Ecodesign Preparatory Studies

ENER Lot 22: Domestic and commercial ovens *(electric, gas, microwave), including when incorporated in cookers*

ENER Lot 23: Domestic and commercial hobs and grills, *including when incorporated in cookers.*

Final Stakeholder Meeting on domestic appliances
Brussels – March 24th 2011

A study being conducted for DG ENER by BIO Intelligence Service and ERA Technology Ltd

Bio Intelligence Service - Scaling sustainable development
Industrial Ecology - Nutritional Health

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Agenda of the meeting

10:00 – 10:30	**Welcome, "Tour de table", schedule update, Introduction to the Ecodesign Directive,**
10:30 – 11:10	**Lot 22 – Tasks 1 to 4: Main outcomes on domestic ovens**
11:10 – 11:30	**COFFEE BREAK**
11:30 – 12:15	**Lot 22 – Tasks 5 & 6: Base-case assessment and BAT/BNAT analysis**
12:15 – 13:00	**Lot 22 – Task 7: Improvement Potential, Open Discussion**
13:00 – 14:00	**LUNCH BREAK**
14:00 – 14:40	**Lot 23 – Tasks 1 to 4: Main outcomes on domestic hobs and grills**
14:40 – 15:25	**Lot 23 – Tasks 5 & 6: Base-case assessment and BAT/BNAT analysis**
15:25 – 15:45	**COFFEE BREAK**
15:45 – 16:30	**Lot 23 – Task 7: Improvement Potential, Open Discussion**
16:30 – 17:00	**Lot 22 & 23 : Final steps and conclusions**

ENER Lots 22/23 team

BIO Intelligence Service:

- Shailendra Mudgal
- Benoît Tinetti
- Eric Hoa
- Guillaume Audard

ERA Technology:

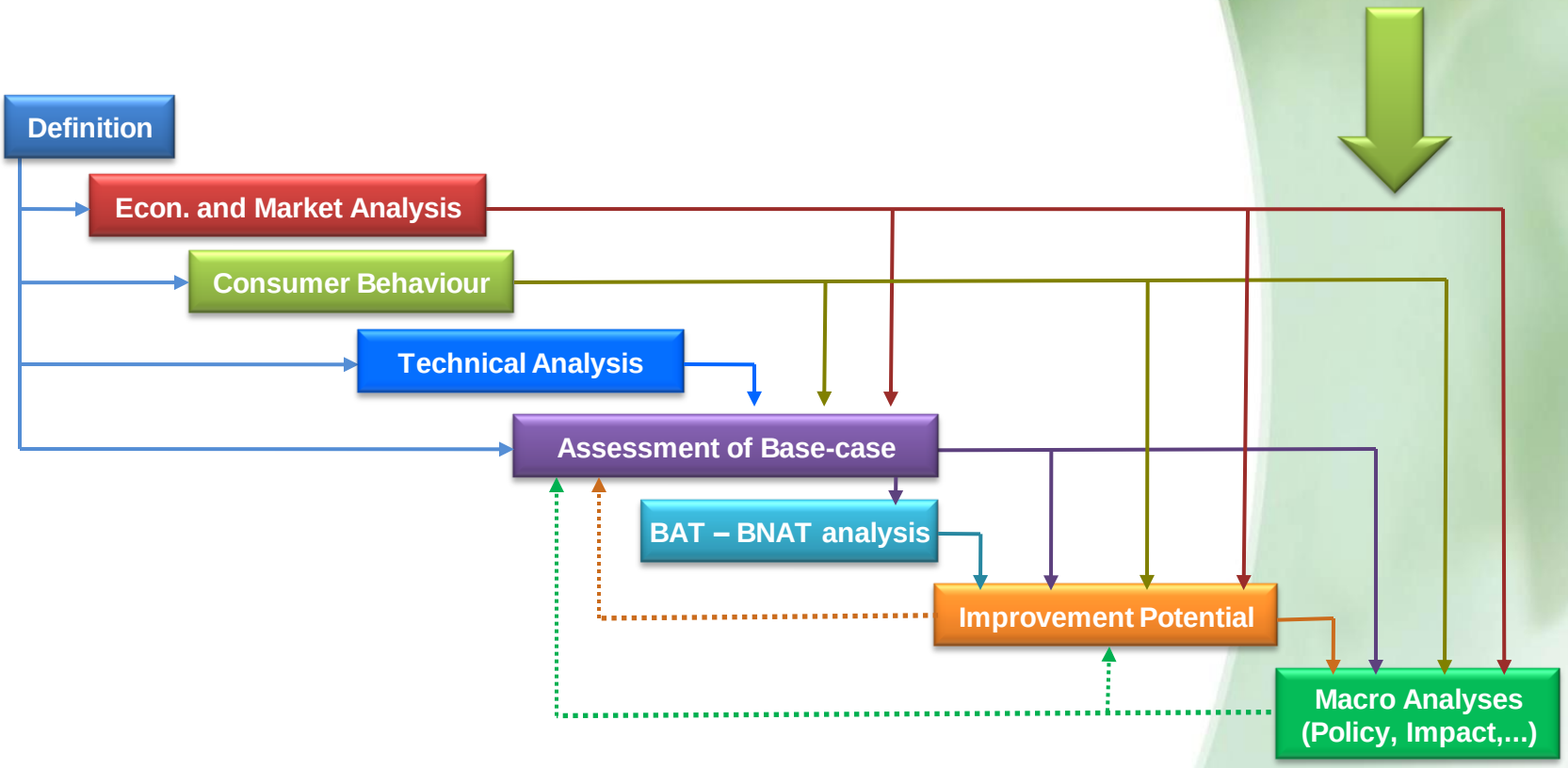
- Chris Robertson
- Paul Goodman

European Commission project officer:

- Villö Lelkes

Timeline for Lot 23

Final Stakeholder Meeting



Task 1 | Task 2 | Task 3 | Task 4 | Task 5 | Task 6 | Task 7 | Task 8

ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

Task 1 – Product Definition

1.1. Product Definition

In this study, the following definitions are used :

- **hob :** appliance or part of an appliance which incorporates one or several distinguishable cooking zones, where pans can be placed on for heating.

- **grill :** appliance or part of an appliance in which food is cooked by radiant or contact heat.

- **Main criteria to be considered within the scope of the study:**
  - ✓Energy Source
  - ✓Heating Mechanisms and Technologies
  - ✓Appliance Configuration

1.1. Product Definition

- Prodcom: Electric domestic appliances
  - ✓ 27.51 - Manufacture of electric domestic appliances
    - ✓ **27.51.28** Other ovens; cookers, cooking plates, boiling rings; grillers, roasters
      - ✓ **27.51.28.10** Domestic electric cookers with at least an oven and a hob (including combined gas-electric appliances)
      - ✓ **27.51.28.33** Domestic electric hobs for building-in
      - ✓ **27.51.28.35** Domestic electric cooking plates, boiling rings and hobs (excluding hobs for free building-in)
- Prodcom: Non-electric domestic appliances
  - ✓ **27.52** - Manufacture of non-electric domestic appliances
    - ✓ **27.52.11** Domestic cooking appliances and plate warmers, of iron or steel or of copper, non electric
      - ✓ **27.52.11.13** Iron or steel gas domestic cooking appliances and plate warmers, with an oven (including those with subsidiary boilers for central heating, separate ovens for both gas and other fuels)
      - ✓ **27.52.11.15** Iron or steel gas domestic cooking appliances and plate warmers (including those with subsidiary boilers for central heating, for both gas and other fuels; excluding those with ovens)
      - ✓ **27.52.11.90** Other domestic cooking appliances and plate warmers, of iron or steel or of copper, non electric

1.1. Product Definition

Built-in Hobs:

Gas

Mixed
Gas/Electric

Electric -
solid plate

Electric - radiant

Electric -
induction

1.1. Product Definition

Free-standing Hobs:

Gas

Electric - solid plate

Electric - radiant

Electric - induction

1.1. Product Definition

Free-standing Grills:

Gas grill

Electric grill

(Charcoal kettle grill)

1.2. Test Standards

- For cooking appliances (not specific for hobs/grills)

Performance Standard	Scope	Grill/hob
EN 30-2-1:1998 / A2:2005	Rational use of energy	Gas (domestic)
EN 30-2-2:1999	Rational use of energy	Gas (domestic forced-convection grill)
EN 50304/60350:2009	Methods for measuring performance	Electric (domestic)
EN 61817:2001	Methods for measuring performance	Electric (domestic portable)

- CENELEC, through its working group TC 59X WG 10 is preparing a method to measure energy efficiency of hobs.

1.3. Existing Legislation

- At EU level:

Scope	Legislation
Environmental Legislation	
Entire Product	Waste Electrical and Electronic Equipment Directive 2002/96/EC
	Restriction of the use of certain Hazardous Substances in electric and electronic equipment Directive 2002/95/EC
	The REACH regulation, 1907/2006 (superseding the Marketing and Use Directive regarding substance restrictions)
Energy Legislation	
Standby and off mode power consumption	Commission Regulation No 1275/2008 of 17 December 2008
Legislations related to Safety	
Entire product	General Product Safety Directive 2001/95/EC
	Low Voltage Directive 2006/95/EC
	Materials and articles intended to come into contact with foodstuffs – Regulation 2004/1935/EC
	Appliances burning gaseous fuels Directive 90/396/EEC

ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

Task 1 – Conclusions

- The panel of products was identified and defined
- Existence of EN test standards for domestic hobs and grills

ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

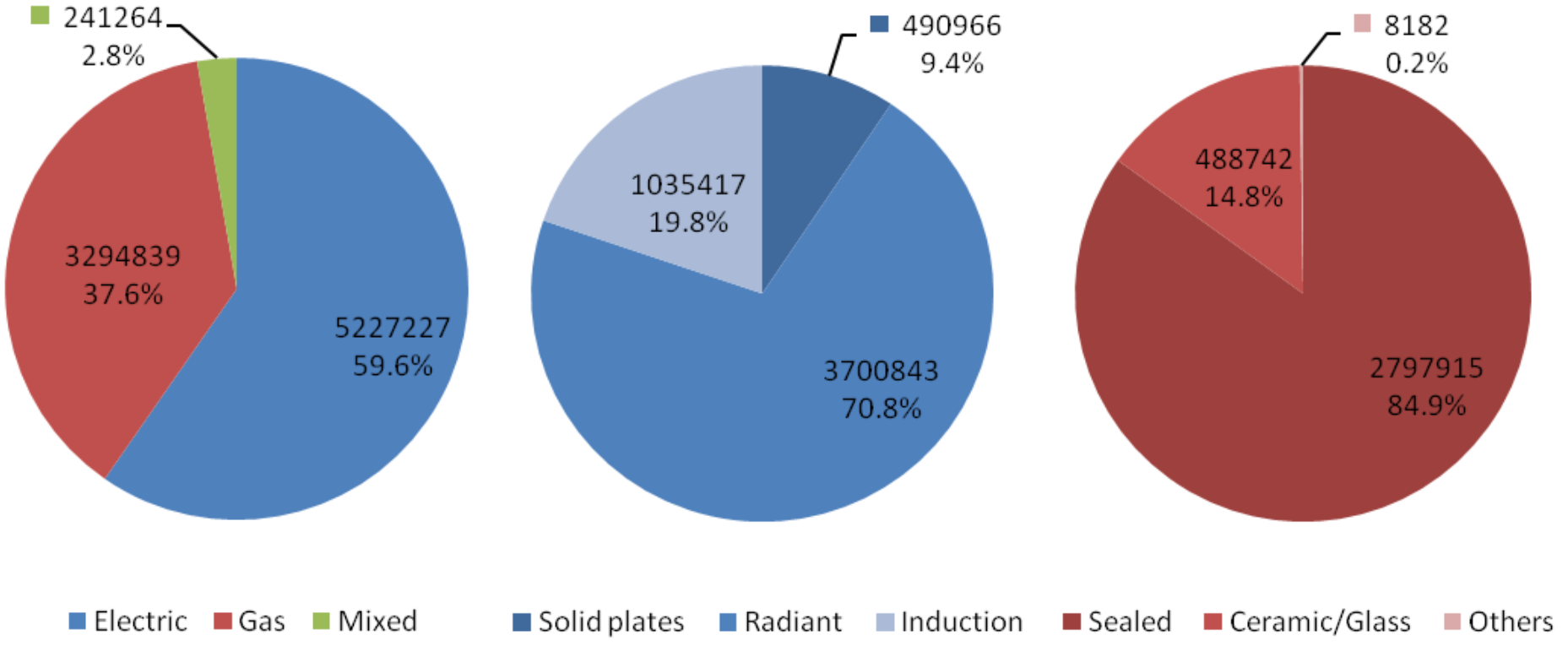
Task 2 – Economic and Market Analysis

Sales Data

- 2007 Sales data provided by GfK
- Adjusted Forecasts
  - ✓ Growth rates differentiated for the periods 2007-2010, 2010-2015, 2015-2020 and 2020-2025
  - ✓ Compliance with the expected increase of the number of households in EU

