

# EuP – Lot 24: Professional washing machines, dryers and dishwashers

## Introduction

### Brief overview on Tasks 1 to 4

Final Stakeholder Meeting on Dishwashers

Paris, 9 December 2010

(Öko-Institut e.V. / Bio Intelligence Service)



# Agenda

<b>10:00 – 10:15</b>	<b>Welcome of participants</b>
<b>10:15 – 10:30</b>	<b>Introduction and Scope of the Meeting</b>
<b>10:30 – 11:00</b>	<b>Brief overview on draft final state of Task 1 - 4</b>
<b>11:00 – 12:00</b>	<b>Presentation and discussion of draft final state of Task 5 (Base Cases)</b>
<b>12:00 – 13:00</b>	<b>Presentation and discussion of draft final state of Task 6 (BAT / BNAT Analysis)</b>
<b>13:00 – 14:00</b>	<b><i>Lunch break</i></b>
<b>14:00 – 15:00</b>	<b>Presentation and discussion of Task 7 (Improvement Potential)</b>
<b>15:00 – 16:00</b>	<b>Presentation and discussion of preliminary results of Task 8 (Policy Options)</b>
<b>16:00 – 16:15</b>	<b>Further proceeding, any other business</b>
<b>16:15</b>	<b>End of meeting</b>

## Project Team

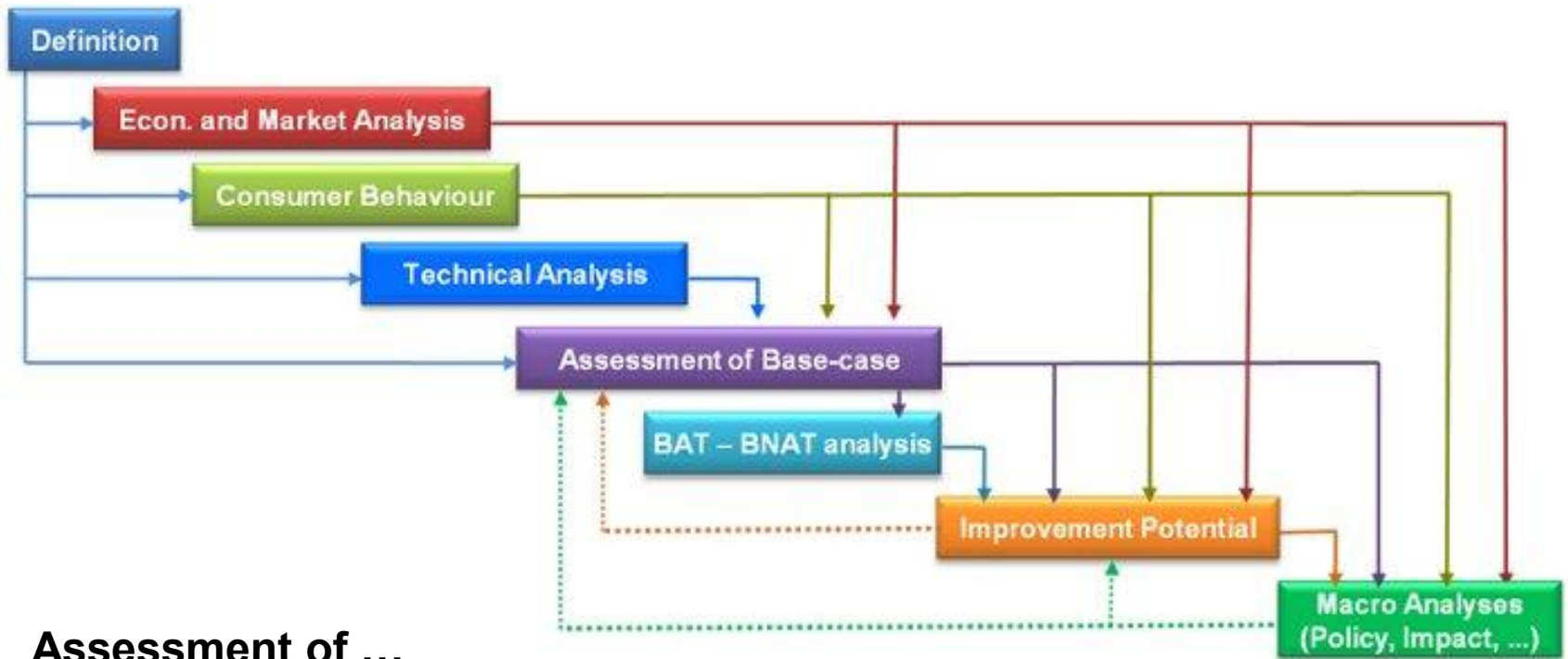
- **Öko-Institut (Project Manager)**
- **BIO Intelligence Service**
- **Büro Ö-Quadrat (subcontractor for dishwashers)**

