Appliances Guide
Get super efficient appliances

bigEE

The overall worldwide saving potential from domestic washing machines

With results detailed for 10 world regions

Authors
Dr. Claus Barthel
Thomas Götz

Published 03/2013

Index

1 The overall worldwide energy and cost saving potential

Domestic washing machines

About **840 million** domestic washing machines are in use worldwide. With an average annual direct electricity consumption of **110 kWh** each, altogether they account for about **2 %** of the total electricity consumption from the residential sector and cause worldwide annual greenhouse gas emissions of **62 million tons** of CO_2-eq. With an average annual water consumption of **23 m³** each, they also consume about **19 billion m³** of water per year. If every time a washing machine is replaced, the most energy- and water-efficient model is chosen, **31.5 TWh** of electricity, **2.2 billion m³** of water and **20.8 million tons** of CO_2-eq and per year can be saved by 2020. Even further savings are achievable by 2030.

1.1 Current worldwide distribution of domestic washing machines

The distribution of domestic washing machines and the related electricity and water consumption is very uneven between different world regions. In many regions, appliance ownership is expected to grow in the future.

The distribution of domestic washing machines is very uneven between different world regions. In North America, Western Europe and Pacific OECD most households own a washing machine, whereas in other world regions the level of ownership is well below saturation (see Figure 1). This is however expected to change in the future.

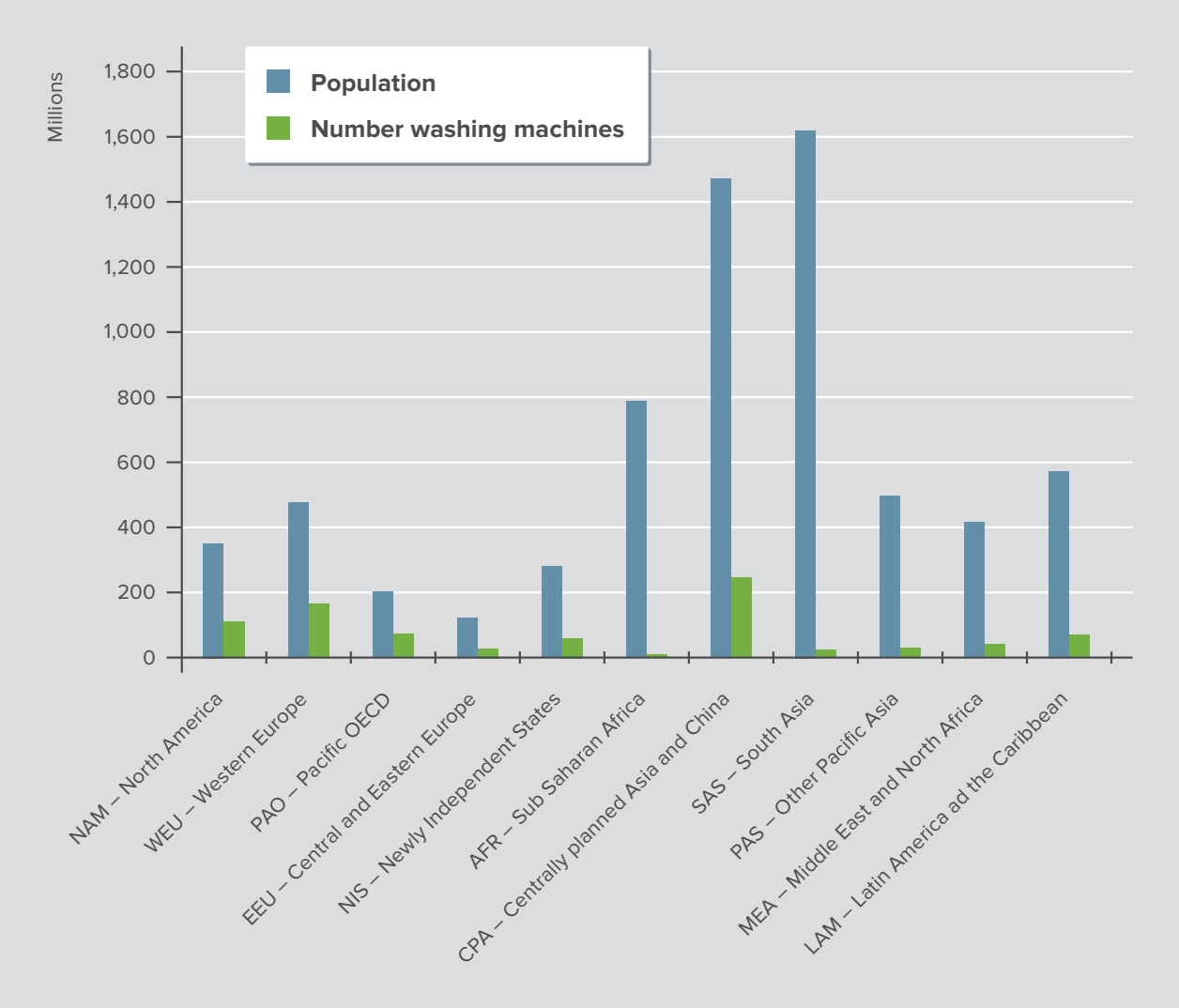

Figure 1: World population and number of washing machines in the different world regions according to IPCC systematic

Source: Own calculation based on IEA, Pakula / Stamminger 2010 and other reports

1.2 Current electricity and water consumption of domestic washing machines

The results of the bigEE appliances model calculation show that laundry washing in private households is done with varying amounts of electricity and water in different parts of the world, both in absolute and relative terms with regard to the overall household consumption. The uneven distribution of domestic washing machines worldwide (see Figure 1), different types of machines (different technologies like horizontal and vertical axis washing machines) and their various efficiency levels, as well as different

wash habits and practices (e.g. wash temperatures, number of wash cycles per year) lead to substantial differences in electricity and water consumption in different world regions (see Figure 2 and Figure 3).

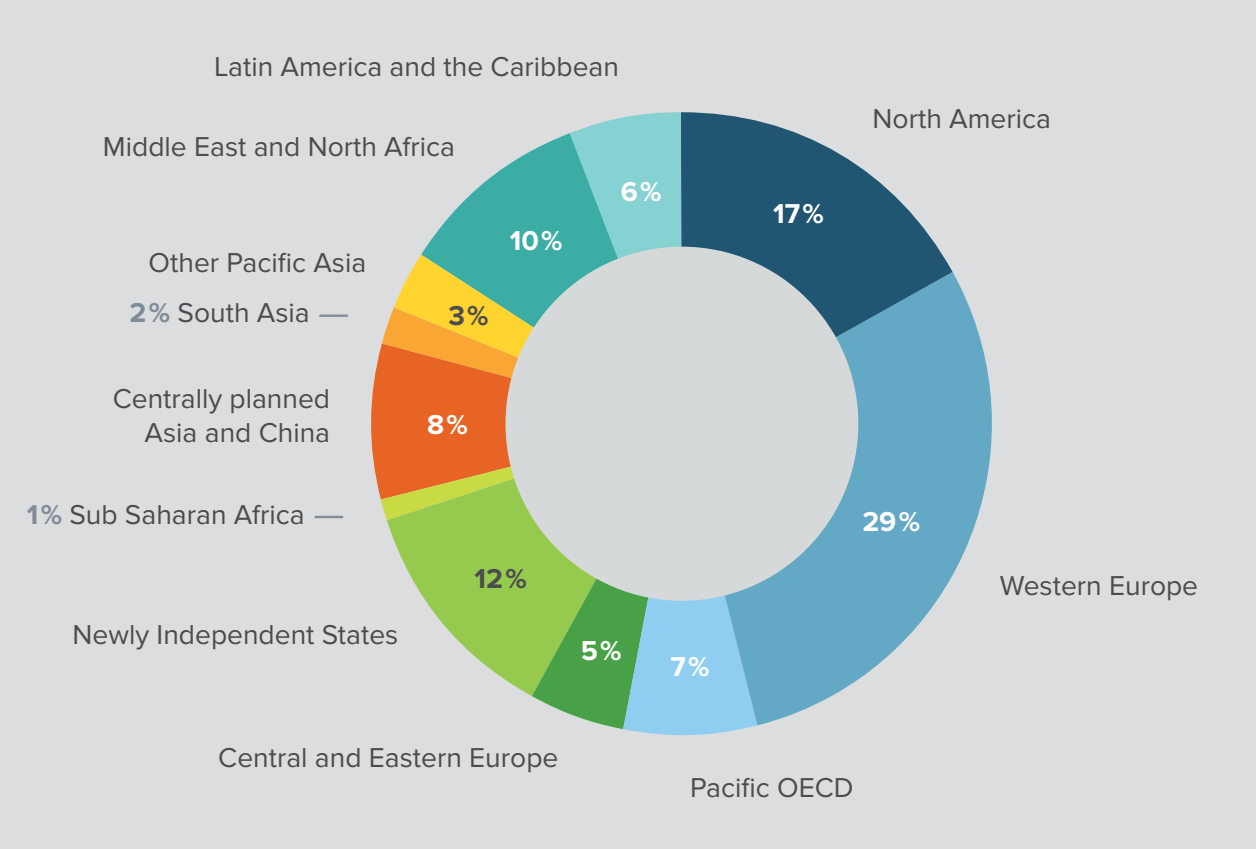

Figure 2: Worldwide distribution of electricity consumption for domestic washing machines

Source: Own calculation based on IEA, Pakula / Stamminger 2010 and other reports

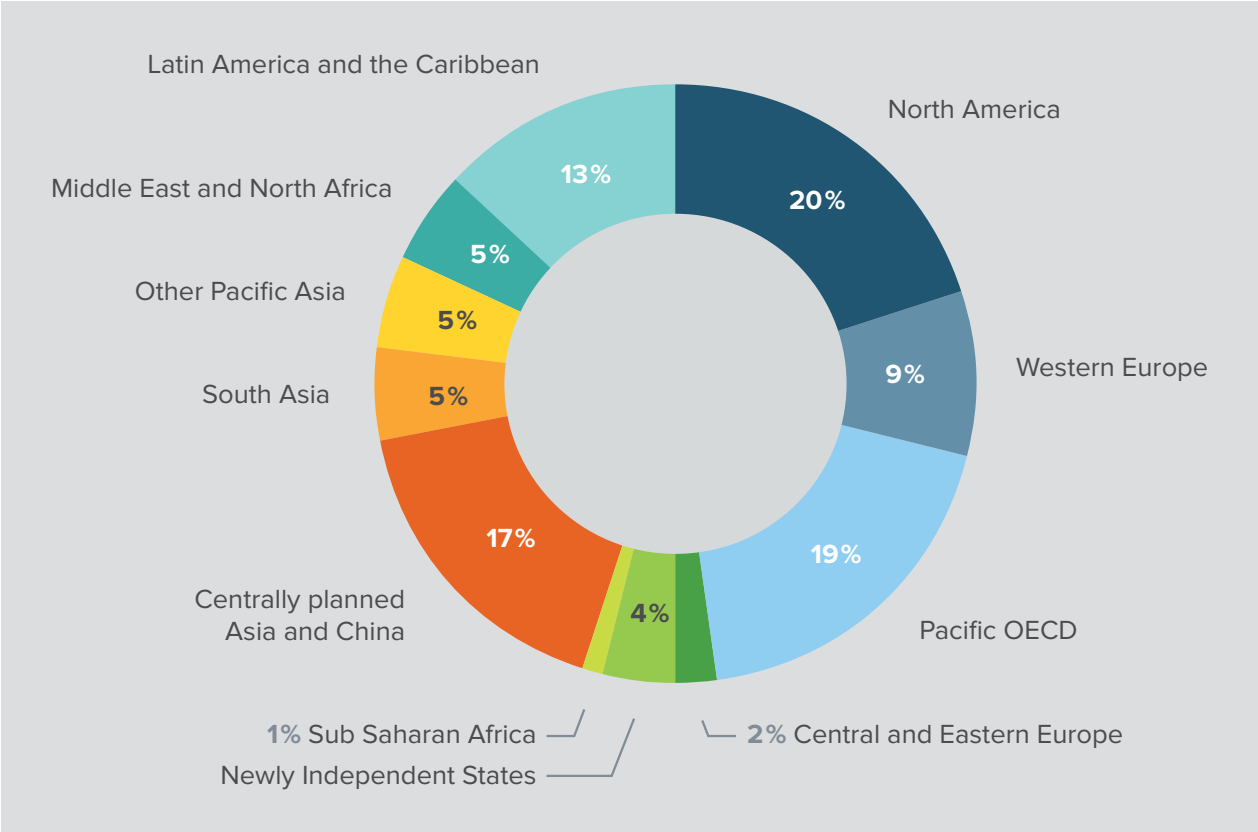

Figure 3: Worldwide distribution of water consumption for domestic washing machines

Source: Own calculation based on IEA, Pakula / Stamminger 2010 and other reports

Based on data by Pakula / Stamminger (2010), other available reports, own calculations and extrapolations as well as expert opinions, the electricity and water consumption of automatic washing machines in households has been calculated and extrapolated to global scale on a country by country basis.

1.3 The worldwide energy and cost saving potential

About **840 million** domestic washing machines are in use worldwide. The average annual consumption of each of these washing machines amounts to about **110 kWh** and **23 m^3 of water**. In total, this causes an annual direct electricity consumption of **92 TWh** and a water consumption of **19 billion m^3**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, a relative decoupling of the growth of the worldwide annual energy and water consumption and the increasing stock of domestic washing machines can be achieved. While the stock is expected to grow by 36 % until 2020, in the efficiency scenario the energy consumption would only increase by 12 % and the water consumption by 5 %. Although the stock is expected to grow by another 26 % until 2030, the increase of the energy and water consumption would be limited to half of that value (13 %), each for energy as well as water consumption (see Figure 4 and Figure 5). Thereby, higher living standards, represented by increasing appliance ownership rates, more wash cycles per household and year, a more frequent usage of warm wash cycles as well as a technological change towards more water efficient horizontal axis washing machines already have been anticipated. In contrast, in the baseline scenario, the energy and water consumption would increase by 43 % and 15 % by 2020 and additionally by 35 % and 18 % by 2030.