Sales Data

- Estimated sales of domestic built-in hobs in EU-27 in 2007 (in units)



Sales Data

- Domestic hobs' sales in the EU-27 in 2007 and forecasts

	Electric Hobs							Gas hobs						
	Solid plates		radiant		induction		Total	Sealed		Ceramic		others		Total
	Sales	growth	Sales	growth	Sales	growth	Sales	Sales	growth	Sales	growth	Sales	growth	Sales
2007	490 966		3 700 843		1 035 417		**5 227 227**	2 797 915		488 742		8 182		**3 294 839**
2010	420 942	-5,0%	3 812 983	1,0%	1 304 328	8,0%	**5 538 252**	2 714 814	-1,0%	474 226	-1,0%	8 182	0,0%	**3 197 222**
2015	325 717	-5,0%	3 967 962	0,8%	1 829 387	7,0%	**6 123 066**	2 581 761	-1,0%	450 984	-1,0%	8 182	0,0%	**3 040 927**
2020	265 581	-4,0%	4 068 158	0,5%	2 334 813	5,0%	**6 668 551**	2 333 707	-2,0%	407 654	-2,0%	8 182	0,0%	**2 749 543**
2025	216 547	-4,0%	4 068 158	0,0%	2 773 025	3,5%	**7 057 730**	2 109 487	-2,0%	368 487	-2,0%	8 182	0,0%	**2 486 155**

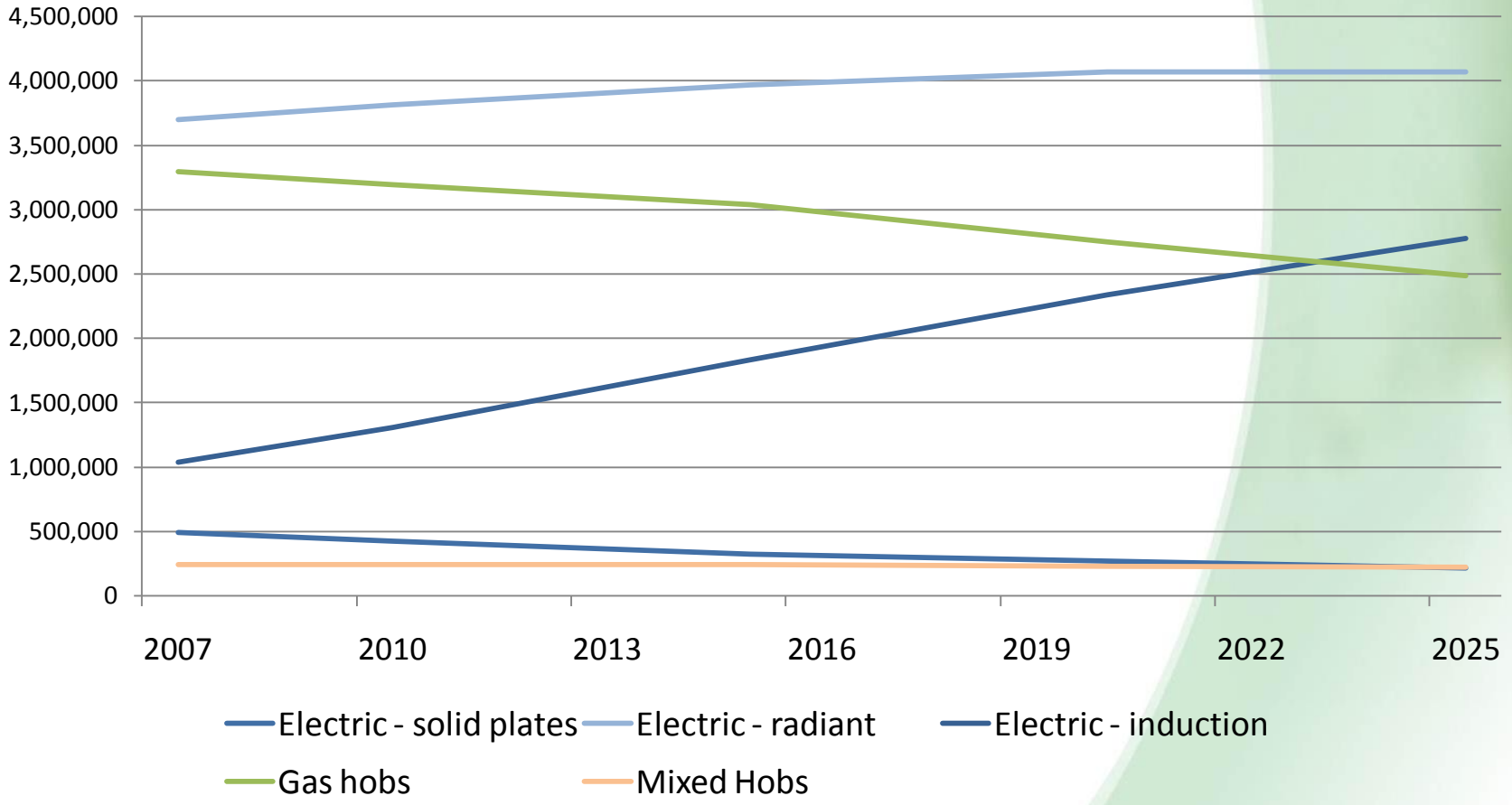
Sales Data

- Domestic hobs' sales in the EU-27 in 2007 and forecasts

	Mixed hobs								Cooker tops					
	Sealed		Radiant		Induction		others		gas		electric		mix	
	Sales	growth	Sales	growth	Sales	growth	Sales	growth	Sales	growth	Sales	growth	Sales	growth
2007	160 160		43 160		31 229		6 715		2 186 851		3 671 104		1 476 157	
2010	160 160	0.0%	43 160	0.0%	31 229	0.0%	6 715	0.0%	2 109 065	-1.2%	3 726 446	0.5%	1 476 157	0.0%
2015	160 160	0.0%	43 160	0.0%	31 229	0.0%	6 715	0.0%	1 985 522	-1.2%	3 820 544	0.5%	1 476 157	0.0%
2020	152 311	-1.0%	41 045	-1.0%	31 229	0.0%	6 715	0.0%	1 869 216	-1.2%	3 917 017	0.5%	1 454 148	-0.3%
2025	144 846	-1.0%	39 033	-1.0%	31 229	0.0%	6 715	0.0%	1 759 723	-1.2%	3 976 126	0.3%	1 432 466	-0.3%

Sales Data

- Domestic hobs' sales in the EU-27 in 2007 and forecasts



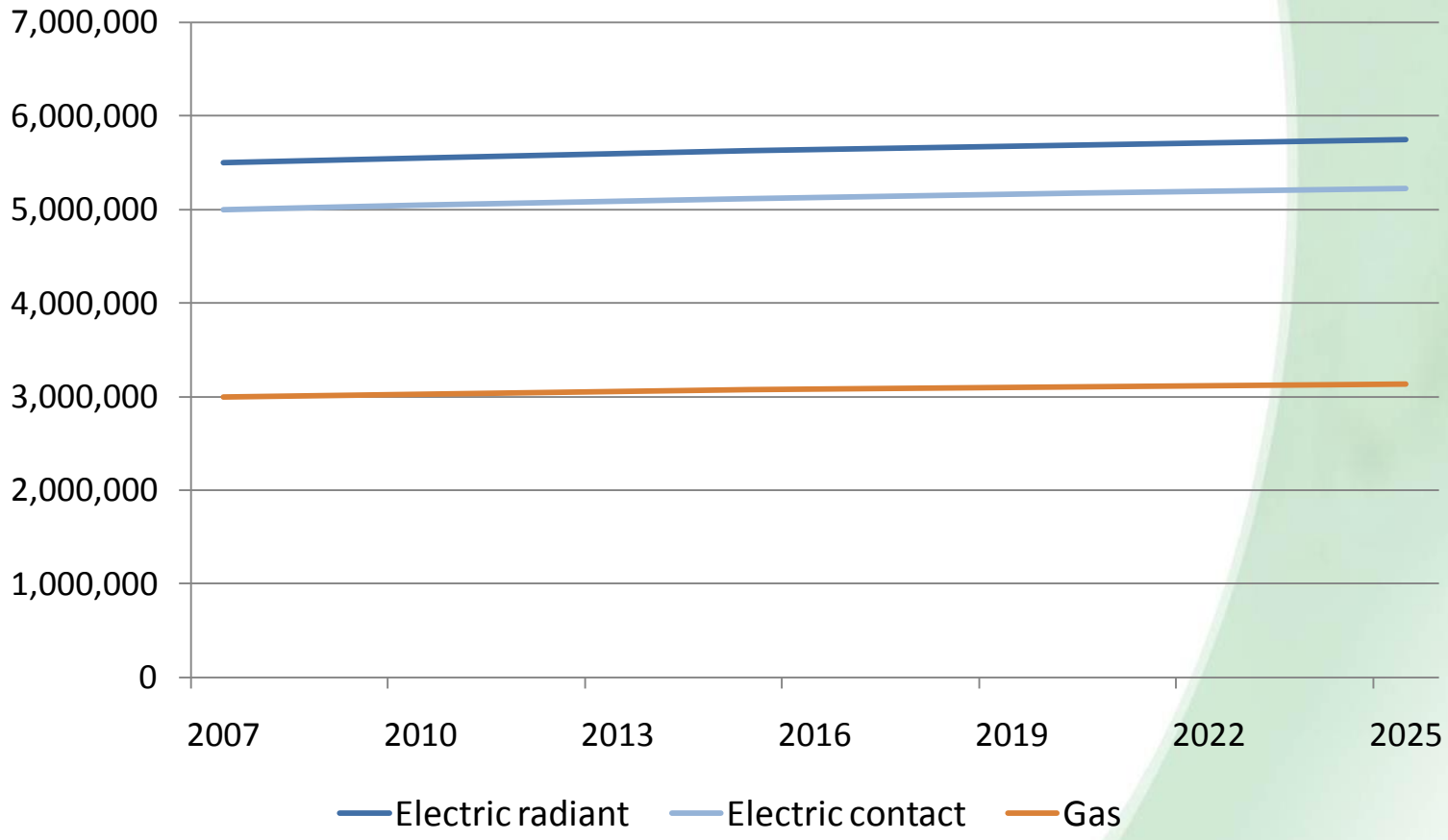
Sales Data

- Domestic grills' sales in the EU-27 in 2007 and forecasts

	Electric Grills				Gas Grills		
	radiant		contact		gas		TOTAL
	Sales	growth	Sales	growth	Sales	growth	Sales
2007	5 500 000		5 000 000		3 000 000		13 500 000
2010	5 549 649	0.3%	5 045 135	0.3%	3 027 081	0.3%	13 621 865
2015	5 633 394	0.3%	5 121 268	0.3%	3 072 761	0.3%	13 827 422
2020	5 689 954	0.2%	5 172 686	0.2%	3 103 611	0.2%	13 966 251
2025	5 747 082	0.2%	5 224 620	0.2%	3 134 772	0.2%	14 106 473

Sales Data

- Domestic grills' sales in the EU-27 in 2007 and forecasts



Stock Data

- 2007 Stock data based on
  - ✓ Rough approach: Sales x Lifetime
  - ✓ Adjustments with the expected increase of the number of households in EU and the recent trends
- Adjusted Forecasts
  - ✓ Growth rates differentiated for the periods 2007-2010, 2010-2015, 2015-2020 and 2020-2025
  - ✓ Consistent with Sales Forecasts

Stock Data

- Estimated stock for domestic hobs in EU-27

	Electric Hobs							Gas hobs						
	Electric - solid plates		Electric - radiant		Electric - induction		Total	Gas - sealed		Gas - ceramic		Gas - others		Total
	Stock	growth	Stock	growth	Stock	growth	Stock	Stock	growth	Stock	growth	Stock	growth	Stock
2007	**12 000 000**		**55 000 000**		**4 500 000**		**71 500 000**	**53 000 000**		**9 000 000**		**150 000**		**62 150 000**
2010	10 952 076	-3,0%	56 666 555	1,0%	6 322 176	12,0%	**73 940 807**	51 425 847	-1,0%	8 865 674	-0,5%	150 000	0,0%	**60 441 521**
2015	9 404 920	-3,0%	58 969 775	0,8%	11 141 834	12,0%	**79 516 530**	48 905 469	-1,0%	8 431 168	-1,0%	150 000	0,0%	**57 486 636**
2020	8 720 397	-1,5%	60 458 836	0,5%	17 944 036	10,0%	**87 123 269**	46 508 614	-1,0%	8 017 957	-1,0%	150 000	0,0%	**54 676 571**
2025	8 085 696	-1,5%	60 458 836	0,0%	26 365 675	8,0%	**94 910 207**	44 229 229	-1,0%	7 624 997	-1,0%	150 000	0,0%	**52 004 226**