## Scope of the study Lot 24

### – Professional washing machines, dryers and dishwashers

- Preparatory study identifying and recommending ways to improve at the design phase the environmental performance of the product throughout its lifecycle.
- Product groups:
  - Professional dishwashers → Part I
  - Professional washing machines & dryers → Part II

# Tasks



Assessment of ...

... present situation

... improvement potential



## Project Team – Responsibilities

	Öko-Institut / Büro Ö-Quadrat	BIO IS
<b>Horizontal Tasks</b>		
Overall project management		
Lot-specific website		
<b>Part A: Present Situation</b>		
1. Definition		
2. Economic and Market Analysis		
3. Consumer Behaviour and Local Infrastructure		
4. Technical Analysis of Existing Products		
5. Definition of Base Cases		
<b>Part B: Improvement Potential</b>		
6. Technical Analysis of BAT		
7. Improvement Potential		
8. Scenario, Policy, Impact and Sensitivity Analysis		

# Task 1 – Product definition

## Structure:

1. **Product category and performance assessment**
2. **Test standards**
3. **Existing legislation + labelling**

## Definition of professional dishwashers

“Professional dishwasher” means a machine which cleans, rinses, and dries dishware, glassware, cutlery, and cooking utensils by chemical, mechanical, thermal, and electric means and which is designed to be used principally for professional purposes.

- Definition mainly taken from Lot 14 on household dishwashers (for non-professional purposes)
- Distinction between household and professional based on machinery directive: intended use as stated by manufacturer

## Differences between household and professional dishwashers

- Main reason for differences: different user requirements
- Professional users:
  - Higher amount of dishes to be cleaned and frequency of use
  - Special types of washware
  - Time is an important factor: much faster programmes
- Main differences
  - (Very) short program duration
  - Mainly tank operation
  - Automatic detergent dosage
  - Usually high load connection, partly other energy sources
  - Variable sizes and operating principles depending on spatial requirements and amount of wash ware to be cleaned.

## **Six categories are distinguished**

- 1. Undercounter water-change**
- 2. Undercounter one-tank**
- 3. Hood-type**
- 4. Utensil/Pot**
- 5. Conveyor-type one-tank**
- 6. Conveyor-type multi-tank**

## Main properties of professional dishwashers categories

Category-Number	Water supply	Number of tanks	Operating principle	Type of loading	Type of washware	Application
<b>No. 1</b> Undercounter water-change	Water-change operation	0	Program automats	Front loaders	Mainly dishes, glasses, cups, cutlery.	Semi-professional
<b>No. 2</b> Undercounter one-tank	Tank operation	1		Pass-through		Black cookware and large utensils.
<b>No. 3</b> Hood-type				Front loaders and pass-through		
<b>No. 4</b> Utensil/pot			Conveyor-type	n.a.	Mainly dishes, glasses, cutlery, also tablets, black cookware.	
<b>No. 5</b> Conveyor-type one-tank		2 and more	n.a.			
<b>No. 6</b> Conveyor-type multi-tank						