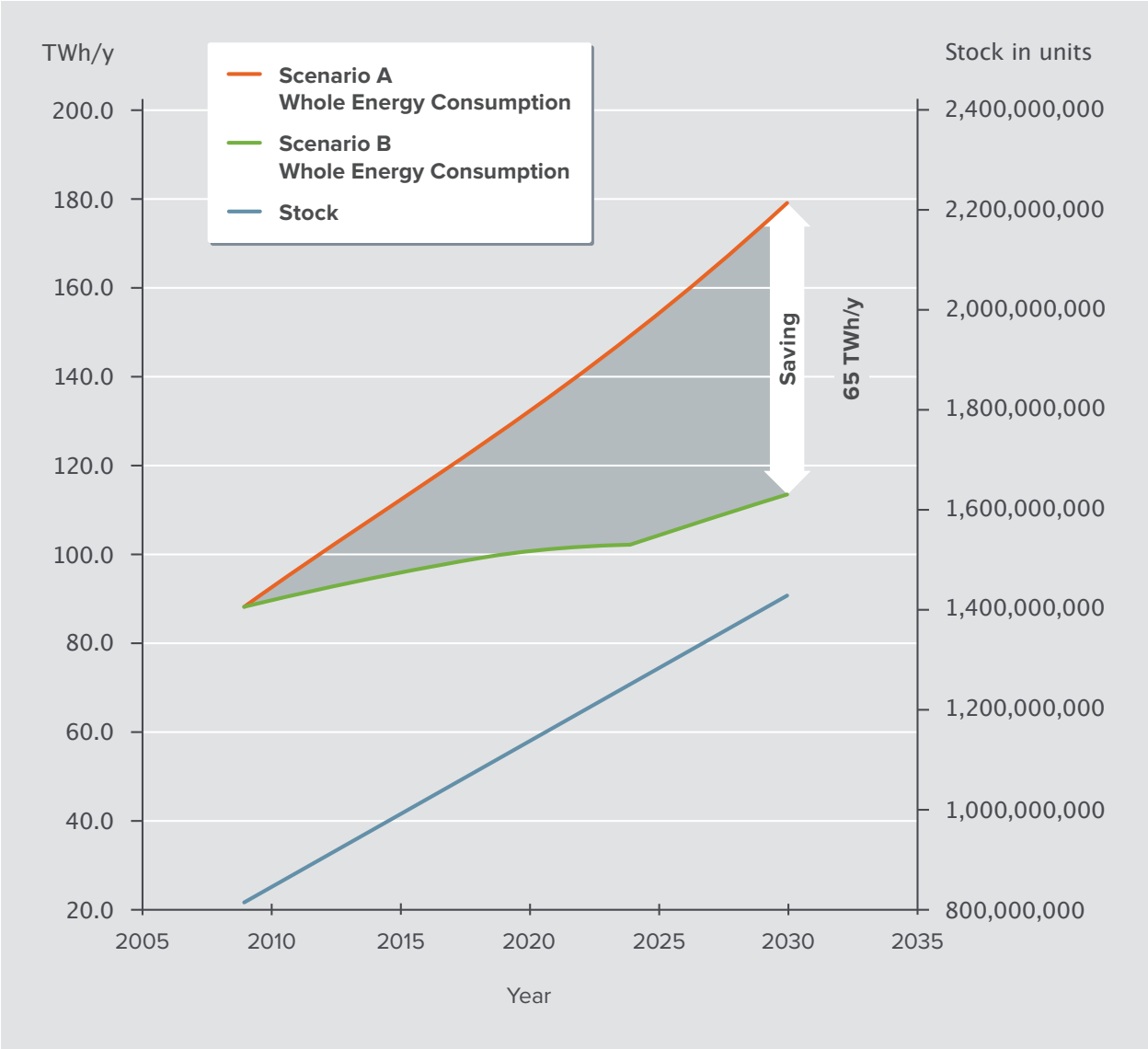

Figure 4: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data

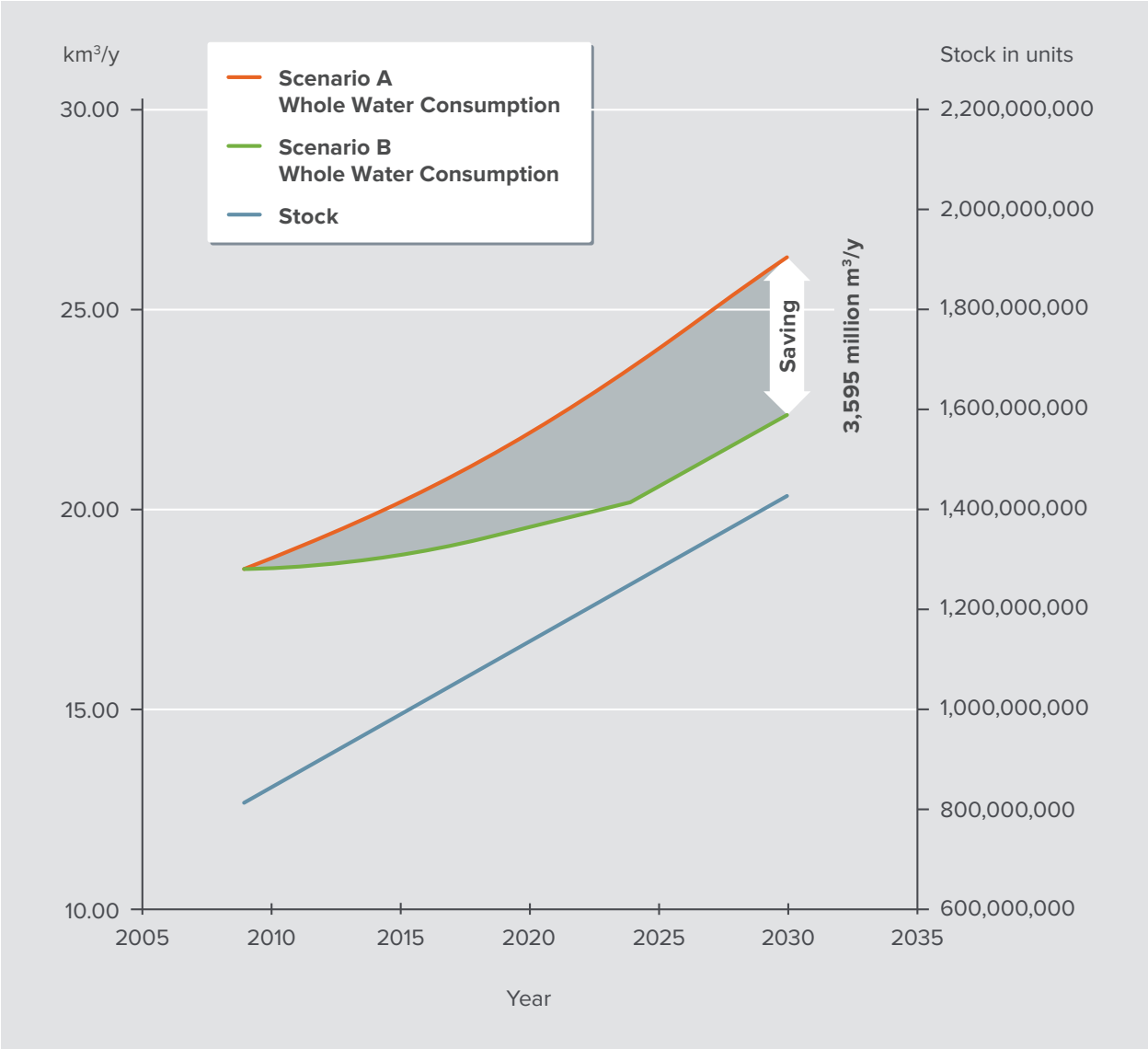

Figure 5: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation; WEC 2009 and IEA 2010 for population data

Table 1: Population, electricity and water consumption data of domestic washing machines for the whole world for the base year 2010 and potential changes by 2020 and 2030

Base year 2010	Population	6,859,396,560
	Quota of households owning a washing machine [%]	46.9
	Total electricity net consumption per year [TWh/year]	17,434
	Total domestic electricity consumption per year [TWh/year]	4,686
	Total energy consumption of washing machines per year [TWh/year]	92.17
	Total water consumption of washing machines per year [km^3/year]	19.08
	Stock number washing machines	839,618,516.41
	Average annual energy consumption of washing machines in the stock [kWh/year]	110
	Average annual water consumption of washing machines in the stock [m^3/year]	23
	Total annual CO_2eq emissions related with washing machines [Mt/year]	62.27
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	31.46
	Water savings potential in 2020 vs. baseline development [km^3/year]	2.17
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	8.37
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	0.76
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	20.76
	Stock number of residential washing machines in 2030	1,138,762,875.62
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	80.06
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	16.24
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	18,662,545,933
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	19,127,313,523
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	14,603,812,552
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	-4,242,808,302
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	65.03
	Water savings potential in 2030 vs. baseline development [km^3/year]	3.60
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	21.09
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	3.37
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	42.44
	Stock number of washing machines in 2030	1,437,907,234.82
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	75.72
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	14.83
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	10,530,386,064
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	56,807,768,953

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	16,949,127,648
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	1,217.89
	Total savings water, scenario B compared to scenario A [km^3]	71.53
	Total GHG emission reductions scenario B compared to scenario A [Mt]	784.48
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	29,192,931,996.8
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	36,268,904,012
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	88,523,101,415
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	51,140,225,010

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2 The energy and cost saving potential by world region

2.1 NAM – North America

2.1.1 Included countries

Aruba, Bermuda, Canada, Cayman Islands, Falkland Islands, Guam, Puerto Rico, Saint Pierre and Miquelon, United States, Virgin Islands, U.S., Virgin Islands, British.

2.1.2 Key messages and data

About **107 million** domestic washing machines are in use in **North America**. With an average annual direct electricity consumption of **149 kWh** each, altogether they account for about **1 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **10.7 million tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **2.6 TWh** of electricity, **250 million m^3** of water and **1.7 million tons** of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

About **107 million** domestic washing machines are in use in **North America**. The average annual consumption of one of these washing machines amounts to about **149 kWh** of electricity and **36 m^3** of water. In total, this causes an annual direct electricity consumption of **15.9 TWh** and a water consumption of **3.9 billion m^3**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, in North America an absolute decoupling of the annual energy and water consumption and the still increasing stock of domestic washing machines can be achieved. While the stock is expected to grow by 20 % until 2020, in the efficiency scenario the energy consumption would decrease by 5 % and the water consumption by 12 %. Although the stock is expected to grow by another 16 % until 2030, the energy consumption would further decrease by 2 % and the water consumption by 4 % within this period (see Figure 8 and Figure 9). Thereby, an increasing appliance ownership rate and a technological change towards more water efficient horizontal axis washing machines already have been anticipated.

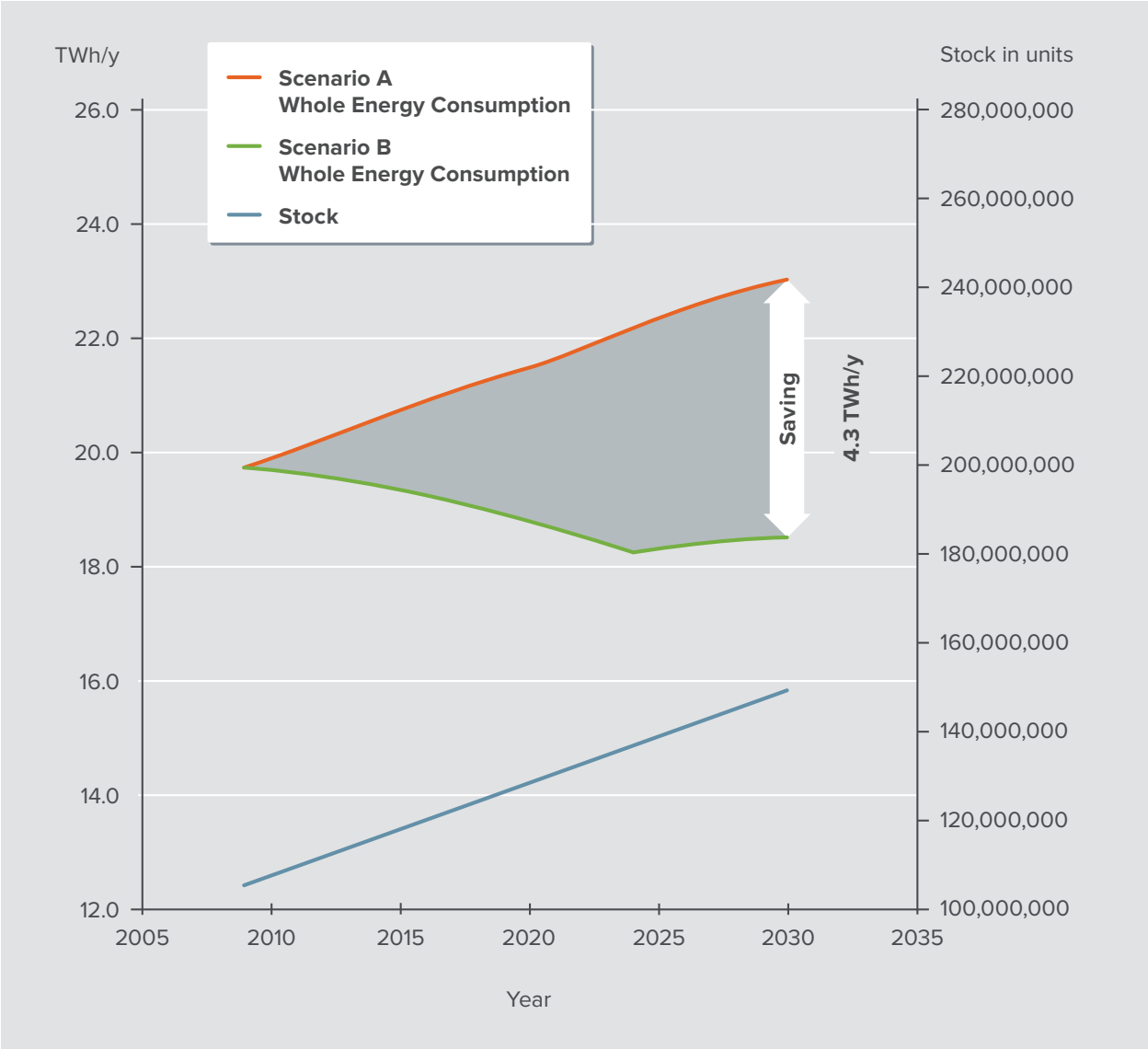

Figure 6: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

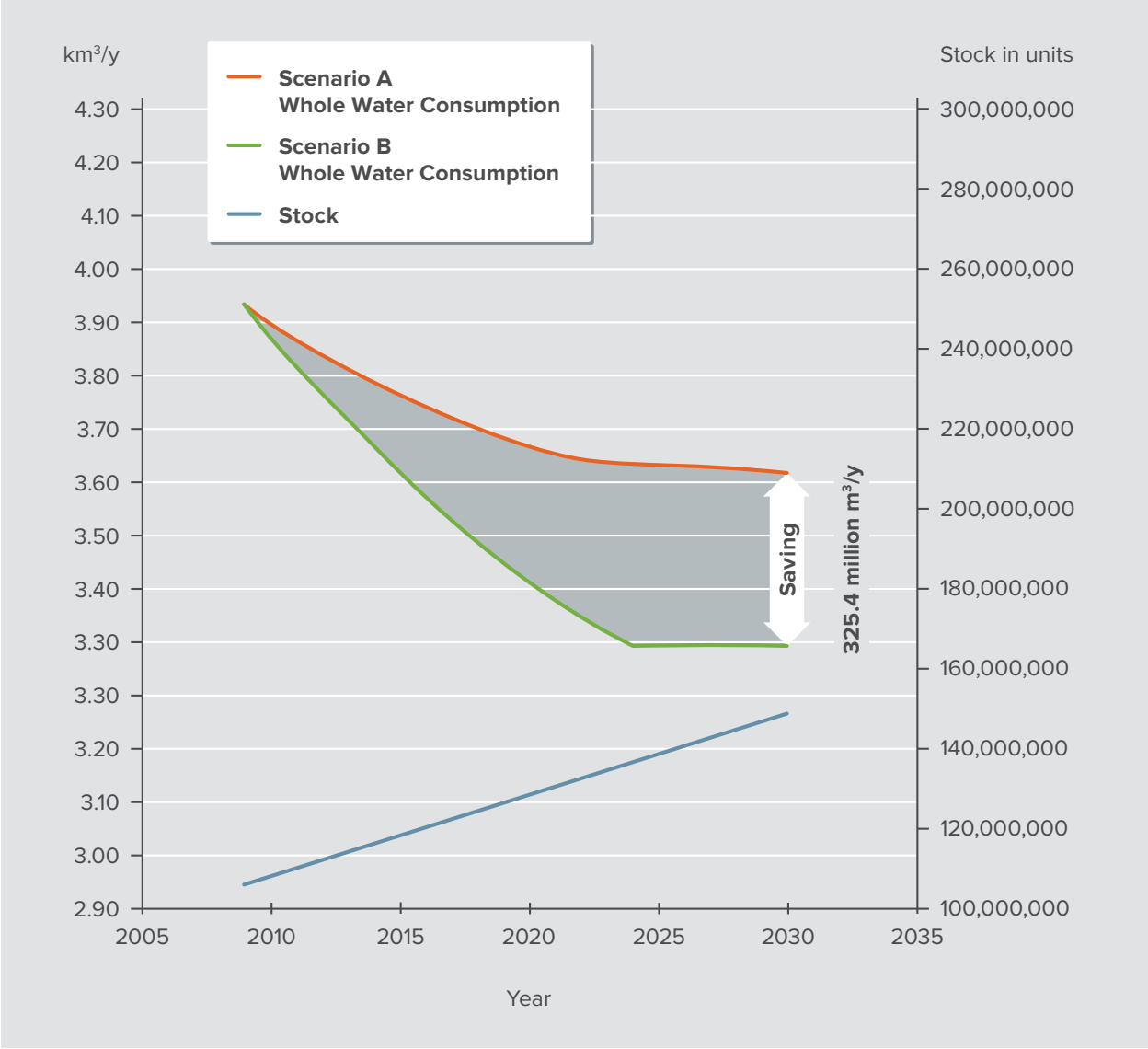

Figure 7: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 2). For hints and links to good practice policy examples also visit www.bigee.net.

Table 2: Population, electricity and water consumption data of domestic washing machines for North America for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	352,728,816
	Quota of households owning a washing machine [%]	85.6
	Total electricity net consumption per year [TWh/year]	4,454
	Total domestic electricity consumption per year [TWh/year]	1,602
	Total energy consumption of washing machines per year [TWh/year]	15,88
	Total water consumption of washing machines per year [km^3/year]	3,90
	Stock number washing machines	106.800.055
	Average annual energy consumption of washing machines in the stock [kWh/year]	149
	Average annual water consumption of washing machines in the stock [m^3/year]	36
	Total annual CO_2eq emissions related with washing machines [Mt/year]	10,73
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	2,58
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,25
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	-1,02
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	-0,48
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1,70
	Stock number of residential washing machines in 2030	127.697.304
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	102,37
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	23,24
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	2.132.979.238
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	2.193.752.888
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.290.230.658
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	-754.603.485
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	4,31
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,33
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-1,32
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	-0,60
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	2,81
	Stock number of washing machines in 2030	148.594.553
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	87,79
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	20,15
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	1.158.121.452
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	4.827.840.459

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	460.557.206
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	84,96
	Total savings water, scenario B compared to scenario A [km^3]	6,99
	Total GHG emission reductions scenario B compared to scenario A [Mt]	54,93
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	3.291.100.689
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	4.070.510.641
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	7.039.387.901
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	2.594.750.970

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.1.3 Background information

In North America, vertical axis machines are most widespread and represent more than 80 % of the stock (RECS 2009). The most frequently used wash temperatures are between 15 and 48°C. Although the average washing temperatures are lower than in countries with traditionally mainly horizontal axis technology and the common usage of hot-wash programmes, the usage of washing machines in North America also causes a significant consumption of energy. Due to the more water intensive vertical axis technology, more water has to be heated for each wash cycle. Thereby, in North America commonly pre-heated water from the tap is used (provided by another distinct and external appliance), which is not further heated by the washing machine itself. Furthermore, North American households run more wash cycles than e.g. households in Europe (Pakula / Stamminger 2010).