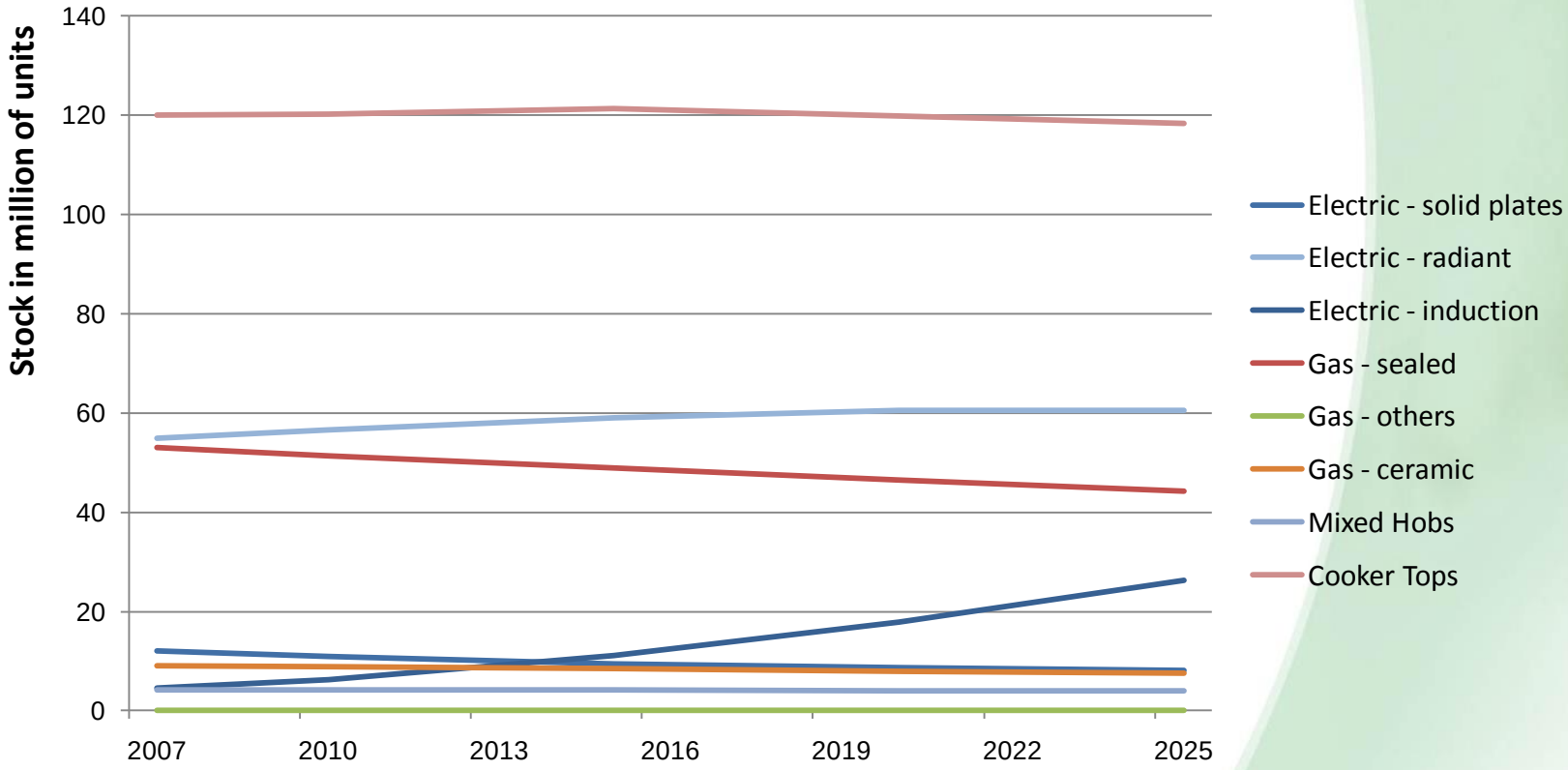
Stock Data

- Estimated stock for domestic hobs in EU-27

	Mixed hobs								Cooker Tops					
	Sealed		radiant		induction		others		gas		electric		mix	
	Stock	growth	Stock	growth	Stock	growth	Stock	growth	Stock	growth	Stock	growth	Stock	growth
2007	**3 000 000**		**820 000**		**300 000**		**80 000**		**50 000 000**		**50 000 000**		**20 000 000**	
2010	3 000 000	0.0%	820 000	0.0%	300 000	0.0%	80 000	0.0%	49 253 744	-0.5%	50 753 756	0.5%	20 301 503	0.5%
2015	3 000 000	0.0%	820 000	0.0%	300 000	0.0%	80 000	0.0%	48 034 652	-0.5%	52 035 352	0.5%	21 337 083	1.0%
2020	2 925 746	-0.5%	799 704	-0.5%	300 000	0.0%	80 000	0.0%	45 680 476	-1.0%	53 349 310	0.5%	20 808 964	-0.5%
2025	2 853 330	-0.5%	779 910	-0.5%	300 000	0.0%	80 000	0.0%	43 441 678	-1.0%	54 154 366	0.3%	20 808 964	0.0%

Stock Data

- Domestic hobs' stock in the EU-27 in 2007 and forecasts



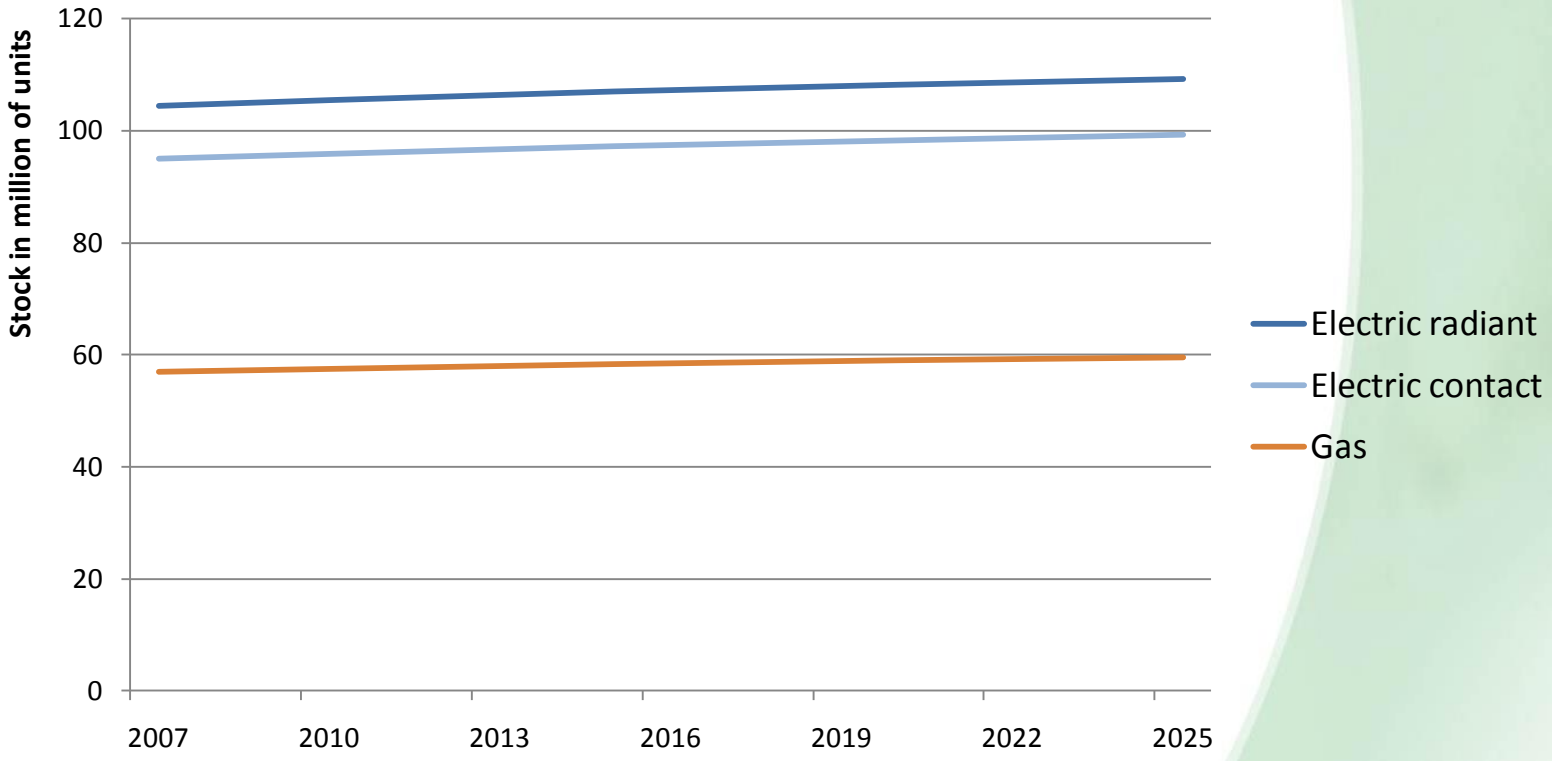
Stock Data

- Estimated stock for domestic grills in the EU-27

	Electric Grills				Gas Grills		
	radiant		contact		gas		TOTAL
	Stock unit	growth	Stock unit	growth	Stock unit	growth	Stock
2007	**104 500 000**		**95 000 000**		**57 000 000**		256 500 000
2010	105 443 324	0.3%	95 857 568	0.3%	57 514 541	0.3%	258 815 432
2015	107 034 493	0.3%	97 304 084	0.3%	58 382 451	0.3%	262 721 027
2020	108 109 127	0.2%	98 281 025	0.2%	58 968 615	0.2%	265 358 767
2025	109 194 552	0.2%	99 267 774	0.2%	59 560 665	0.2%	268 022 991

Stock Data

- Estimated stock for domestic grills in the EU-27



Average Price Range

Type of hob/grill	Domestic appliances		
	Low range (€)	High range (€)	Average price (€)
Solid plates	150	300	137
Radiant hob	150	650	380
Induction hob	300	1,200	810
Gas hob	130	1,000	268
Range cooker	160	1,500	-
Electric grill	80	1,500	-
Gas grill	100	1,500	-
Charcoal grill	50	1,500	-

Running Costs

	Rates
Electricity rate	16.58 € / 100 kWh
Natural gas rate	16.21 € / GJ
Discount rate	4 %

ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

Task 2 – Conclusions

- All categories are sold in a number of units above the indicative value of 200,000 units per year as set in the Ecodesign Directive
- Electricity is the preferred energy source at the EU level, although there are strong differences between Member States
- The sales of solid plate hobs are expected to decrease in the coming years, while induction hobs sales should rise
- Given the diversity in the domestic grills market, only estimations could be provided. Following the current trend, the stock of these appliances should grow until 2025

ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

Task 3 - Consumer Behaviour Analysis

Task 3 – Real life efficiency

Type of Appliance	Average cooking time	Uses/ year	Energy consumption per use (kWh)	Annual Consumption (kWh/year)	Economic lifetime
Gas hobs	30	438	0.75	330	19
Electric hobs - Solid plates	30	438	0.53	230	19
Electric hobs - Radiant	30	438	0.55	240	19
Electric hobs - Induction	30	438	0.43	190	19
Mix hobs	30	438	-	-	19
Gas grills (radiant)	20	52	0.96	50	19
Electric radiant grills	20	52	0.96	50	19
Electric contact grills	20	52	0.96	50	19

(compiled from MTP survey and EU manufacturers' data - approved by CECED)

Task 3 – Possible barriers

- Barriers to increased ownership of more efficient cooking appliances :
  - ✓ Higher costs of better technology
  - ✓ Inertia
  - ✓ Lack of knowledge

- Specificities of the domestic sector:
  - ✓ Small potential in energy efficiency gains
  - ✓ Lack of a comparative energy or performance test data
  - ✓ Low energy cost of the appliance

ENER Lot 23: Domestic hobs and grills,
including when incorporated in cookers.

