Wuppertal Institut
für Klima, Umwelt, Energie
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Bottom-up scenario calculations for 10 world regions reveal worldwide efficiency potentials of about 50 % for refrigeration and washing

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Your guide to energy efficiency in buildings.

Introduction

Domestic refrigerators, freezers and washing machines are among the **most widely used electrical household appliances** all around the world.

They have a **high electricity and water consumption** and contribute to the greenhouse effect.

It is well known, that **huge differences between the average and the most efficient appliances** exist.

This talk is about the results of:

- **Country specific bottom-up analysis** of the **worldwide electricity and water consumption** in the different world regions for these appliances.
- Development of **Baseline and Efficiency Scenarios by 2030.**
- Developing of **policy recommendations** to address the efficiency potentials.

Cold appliances

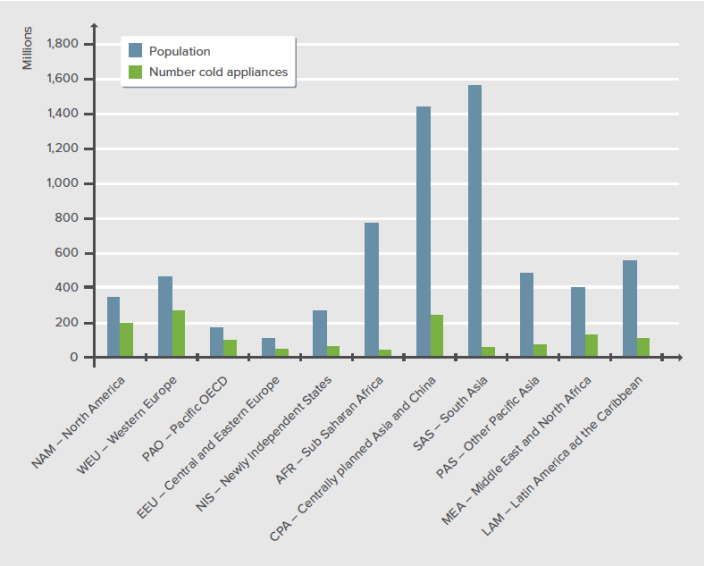
The most common types of cold appliances worldwide

- The **storage and refrigeration of food in households** is carried out in almost all regions of the world with the help of **domestic cold appliances**.
- The **technology for cooling is identical** worldwide. Differences exist in the kinds of appliances, which are preferred in different world regions.
- The **most common types of cold appliances worldwide** are:
  - Single-door refrigerator without freezer
  - Single-door refrigerator with freezer
  - Double-door fridge-freezer
  - Side-by-side fridge-freezer
  - Upright freezer
  - Chest freezer

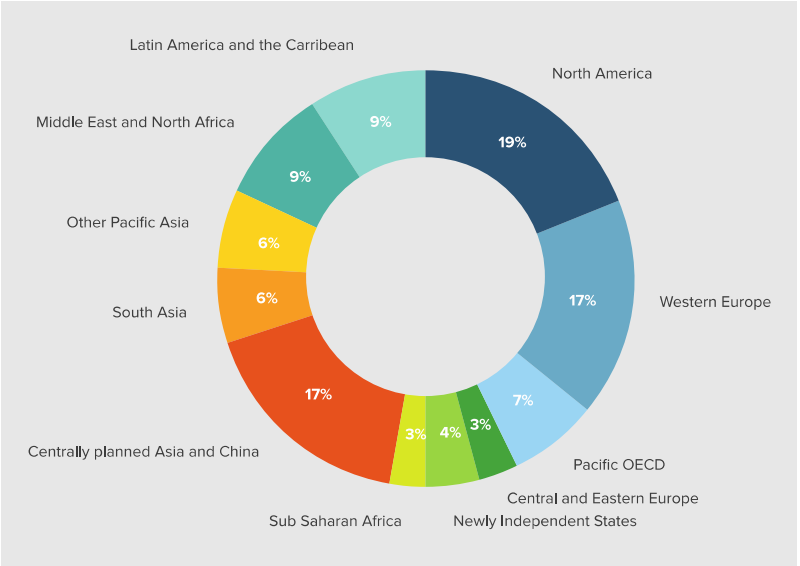
Cold appliances: Country specific bottom-up analysis of the status quo