Cleaning performance depends on a minimum amount of energy and resource input in terms of mechanical work, thermal energy, chemicals and time. In countries, in which vertical axis washing machines are prevailing, a better cleaning performance is often achieved by an additional input of detergents and/or mechanical energy outside the washing machine. If such supplementary manual pre- or post treatment processes are performed, a significant amount energy and water may be used in addition to the consumption calculated for washing machines alone.

2.2 WEU and EEU - Western, Central and Eastern Europe

2.2.1 Included countries

Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Cyprus (incl. North Cyprus), Denmark, Faroe Islands, Finland, France, Germany, Gibraltar, Greece, Greenland, Hungary, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Macedonia, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia (incl. Kosovo), Slovakia, Slovenia Spain, Sweden, Switzerland, Turkey and United Kingdom.

2.2.2 Key messages and data

About **193 million** domestic washing machines are in use in Western, Central and Eastern Europe. With an average annual direct electricity consumption of **161 kWh** each, altogether they account for about **3 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **21 million tons** of CO_2-eq.

If every time a washing machine is replaced, the most energy-efficient model is chosen, **4.3 TWh** of electricity, **220 million m^3** of water and **2.8 million tons** of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

193 million domestic washing machines are in use in Western, Central and Eastern Europe. The average annual consumption of one of these washing machines amounts to about **161 kWh** of electricity and **10 m^3** of water. In total, this causes an annual direct electricity consumption of **31 TWh** and a water consumption of **2 billion m^3**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, in Western, Central and Eastern Europe an absolute decoupling of the annual energy and water consumption and the still increasing stock of domestic washing machines can be achieved. While the stock is expected to grow by 12 % until 2020, in the efficiency scenario the energy consumption would decrease by 17 % and the water consumption by 13 %. Although the stock is expected to grow by another 11 % until 2030, the energy consumption would further decrease by 17 % and the water consumption by 1 % within this period (see Figure 8 and Figure 9). Thereby, an increasing appliance ownership rate and a change towards even more efficient horizontal axis washing machines and a reduced average washing temperature of 30 to 40°C have been anticipated.

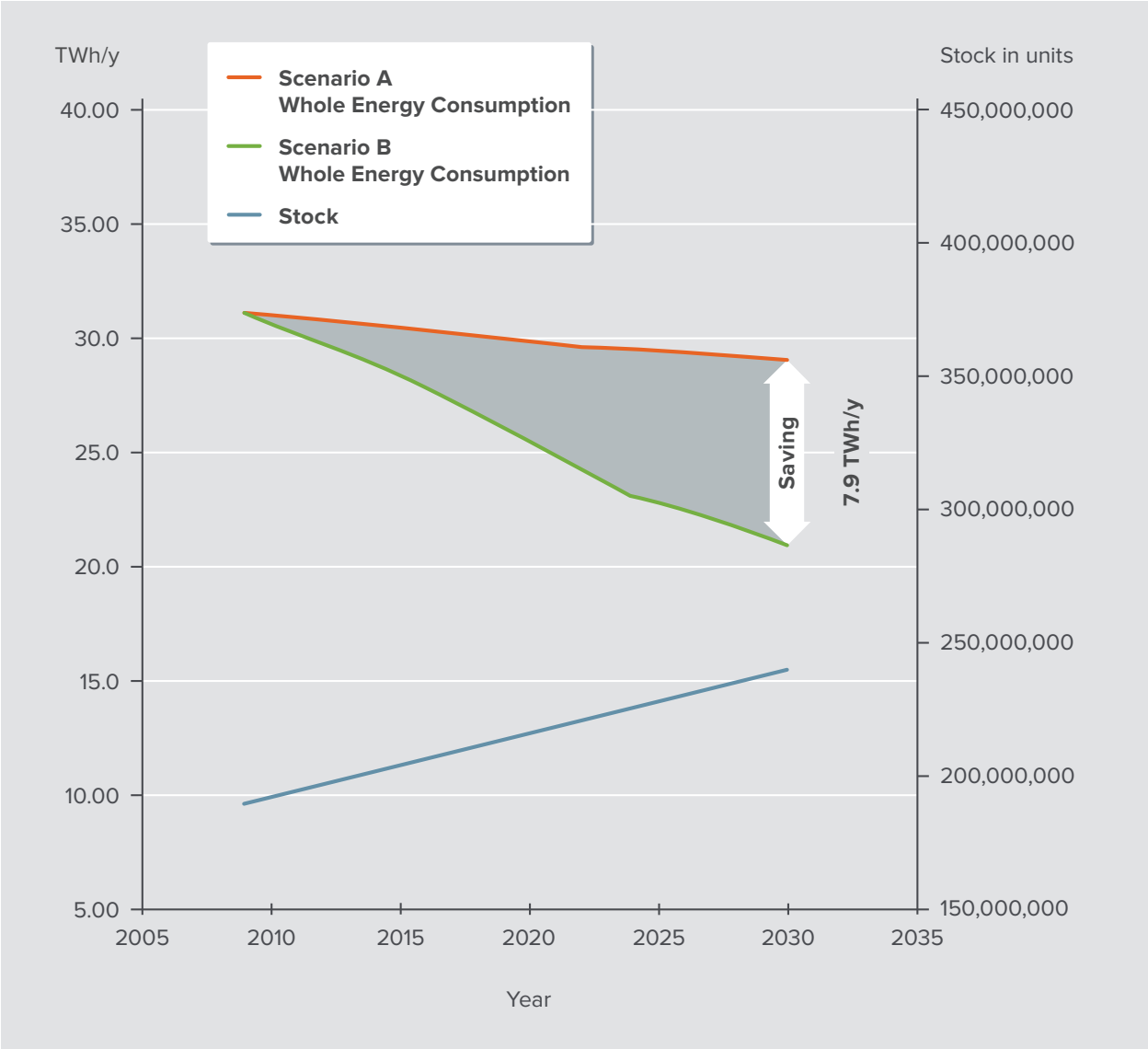

Figure 8: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

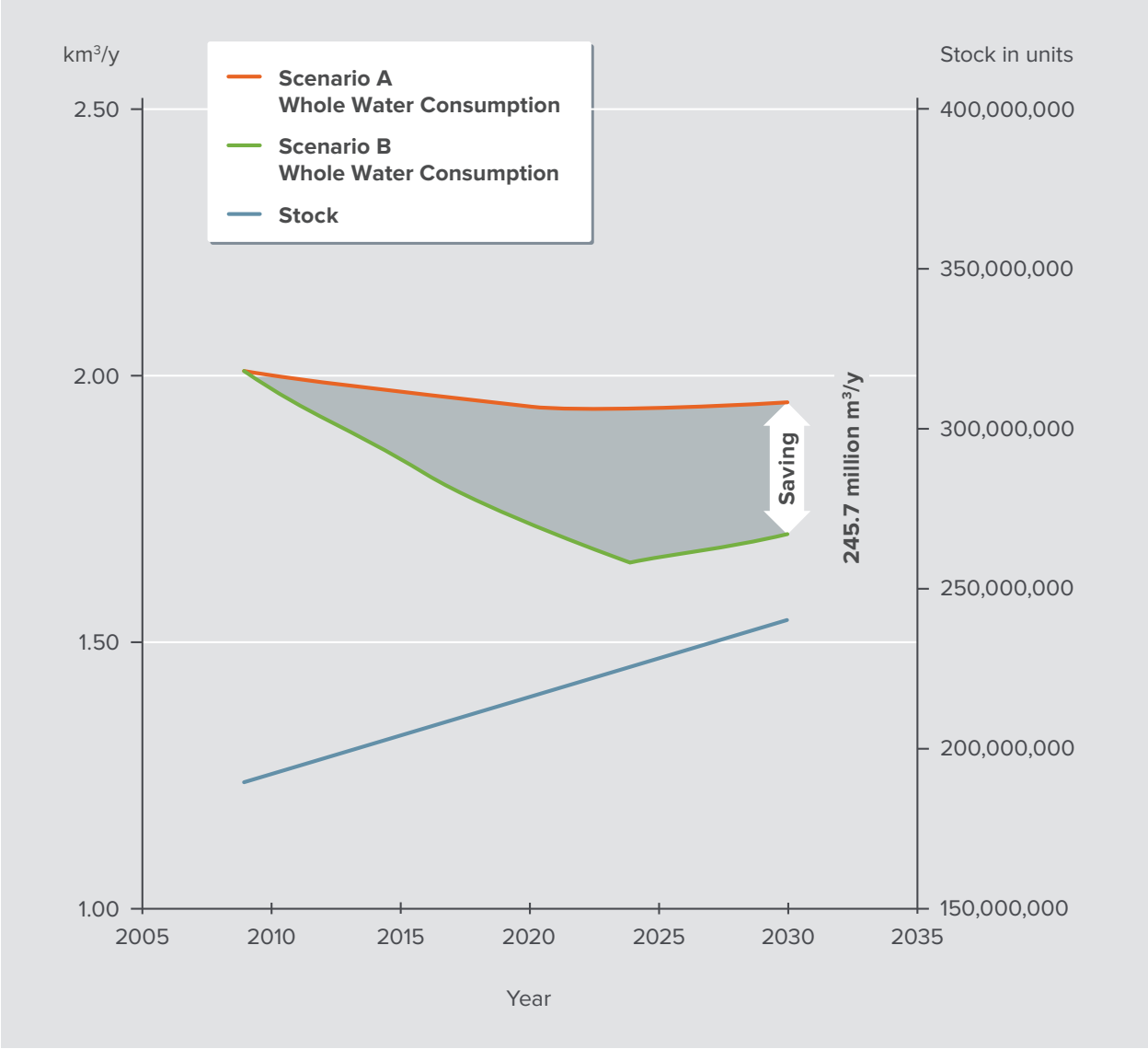

Figure 9: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 3). For hints and links to good practice policy examples also visit www.bigee.net.

Table 3: Population, electricity and water consumption data of domestic washing machines for Western, Central and Eastern Europe for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	600,872,150
	Quota of households owning a washing machine [%]	86.4
	Total electricity net consumption per year [TWh/year]	3,396
	Total domestic electricity consumption per year [TWh/year]	942.6
	Total energy consumption of washing machines per year [TWh/year]	31,04
	Total water consumption of washing machines per year [km^3/year]	1,99
	Stock number washing machines	192.853.372
	Average annual energy consumption of washing machines in the stock [kWh/year]	161
	Average annual water consumption of washing machines in the stock [m^3/year]	10
	Total annual CO_2eq emissions related with washing machines [Mt/year]	20,97
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	4,31
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,22
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	-5,41
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	-0,28
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	2,84
	Stock number of residential washing machines in 2030	216.307.386
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	96,17
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	7,18
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	4.608.698.188
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	4.727.072.142
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	-1.255.049.707
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	-3.599.668.079
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	7,90
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,25
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-9,83
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	-0,30
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	5,16
	Stock number of washing machines in 2030	239.761.400
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	72,04
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	6,81
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	2.273.298.173
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.315.315.086

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	-4.371.782.834
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	150,55
	Total savings water, scenario B compared to scenario A [km^3]	5,61
	Total GHG emission reductions scenario B compared to scenario A [Mt]	97,20
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	6.881.996.362
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	8.400.177.059
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	3.713.100.361
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	-2.221.339.167

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.2.3 Background information

In Western, Central and Eastern Europe as well as in Turkey, horizontal axis washing machines with integrated electric heating rods are used. The market in many European countries is already saturated and nowadays dominated by substitution. Although the usage of warm and hot wash cycles is common in Europe, the overall electricity and water efficiency of Western European horizontal axis washing machine technology has been improved by about 30 % within 10 years, which is a result of the forced energy efficiency policy of the European Union. Due to the economical water consumption of their washing machines, households in Europe use less water for clothes washing per cycle and year than most other countries in the world (Pakula / Stamminger 2010). This development is not only a success of continuous optimisation, but also a result of the practice of discarding the most inefficient models by Ecodesign.

2.3 PAO – Pacific OECD (+ South Korea)

2.3.1 Included countries

Australia, Cook Islands, Japan, New Zealand, Niue + additionally South Korea (originally IPCC PAS region, but assigned for the purposes of this text to PAO countries due to similar socioeconomic as well as technological parameters).

2.3.2 Key messages and data

About **71 million** domestic washing machines are in use in **Pacific OECD countries**. With an average annual direct electricity consumption of **85 kWh** each, altogether they account for almost **1.4 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **4.1 million tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **1 TWh** of electricity, **96 million m³** of water and **1 million tons** of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

71 million domestic washing machines are in use in **Pacific OECD countries**. The average annual consumption of one of these washing machines amounts to about **85 kWh** of electricity and **50 m³** of water. In total, this causes an annual direct electricity consumption of **6.1 TWh** and a water consumption of **3.6 billion m³**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, in Pacific OECD countries an absolute decoupling of the annual energy and water consumption and the increasing stock of domestic washing machines can be achieved. While the stock is expected to grow by 10 % until 2020, in the efficiency scenario the energy consumption would decrease by 6 % and the water consumption by 13 %. Although the stock is expected to grow by another 9 % until 2030, the energy consumption could be further decreased by 2 % and the water consumption by 11 % within this period (see Figure 10 and Figure 11). Thereby, an increasing appliance ownership rate and a change towards more efficient horizontal axis washing machines combined with an average washing temperature of 30-40°C have been anticipated.