Task 3 – Conclusions

- Consumer behaviour (cooking times, temperatures and frequencies) can have a major impact on consumption

Dr Paul Goodman,
Reliability and Failure Analysis Group

March 2011

ERA TECHNOLOGY ANTENNA AND ELECTRONIC SYSTEMS

ERA TECHNOLOGY ENGINEERING CONSULTANCY SERVICES

VECTOR FIELDS SOFTWARE

LIGHTNING TESTING AND CONSULTANCY

DG ENER Lot 23 Ecodesign preparatory study
Task 4 - Domestic Hobs and Grills
Technical Analysis of existing products

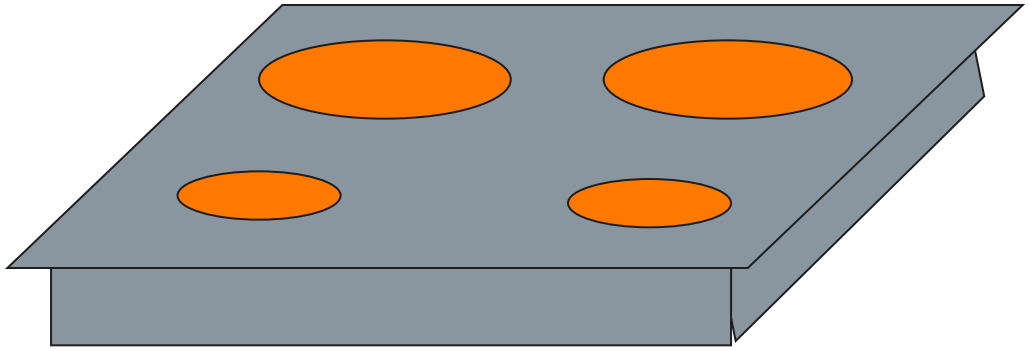
conducted on behalf of the European Commission, DG ENER, by ERA Technology and Bio Intelligence Service

Task 4 – Product functions and types

- Hobs
  - Gas burners
  - Electric hotplates
    - Solid plate (resistance heating)
    - Radiant
    - Induction
  - Built-in or part of range cookers
  - Portable appliances
- Grills – many designs
  - Contact – e.g. griddles, Panini grills, etc
  - Radiant – standalone or part of range cookers, toasters

Typical domestic hob

- Most domestic hobs have 3 – 5 electric hotplates or gas burners
- Several different sizes to accommodate large, medium and small pots
- Wok gas burners – high power multi-ring
- Difficult to simmer with largest size gas burners due to limited output range, electric hotplates have larger output range



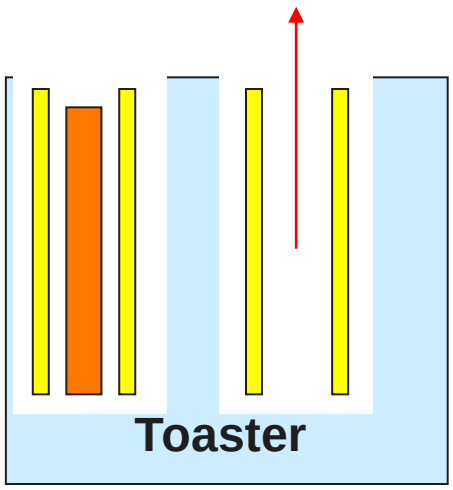
Grill types

Reflective surface – clean!

Grill elements

Food

Radiant grill (heat directed down)



Outdoor (barbecue) grill heat upwards

Food

Gas burners

Single-sides contact grill (panini = both sides)

Food

Contact grill

Main materials and components
- include

- Coated steel parts widely used (porcelain, polymer and paint coatings)
- Thermal insulation (for safety / energy efficiency)
- Heat output regulation (not temperature control)
- Gas igniters – mostly HV spark
- Gas safety sensors
- Power supply for induction hobs
- Glass ceramic for hobs (crystallised glass)
- Nichrome wire radiant grill elements
- Etc.

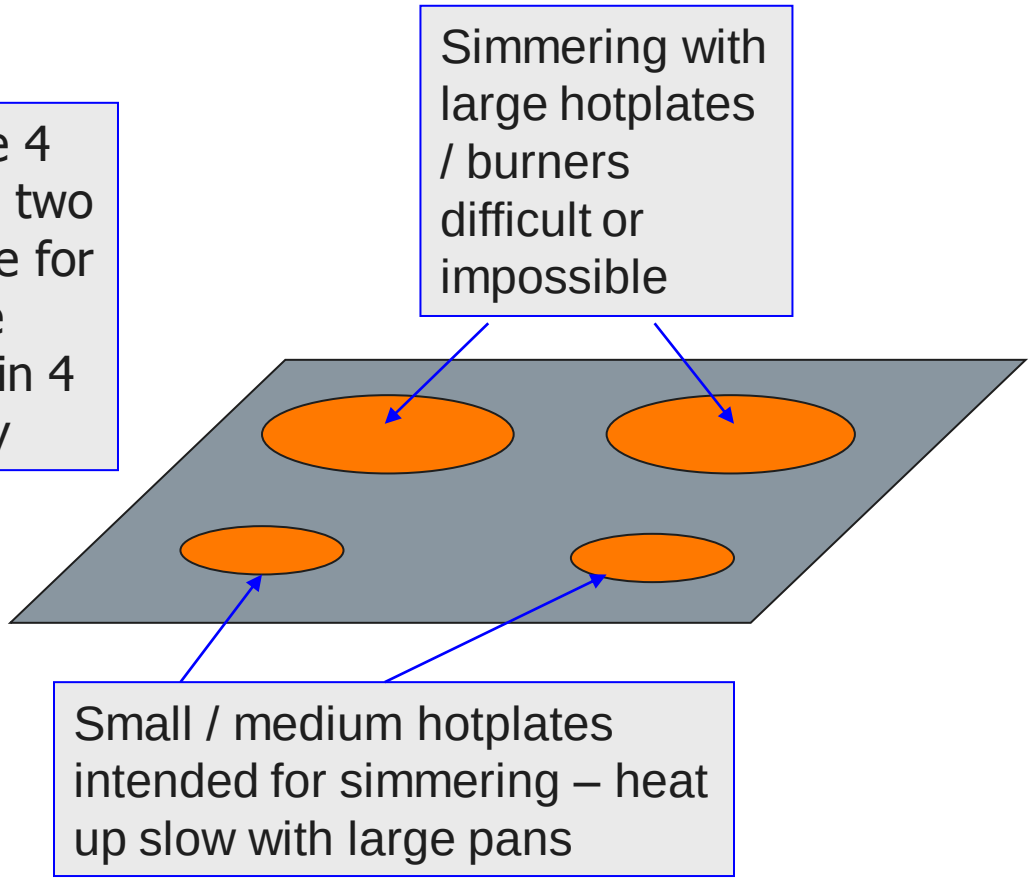
Assessment of performance - hobs

- Difficult to compare gas with electric
  - Heat up and simmering behaviour different for each type of hob
  - Electricity is not primary energy: Generation is ~30% efficient
  - Results depend on test method so cannot compare published non-standard test results
  - Simmer control can be poor for gas (limited power output range) and solid plate electric (slow response time)
- Energy efficiency depends on efficiency of heat transfer and heat losses
  - Heat lost from pan (also around pan, especially if pan too small)
  - Simmer control depends on burner / hotplate design & size

Hobs – heat up & simmer

- Simmering = defined as holding at 90°C
- Ability to simmer is variable (good with induction & radiant, less flexible with gas)

Hobs commonly have 4 hotplate / burners with two small / medium suitable for simmering. May be impossible to simmer in 4 pots simultaneously



Hob energy efficiency - results
- From 3 pubications

Type of heat source	Cooking rice (heat up & simmer)	VHK study (boiling water) – primary energy	FRPERC study (heat up only)
Induction	84%	15%	77%
Solid plate	65.7%	-	65%
Radiant	-	13%	57%(?)
Gas	60% (LPG – primary)	23%	31% (primary - low!)

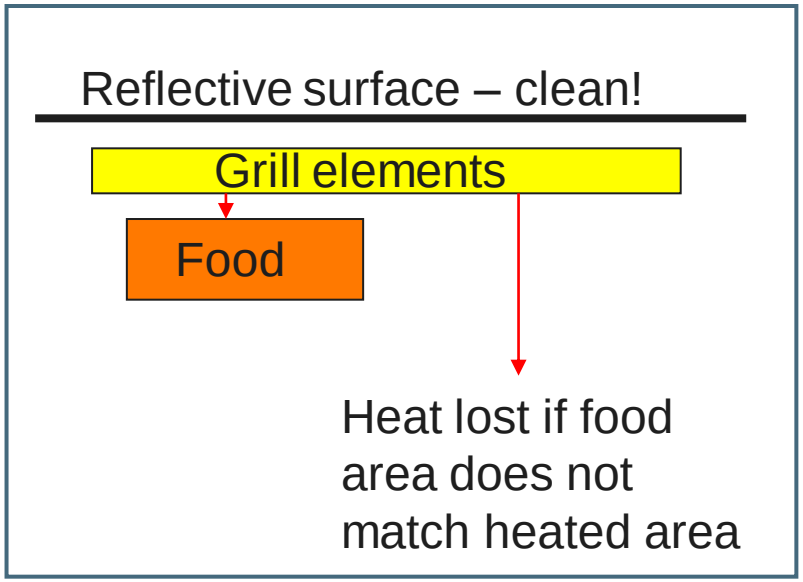
Preliminary measurements using new standard method

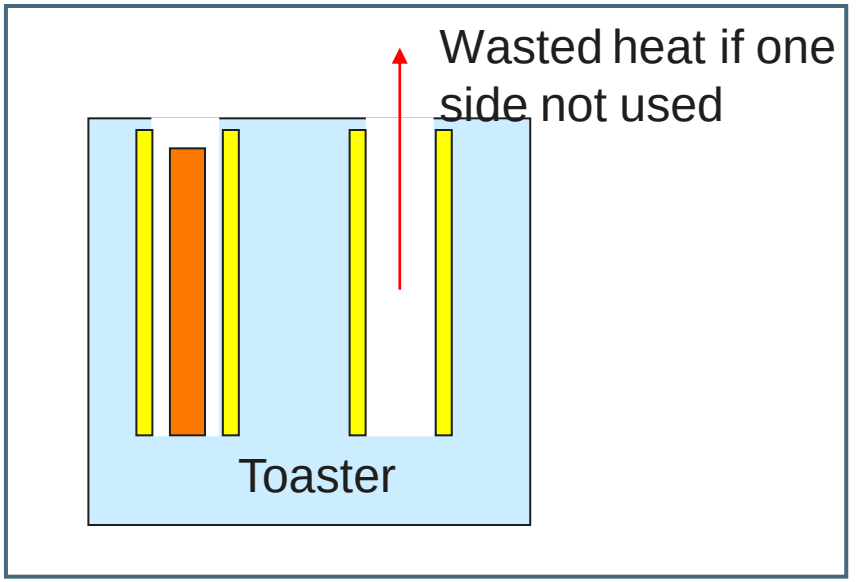
- Method not yet approved
  - Designed for hobs and measure energy per litre water
  - Includes heat up and simmer
  - Intended to be representative of real cooking
- Results for 16 electric hobs only range = +/- 7.5% of average
  - Solid plate – highest consumption during heat up but high thermal mass retains heat so consumes less during simmering.
  - Radiant – less heat in heat up than solid plate and glass ceramic retains some heat used for simmering
  - Induction – Overall most efficient, consumes least during heat up but more for simmering as no retained heat available

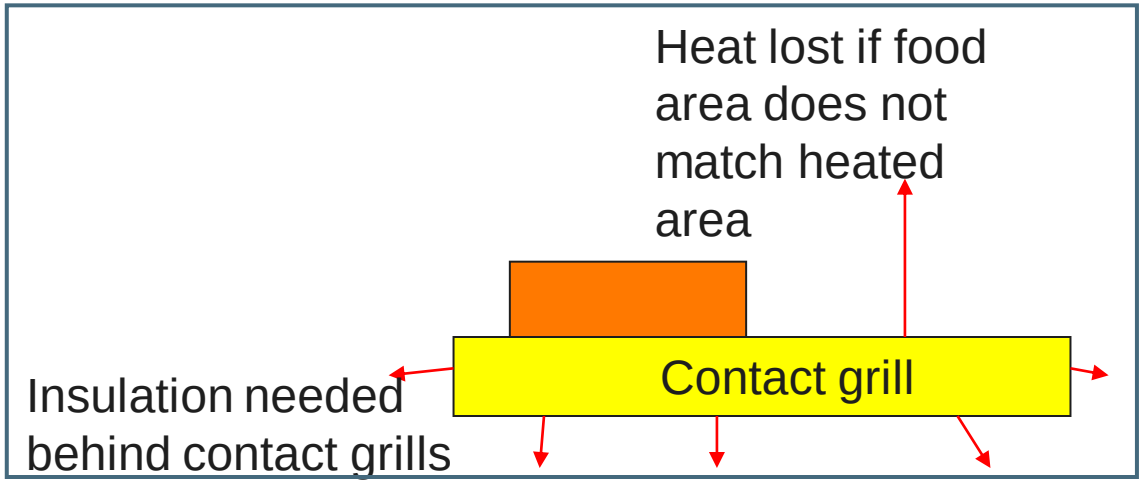
Grills energy consumption

- Contact grills - energy losses:
  - From heated areas that are not used
  - Locations away from food contact surfaces through insulation
  - Poor temperature control – causing overcooking food
- Radiant grills – energy losses:
  - Thermal insulation needed to prevent external surfaces being too hot – will have smaller effect on energy consumption
    - Need clean reflective surfaces behind elements
  - Losses from unused grill areas
- Some grills have limited temperature control (on/off only)

