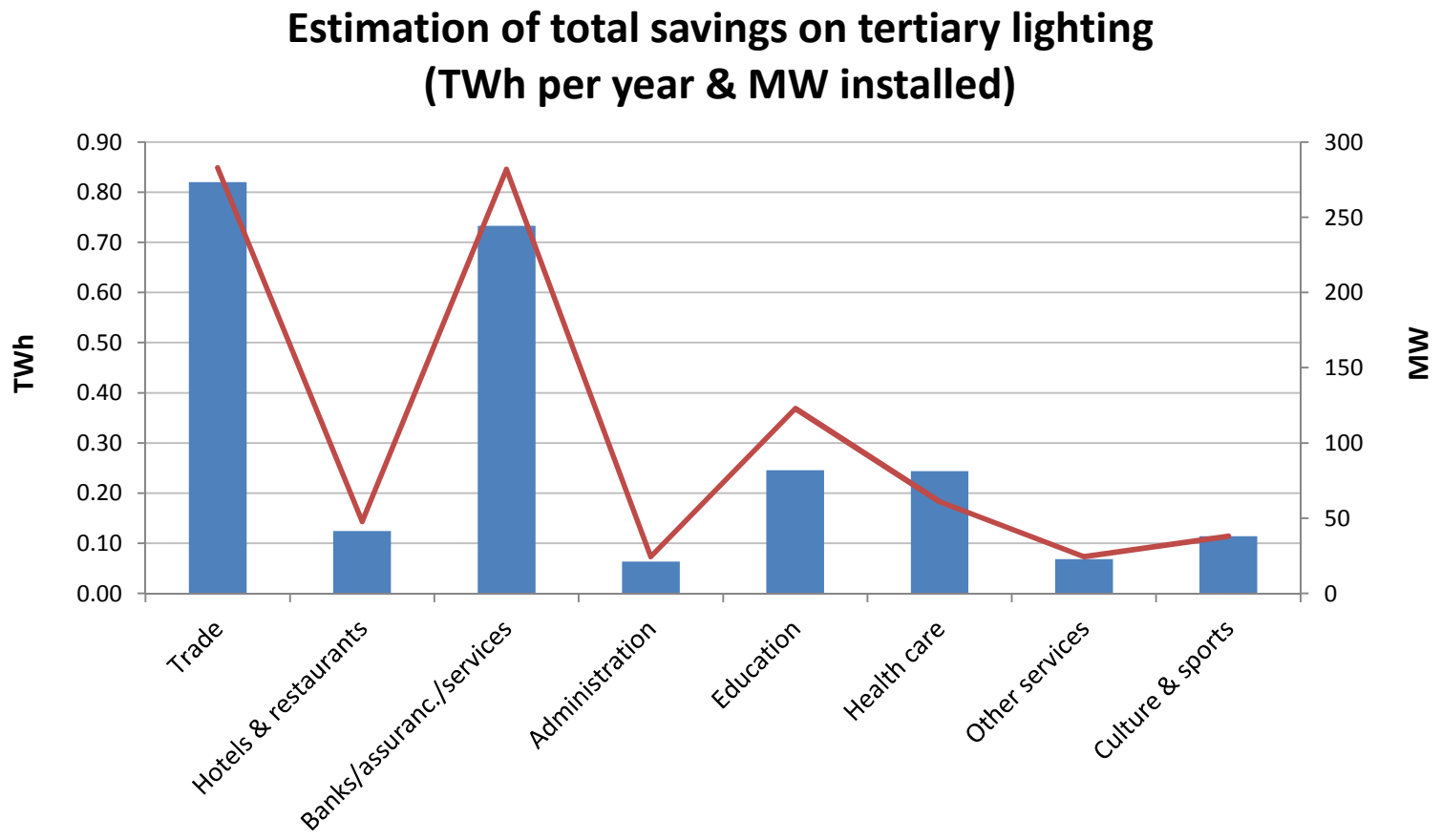
Office	2600
Education	2000
Health care	4000
Horeca	2600
Trade	2900
Industry	2400
Sports	3000

→ Possible saving:

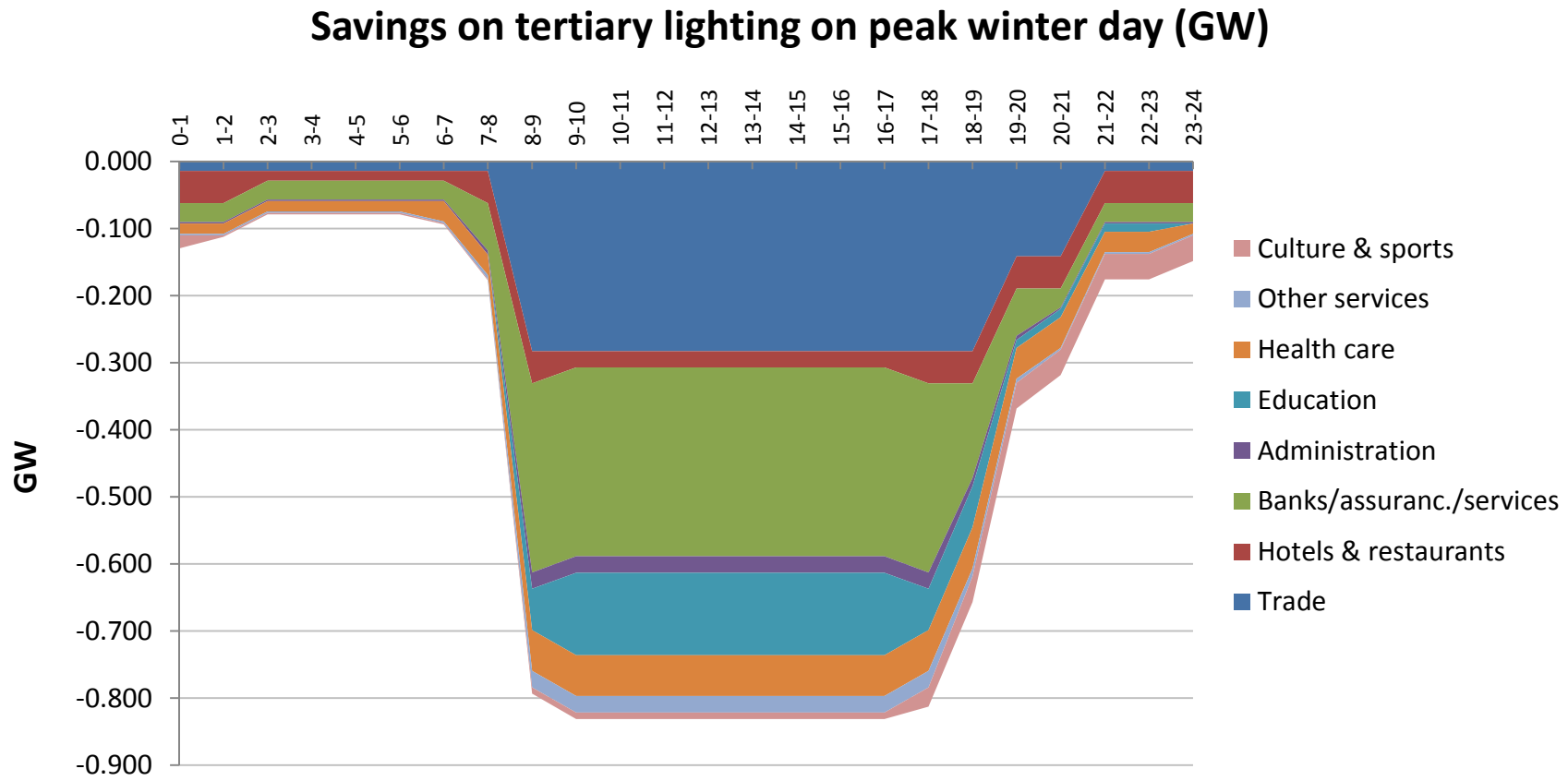
- Average possible saving: 40% [2, 3, 4]
- Remaining potential: 75% [2]

[1] Cijfers en tabellen 2007, SenterNovem, April 2007
[2] The European Lighting Industry Position on How to Maximise the Potential Benefits of European Policy on Energy Efficiency in Lighting, CELMA, 2008
[3] Groen Licht Vlaanderen 2020
[4] 3E Expert estimation

TERTIARY SECTOR: LIGHTING



TERTIARY SECTOR: LIGHTING

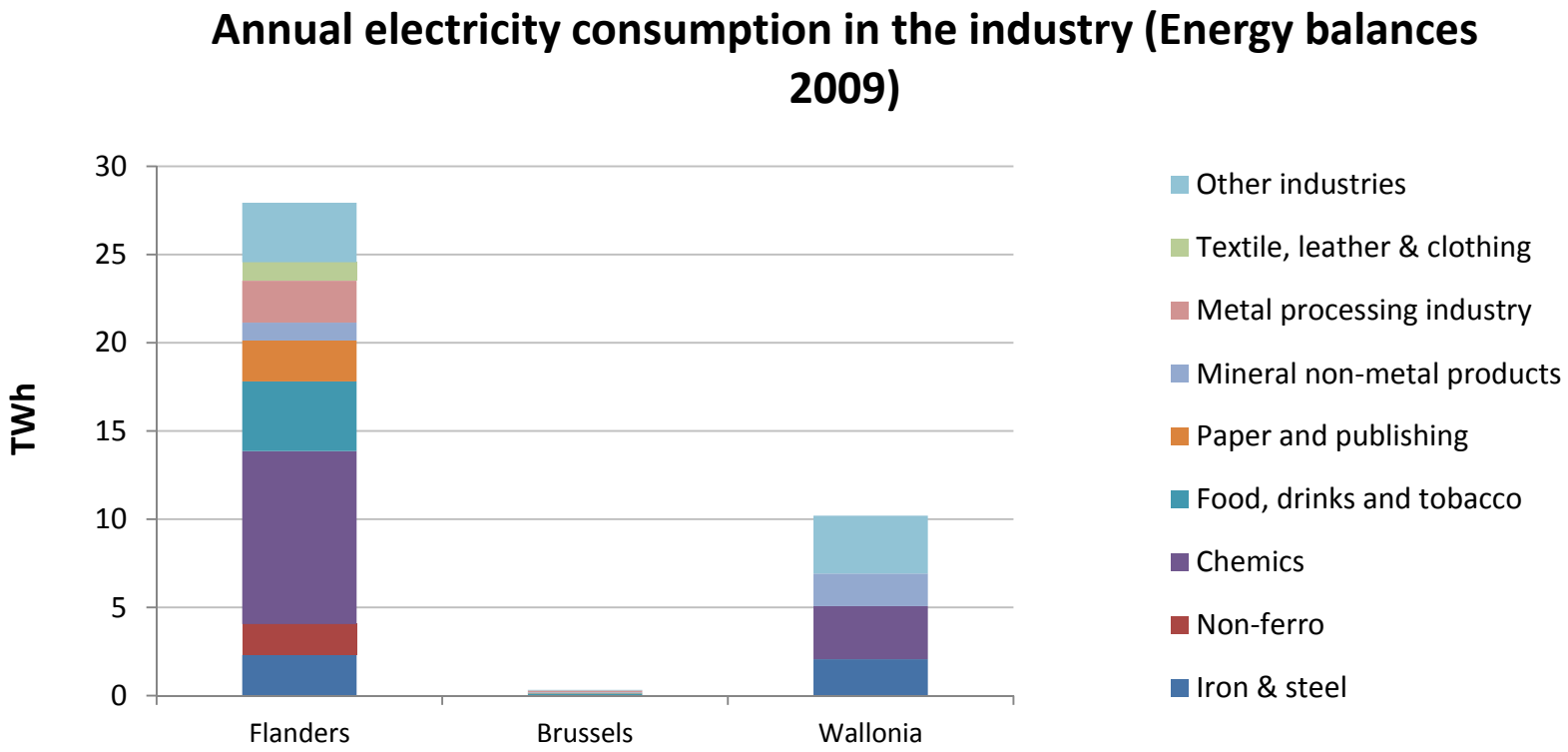


- Total energy savings: **2.41 TWh** (11.0% of tertiary consumption)
- Peak reduction: **812 MW** (6.2% of winter load peak)
- Annual electricity cost savings: **362 M€**