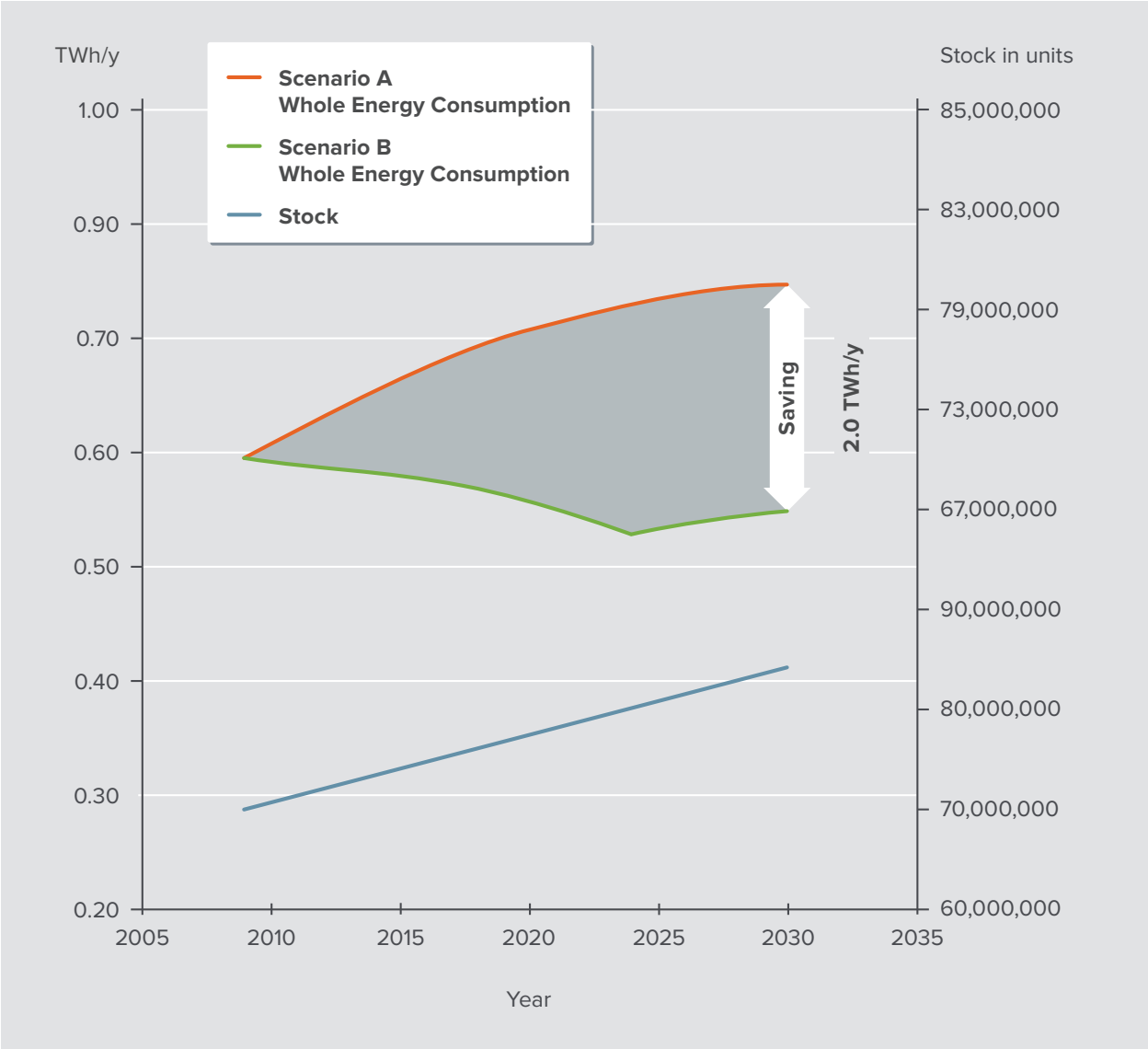

Figure 10: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

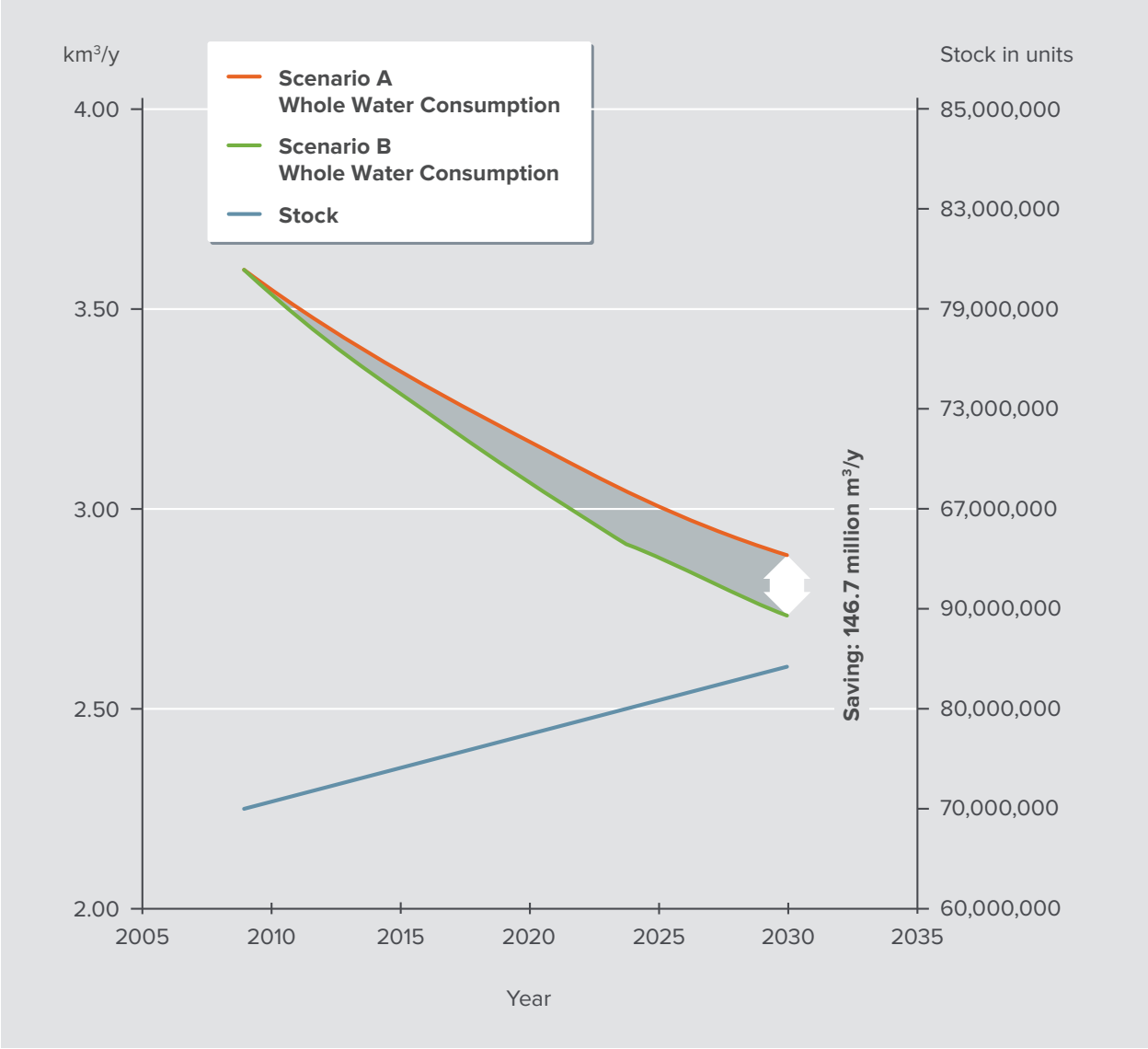

Figure 11: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 4). For hints and links to good practice policy examples also visit www.bigee.net.

Table 4: Population, electricity and water consumption data of domestic washing machines for Pacific OECD countries for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	201,061,224
	Quota of households owning a washing machine [%]	98.4
	Total electricity net consumption per year [TWh/year]	1,684
	Total domestic electricity consumption per year [TWh/year]	428.2
	Total energy consumption of washing machines per year [TWh/year]	6,06
	Total water consumption of washing machines per year [km^3/year]	3,55
	Stock number washing machines	70.975.507
	Average annual energy consumption of washing machines in the stock [kWh/year]	85
	Average annual water consumption of washing machines in the stock [m^3/year]	50
	Total annual CO_2eq emissions related with washing machines [Mt/year]	4,09
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	1,50
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,10
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	-0,49
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	-0,48
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0,99
	Stock number of residential washing machines in 2030	78.322.566
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	64,52
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	34,05
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	1.679.267.508
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	1.719.295.698
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	-248.593.916
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	-1.211.498.167
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	2,00
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,15
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-0,58
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	-0,81
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1,31
	Stock number of washing machines in 2030	85.669.626
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	60,24
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	28,25
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	852.809.852
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	787.701.855

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	-1.528.684.598
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	42,98
	Total savings water, scenario B compared to scenario A [km^3]	3,03
	Total GHG emission reductions scenario B compared to scenario A [Mt]	27,90
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	2.532.077.360
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	3.100.133.040
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.740.096.297
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	-755.283.399

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.3.3 Background information

Most of the washing machines in PAO countries are vertical axis machines, although the sales show that purchases are gradually migrating from vertical-axis top loaders to horizontal-axis front loaders. Households in PAO countries run more wash cycles than e.g. households in Europe, which seems to correlate with the dominating vertical axis technology and the use of frequent short cold or low-temperature washing programs (Pakula / Stamminger 2010).

2.4 NIS – Newly Independent States

2.4.1 Included countries

Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan.

2.4.2 Key messages and data

About **58 million** domestic washing machines are in use in **Newly Independent States**. With an average annual direct electricity consumption of **194 kWh** each, altogether they account for almost **6.2 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **7.7 million tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **1.9 TWh** of electricity, **64 million m³** of water and **1.3 million tons** of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

About **58 million** domestic washing machines are in use in **Newly Independent States**. The average annual consumption of one of these washing machines amounts to about **194 kWh** and **12 m³** of water. In total, this causes an annual direct electricity consumption of **11.3 TWh** and a water consumption of **700 million m³**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, in Newly Independent States an absolute decoupling of the annual energy and water consumption and the increasing stock of domestic washing machines can be achieved. While the stock is expected to grow by 6 % until 2020, in the efficiency scenario the energy consumption would decrease by 30 % and the water consumption by 21 %. Although the stock is expected to grow by another 6 % until 2030, the energy consumption would further decrease by 25 % and the water consumption by 8 % within this period (see Figure 12 and Figure 13). Thereby, higher living standards represented by increasing appliance ownership rates and a change towards even more efficient horizontal axis washing machines combined with an average washing temperature of 30-40°C have been anticipated.

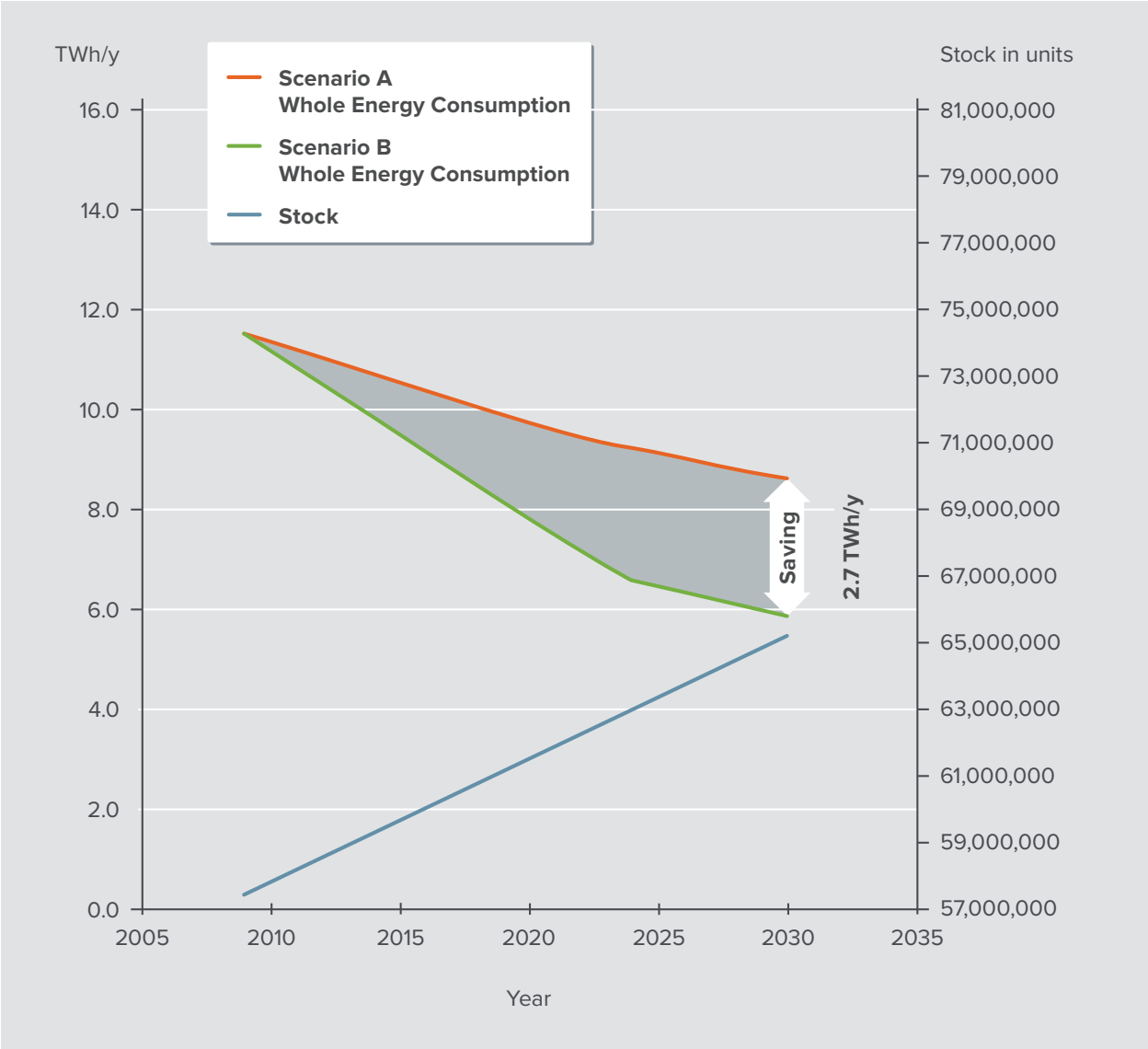

Figure 12: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

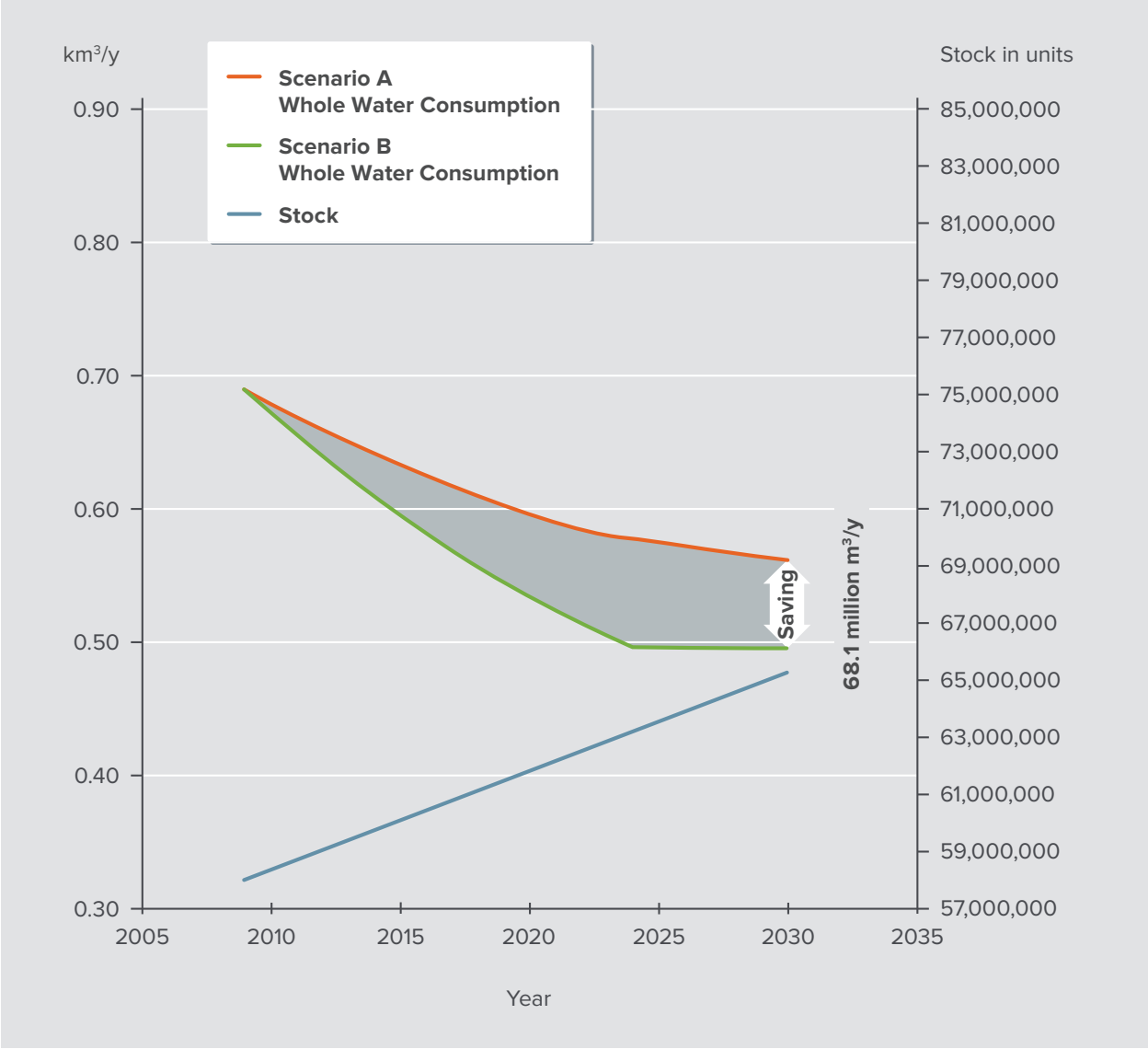

Figure 13: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users. For hints and links to good practice policy examples also visit www.bigee.net.

Table 5: Population, electricity and water consumption data of domestic washing machines for Newly Independent States for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	283,540,000
	Quota of households owning a washing machine [%]	65.3
	Total electricity net consumption per year [TWh/year]	1,238
	Total domestic electricity consumption per year [TWh/year]	187
	Total energy consumption of washing machines per year [TWh/year]	11,33
	Total water consumption of washing machines per year [km^3/year]	0,68
	Stock number washing machines	58.284.296
	Average annual energy consumption of washing machines in the stock [kWh/year]	194
	Average annual water consumption of washing machines in the stock [m^3/year]	12
	Total annual CO_2eq emissions related with washing machines [Mt/year]	7,66
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	1,90
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,06
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	-3,50
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	-0,15
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1,25
	Stock number of residential washing machines in 2030	61.735.351
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	98,12
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	7,71
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	950.299.328
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	973.133.432
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	500.678.167
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	-297.281.138
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	2,73
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,07
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	-5,42
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	-0,19
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1,78
	Stock number of washing machines in 2030	65.186.405
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	74,12
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	7,22
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	451.139.650
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.931.182.118

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	377.725.852
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	56,35
	Total savings water, scenario B compared to scenario A [km^3]	1,58
	Total GHG emission reductions scenario B compared to scenario A [Mt]	36,53
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.401.438.979
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	1.700.570.725
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	2.743.825.285
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	1.238.042.605

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.5 AFR – Sub-Saharan Africa

2.5.1 Included countries

Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Brazzaville), Congo (Kinshasa), Cote d´Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauretania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia (incl. Somaliland), South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

2.5.2 Key messages and data

About **6.4 million** domestic washing machines are in use in **Sub-Saharan Africa**. With an average annual direct electricity consumption of **198 kWh** each, altogether they account for almost **1.5 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **860,000 tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **532 GWh** of electricity, **39 million m^3** and **350,000 tons** of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

About **6.4 million** domestic washing machines are in use in **Sub-Saharan Africa**. The average annual consumption of one of these washing machines amounts to about **198 kWh** and **31 m^3** of water. In total, this causes an annual direct electricity consumption of **1.3 TWh** and a water consumption of **200 million m^3**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, a relative decoupling of the growth of the annual energy and water consumption and the increasing stock of domestic washing machines in Sub-Saharan Africa can be achieved. While the stock is expected to grow by 105 % until 2020, in the efficiency scenario the energy consumption would only increase by 33 % and the water consumption by 58 %. Although the stock is expected to grow by another 51 % until 2030, the increase would be limited to 9 % for energy and to 32 % for the water consumption (see Figure 14 and Figure 15). Thereby, higher living standards, represented by increasing appliance ownership rates, a more frequent usage of warm wash cycles as well as a slow technological change towards horizontal axis washing machines already have been anticipated. In contrast, in the baseline scenario the energy and water consumption would increase by 70 % and 75 % by 2020 and additionally by 22 % and 35 % by 2030.