Grill energy losses







Grill energy consumption

- Very little published data
  - US Energy Star for commercial only
  - Japan Top Runner domestic grills shows significant variation in energy consumption
    - Single sided gas grills range energy consumption = 230 – 480Wh
      - Worst used more than double the best grill
  - No EU grill test data
  - Outdoor barbecue grill data from US manufacturer shows very large variation in energy efficiency (in-house test)
    - Range from 15 to 40%

Conclusions

- Four types of hob heat source
  - Published test data vindicate that induction is most efficient of electric types
  - Gas consumes least primary energy (in EU)
  - Energy consumption depends on test method – cannot copmpare different publications
- EN approved test methods being developed
  - Preliminary results for 16 hobs shows relatively small improvement potential
- Japanese and US results for grills indicate improvement potential is significant

Thank you

Questions

Agenda of the meeting

10:00 – 10:30	**Welcome, "Tour de table", schedule update, Introduction to the Ecodesign Directive,**
10:30 – 11:10	**Lot 22 – Tasks 1 to 4: Main outcomes on domestic ovens**
11:10 – 11:30	**COFFEE BREAK**
11:30 – 12:15	**Lot 22 – Tasks 5 & 6: Base-case assessment and BAT/BNAT analysis**
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ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

Task 5 – Assessment of Base-cases

Objectives

- Assessment of average EU products, the so called “base-cases”
  - ✓ A base-case is “a conscious abstraction of reality”
- The description of the Base-Cases is the synthesis of the results of Tasks 1 to 4
- Most of the environmental and life cycle cost analysis are built on these Base-Cases throughout the rest of the study and it serves as the point-of-reference for Task 6 (technical analysis of BAT), Task 7 (improvement potential), and Task 8 (policy analysis)

Domestic Base-cases for the Lot 23 study:

- Hobs

Base-Case	Configuration	Number of cooking zones	Technology Type	Total maximum power (kW)	Lifetime (years)
BC1 - Domestic electric hob	Built-in independent	4	Radiant (Vitroceramic surface)	7.4	19
BC2 - Domestic gas hob	Built-in independent	4	Stainless Steel on open-burners	9	19

- Grills: no average Base-Case was highlighted due to :
  - ✓ Low frequency of use
  - ✓ Too diverse panel of products

Task 5 – Inputs (1/5)

Production Phase

Base-Case	Weight	1 Bulk Plastics	2 Tech. Plastics	3 Ferro	4 Non-ferro	5 Coating	6 Electronics	7 Misc.	Total
Base-Case 1: Domestic electric hob	in g	121	106	5,147	616	0	489	3,230	9,709
	in %	1%	1%	53%	7%	0%	5%	33%	100%
Base-Case 2: Domestic gas hob	in g	107	150.5	5,467	2,030.5	0	0	39	7,794
	in %	1.5%	2%	70%	26%	0%	0%	0.5%	100%

Task 5 – Inputs (2/5)

Distribution Phase

Base-Case	Volume of packaged product (in m^3)
BC1: Domestic electric hob	0.061
BC2: Domestic gas hob	0.057

Task 5 – Inputs (3/5)

Use Phase

Base-Cases	Consumption per cycle (kWh)	Number of cycle per year	Annual consumption (kWh)
BC1: Domestic electric hob	0.55	438	240
BC2: Domestic gas hob	0.75 (2.7 MJ)	438	330 (~1.2 GJ)

Task 5 – Inputs (4/5)

End-of-Life Phase

Base-Case	Percentage of the total weight going to landfill	Plastics		
		Re-use, close-loop recycling	Material recycling	Thermal recycling
BC1: Domestic electric hob	54%	30%	53%	17%
BC2: Domestic gas hob	2%	15%	83%	2%

Task 5 – Inputs (5/5)

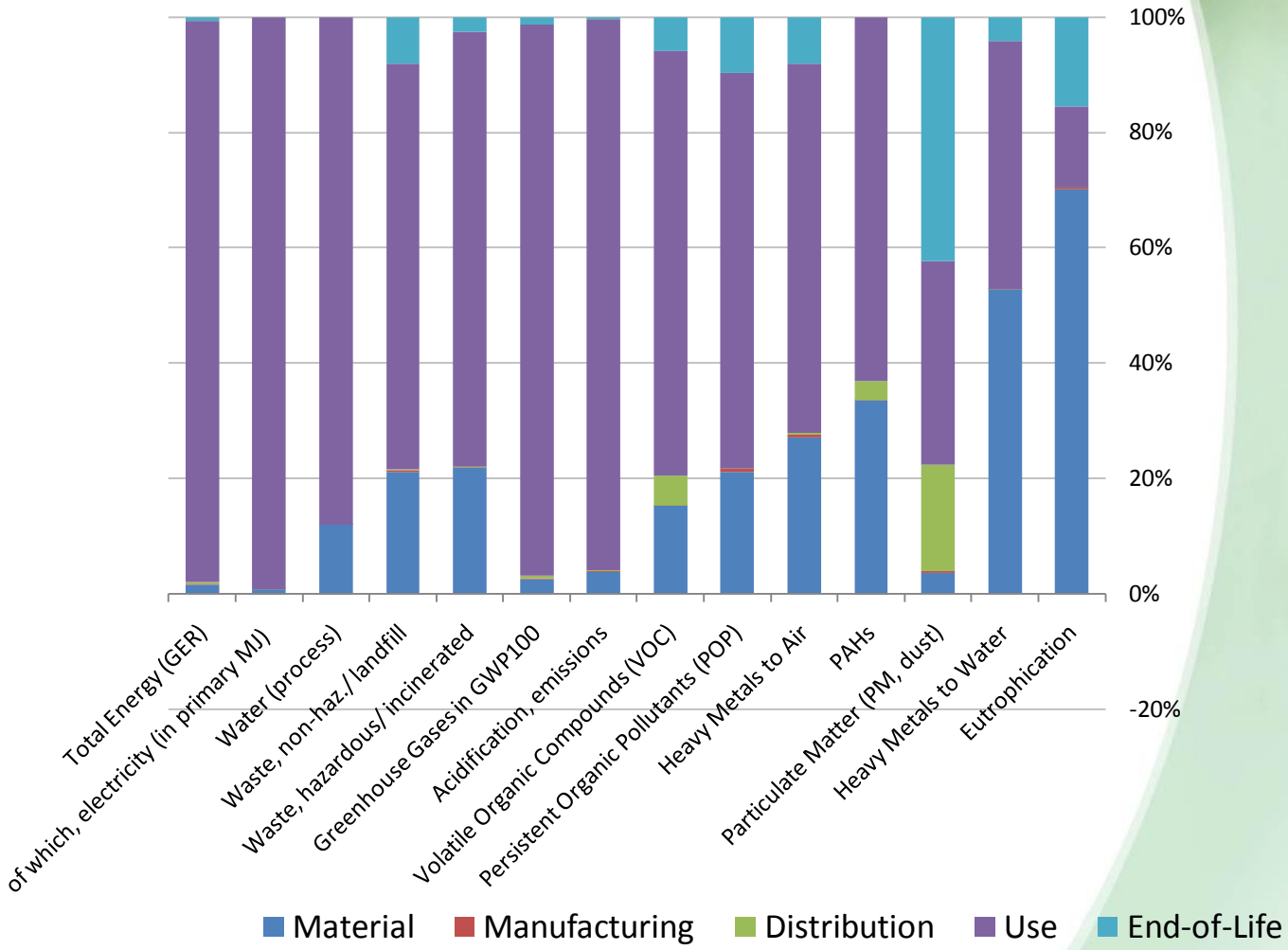
Market Data

Base-Case	Product Lifetime (in years)	Sales in 2007 (units)	Stock in 2007 (units)	Product price (in €)
BC1: Domestic electric hob	19	5,200,000	71,500,000	380*
BC2: Domestic gas hob	19	3,300,000	62,150,000	268

*representative of radiant hobs, based on Task 2.

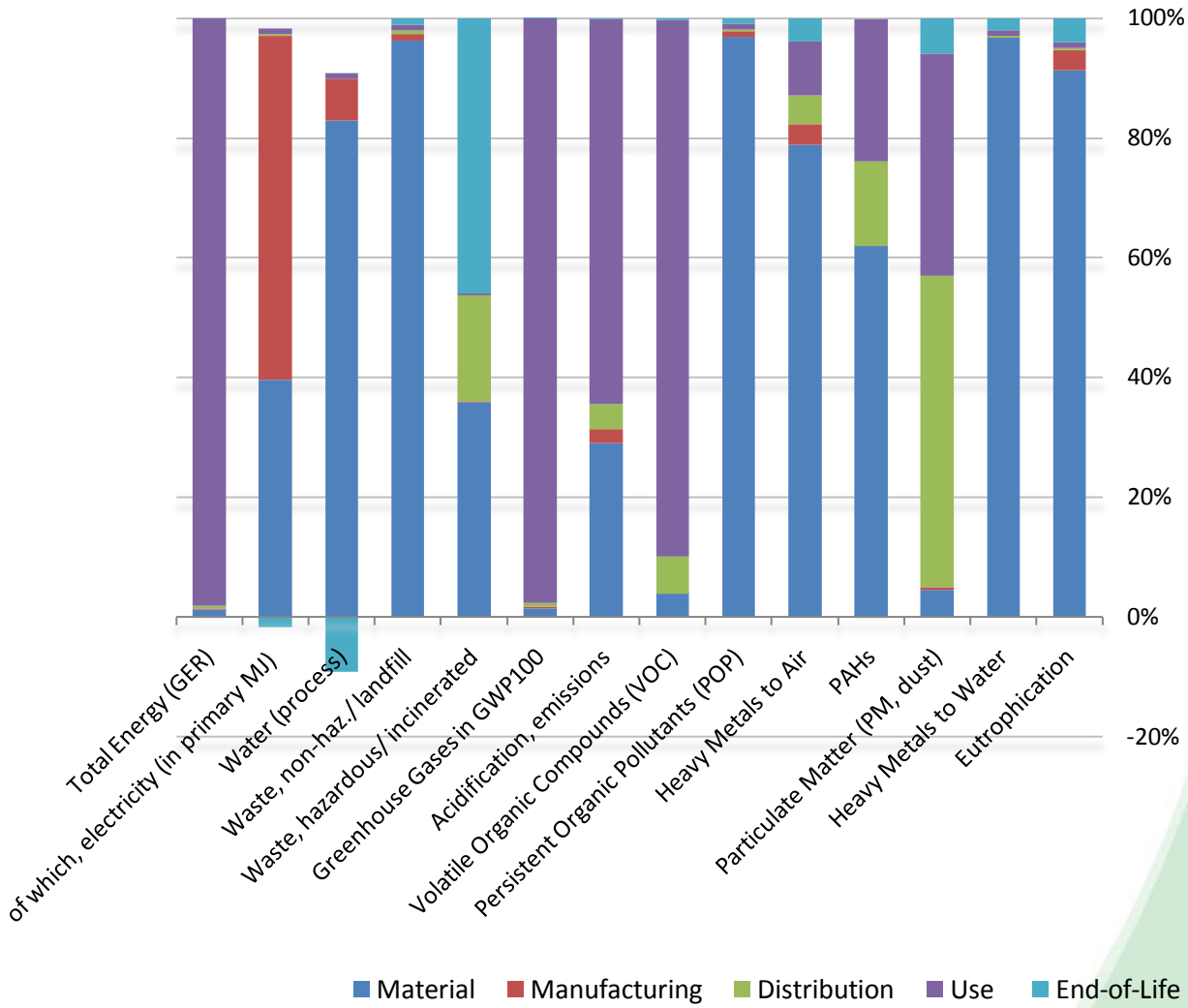
- Installation, maintenance and end-of-life costs are neglected

Base-case 1: Domestic electric hob



Task 5 - Env. Impact Assessment (2/4)

Base-case 2: Domestic gas hob



Overview of the life cycle:

- Predominance of the use phase
- Production phase better represented in Gas hobs, but quantitatively, lower impacts than for Electric ones
- Distribution phase mainly affects the emissions of particulate matter
- End-of-life mainly affects the production of hazardous waste and the emissions of particulate matter