*n.a. = not applicable*

# Performance of professional dishwashers (I)

- EN 50242/60436
  - Performance measurement of household dishwashers, partly voluntarily applied in case of semi-professional dishwashers
  - Defines measurement procedure for the following aspects:
    - Cleaning + drying performance, energy + water consumption, time, airborne acoustical noise (ref. to IEC 60704-3)
  - According to stakeholders standard is not applicable to professional dishwashers as
    - Soiling different, too complex procedure difficult for SMEs
  - CENELEC/TC59C modified scope to “household and similar electrical appliances”:
    - Make sure that standards for household and professional appliances are not separate standards

# Performance of professional dishwashers (II)

- DIN 10510, 10511, 10512 – Food hygiene (Germany)
  - Covers hygienic performance of one tank dishwashers, glasswashers and conveyor-type dishwashers
  - Cleaning performance is not covered
- DIN 10522 – Food hygiene (Germany)
  - Covers hygienic performance with regard to commercial cleaning of reusable boxes and containers for unpackaged foodstuffs

→ Currently under revision (goal: revision, consolidation and translation into English, publication via CEN on European level): DIN SPEC 10534

### Performance of professional dishwashers (III)

- ASTM International Standards (USA / International)
- ASTM = international standards organisation that develops and publishes voluntary consensus technical standards.
- Application of ASTM standards is voluntarily expect for publicly funded areas in the USA. ASTM International has no role in requiring or enforcing compliance with its standards.
- The standards, however, may become mandatory when referenced by an external contract, corporation or government. E.g. these standard test methods are referenced in the EPA Energy Star criteria and used by manufacturers to obtain an Energy Star qualification or rating.
- See extensive listing of ASTM standards in Task 1 report  
**=> Are they applicable and currently used by European professional dishwasher manufacturers?**

# Performance of professional dishwashers (VI)

- Activities within EFCEM (Europe) => **update needed!**
  - The “Energy Performance Standards Committee” within European Federation of Catering Equipment Manufacturers (EFCEM) aims to develop a standard on the cleaning performance and energy efficiency of professional dishwashers
  - CECED Italia (member of EFCEM) proposed a standard for one-tank under-counter and hood-type dishwashers (approved by EFCEM in April 2010) for measuring the washing performance (derived from EN 50242), the rinsing performance and the energy consumption (based on ASTM F1696-07)
  - HKI (member of EFCEM) currently prepares a proposal for a standard on utensil/pot dishwashers. The standard shall comprise measurement of performance and energy consumption.

# Performance of professional dishwashers (VII)

In summary

- Currently no common standard for professional dishwashers exists for measurement of
  - Cleaning and hygienic performance and
  - Energy and water consumption
- Several activities ongoing:
  - Modification of scope of CENELEC/TC59X
  - EFCEM (including HKI and CECED italia proposals)

## Task 2 – Economic and market analysis

**2.1. Generic economic data:** production, exports, imports

**2.2. Market and stock data:** installed base, annual sales growth rate, average product life, real EU consumption

**2.3. Market and production structures:** market & production structure, general trends in product design, redesign cycle

**2.4. User expenditure base data:** electricity, gas, detergents, repair & maintenance, installation, disposal

## No changes in the sales figures

Product type	Estimated number of units sold per year
Undercounter water-change	20 000
Undercounter one-tank	138 200
Hood-type	65 900
Utensil/Pot	2 600
Conveyor-type one-tank	6 600
Conveyor-type multi-tank	1 300
<b>Total</b>	<b>234 600</b>

## Average product lifetimes updated

Product type	Average product lifetime (in years)
Undercounter water-change	12
Undercounter one-tank	8
Hood-type	8
Utensil/Pot	8
Conveyor-type one-tank	12
Conveyor-type multi-tank	17

## Average capacities and prices updated:

Type of appliance	Approximate capacity	Average price (Euro)
Undercounter water-change	200 dishes/hour	3 200
Undercounter one-tank	550 dishes/hour	3 500
Hood-type	860 dishes/hour	4 700
Utensil/Pot	0.42 m <sup>2</sup> (rack area) 20 cycles/hour	10 500
Conveyor-type one-tank	1 750 dishes/hour	15 000
Conveyor-type multi-tank	3 600 dishes/hour	45 000