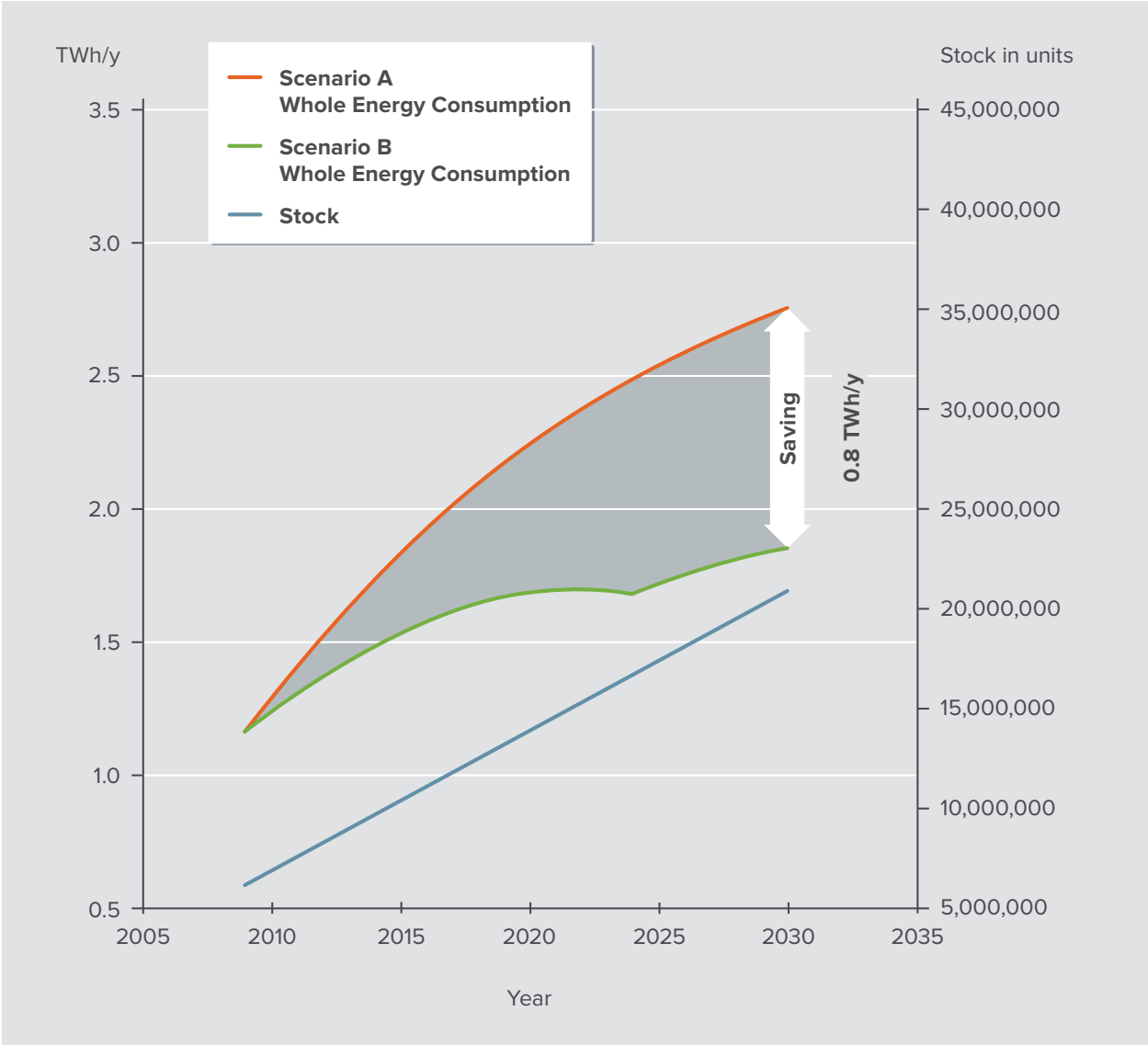

Figure 14: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

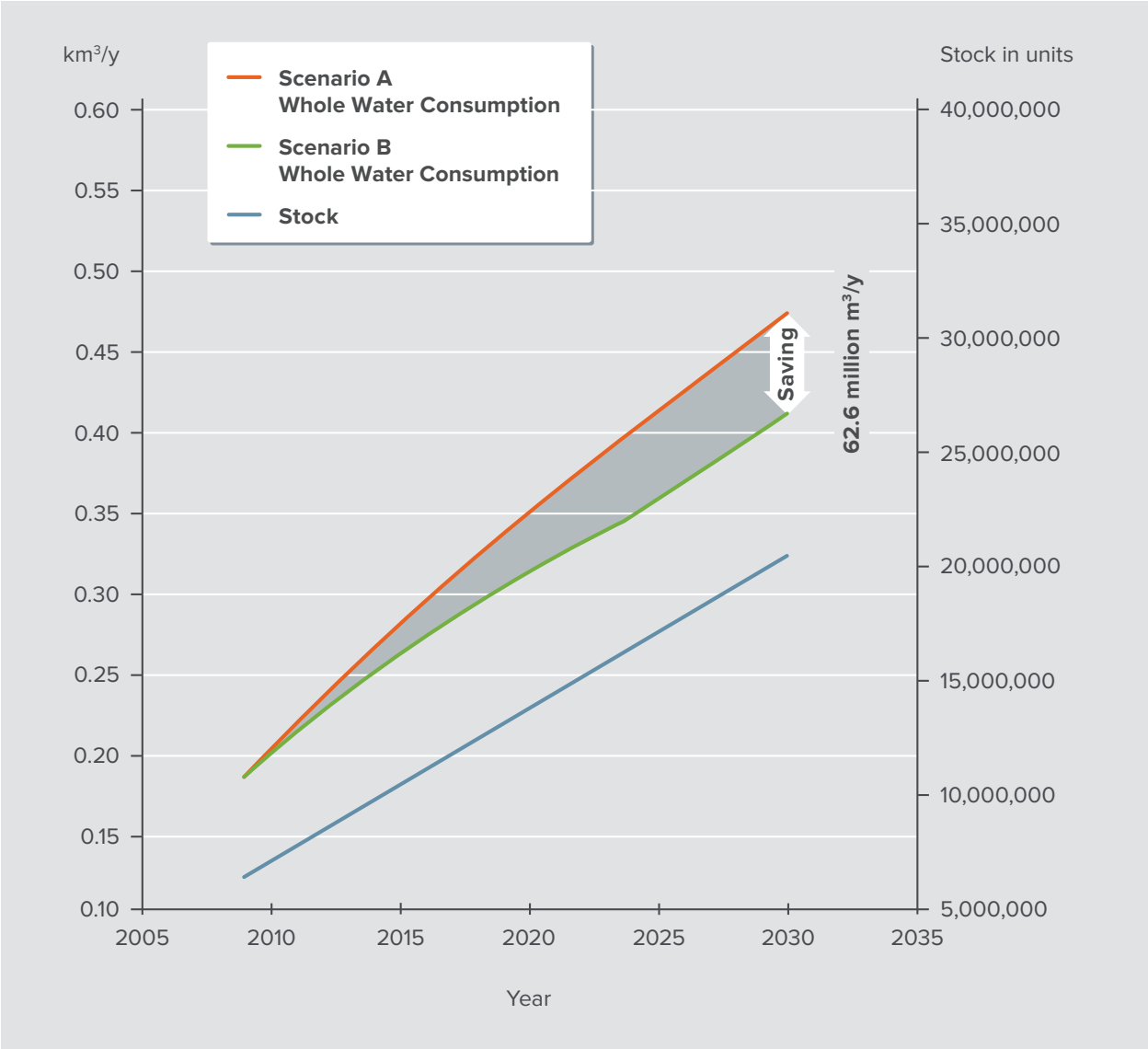

Figure 15: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 6). For hints and links to good practice policy examples also visit www.bigee.net.

Table 6: Population, electricity and water consumption data of domestic washing machines for Sub-Saharan Africa for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	800,157,500
	Quota of households owning a washing machine [%]	4.0
	Total electricity net consumption per year [TWh/year]	330.6
	Total domestic electricity consumption per year [TWh/year]	84.5
	Total energy consumption of washing machines per year [TWh/year]	1,27
	Total water consumption of washing machines per year [km^3/year]	0,20
	Stock number washing machines	6.417.513
	Average annual energy consumption of washing machines in the stock [kWh/year]	198
	Average annual water consumption of washing machines in the stock [m^3/year]	31
	Total annual CO_2eq emissions related with washing machines [Mt/year]	0,86
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	0,53
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,04
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	0,36
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	0,11
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0,35
	Stock number of residential washing machines in 2030	13.179.878
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	97,47
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	21,22
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	155.272.918
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	160.717.593
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	472.999.227
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	150.213.360
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	0,85
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,06
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	0,51
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	0,21
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0,55
	Stock number of washing machines in 2030	19.942.243
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	75,28
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	19,38
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	105.647.944
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.294.891.552,41

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	680.109.620,12
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	16,98
	Total savings water, scenario B compared to scenario A [km^3]	1,25
	Total GHG emission reductions scenario B compared to scenario A [Mt]	10,99
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	260.920.862
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	332.590.208
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.770.859.571
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	1.196.585.263

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.6 CPA – Centrally planned Asia and China

2.6.1 Included countries

Cambodia, China, Hong Kong, Korea (North), Laos, Macau, Mongolia, Vietnam

2.6.2 Key messages and data

About **247 million** domestic washing machines are in use in **Centrally planned Asia and China**. With an average annual direct electricity consumption of **30 kWh** each, altogether they account for about **1.7 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **5 million tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **12 TWh** of electricity and **7.9** million tons of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

247 million domestic washing machines are in use in **Centrally planned Asia and China**. The average annual consumption of one of these washing machines amounts to about **30 kWh** and **13 m^3** of water. In total, this causes an annual direct electricity consumption of **7.4 TWh** and a water consumption of **3.3 billion m^3**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, the growth of the annual energy and water consumption of the fast increasing stock of domestic washing machines in Centrally planned Asia and China can be mitigated. The stock is expected to grow by 43 % until 2020 and by another 30 % until 2030. Thereby, higher living standards, represented by increasing appliance ownership rates and wash cycles per household and year, a change from predominantly cold wash to warm wash cycles as well as a fast technological change towards horizontal axis washing machines have been anticipated. Due to the presumed change of wash habits to more energy intensive warm wash cycles, in the baseline scenario the energy consumption would increase by 320 % by 2020 and additionally by 118 % by 2030. The water consumption would increase by 8 % and 44 % in the respective periods. In the efficiency scenario, by 2020 the growth of the energy consumption could be limited to 190 % and the water consumption would even decrease by 6 %, especially due to the diffusion of much more water efficient horizontal axis washing machines. By 2030 the growth of energy consumption could be limited to 81 % and to 30 % with regard to water consumption (see Figure 16 and Figure 17).