The overall worldwide results for domestic cold appliances

- About **1,4 billion domestic refrigerators and freezers** are in use worldwide with an average annual electricity consumption of **450 kWh each**.
- Altogether they account for almost **14 % of the total electricity consumption from the residential sector or 650 TWh/a**.
- They cause worldwide annual **greenhouse gas emissions of 450 million tons of CO_{2eq}.**



World population and number of cold appliances in the different world regions



Worldwide distribution of electricity consumption of domestic cold appliances

Development of a Baseline and an Efficiency Scenario by 2030
Scenario calculations to calculate the saving potential

- **Bottom-up scenario calculations** were carried out to assess the **efficiency potential and the financial benefits/costs.**

- In the **BAU-Scenario moderate improvements** are regarded.

- In the **Efficiency Scenario** it is assumed that old inefficient models are replaced by **the most energy-efficient ones** every time a new appliance is bought (100 % market share of BAT products).

- The calculations include **improvements in the most efficient models (BAT -> BNAT)** over the years as well as **increasing saturation** and the **trend to bigger models.**

- **BAT** values are based on the **Topten (www.topten.info)** databases, future efficiency improvements for **(BNAT)** are based on Eco-Design studies and other sources.

Development of a Baseline and an Efficiency Scenario by 2030

Comparing inefficient models with BAT and BNAT models

Best Practice Example:
Double-door fridge-freezer

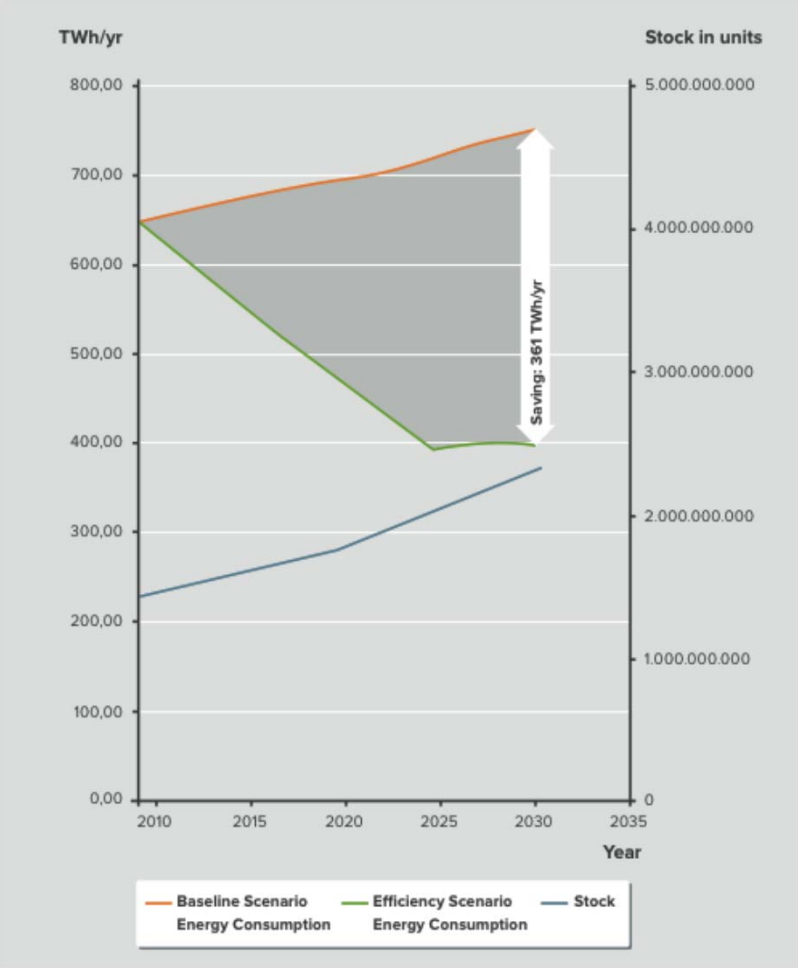
Comparing inefficient models and Best Available Technologies (BAT) on the worldwide market with future Best No yet Available Technologies (BNAT) potential