- Average detergent and rinsing aid prices assumed at **3€/kg**
- **Maintenance costs updated, along with purchase prices:**

Product type	Lifetime maintenance cost in € (percentage of purchase price)
Undercounter water-change	1 200 (37.5%)
Undercounter one-tank	1 540 (44%)
Hood-type	2 068 (44%)
Utensil/Pot	4 620 (44%)
Conveyor-type one-tank	6 600 (44%)
Conveyor-type multi-tank	19 800 (44%)

# Task 3 – Consumer behaviour and local infrastructure

## Structure:

### 3.1 Real life efficiency

### 3.2 End of life behaviour

### 3.3 Local Infrastructure

## Methodology and assessment of data quality

- Methodology: Stepwise approach:
  - Discussions with stakeholders, literature review
  - Working paper by Öko-Institut incl. preliminary assumptions
  - Self-administrated survey amongst stakeholders
- Assessment of data quality:
  - Responding manufacturers cover ca. 70% of the market
  - Lack of respondents from user side, however, manufacturers having a quite good knowledge on professional user behaviour
  - Main difficulty: lack of mandatory standard to measure consumption of energy, water, detergent and rinse aid
  - Usage information given by manufacturers usually under “ideal” conditions (data are used for promotional purposes)

## Main applications and typical capacities

Dishwasher category	Applications / Market Segments	Spatial requirements	Capacity range (in brackets: typical capacity) [dishes/hour]
<b>No 1</b> Undercounter water-change	Bistros, (small) restaurants, offices, hospitals, hotels, institutional kitchens, schools, etc	Rather small amount of space available / necessary	80-300 <b>(200)</b>
<b>No 2</b> Undercounter one-tank	(Small) restaurants, hotels, bakeries, butcheries, old age homes etc.	Rather small amount of space available / necessary	300-800 <b>(550)</b>
<b>No 3</b> Hood-type	Institutional kitchens, care homes, school canteens, small business canteens, bakeries, butcheries etc.	Medium amount of space necessary. Used in separate kitchen or dishwashing rooms.	500-1 300 <b>(860)</b>
<b>No 4</b> Utensil/Pot	Institutional kitchens, bread and bakery, industry butcheries, hypermarkets	Medium amount of space necessary.	10-30 cycles/hour <b>(20 cycles/hour)</b>
<b>No 5</b> Conveyor-type one-tank	Medium business canteens, hospitals, cafeterias, caterers, hotels	Medium to large amount of space required.	1 500-2 000 <b>(1 750)</b>
<b>No 6</b> Conveyor-type multi-tank	Big business canteens, hospitals, cafeterias, caterers	Large amount of space required.	1 700-6 000 <b>(3 600)</b>

## Typical use intensity

Dishwasher category	Average capacity per cycle or per hour	Number of cycles per day	Time in active mode per day	Working days per year	Typical workload of basket/belt	Number of dishes / cycles per year
<b>No 1</b> Undercounter water-change	30 dishes/cycle	5	1h 30	200	80%	24 000 dishes
<b>No 2</b> Undercounter one-tank	18 dishes/cycle	55	1h 50	300	80%	237 600 dishes
<b>No 3</b> Hood-type	18 dishes/cycle	80	2h 40	300	80%	345 600 dishes
<b>No 4</b> Utensil/Pot	not applicable	30	2h 08	300	60%	9 000 cycles
<b>No 5</b> Conveyor-type one-tank	1 750 dishes/hour	not applicable	3h 30	330	75%	1 515 900 dishes
<b>No 6</b> Conveyor-type multi-tank	3 600 dishes/hour	not applicable	4h 30	330	75%	4 009 500 dishes