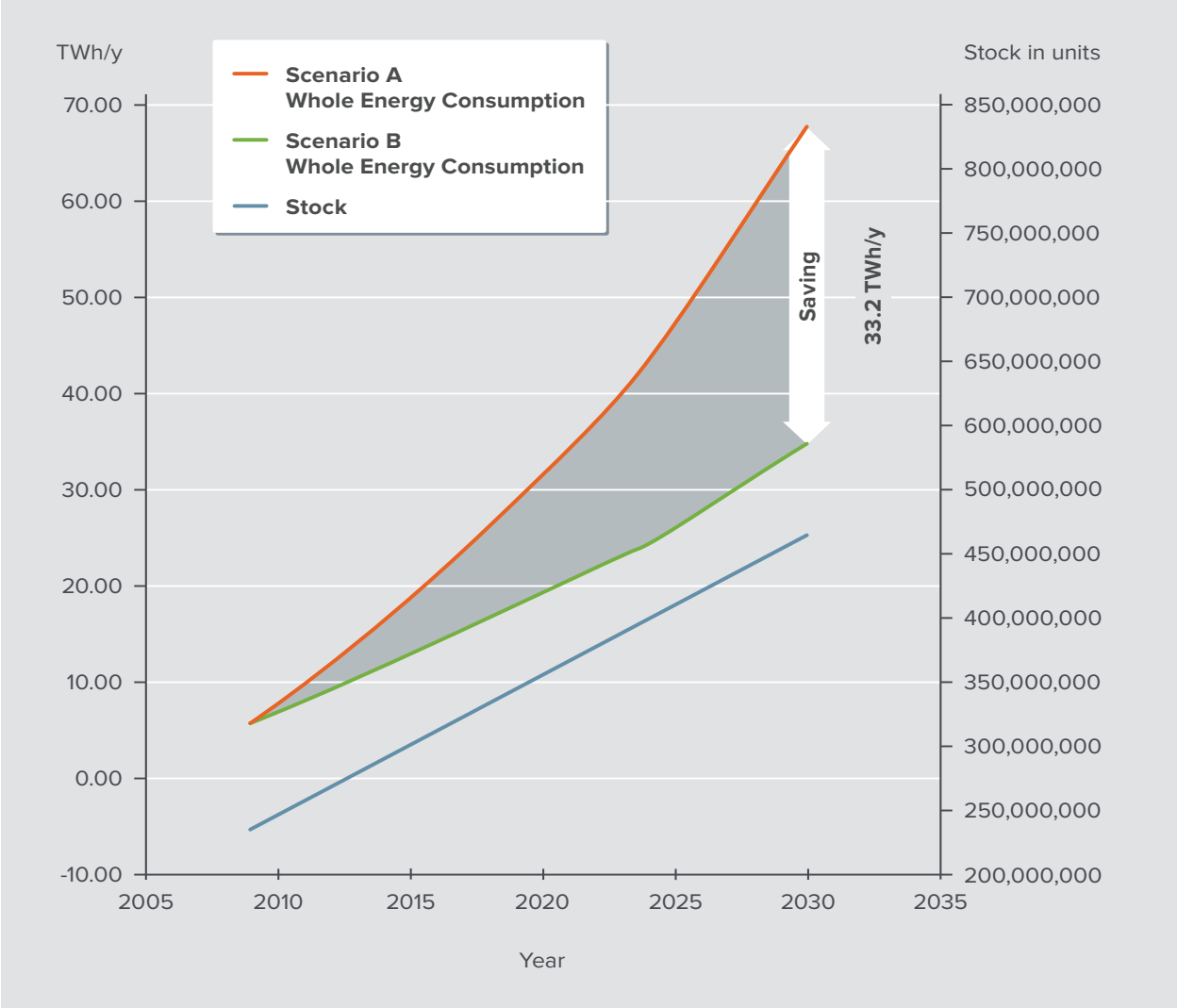

Figure 16: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

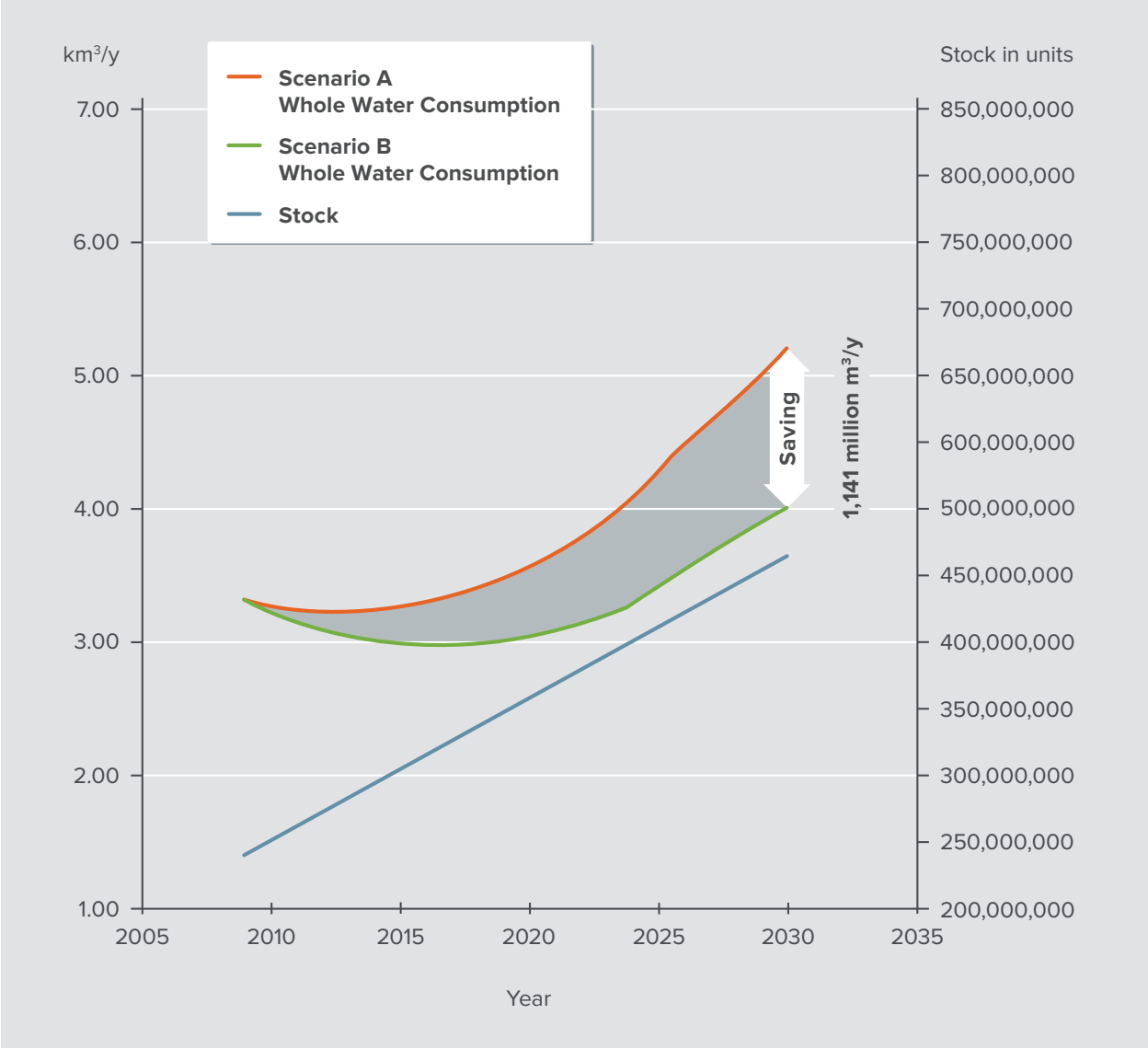

Figure 17: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 7). For hints and links to good practice policy examples also visit www.bigee.net.

Table 7: Population, electricity and water consumption data of domestic washing machines for Centrally planned Asia and China for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	1,496,590,500
	Quota of households owning a washing machine [%]	57.1
	Total electricity net consumption per year [TWh/year]	3,103
	Total domestic electricity consumption per year [TWh/year]	435
	Total energy consumption of washing machines per year [TWh/year]	7,38
	Total water consumption of washing machines per year [km^3/year]	3,30
	Stock number washing machines	247.436.942
	Average annual energy consumption of washing machines in the stock [kWh/year]	30
	Average annual water consumption of washing machines in the stock [m^3/year]	13
	Total annual CO_2eq emissions related with washing machines [Mt/year]	4,99
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	11,98
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,50
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	11,67
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	-0,22
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	7,91
	Stock number of residential washing machines in 2030	354.733.800
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	64,65
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	8,86
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	5.043.165.703
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	5.134.279.309
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	4.329.383.710
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	-658.794.831
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	33,19
	Water savings potential in 2030 vs. baseline development [km^3/year]	1,14
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	27,07
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	0,71
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	21,66
	Stock number of washing machines in 2030	462.030.657
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	88,40
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	8,75
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	3.080.655.517
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	19.964.324.580

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	9.373.118.572
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	584,08
	Total savings water, scenario B compared to scenario A [km^3]	20,98
	Total GHG emission reductions scenario B compared to scenario A [Mt]	374,55
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	8.123.821.219
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	10.194.660.141
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	34.269.152.619
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	26.138.765.321

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.6.3 Background information

China

Despite the fast increasing standard of living in China, electricity and water consumption for automatic laundry washing per household is still considered to be comparatively low. This is due to the low number of about 100 wash cycles per year and the fact that a significant part of the residential wash is further on performed in cold water. But even for people owning a washing machine, manual washing is quite common in China. Hence, the overall electricity and water consumption for all laundry washing may be a factor of 3 to 4 higher than estimated for using washing machines alone (Pakula / Stamminger 2010).

Nevertheless, ownership levels of washing machines are already high in China, divided between the traditionally dominating vertical axis impeller type machines and modern horizontal axis drum type washing machines (Fridley et al. 2007). Low-income families still focus on inexpensive, partially semi-automatic vertical axis machines, whereas wealthy families prefer advanced automatic vertical axis and horizontal axis models with improved functions, such as low abrasion, high rate of washing ability and sanitizing technologies. Thereby, drum type horizontal axis washing machines are gaining market shares in spite of having entered market relatively recently. This trend seems also to be driven by consumers' desire for washing machines with a larger washing capacity but smaller and stackable dimensions (IEA-4E 2011A).

Nevertheless, results of the model calculation show: If the availability of inefficient models with internal electric heating features should lead to an altered washing behaviour from cold to hot wash and more machine wash cycles per year, the amount of energy used for washing machines in China would increase substantially in the future.

2.7 SAS – South Asia

2.7.1 Included countries

Afghanistan, Bangladesh, Bhutan, Fiji, French Polynesia, India, Maldives, Nepal, Pakistan, Sri Lanka

2.7.2 Key messages and data

About **21 million** domestic washing machines are in use in **South Asia**. With an average annual direct electricity consumption of **77 kWh** each, altogether they account for **0.9 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **1.1 million tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **3.1 TWh** of electricity and **2.1 million tons** of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

About **21 million** domestic washing machines are in use in **South Asia**. The average annual consumption of one of these washing machines amounts to about **77 kWh** and **48 m^3** of water. In total, this causes an annual direct electricity consumption of **1.6 TWh** and a water consumption of **1 billion m^3**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, the growth of the annual energy and water consumption of the massively increasing stock of domestic washing machines in South Asia can be mitigated. The stock is expected to grow by 314 % until 2020 and by another 76 % until 2030. Thereby, higher living standards, represented by increasing appliance ownership rates, a change from predominantly cold wash to more warm wash cycles as well as a slow technological change towards horizontal axis washing machines have been anticipated. Due to the growing stock and the presumed change of wash habits to more energy intensive warm wash cycles, in the baseline scenario the energy consumption would increase by 452 % by 2020 and additionally by 55 % by 2030. The water consumption would increase by 251 % and 57 % in the respective periods. In the efficiency scenario, by 2020 the growth of the energy consumption could be limited to 339 % and the water consumption to 213 %, especially due to the diffusion of much more water efficient horizontal axis washing machines. By 2030 the growth of energy consumption could be limited to 47 % and to 53 % with regard to water consumption (see Figure 18 and Figure 19).

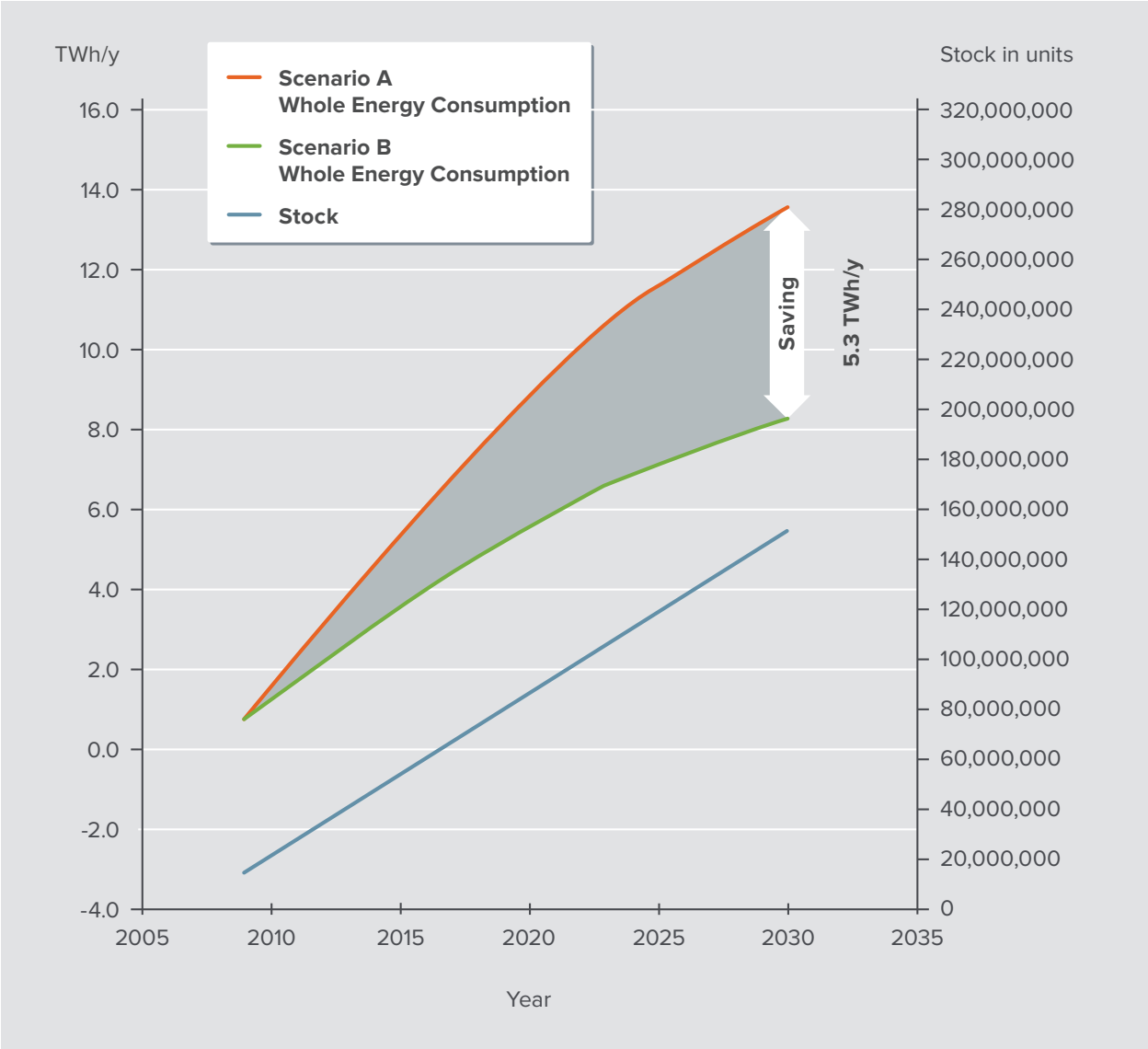

Figure 18: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

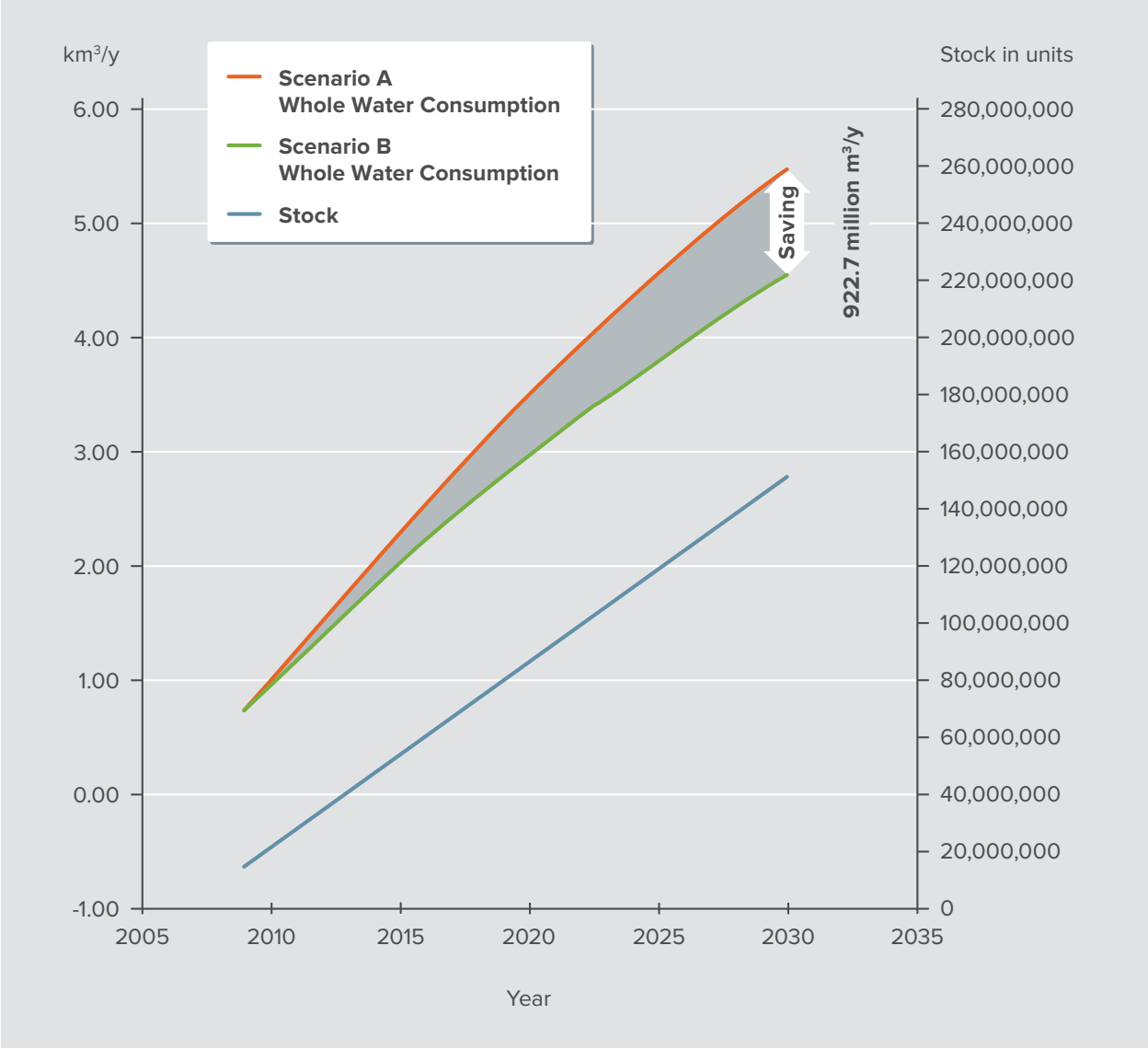

Figure 19: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 8). For hints and links to good practice policy examples also visit www.bigee.net.

Table 8: Population, electricity and water consumption data of domestic washing machines for South Asia for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	1,620,871,000
	Quota of households owning a washing machine [%]	6.0
	Total electricity net consumption per year [TWh/year]	693
	Total domestic electricity consumption per year [TWh/year]	174.2
	Total energy consumption of washing machines per year [TWh/year]	1,59
	Total water consumption of washing machines per year [km^3/year]	1,00
	Stock number washing machines	20.744.213
	Average annual energy consumption of washing machines in the stock [kWh/year]	77
	Average annual water consumption of washing machines in the stock [m^3/year]	48
	Total annual CO_2eq emissions related with washing machines [Mt/year]	1,07
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	3,14
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,52
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	4,05
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	1,99
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	2,07
	Stock number of residential washing machines in 2030	85.848.932
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	57,27
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	31,72
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	1.002.704.217
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	1.030.459.700
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	5.676.840.681
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	2.156.438.443
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	5,30
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,92
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	6,72
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	3,57
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	3,46
	Stock number of washing machines in 2030	150.953.651
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	50,44
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	28,19
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	724.373.032
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	14.925.505.239

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	8.159.400.188
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	106,34
	Total savings water, scenario B compared to scenario A [km^3]	18,01
	Total GHG emission reductions scenario B compared to scenario A [Mt]	68,68
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.727.077.250
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	2.222.864.362
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	20.700.248.784
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	14.309.545.681

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.7.3 Background information

India

The washing machine market in India is segmented into fully automatic machines and the still dominating semi-automatic vertical axis machines, which have a market share of about 85 % (World Bank 2008 / productivity.in 2009). Out of the automatic washing machine market, about one third of the machines are horizontal axis front-loading units. Ownership rates for household appliances in India are still low and only about 6 % of the total population use a washing machine (productivity.in 2009). Rural India, which accounts for nearly 70 % of the total households, has a 0.5 % ownership rate for washing machines. Many less affluent households prefer to wash clothes manually rather than to invest in washing machines. Water scarcity in many Indian cities and frequent power blackouts are other major obstacles. However, it is expected that due to rising living standards the ownership rate of washing machine will increase significantly in the future (productivity.in 2009). Likewise, electricity consumption of washing machines in India is also expected to grow enormously, especially under consideration of a potential shift from cold to warm wash cycles.