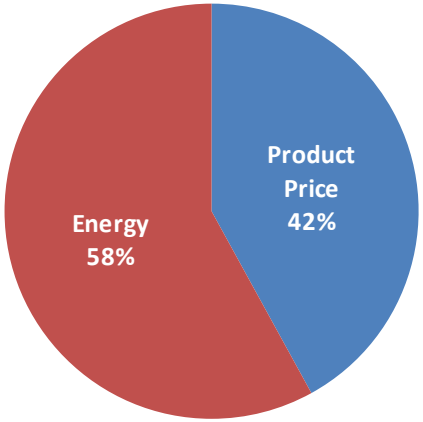
Comparison of the main impacts at product level over its whole life cycle:

Base-Case	Total primary energy consumption (MJ)	Waste (non-hazardous, landfill) (g)	GHG emissions (kg CO_2 eq)	PM (g)
BC1: Domestic electric hob	49,435	79,422	2,195	1,125
BC2: Domestic gas hob	24,440	17,351	1,359	375

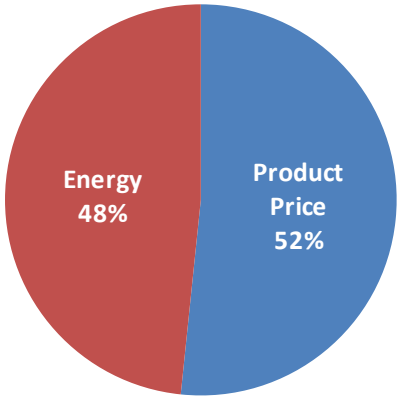
Life cycle cost results:

	Base-Case 1	Base-Case 2
Product price (€)	380	268
Energy cost (€)	525	251
Life Cycle Cost (€)	905	519

Base-Case 1 : Domestic electric hob

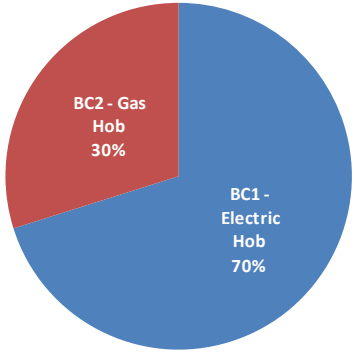


Base-Case 2 : Domestic gas hob

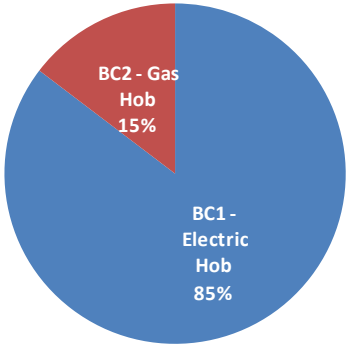


Base-Case	Total primary energy consumption (PJ)	Waste (non-hazardous, landfill) (kt)	GHG emissions (Mt CO_2 eq)	PM (ton)
BC1: Domestic electric hob	188	333	8.4	5.3
BC2: Domestic gas hob	80	57	4.4	1.2
Total EU	268	390	12.8	6.5

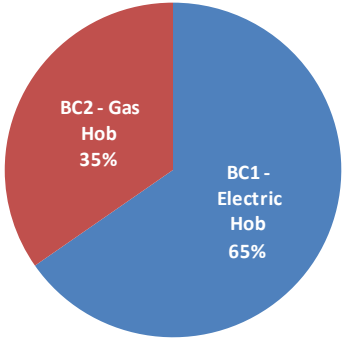
Total Energy (GER)



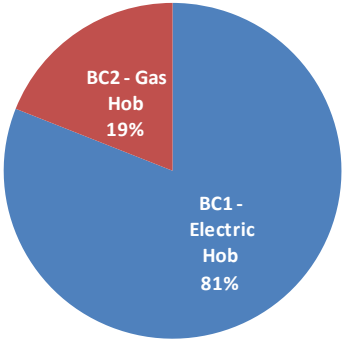
Waste, non-haz./ landfill



Greenhouse Gases in GWP100



Particulate Matter (PM, dust)

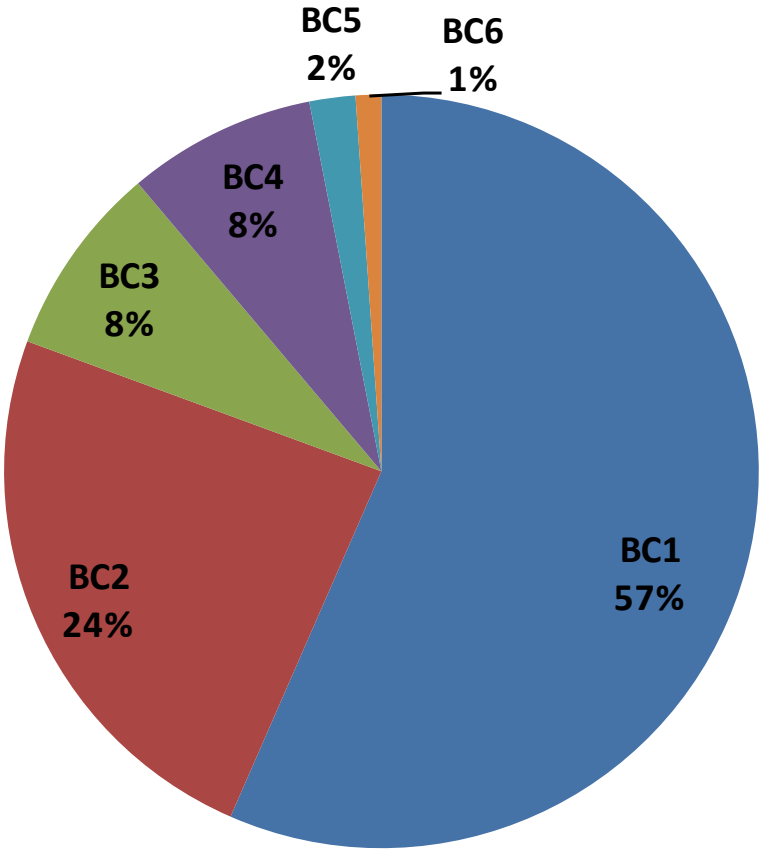


Total Annual Consumer expenditure in EU-27 in 2007:

	Base-Case 1	Base-Case 2	Total domestic
Share of the EU-27 sales	*61%*	*39%*	***100%***
Share of the EU-27 stock	*53.5%*	*46.5%*	***100%***
Product Price (in mln €)	1,976	884	**2,860**
Energy (in mln €)	2,856	1,189	**4,045**
Total (in mln €)	**4,832**	**2,073**	**6,905**
Share of the total expenditure	*70 %*	*30 %*	***100 %***

Lot 23 energy consumption at EU-level in 2007

Total Energy (GER)



- Total primary energy: 332 PJ
- Domestic Sector : 81%

ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

Task 5 – Conclusions

- The use phase is by far the most impacting stage of the life cycle in terms of energy consumption and greenhouse gases emissions.
- Electricity generation is contributing to an important part of the global environmental impacts of the electric hobs.
- For gas hobs, the quantitative impacts are lower.
- The LCCis higher for electric hobs than for gas hobs at product level with comparable shares of energy costs. At EU level, consumer expenditure for electric hobs are 2.3 times higher than for gas hobs.

Dr Paul Goodman,
Reliability and Failure Analysis Group

March 2011

ERA TECHNOLOGY ANTENNA AND ELECTRONIC SYSTEMS

ERA TECHNOLOGY ENGINEERING CONSULTANCY SERVICES

VECTOR FIELDS SOFTWARE

LIGHTNING TESTING AND CONSULTANCY

DG ENER Lot 23 Ecodesign preparatory study
Task 6 Domestic Hobs and Grills
BAT & BNAT

conducted on behalf of the European Commission, DG ENER, by ERA Technology and Bio Intelligence Service

Task 6 - Domestic hobs and grills

- BAT
  - Best currently available technology in EU
- BNAT
  - Technology not currently available in EU – could be available within ~10 years

Sources of information

- Stakeholders – questionnaire responses
  - BAT and BNAT information provided by CECED
- Manufacturers marketing information
- Publications
  - Technical papers
  - Patents
  - Technology used by other industries
  - Products available outside EU

Domestic Hobs - technology

- Gas burners
  - Flame orifice design affects gas/air ratio, heat transfer and heat control
  - Separately controllable dual / triple ring give wider heat range
  - Novel technologies e.g. catalytic combustion
- Electric hotplates
  - Solid plate – rely on good thermal contact - special coatings (also needed on pots)
  - Radiant – electronic control of heat output, insulation to prevent heat losses, reflective surfaces behind radiating elements,
  - Induction – little scope for further improvement
- All types – cooking sensors – up to 30% energy saving

Domestic Grills - technology

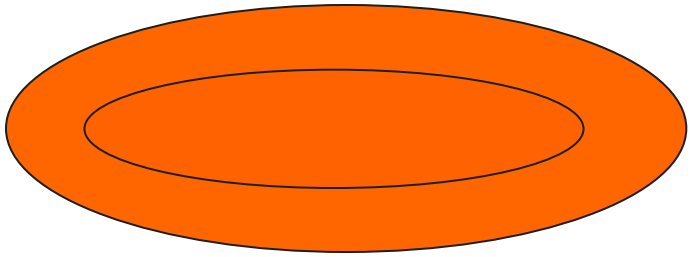
- Radiant grills
  - Most heat transfer by radiation, reflectors at rear need to be clean
  - Insulation to prevent heat losses from radiant element from rear
  - Toasters – power only to slots in use (sensors or switch)
- Contact grills
  - Thermal insulation to prevent heat losses
  - Minimise radiated heat loss from unused areas (e.g. chrome plating)
- All types
  - Ability to heat only areas needed for food (heating zones)
    - 2 zones fairly common
  - Control of power input (usually limited)
    - None or up to 3 levels fairly common (usually fewer levels than for hobs)

Improvement potential
- Hobs

- Initial tests show performance variation within 15% range
  - Best consumes 15% less energy than worst
    - So average improvement potential = 7%
- No results with gas yet (60% efficiency should be possible)
  - Likely to consume less primary energy that all electric hob types
- Results from publications show larger differences between types of hob
  - All use different methods
- Hob efficiency depends largely on good heat transfer to pot
  - And low losses from pot (pot design is not part of study)
  - Induction therefore most efficient
  - For other types, diameter of pot needs to match diameter of hotplate / burner
    - Unless diameter can be pre-set to match pot

Improvement potential
- Hobs

- Hotplate / burner diameter control
  - Allows consumers to use small or large pots
  - No benefit shown in standard energy consumption test



Electric hotplate with two choices of diameter

Domestic gas multi-ring design (image from HKI)

Improvement potential
- Grills

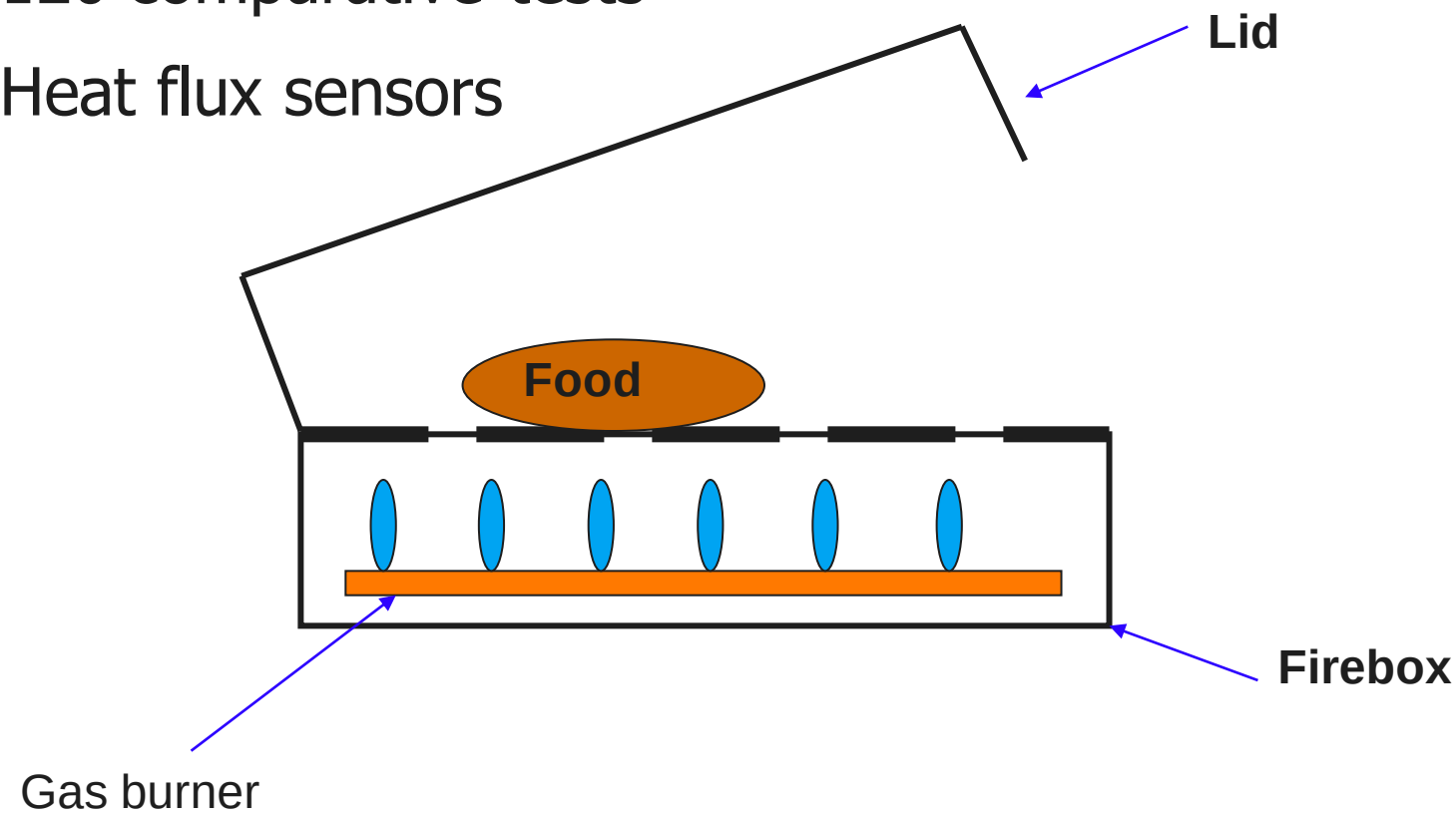
- There is no EU data for domestic grills – no standards yet
- There are many designs of domestic grill so no base-cases selected
- US data (Charbroil) and Japanese Top Runner data suggests that significant variation in performance may occur