		Energy (kWh/ year), in accordance with ISO standard **	Energy class	Energy saving potential vs. inefficient model	Energy cost savings versus inefficient model (EUR in 15 years at 12 EUR-Cent/kWh)
Small[1] 172 litres (Volume in accordance with Chinese standard)	Inefficient model	237	Chinese National energy efficiency grade 2 (equivalent to EU Energy class A)		
	BAT level	91	55 % better than required by the Chinese National energy efficiency grade 1 (equivalent to EU Energy class A+++)	62 %	262
	BNAT level (Calculated in accordance with EU EEI* = 15 %)	77	32 % better than required by EU Energy class A+++	68 %	288
Medium[2] 293 litres (Volume in accordance with EU/ISO standard)	Inefficient model	303	EU Energy class: A+		
	BAT level	139	EU Energy class: A+++	54 %	296
	BNAT level (Calculated in accordance with EU EEI* = 15 %)	97	32 % better than required by EU Energy class A+++	68 %	371
Large[3] 583 litres (Volume in accordance with AHAM U.S. standard)	Inefficient model	510	No Energy Star (equivalent to EU Energy class A+)		
	BAT level	356	12,5 % better than required by Energy Star (equivalent to EU Energy class A++)	30 %	249
	BNAT level (Calculated in accordance with EU EEI* = 15 %)	192	32 % better than required by EU Energy class A+++	62 %	514

Source: [1]top10.cn / [2]topten.eu / [3]toptenusa.org (2012) for Energy (kWh/year) of a typical inefficient model and example of a BAT model, own calculations of BNAT level, Energy saving potential and Energy cost savings

Development of a Baseline and an Efficiency Scenario by 2030
Results for domestic cold appliances for 2030

- **Model calculations show enormous efficiency improvements** if old inefficient models are replaced by modern energy-efficient ones every time a new cold appliance is bought.
- They include **improvements in the most efficient models** over the years as well as **increasing saturation** and the **trend to bigger models**.
- The worldwide **annual electricity consumption** by domestic cold appliances **could be reduced from 649 TWh to 413 TWh by 2030** despite the expected 62 % increase in the number of cold appliances in use by 2030



Development of a Baseline and an Efficiency Scenario by 2030
Results for domestic cold appliances for 2030

- The calculations show that **policy measures and programmes to capture this potential improvement are cost-effective** for society as well as for end-users **in all 11 world regions**.
- Over the lifetime of the energy-efficient refrigerators and freezers in use by 2030, **consumers worldwide would benefit from total net savings of around € 13 billion** (including energy taxes and value added taxes) while **net benefits to society would be about € 10 billion**.

The issue “clothes washing”
More complicated than food preservation

- The issue “**clothes washing**” is more complicated than food preservation as tradition and culture of washing affects the kind of washing in different world regions.

- The four parameters: **Temperature, chemistry, time and mechanics** are not equally important in all world regions.

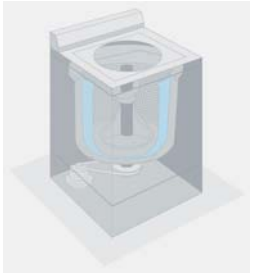
- This resulted in **different kinds of washing appliances**.

Washing machines

The most common types of washing machines worldwide

- The **most common types of washing machines** worldwide are:
- **Horizontal axis**, top- or front-loading
  - Electricity consumption: Low to high
  - Water consumption: Low
  - Mainly used in Western Europe, Eastern Europe and increasingly in most other markets

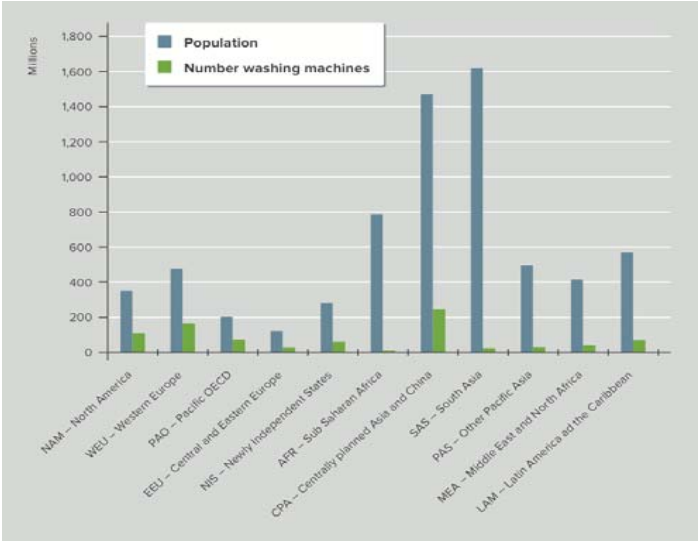
- **Vertical axis with agitator**, top-loading
  - Electricity consumption: Low but often additional external energy
  - Water consumption: Very high
  - Widespread in North- and Latin America as well as in Australia