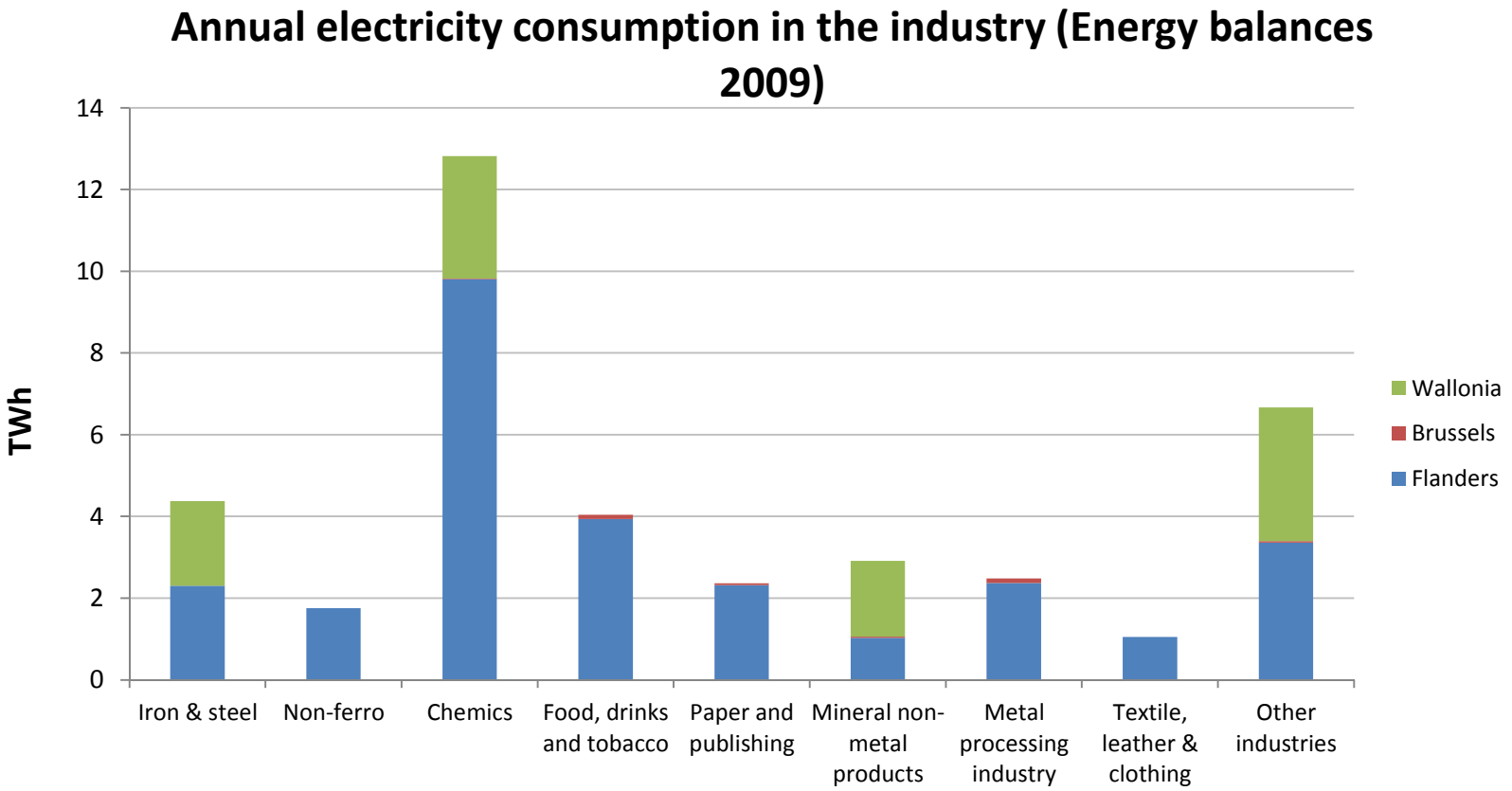
INDUSTRY SECTOR:

PUMPS AND VENTILATORS

INDUSTRY: EFFICIENT MOTOR SYSTEMS



INDUSTRY: EFFICIENT MOTOR SYSTEMS



INDUSTRY: EFFICIENT MOTOR SYSTEMS

Estimation of savings potential for pumps & ventilators

- 68 % of industrial consumption is used by motor systems [1]
- 38 % of this is used by pumps and ventilators [1]
- 75 % of these applications have a variable load [2]
- 50 % is estimated to be undeveloped potential [4]
- 29 % improvement in efficiency is possible by using: [3]
    - frequency control
    - more efficient motors
    - better dimensioning of the systems