## Ideal user behaviour – annual consumption

Dishwasher category	Number of dishes / cycles per year	Energy consumption	Water consumption	Detergent/rinse aid consumption
		kWh/year	litres/year	kg/year
<b>No 1</b> Undercounter water-change	24 000 dishes	1 032	19 200	64
<b>No 2</b> Undercounter one-tank	237 600 dishes	3 802	38 016	127
<b>No 3</b> Hood-type	345 600 dishes	5 875	55 296	185
<b>No 4</b> Utensil/Pot	9 000 cycles	4 500	46 800	157
<b>No 5</b> One-tank conveyor-type	1 515 900 dishes	30 319	197 072	660
<b>No 6</b> Multi-tank conveyor-type	4 009 500 dishes	80 190	481 140	1 612

## Real life user behaviour

- Influence of user behaviour
  - Partial work load
  - Use of other programs than 'standard' program
  - Misuse (e.g. incorrect dosage of detergent and rinse aid)
- Influence of heating up the initial filling
- Influence of standby consumption

## Real life user behaviour – annual consumption

Dishwasher category	Number of dishes / cycles per year	Energy consumption	Water consumption	Detergent/rinse aid consumption
		kWh/year	litres/year	kg/year
<b>No 1</b> Undercounter water-change	24 000 dishes	1 144	24 000	80
<b>No 2</b> Undercounter one-tank	237 600 dishes	4 867	52 020	174
<b>No 3</b> Hood-type	345 600 dishes	7 666	81 120	272
<b>No 4</b> Utensil/Pot	9 000 cycles	8 473	84 840	284
<b>No 5</b> One-tank conveyor-type	1 515 900 dishes	36 127	245 440	822
<b>No 6</b> Multi-tank conveyor-type	4 009 500 dishes	98 460	621 030	2 080

Real life user behaviour: 20-25% higher compared to ideal usage

## Measures to optimize user behaviour

- Education, incentives, responsibilities
- Automatic information and control systems
- One button machine – easy operation to reduce misuse
- Sensor systems regulating the water consumption

## Local infrastructure – Water supply

- Water connection of professional DW

Dishwasher category	Only cold water connection	Cold and warm water (continuous operation)	Warm water (initial filling) Cold water (final rinse)	Only warm water connection (for initial filling and final rinse)
<b>No 1</b> Undercounter water-change	50%	50%	-	-
<b>No 2</b> Undercounter one-tank	80%	-	-	20%
<b>No 3</b> Hood-type	75%	-	-	25%
<b>No 4</b> Utensil / Pot dishwashers	70%	-	5%	25%
<b>No 5</b> One-tank conveyor-type	60%	-	35%	5%
<b>No 6</b> Multi-tank conveyor-type	60%	-	35%	5%

- In general, warm water connection leads to shorter program times and lower energy consumption.
- However, the overall advantage strongly depends on the type of water heating outside the appliance and other infrastructural parameters, like the length of the stub water line

## Local infrastructure

- Water heating
  - Basically: electric heating (categories 1-3)
  - Alternatives: low pressure steam, hot water, direct gas (cat. 4-6);  
=> reducing electricity consumption, however, e.g. extra ventilation needed reducing the initial energy savings of alternative heating

## **Task 4 – Technical analysis of existing products**

### **Structure:**

**4.1 Production Phase**

**4.2 Distribution phase**

**4.3 Use phase (product, system)**

**4.4 End-of-life phase**

**4.5 Recommendations on mandates**

## Methodology and assessment of data quality

- Methodology: Stepwise approach
  - Discussions with stakeholders, literature review
  - Self-administrated survey amongst stakeholders
    - Data on energy, water and detergent consumption (working document, see also Task 3)
    - Data on production, distribution and end-of-life phase (Excel file + additional questions)
- Assessment of data quality:
  - Responding manufacturers cover ca. 70% of the market
  - Lack of respondents from user side, however, manufacturers having a quite good knowledge on professional user behaviour
  - Response to T4-specific questions only by 3 manufacturers

## Technical analysis production phase

- Share of material categories:

In all categories, the share of ferrous metal (mainly stainless steel) is the highest of all materials and, at 55% to 75%, the predominant material