Hob and grill improvement potential
- examples

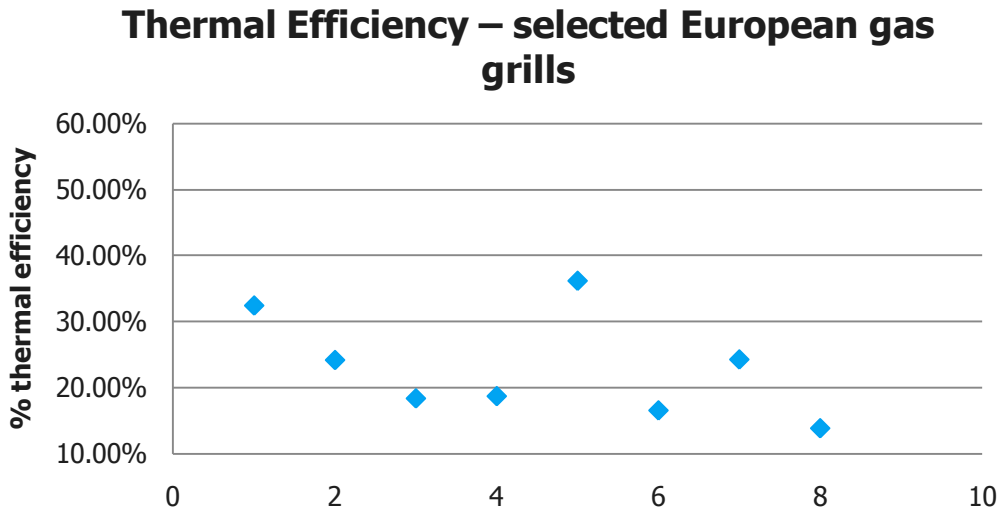
Technology	Comments	Improvement
Solid plate hotplate – mass reduction, special coatings	Declining market so little incentive	~1% for each
Electronic control – radiant electric	Already used on some models	3%
Heat output control – gas hob	Electronic control and burner design	~3%, possibly more
Cooking sensors (various types)	Avoids over-heating and overcooking	Individually up to 30% but overall ~ 3 to 10%?
Individually controlled multiple ring gas burners	Gives greater flexibility (may have lower efficiency)	Overall ~2 - 5%
Grill zone and temperature control	Some grills (& toasters) already have limited control	Individually up to 50% but overall ~ 10 - 20%?
Burner design	Increase infrared radiation and reduce flue gas losses	~10%

Charbroil outdoor grill test results

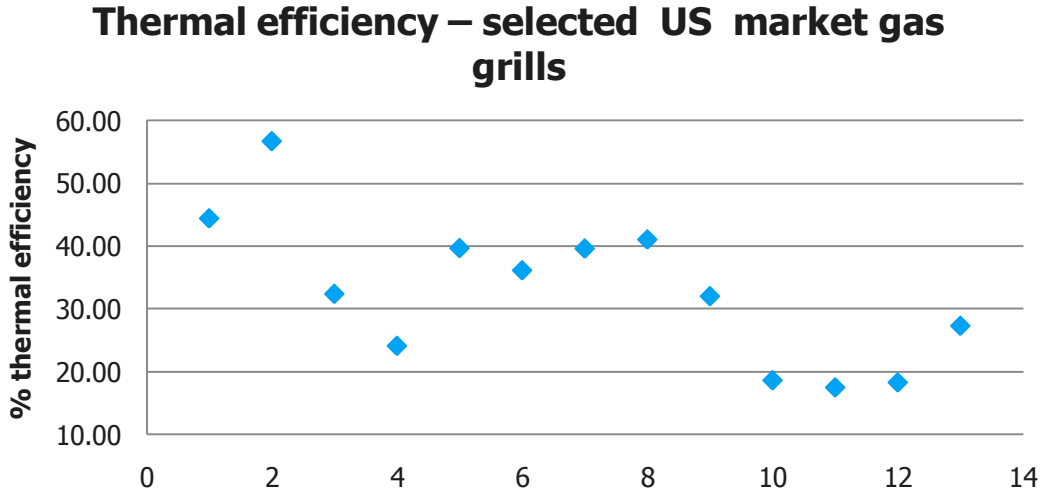
- 120 comparative tests
- Heat flux sensors



Range of test results – Charbroil in-house test with outdoor grills



- European gas grills



- US market gas grills

Best available technologies for gas grills – Charbroil results with outdoor grills

- Presence of a lid – recorded increase of thermal efficiency from 16% lid open to 21% lid closed by use of a simple single wall lid
- Construction of lid – use of a double walled lid with internal reflector raised thermal efficiency on one grill from 19% to 33%
- Firebox construction – typical large single wall firebox replaced with double wall reduced volume firebox increased measured efficiency from 22% to 48%
- Combustion air control – optimization produced increase in efficiency from 24% to 27% without increase of CO
- Zonal cooking – specifically designed separation of cooking areas and burners can show 100 to 200C temp differences while systems without separation show no more than 40C difference

Conclusions

- Limited hob energy consumption data
- Hobs – little variation in design on EU market for domestic hobs
  - Differences small so energy consumption variation small
  - New technologies exist for reducing energy consumption but some not accounted for by simple measurement method
- Large grill energy consumption variation found outside EU – probably also in the EU
  - No EU data yet (as no standard test)
  - Little variation in design within EU for each type of domestic grill
  - Technology available to improve performance

Thank you

Questions?

Agenda of the meeting

10:00 – 10:30	Welcome, "Tour de table", schedule update, Introduction to the Ecodesign Directive,
10:30 – 11:10	Lot 22 – Tasks 1 to 4: Main outcomes on domestic ovens
11:10 – 11:30	COFFEE BREAK
11:30 – 12:15	Lot 22 – Tasks 5 & 6: Base-case assessment and BAT/BNAT analysis
12:15 – 13:00	Lot 22 – Task 7: Improvement Potential, Open Discussion
13:00 – 14:00	LUNCH BREAK
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ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

Task 7 – Improvement Potential

Objectives

- Evaluate the options for improvement in terms of reduced environmental impacts and life cycle costs

- Establish the key products or product groups which will be used towards Task 8 « Implementation » in terms of:
  - ✓ Best Available Technology (BAT) Improvements
  - ✓ Lowest Life Cycle Cost (LLCC) Improvements

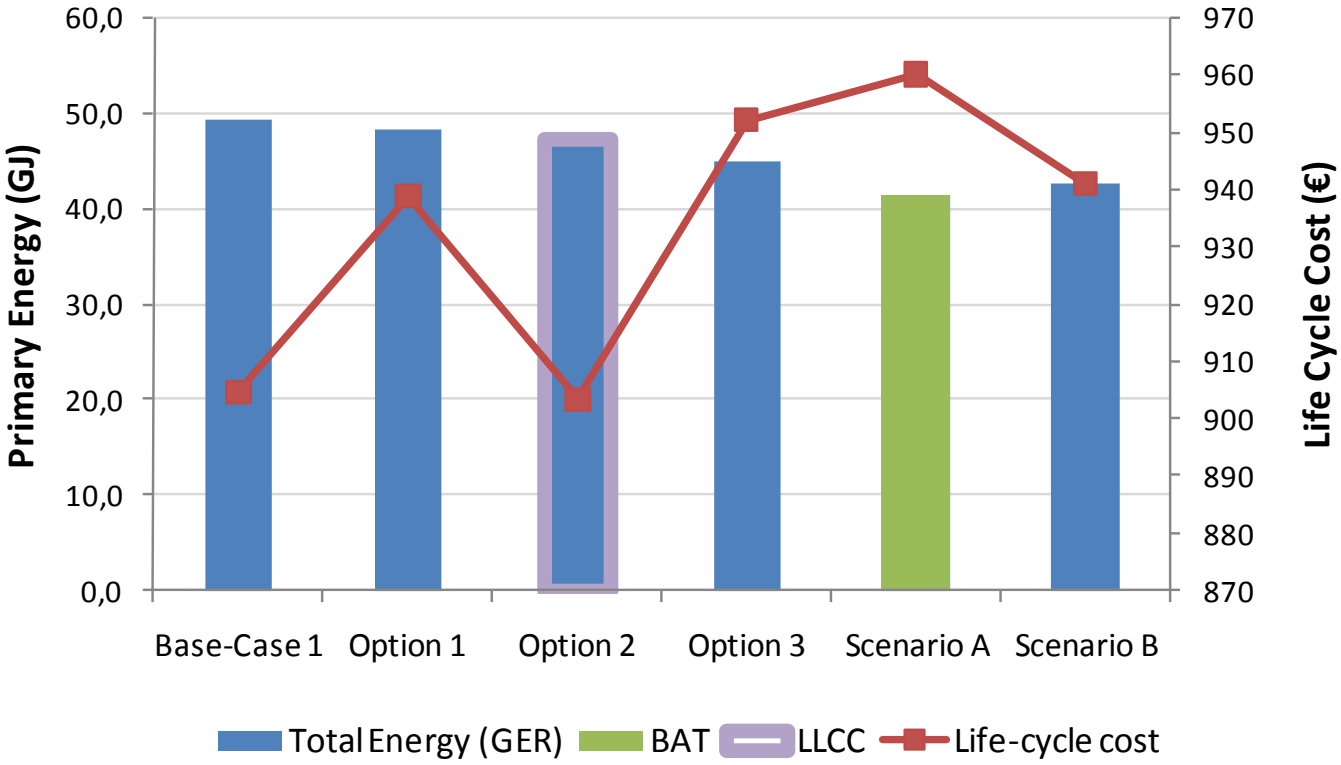
Base-case 1: Domestic electric hob

	Improvement Options	Energy consumption per cycle (kWh)	Annual energy consumption (kWh)	Comparison to Base-case		
				Energy savings (%)	Increase of product price (€)	Payback time (years)
Base-case		0.55	240			
Option 1	Heat output control accuracy (by electronic control)	0.53	232.8	3%	50€	42
Option 2*	Pot sensors	0.52/0.53	228/232.8	5%/3%	25/35€	13/29
Option 3*	Cooking sensors (automatic temperature control)	0.49	216	10%	100€	25
Scenario A*	1+2+3	0.45/0.47	196.8/206.4	18/16%	150/160€	21/25
Scenario B*	2+3	0.47/0.48	204/208.8	15/13%	115/125€	19/24

(potential corrections, based on CECED feedback)