→ 2.8 % of the industrial electricity consumption can be avoided

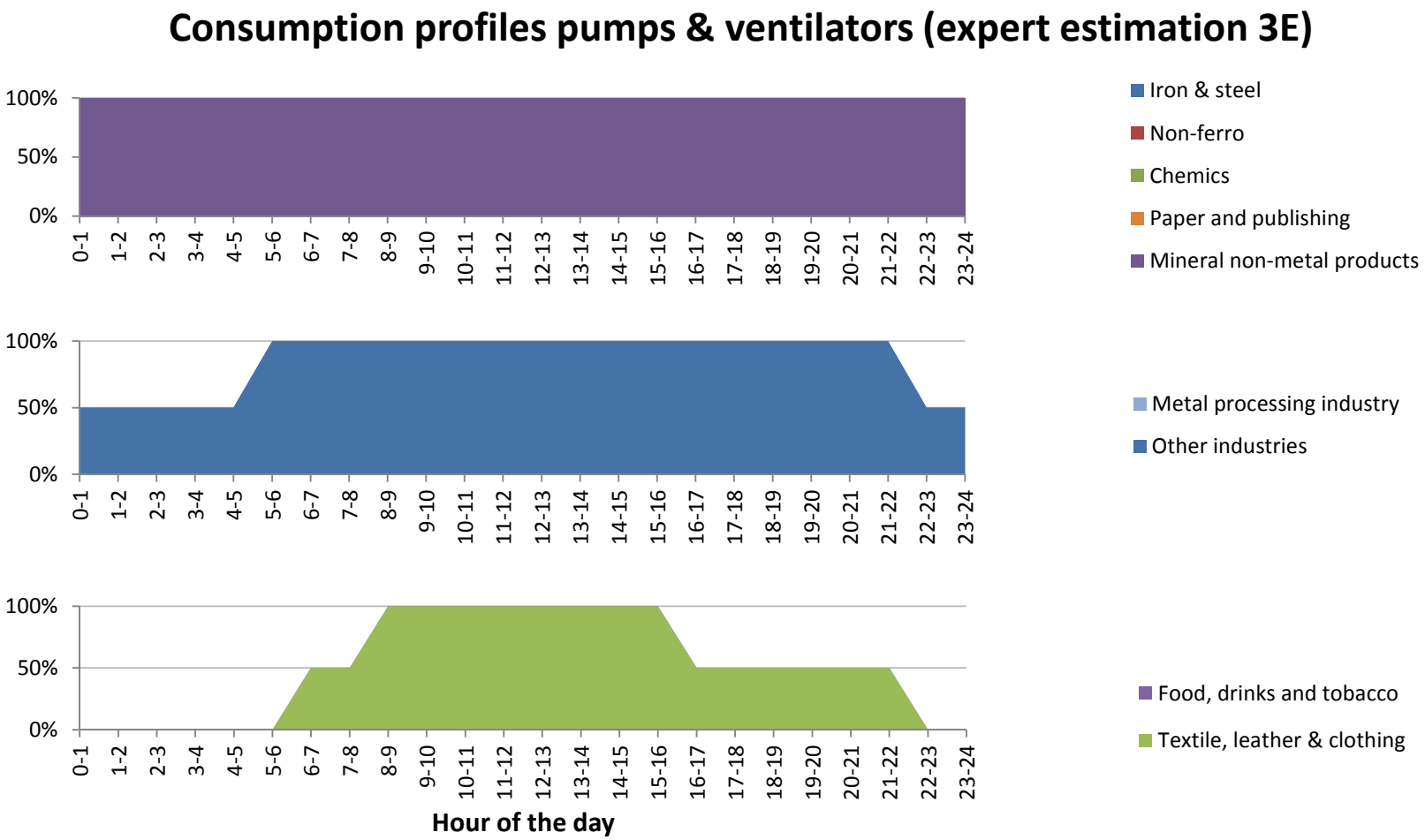
[1] Reference Document on Best Available Techniques for Energy Efficiency (BREF), European Commission, February 2009

[2] Improving Pumping System Performance, A Sourcebook for Industry, Second Edition, U.S. Department of Energy's Industrial Technologies Program and Hydraulic Institute, May 2006

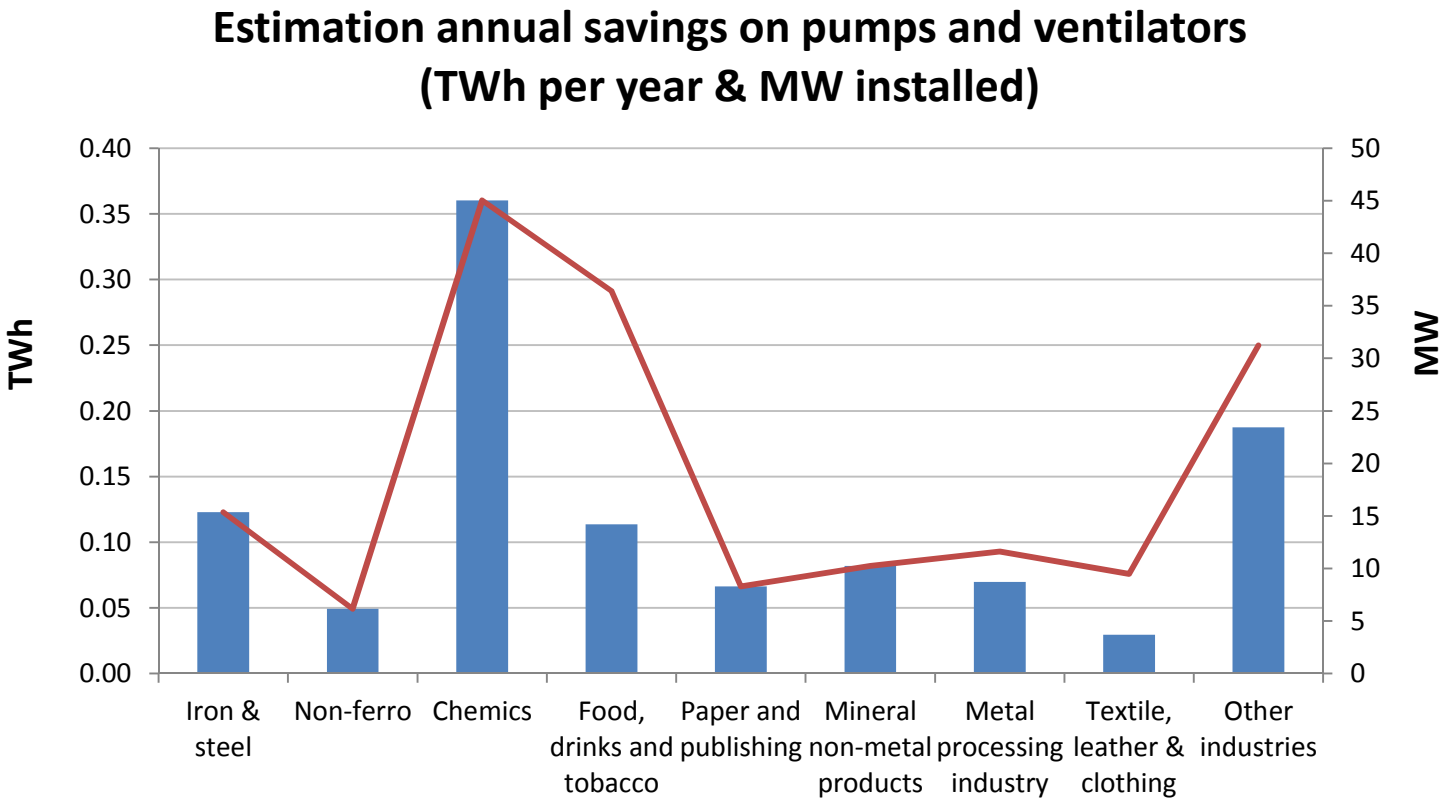
[3] Energy Efficient Motor Driven Systems, European Copper Institute, April 2004