Materials-category	Unit	No.1	No. 2	No. 3	No. 4	No. 5	No. 6
Bulk Plastics	g	17.4%	10.2%	7.0%	7.1%	10.2%	7.5%
Tec Plastics	g	2.0%	1.9%	1.3%	1.8%	0.6%	1.3%
Ferrous	g	53.8%	68.8%	72.9%	76.1%	68.9%	71.2%
Non-ferrous	g	2.7%	7.4%	5.7%	5.5%	11.2%	7.1%
Coating	g	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Electronics	g	0.9%	0.6%	0.4%	0.9%	1.0%	1.1%
Misc.	g	23.2%	11.1%	12.6%	8.6%	8.1%	11.9%
<b>Total weight</b>	<b>g</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Total weight</b>	<b>g</b>	<b>50 696</b>	<b>79 185</b>	<b>135 155</b>	<b>226 000</b>	<b>973 225</b>	<b>1 465 000</b>

## Technical analysis production phase

- Other materials:
  - Mercury: not used (complying with RoHS Directive)
  - Refrigerants: might be used in DW equipped with heat pumps
  - Silver ions:
    - According to stakeholders not applied anymore due to risk warnings.
    - No need of silver ions due to other possibilities (temperature, chemistry, steam) to guarantee the same hygienic standard

## Technical analysis distribution phase

- Average volume and weight of products

Dishwasher category	Average volume of the final packaged product	Average weight of the final packaged product
Undercounter water-change	0.40 m <sup>3</sup>	ca. 50 kg
Undercounter one-tank	0.48 m <sup>3</sup>	ca. 80 kg
Hood-type	1.03 m <sup>3</sup>	ca. 135 kg
Utensil/pot	4.95 m <sup>3</sup>	ca. 225 kg
Conveyor-type one-tank	12.25 m <sup>3</sup>	ca. 975 kg
Conveyor-type multi-tank	16.58 m <sup>3</sup>	ca. 1 465 kg

## Technical analysis use phase (product)

- Annual energy, water and detergent consumption (real life usage)

Dishwasher categories	Annual energy consumption per appliance (kWh)	Annual water consumption per appliance (litres)	Annual detergent consumption per appliance (kg)
Undercounter water-change	1 144	24 000	80
Undercounter one-tank	4 867	52 020	174
Hood-type	7 666	81 120	272
Utensil/pot	8 473	84 840	284
One-tank conveyor-type	36 127	245 440	822
Multi-tank conveyor-type	98 460	621 030	2 080

## Technical analysis use phase (system)

- Factors influencing the consumption of professional dishwashers:
  - Type of dishes (weight, heat capacity)
  - Input temperature of dishes
  - Soiling of the dishes
  - Quality of water
  - Input water temperature
  - Ambient temperature and humidity
  - Infrastructure (see Task 3: initial heating, heating during operation)

## Technical analysis of end-of-life phase

Almost all components will be recycled

- Stainless steel (55 – 75%)
- Printed wiring boards (PWB) completely recycled by certified scrap dealers
- Plastic share less than 10%
  - Reuse/close loop recycling 1%
  - Material recycling 29%
  - Thermal recycling 70%

## Recommendations on mandates

### Situation today

- No official energy consumption data in advertising material
  - Existing data not comparable, because there is no standard measuring method
  - Competition in relation to energy consumption and environmental aspects distorted
  - Development of efficient technologies slowed
  - Insufficient allocation of resources
- => Implementation of a standardised measuring method as starting point for additional measures necessary

## Recommendations on mandates

### Definition of

- Ambient temperature and humidity
- Input temperature water
- Input temperature wash ware
- Selection of program
- Cleaning capacity (dishes per hour)
- Type (formulation) and dosage of detergent and rinse aid
- Standard wash ware in terms of size, surface and heat capacity
- Soiling of items including dry-on time of the soiling

### Parameters to be evaluated / measured

- Cleaning results and hygienic performance
- Energy and water consumption (per hour or per cycle)
- Energy demand in standby modes
- Energy and water consumption under real-life-use conditions

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