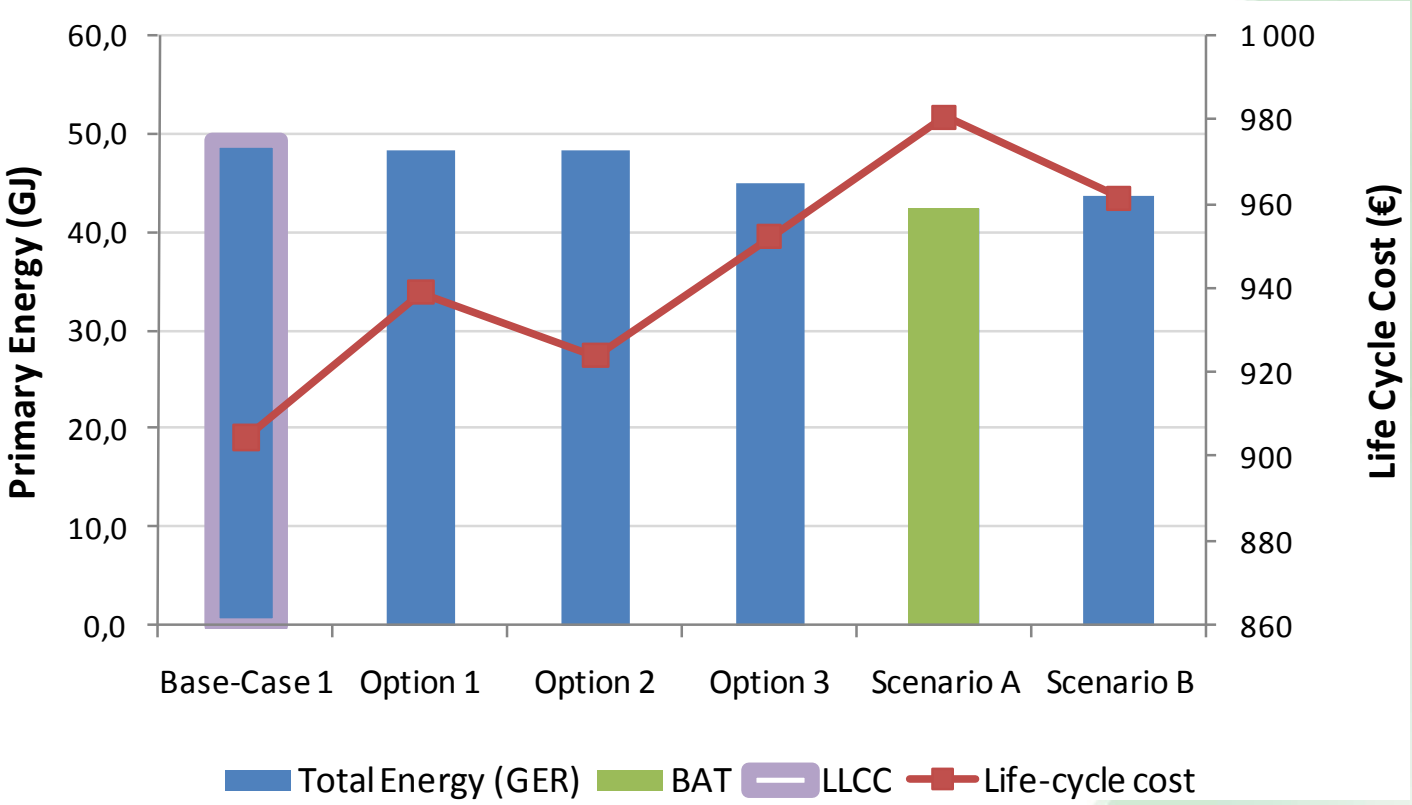
Base-case 1: Domestic electric hob

- BAT : Scenario A
- LLCC : Option 2 (Pot sensors)



Base-case 1: Domestic electric hob

- BAT : Scenario A
- LLCC : Base-Case



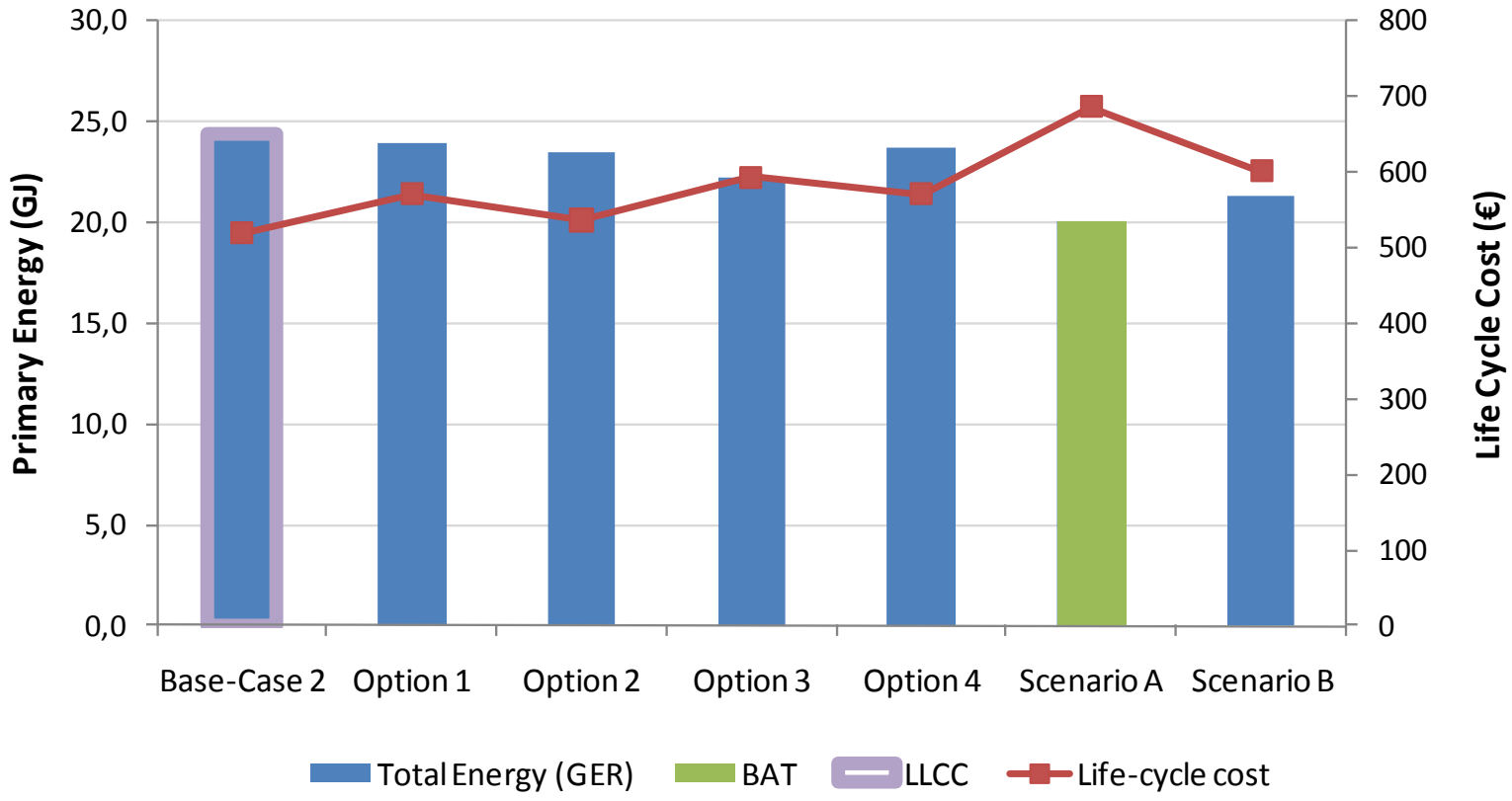
(potential corrections, based on CECED feedback)

Base-case 2: Domestic gas hob (potential corrections, based on CECED feedback)

	Improvement Options	Energy consumption per cycle (kWh)	Annual energy consumption (kWh)	Comparison to Base-case		
				Energy savings	Increase of product price	Payback time (years)
Base-case		0.75	330			
Option 1	Heat output control accuracy (by electronic control)	0.73	320.1	3%	60/80€	139
Option 2*	Pot sensors	0.71/0.73	313.5/320.1	5/3%	30/40€	31/70
Option 3*	Cooking sensors (automatic temperature control)	0.675	297	10%	100€	52
Option 4	Individually controlled multiple crown burners for wider output range	0.73	320.1	3%	60€	104
Scenario A*	1+2+3+4	0.59/0.61	260.7/267.3	21/19%	220/250€	55/68
Scenario B*	2+3	0.64/0.66	280.5/287.1	15/13%	120/130€	42/52
Scenario C	1+4	0.71	310.2	6%	140€	122

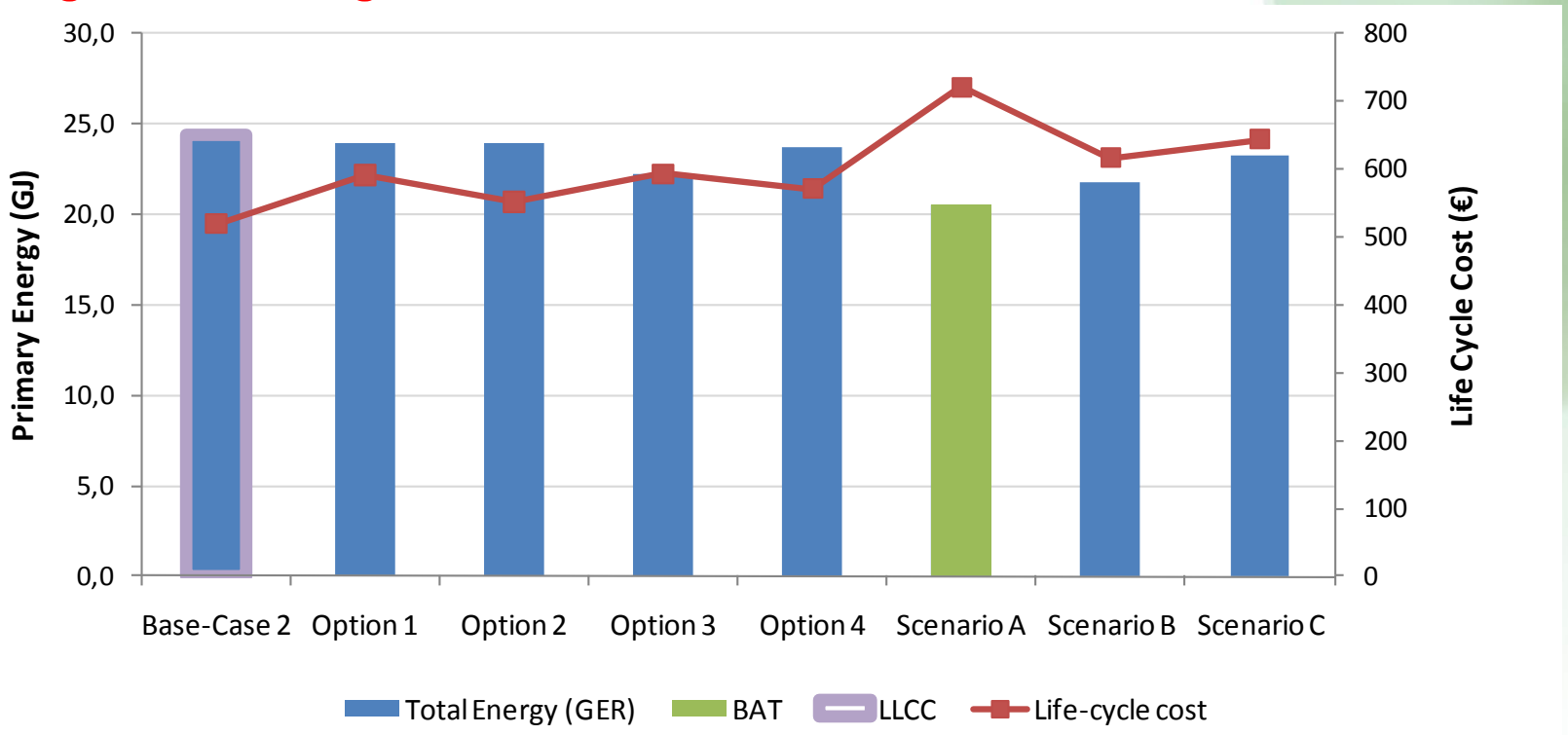
Base-case 2: Domestic gas hob

- BAT : Scenario A
- LLCC : Base-Case



Base-case 2: Domestic gas hob

- BAT : Scenario A
- LLCC : Base-Case
- No significant changes



(potential corrections, based on CECED feedback)

ENER Lot 23: Domestic hobs and grills *including when incorporated in cookers*

Task 7 – Conclusions

- The Base-Cases would be the LLCCs
- Little room for improvement without additional life cycle costs
- Introduction of Scenarios B / C as mid-term compromises
- Pot/cooking sensors show most potential, but are user-dependent options

Open Discussion

- Contact :
  - ✓ contact@ecocooking.org

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Next actions

- **Deadline for providing comments: April 1st**
- **Minutes of the meeting will be sent within 2 weeks**
- **Final report including revised versions of Tasks 1 to 7 and Task 8: to be sent to the EC by April 23rd.**

For any questions, please contact us:

contact@ecocooking.org

Thank you for your participation and support in this study!