[4] Very little information available → Expert estimate based on 'Energy Efficiency makes a difference, ABB, November 2008' (15% realised potential) and on estimated progress since.
As a reality check, the results are compared to 'Energy efficiency in Belgium, McKinsey, 2009', which calculates a potential of 3.06 TWh in Belgium industry, only via variable speed motors systems.

INDUSTRY: EFFICIENT MOTOR SYSTEMS



INDUSTRY: EFFICIENT MOTOR SYSTEMS



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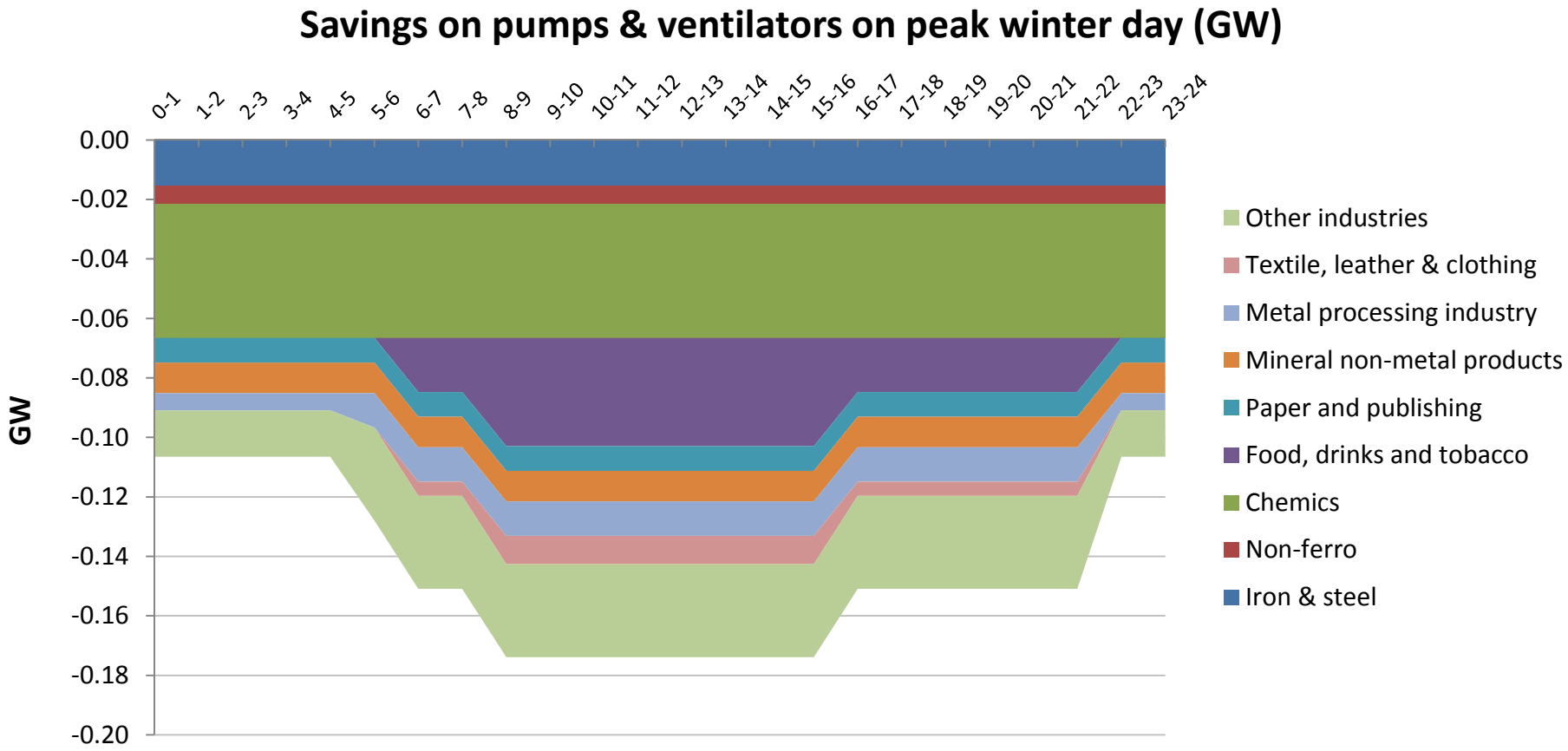