2.8 PAS – Other Pacific Asia (without South Korea)

2.8.1 Included countries

American Samoa, Brunei, Burma (Myanmar), Indonesia, Kiribati, Malaysia, Micronesia, Nauru, New Caledonia, Papua New Guinea, Philippines, Salomon Islands, Samoa, Singapore, Taiwan, Thailand, Timor-Leste, Tonga, Vanuatu.

2.8.2 Key messages and data

About **28 million** domestic washing machines are in use in **Other Pacific Asia (excluding South Korea)**. With an average annual direct electricity consumption of **93 kWh** each, altogether they account for almost **1.5 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **1.8 million tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **1.5 TWh** of electricity and **1 million tons of CO_2-eq** per year can be saved by 2020. Further savings are achievable by 2030.

About **28 million** domestic washing machines are in use in **Other Pacific Asia (excluding South Korea)**. The average annual consumption of one of these washing machines amounts to about **93 kWh** and **34 m^3** of water. In total, this causes an annual direct electricity consumption of **2.7 TWh** and a water consumption of **1 billion m^3**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, the growth of the annual energy and water consumption of the fast increasing stock of domestic washing machines in Other Pacific Asia (excluding South Korea) can be mitigated. The stock is expected to grow by 75 % until 2020 and by another 43 % until 2030. Thereby, higher living standards, represented by increasing appliance ownership rates, a change from predominantly cold wash to more warm wash cycles as well as a slow technological change towards horizontal axis washing machines have been anticipated. Due to the rising stock and the presumed change of wash habits to more energy intensive warm wash cycles, in the baseline scenario the energy consumption would increase by 111 % by 2020 and additionally by 30 % by 2030.

The water consumption would increase by 35 % and 23 % in the respective periods. In the efficiency scenario, by 2020 the growth of the energy consumption could be limited to 63 % and the water consumption to 24 %, especially due to the diffusion of much more water efficient horizontal axis washing machines. By 2030 the growth of energy consumption could be limited to 17 % and to 19 % with regard to water consumption (see Figure 20 and Figure 21).

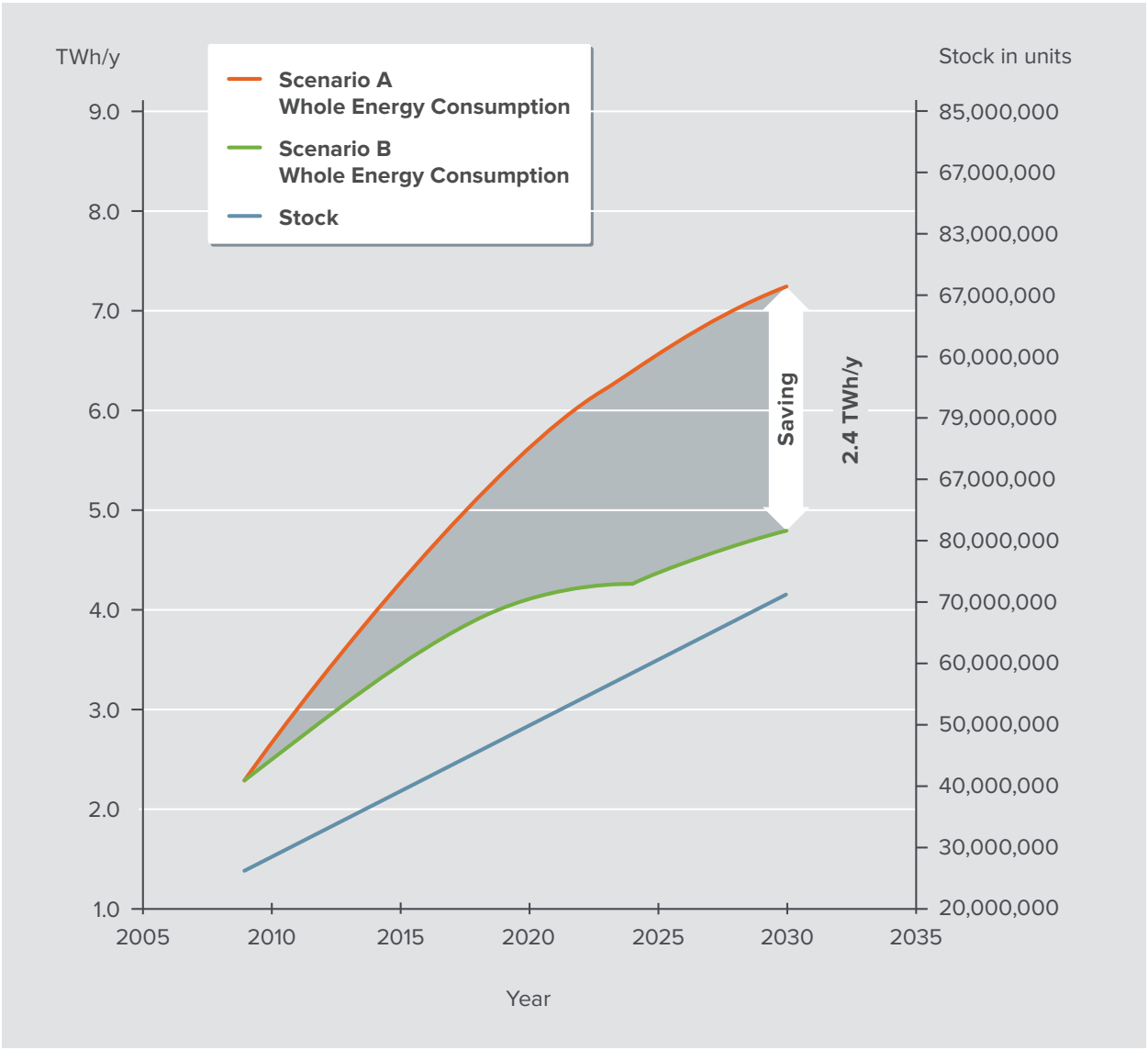

Figure 20: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

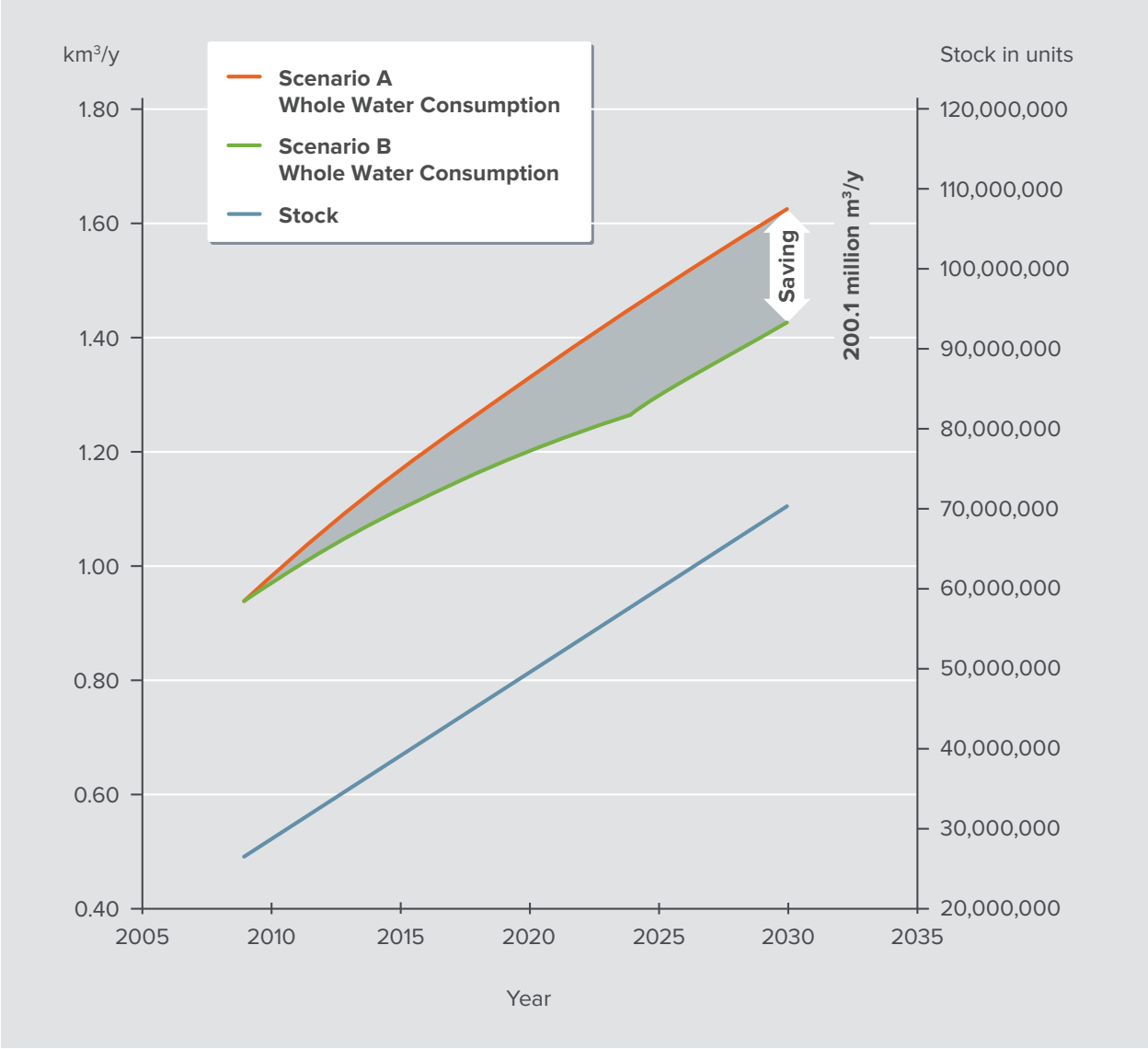

Figure 21: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 9). For hints and links to good practice policy examples also visit www.bigee.net.

Table 9: Population, electricity and water consumption data of domestic washing machines for Other Pacific Asia (without South Korea) for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	504,917,270
	Quota of households owning a washing machine [%]	25.0
	Total electricity net consumption per year [TWh/year]	687.3
	Total domestic electricity consumption per year [TWh/year]	180.6
	Total energy consumption of washing machines per year [TWh/year]	2,65
	Total water consumption of washing machines per year [km^3/year]	0,98
	Stock number washing machines	28.374.705
	Average annual energy consumption of washing machines in the stock [kWh/year]	93
	Average annual water consumption of washing machines in the stock [m^3/year]	34
	Total annual CO_2eq emissions related with washing machines [Mt/year]	1,79
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	1,49
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,13
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	1,45
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	0,22
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0,98
	Stock number of residential washing machines in 2030	49.650.202
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	69,39
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	21,25
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	570.267.817
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	588.674.665
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.368.798.556
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	342.064.110
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	2,45
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,20
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	2,15
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	0,44
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1,60
	Stock number of washing machines in 2030	70.925.700
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	60,24
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	18,45
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	376.227.023
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	3.819.567.827

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	1.808.628.657
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	48,89
	Total savings water, scenario B compared to scenario A [km^3]	4,03
	Total GHG emission reductions scenario B compared to scenario A [Mt]	31,62
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	946.494.840
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	1.201.018.045
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	5.270.182.937
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	3.350.662.674

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.9 MEA – Middle East and North Africa

2.9.1 Included countries

Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, Western Sahara, Yemen.

2.9.2 Key messages and data

About **39 million** domestic washing machines are in use in **Middle East and North Africa**. With an average annual direct electricity consumption of **242 kWh** each, altogether they account for almost **2.6 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **6.3 million tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **2.7 TWh** of electricity, **117 million m³** and **1.8 million tons** of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

About **39 million** domestic washing machines are in use in **Middle East and North Africa**. The average annual consumption of one of these washing machines amounts to about **242 kWh** and **27 m³** of water. In total, this causes an annual direct electricity consumption of **9.3 TWh** and a water consumption of **1 billion m³**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, the annual energy and water consumption of the increasing stock of domestic washing machines in Middle East and North Africa can be mitigated. The stock is expected to grow by 42 % until 2020 and by another 29 % until 2030. Thereby, higher living standards, represented by increasing appliance ownership rates, a change to more warm wash cycles as well as a technological change towards horizontal axis washing machines have been anticipated. In the baseline scenario the energy consumption would increase by 32 % by 2020 and additionally by 11 % by 2030. The water consumption would increase by 5 % and 7 % in the respective periods. In the efficiency scenario, by 2020 the growth of the energy consumption could be limited to 5 % and the water consumption could even be reduced by 1 %, especially due to the diffusion of much more water efficient horizontal axis washing machines. By 2030 the energy consumption could be reduced by 1 % and the growth of the water consumption could be reduced to 5 % (see Figure 22 and Figure 23).