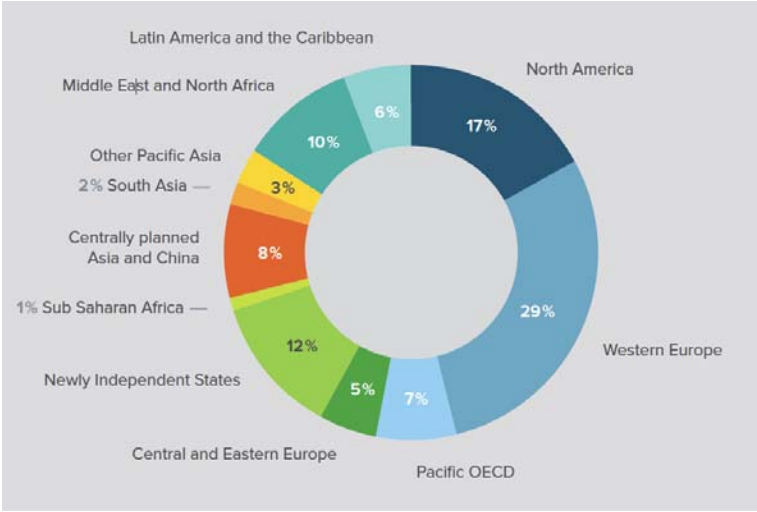
- **Vertical axis with impeller**, top-loading
  - Electricity consumption: Low but often additional external energy
  - Water consumption: Very high
  - Widespread in Asia (China, India, South Korea, Japan) and Australia

Country specific bottom-up analysis of the status quo
The overall worldwide data of domestic washing machines

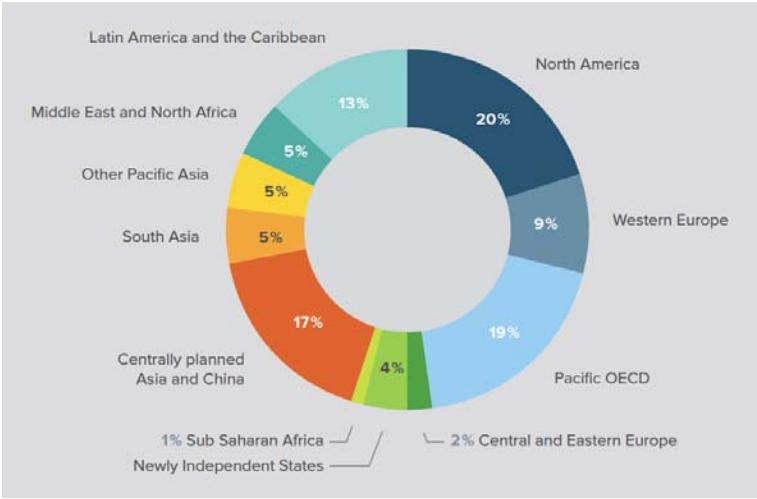
- About **840 million domestic washing machines** are in use worldwide with an average annual **electricity** consumption of **110 kWh** and **water** consumption of **23 m³ each**.
- Altogether they consume **92 TWh/a of electricity** and **19 billion m³/a of water**.