- Total energy savings: **1.08 TWh** (2.8% of industrial consumption)
- Peak reduction: **151 MW** (1.1% of winter peak)
- Annual electricity cost savings: **108 M€**

SUMMARY & CONCLUSIONS

SUMMARY: ENERGY SAVINGS

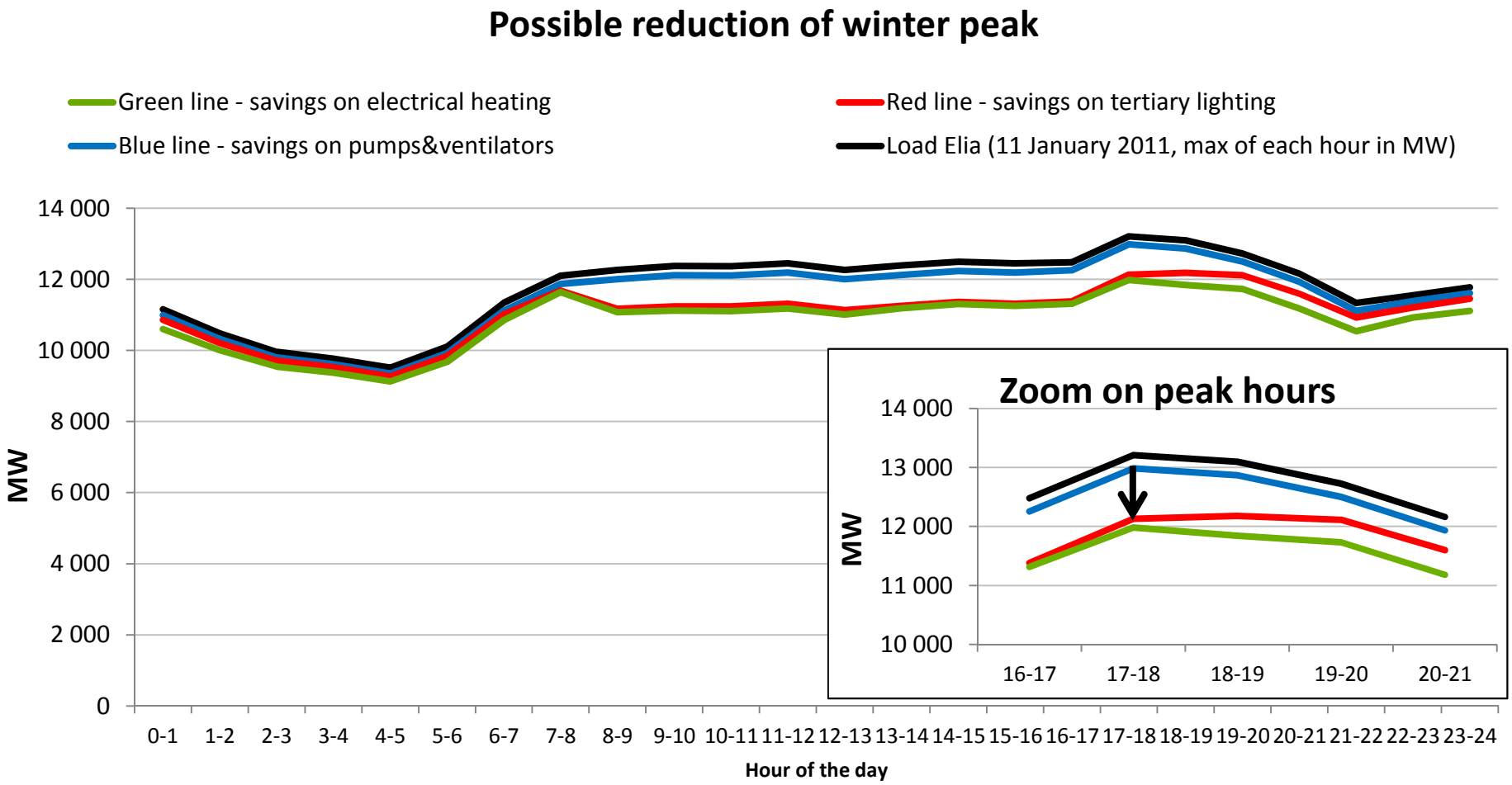
• Residential electric heating:	0.63 TWh
• Tertiary lighting:	2.41 TWh
• Industrial motors:	1.08 TWh
	4.13 TWh

Total savings: 4.13 TWh

~5.0 % of Belgian electricity consumption

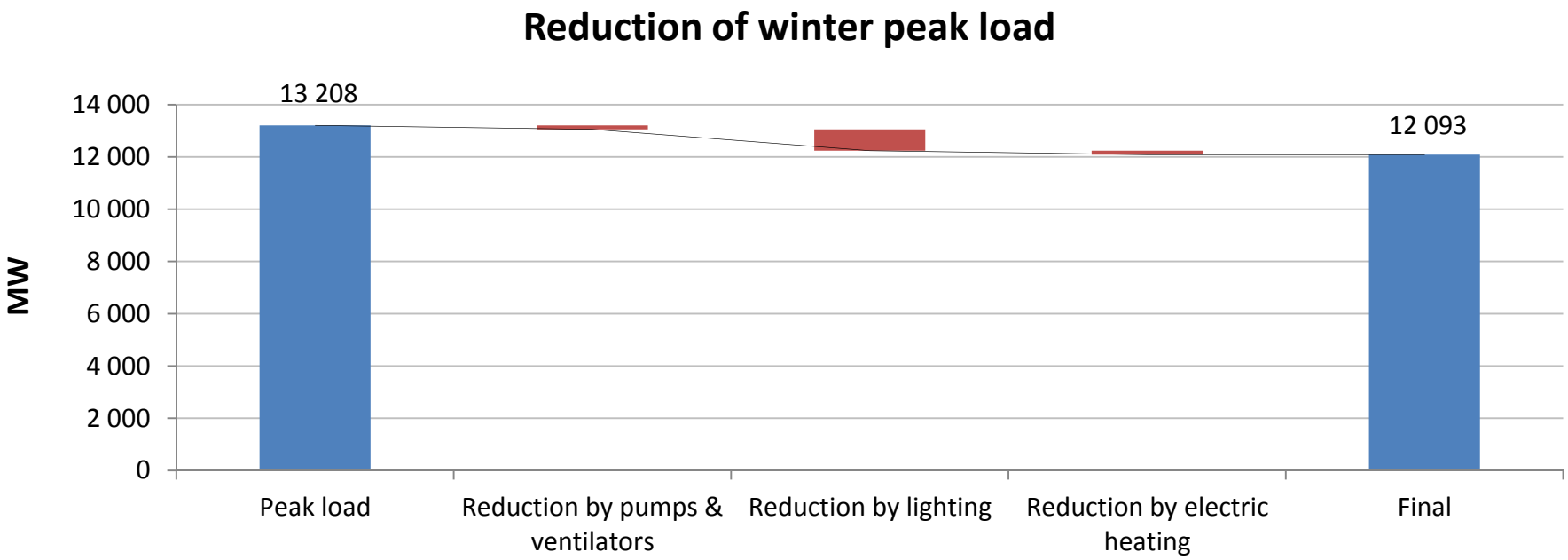
~576 M€ electricity cost savings each year

SUMMARY: REDUCTION OF THE WINTER PEAK



- The three measures can significantly reduce the winter peak load.

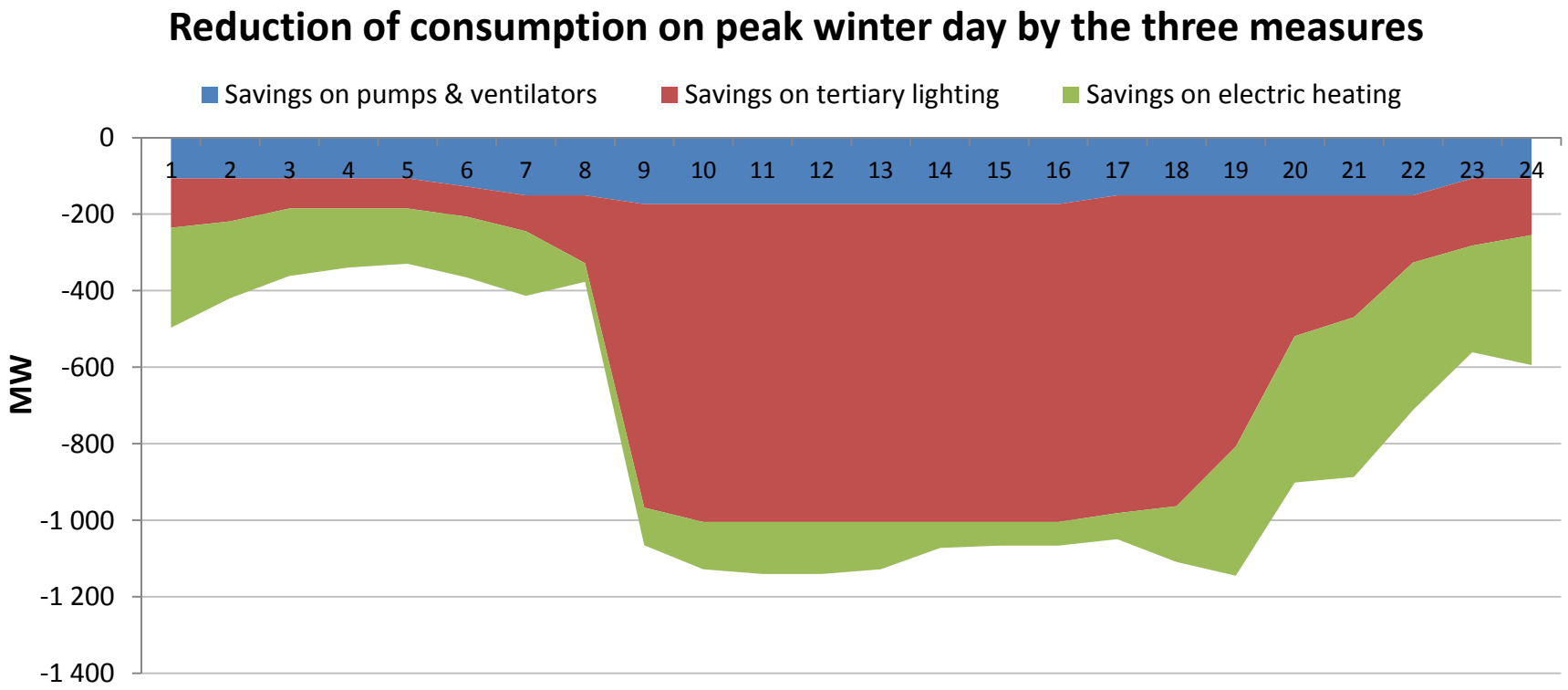
SUMMARY: REDUCTION OF THE WINTER PEAK



Reduction of winter peak with 1116 MW (8.5%) possible (with 3 measures).

→ Energy efficiency offers important opportunities for controlling the peak consumption!