World population and number of washing machines in the different world regions



Worldwide distribution of electricity consumption of domestic washing machines

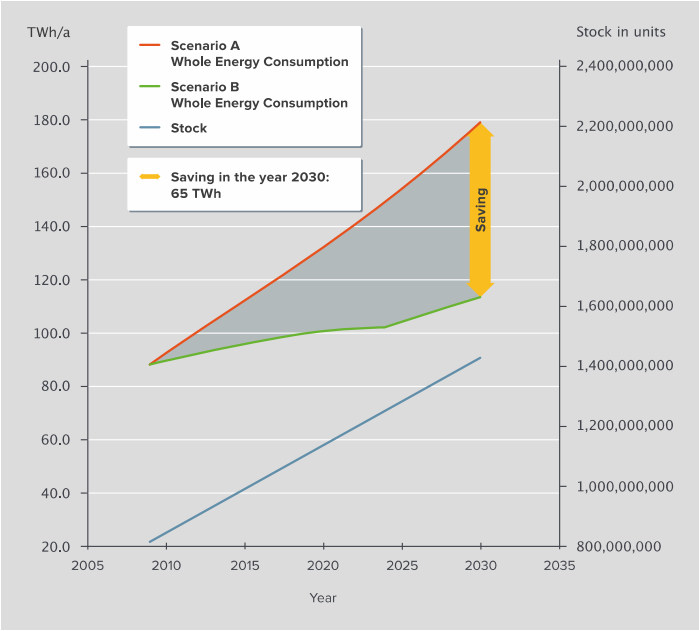


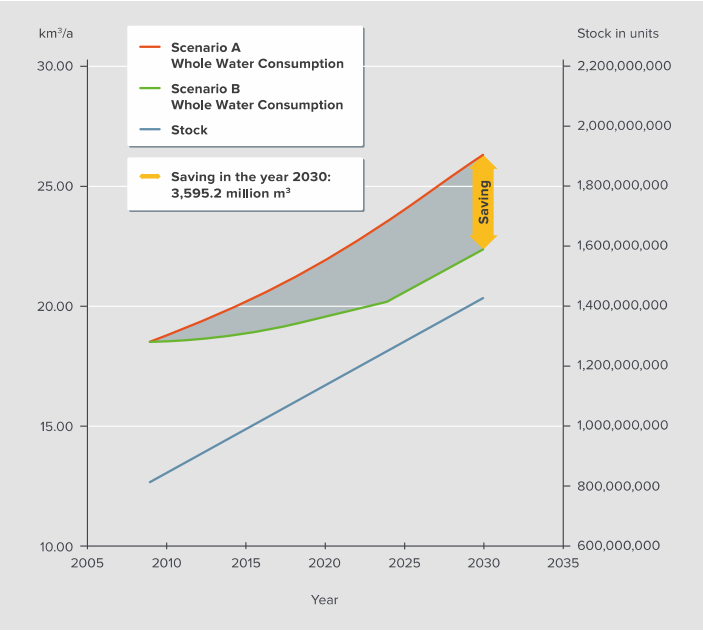
Worldwide distribution of water consumption of domestic washing machines

Development of a Baseline and an Efficiency Scenario by 2030

Results for domestic washing machines for 2030

- The worldwide **increase** of the **annual electricity consumption** by domestic washing machines **could be reduced by 65 TWh and the increase of water consumption could be reduced by 3,6 million km³/a in 2030** despite the expected strong increase of the number of washing machines, which are expected to nearly double by 2030.
- The calculations include **improvements in the most efficient models** over the years as well as **increasing saturation** and the **trend to horizontal axis machines**.





Summary of the results of model calculations for domestic cold appliances and washing machines

- Between **2010 and 2030 a stock increase** is expected
  - of **more than 60 % worldwide for cold appliances**
  - and of **about 70 % for washing machines**.

- The following **electricity and water savings** could be achieved by 2030:
  - **Electricity savings of 426 TWh/year or 45 %** compared to BAU (954 TWh),
  - **Water savings of 3,6 million m^3 or 14 %** compared to BAU (26,1 million m^3)

- Over the lifetime of the energy-efficient cold appliances and washing machines in use by 2030,
  - **consumers worldwide would benefit from total net savings of around € 100 billion** (including energy taxes and value added taxes)
  - while **net benefits to society would be about € 60 billion**.

Policy is needed…
Policy strategies to address the potentials

- **Market transformation** towards energy efficient appliances **is unlikely to happen itself.**
- **Barriers** like financial, knowledge and technical barriers hinder a market transformation towards energy efficiency.
- From an **analysis of pro-active countries** it can concluded that
  - **Policy packages** with instruments to pull and push the market are necessary to overcome the barriers and to exploit the existing potentials.
  - No single policy instrument can address all the barriers and incentives. **Therefore policies addressing the demand- and supply side should be properly combined.**
  - A **sound balance between mandatory measures, incentives, information and capacity building** is needed
- Examples of **successful policy packages** should be tailored with the following **elements**
  - MEPS and labelling, rebate programmes,
  - information programmes, trainings for sales staff,
  - procurement programmes, bulk purchasing projects,
  - product competitions;
- **Policy packages must be adapted to national conditions.**

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Thank you for your attention!

More information at www.bigee.net

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