SUMMARY: POWER SAVINGS ON WINTER DAY



SUMMARY OF SAVINGS

Share of each measure

Energy savings (4.1 TWh = 5.0% of total BE consumption)

Peak reduction (1116 MW = 8.5% of peak)

Electricity cost savings (total 576 M€/year)

SUMMARY OF SAVINGS
Costs and profits

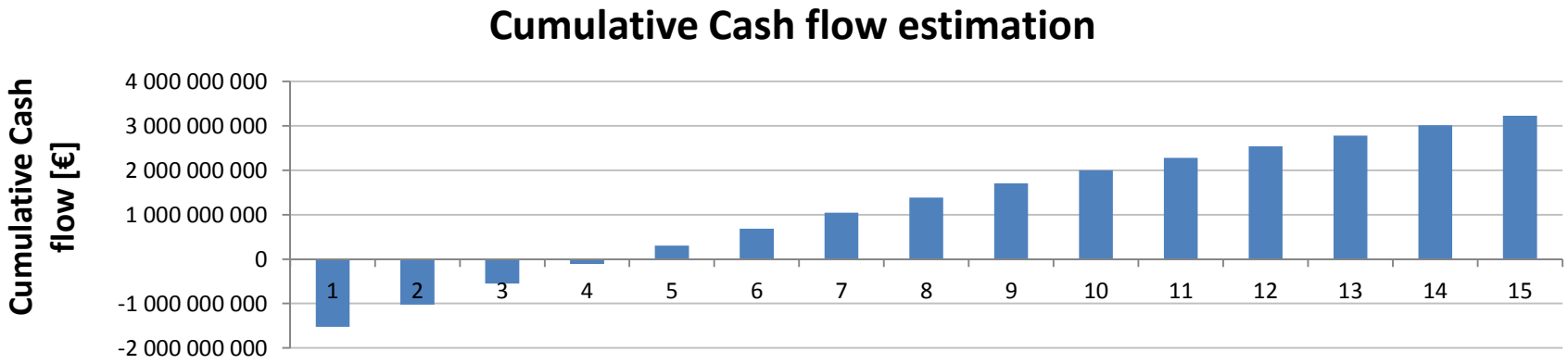
Assumptions average payback:

- Replacing electric heating: 5y
- Reducing tertiary lighting consumption: 4y
- Optimisation of pumps & ventilators: 2.5y

Financial assumptions:

- 4% discount factor for residential sector
- 10% discount factor for tertiary and industry
- 2% annual rise of electricity price
- 15 years depreciation period

➔ Cash flow calculation:
- ➔ 2.07 bn EUR investment costs
- ➔ 3.24 bn EUR total profits
- ➔ Each invested EUR brings 1.56 EUR benefits !



POLICY RECOMMENDATIONS (1)

Energy efficiency urgently needs more policy attention!

- Important economic savings possible with low payback times
- Supports the Belgian power system and reduces peak load
- Reduces dependency on fuel imports and increases competitiveness of our industry
- Helps reaching the 2020 targets of EE, RE and CO2

Concrete actions:

- Develop large-scale program to replace electric heating with attention for the social aspect
- Stimulate audits and relighting in the tertiary sector
- Further an ambitious energy savings policy for the industry (focusing on innovation while keeping the long term transition towards a carbon-free economy in mind)

POLICY RECOMMENDATIONS (2)

- The three measures studied are only examples. Energy efficiency has a lot more potential, e.g.:
  - Energy performant appliances (+ phase-out of old appliances)
  - Efficient lighting in residential and industry sectors
  - Reduce standby consumption
  - Efficient motors in tertiary and residential applications (e.g. circulation pumps heating)
  - Etc.
- Find solutions for financing
  - Large potential is not developed, amongst others because of financing problems (e.g. economic crisis, owner vs tenant, low payback times demanded in industry etc.)
  - Well developed ESCO systems, financing schemes, etc. can help
- Support and incentivise flexibility:
  - Flexibility is key in a future power system with high penetration of renewables
  - Electricity contracts can be based more on hourly pricing – gives incentive to the industry
  - Provide information for voluntary reductions or shifts (e.g. during peak hours, boil water on cooking fire instead of with water boiler, use gas oven instead of microwave, etc.)
  - Incentivise economically viable storage options (e.g. heat storage with CHP or heat pump…)

EXAMPLE: VOLUNTARY REDUCTION AT PEAK MOMENTS?

Not an illusion: example of Earth Hour

- Earth Hour: world-wide action by WWF to switch off lighting at 8:30 PM (every March)

- Impact in Belgium (press releases Elia):
  - **2010:**
    - From 18h30 onwards, the consumption was ~200 MW less than the forecast for a normal Saturday, at some moments the difference was up to 300 MW → participants have ancipated.
    - At 20h30, the official start, the consumption was **175 MW** lower than the forecast.
  - **2011**:
    - The whole day the consumption was 350 to 400 MW lower than forecasted for a normal Saturday, because of the sunny weather.
    - From 19h onwards, the effect was enforced by an extra 200-250 MW → participants have anticipated.
    - At 20h30, the official start, the consumption was **~550 MW** lower than the forecast (& impact of PV is much less at this hour)

➔ Voluntary energy reductions can help to reduce the peak consumption and should not be underestimated

➔ IPSOS enquete proved that 57% of people with electric heating is willing to shift or reduce the consumption

CONCLUSIONS

Savings of three measures have been investigated:

- Residential sector: Replacing electric heating (direct & accumulation)
- Tertiary sector: More efficient lighting
- Industry sector: More efficient motors systems in pumps & ventilators

→ Total estimated savings:

- Energy: ~4.13 TWh (5.0% of BE consumption)
- Peak reduction: ~1116 MW (8.5% of winter load peak)
- Annual costs: ~576 M€

➔ Investment of 2.06 bn EUR with payback of ~4 years
Total profit over 15 years = 3.24 bn EUR

➔ Taking energy efficiency measures can significantly support the Belgian energy system in a cost-effective way!