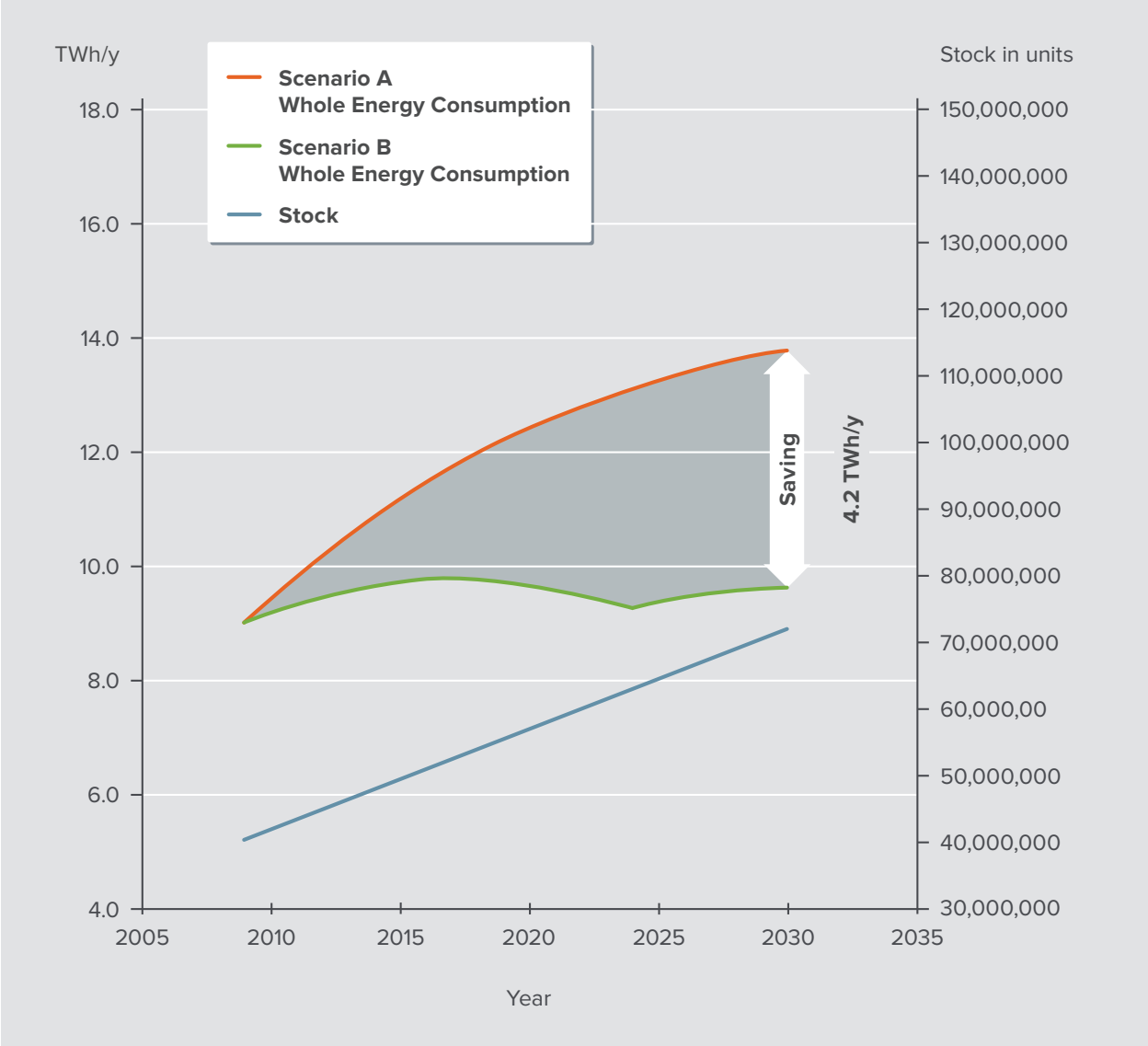

Figure 22: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

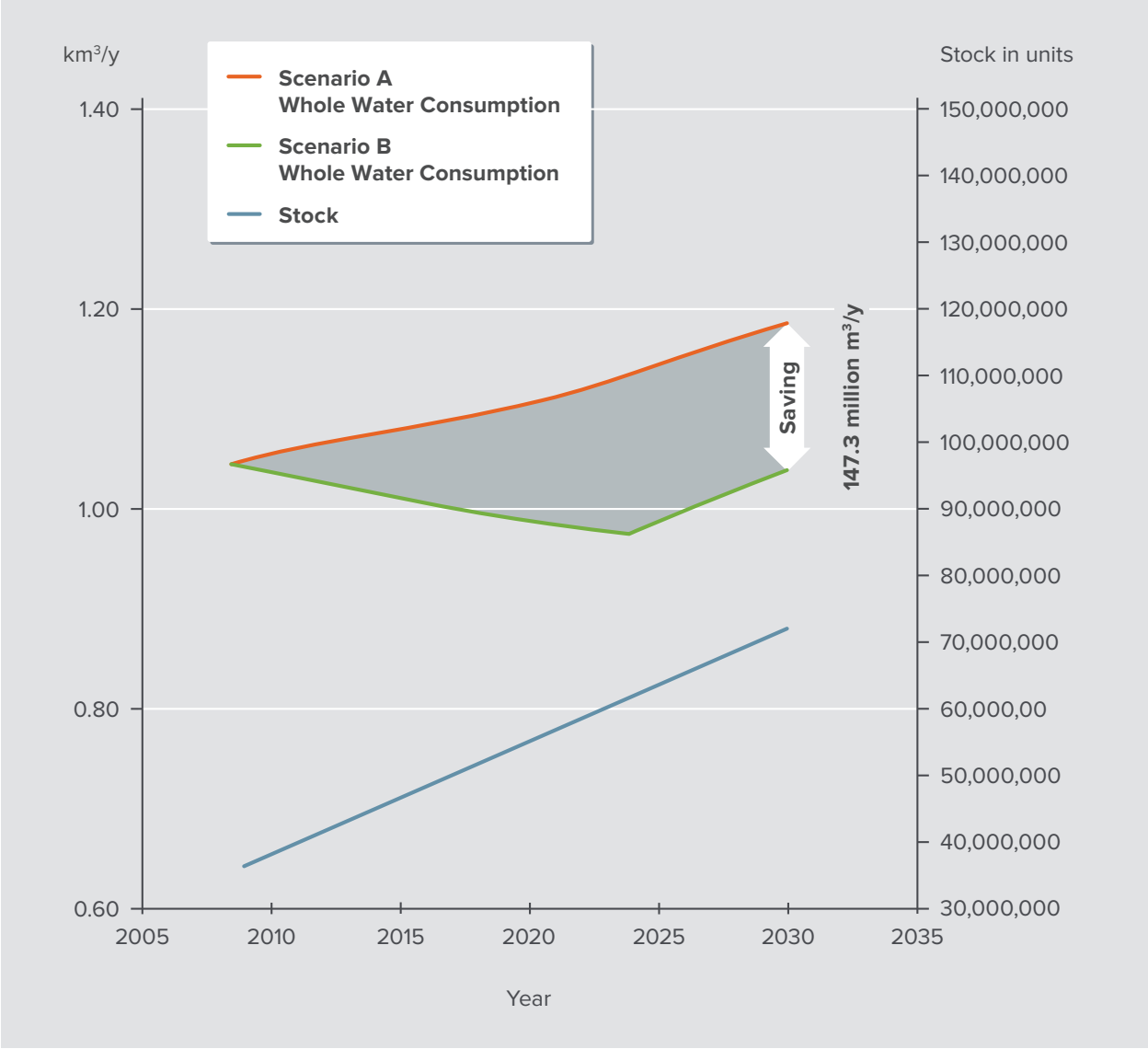

Figure 23: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 10). For hints and links to good practice policy examples also visit www.bigee.net.

Table 10: Population, electricity and water consumption data of domestic washing machines for Middle East and North Africa for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	420,130,000
	Quota of households owning a washing machine [%]	46.4
	Total electricity net consumption per year [TWh/year]	812.5
	Total domestic electricity consumption per year [TWh/year]	370.2
	Total energy consumption of washing machines per year [TWh/year]	9,32
	Total water consumption of washing machines per year [km^3/year]	1,05
	Stock number washing machines	38.505.942
	Average annual energy consumption of washing machines in the stock [kWh/year]	242
	Average annual water consumption of washing machines in the stock [m^3/year]	27
	Total annual CO_2eq emissions related with washing machines [Mt/year]	6,30
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	2,73
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,12
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	0,24
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	-0,06
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1,80
	Stock number of residential washing machines in 2030	54.518.571
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	144,52
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	15,41
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	1.012.152.549
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	1.045.423.416
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.381.838.808
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	131.076.664
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	4,18
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,15
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	0,19
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	-0,01
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	2,73
	Stock number of washing machines in 2030	70.531.200
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	115,21
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	13,53
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	614.852.370
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	4.025.369.749

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	1.627.761.309
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	84,71
	Total savings water, scenario B compared to scenario A [km^3]	3,19
	Total GHG emission reductions scenario B compared to scenario A [Mt]	54,86
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.627.004.920
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	2.043.249.699
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	5.524.439.003
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	3.248.908.598

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

2.10 LAM - Latin America and the Caribbean

2.10.1 Included countries

Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, French Guyana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Lucia, St. Vincent / Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela.

2.10.2 Key messages and data

About **69 million** domestic washing machines are in use in **Latin America and the Caribbean**. With an average annual direct electricity consumption of **81 kWh** each, altogether they account for almost **2 %** of the total domestic electricity consumption and cause annual greenhouse gas emissions of **3.8 million tons** of CO_2-eq. If every time a washing machine is replaced, the most energy-efficient model is chosen, **1.3 TWh** of electricity, **227 million m^3** of water and **850,000 tons** of CO_2-eq per year can be saved by 2020. Further savings are achievable by 2030.

About **69 million** domestic washing machines are in use in **Latin America and the Caribbean**. The average annual consumption of one of these washing machines amounts to about **81 kWh** and **35 m^3** of water. In total, this causes an annual direct electricity consumption of **5.7 TWh** and a water consumption of **2.4 km^3**. As model calculations show, enormous efficiency improvements can be achieved, especially if old inefficient models are replaced by modern efficient ones. The calculations of the efficiency scenario are based on the assumption that every time a new washing machine is bought, the most efficient model (BAT) is chosen and that the improvements of the most efficient models over the years are taken into account.

By this means, the energy and water consumption of the increasing stock of domestic washing machines in Latin America and the Caribbean can be mitigated. The stock is expected to grow by 40 % until 2020 and by another 28 % until 2030. Thereby, higher living standards, represented by increasing appliance ownership rates, a change to more warm wash cycles as well as a slow technological change towards horizontal axis washing machines have been anticipated. In the baseline scenario the energy consumption would increase by 41 % by 2020 and additionally by 18 % by 2030.

The water consumption would increase by 14 % and 12 % in the respective periods. In the efficiency scenario, by 2020 the growth of the energy consumption could be limited to 21 % and the water consumption to 6 %, especially due to the diffusion of much more water efficient horizontal axis washing machines. By 2030 the growth of energy and water consumption could be limited to 9 % each (see Figure 24 and Figure 25).

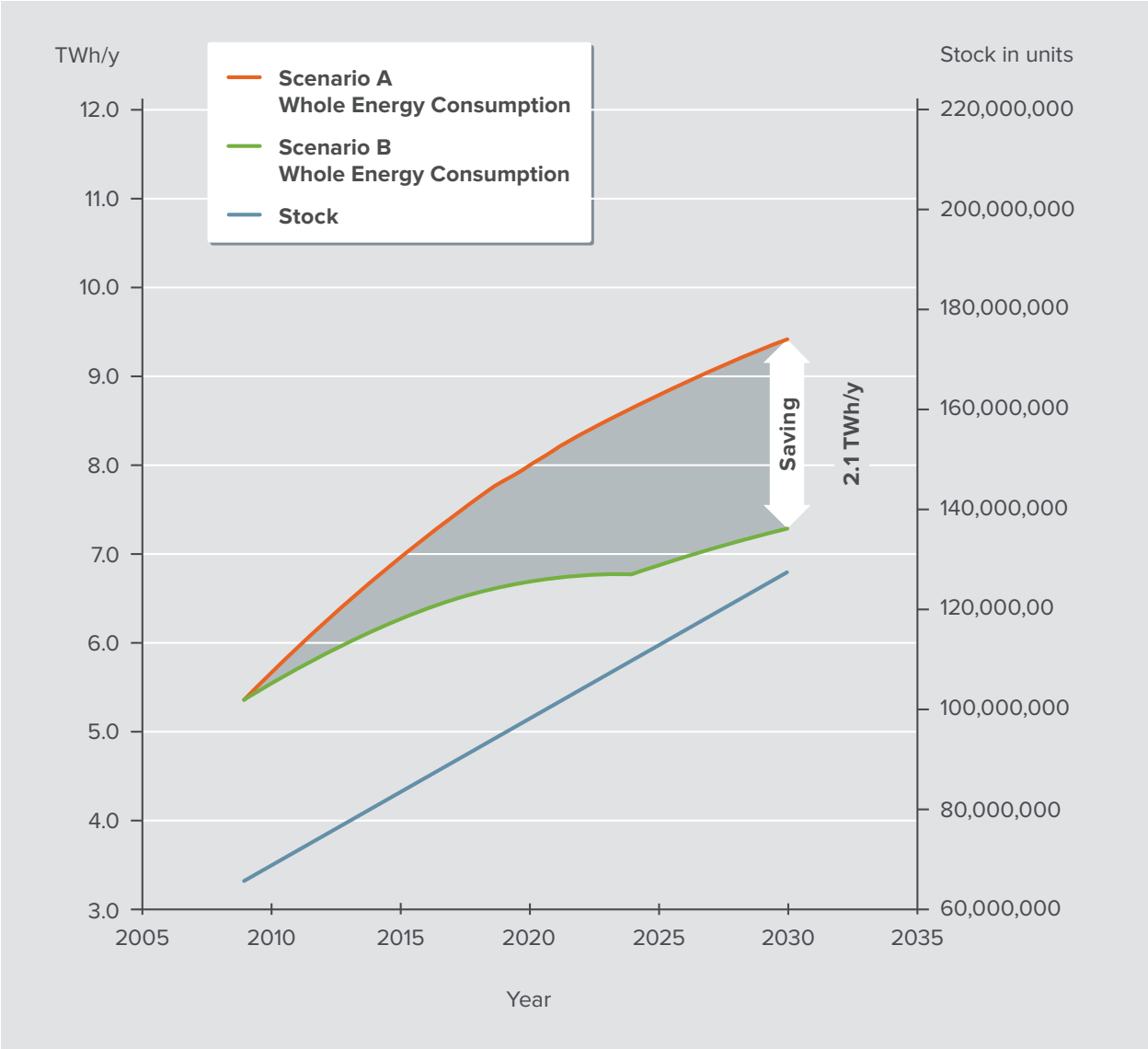

Figure 24: Total electricity consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

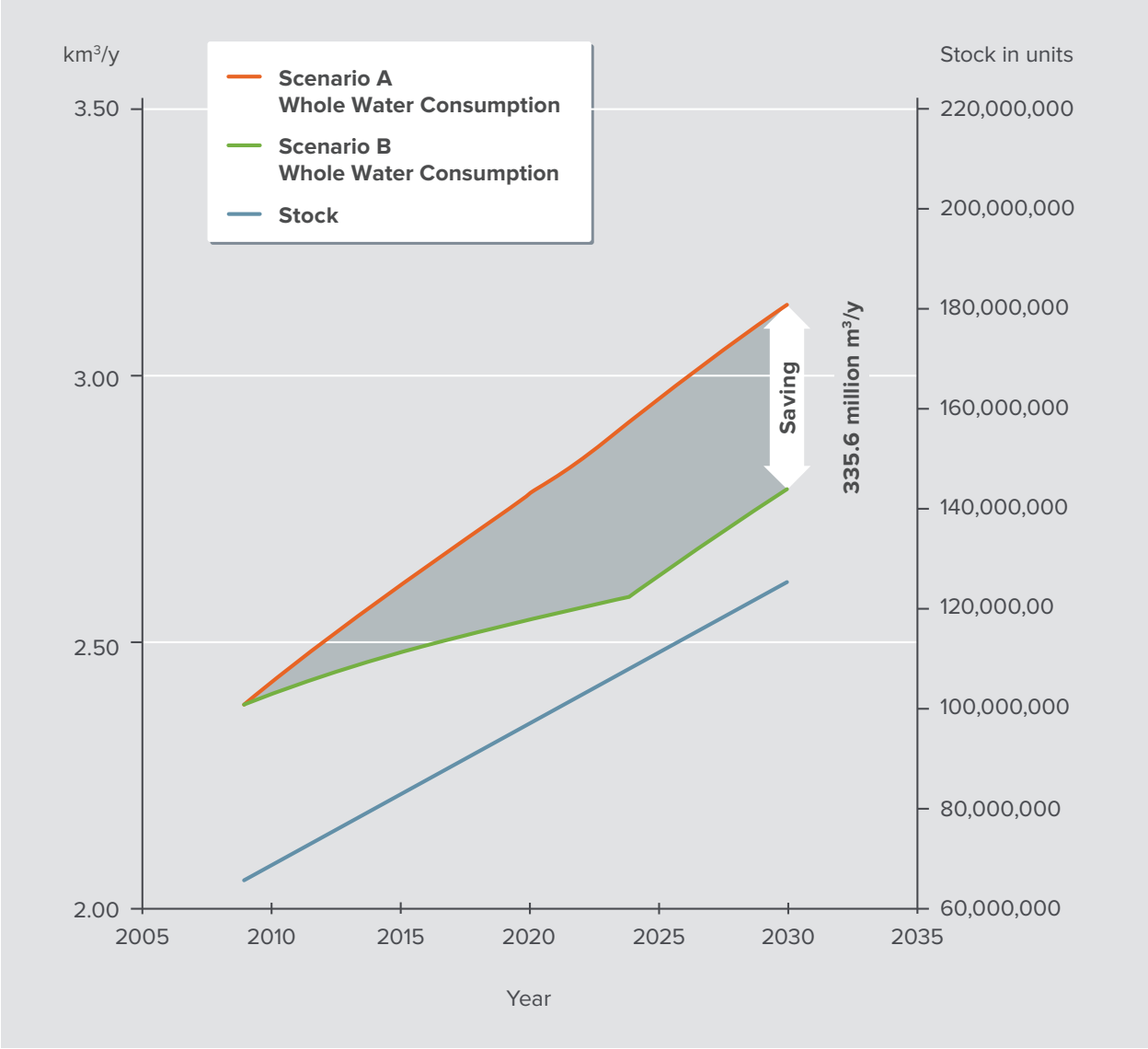

Figure 25: Total water consumption of domestic washing machines, Baseline Scenario compared to the Efficiency Scenario

Source: Own calculation

However, the likelihood of realising this efficiency potential is largely dependent on different investment costs as well as different electricity and water tariffs. The incremental investment costs for the best available technology (BAT) in this calculation is assumed to be 10 % of the investment costs of the non-BAT washing machines. Policy measures and programmes have to address the energy and water efficiency potentials under consideration of cost-effectiveness for society as well as for end-users (Table 11). For hints and links to good practice policy examples also visit www.bigee.net.

Table 11: Population, electricity and water consumption data of domestic washing machines for Latin America and the Caribbean countries for 2010 and potential changes by 2020 and 2030

Base year 2010	Population	578,528,100
	Quota of households owning a washing machine [%]	47.3
	Total electricity net consumption per year [TWh/year]	1,035
	Total domestic electricity consumption per year [TWh/year]	282
	Total energy consumption of washing machines per year [TWh/year]	5,64
	Total water consumption of washing machines per year [km^3/year]	2,44
	Stock number washing machines	69.225.971
	Average annual energy consumption of washing machines in the stock [kWh/year]	81
	Average annual water consumption of washing machines in the stock [m^3/year]	35
	Total annual CO_2eq emissions related with washing machines [Mt/year]	3,81
2020	Energy savings potential in 2020 vs. baseline development [TWh/year]	1,29
	Water savings potential in 2020 vs. baseline development [km^3/year]	0,23
	Resulting change in energy consumption 2020 vs. 2010 [TWh/year]	1,01
	Resulting change in water consumption 2020 vs. 2010 [km^3/year]	0,11
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	0,85
	Stock number of residential washing machines in 2030	96.768.885
	Average annual energy consumption of new washing machines (all BAT) in 2020 [kWh/year]	60,28
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	23,39
	Total incremental investment costs [discounted] until 2020 (end-user perspective) [€]	1.507.738.467
	Total incremental investment costs [discounted] until 2020 (societal perspective) [€]	1.554.504.681
	Total economic benefit until 2020 [discounted] (end-user perspective) [€] scenario B vs. scenario A	1.086.686.368
	Total economic benefit until 2020 [discounted] (societal perspective) [€] scenario B vs. scenario A	-500.755.179
2030	Energy savings potential in 2030 vs. baseline development [TWh/year]	2,11
	Water savings potential in 2030 vs. baseline development [km^3/year]	0,34
	Resulting change in energy consumption 2030 vs. 2010 [TWh/year]	1,60
	Resulting change in water consumption 2030 vs. 2010 [km^3/year]	0,35
	CO_2eq emission reduction potential vs. baseline development [Mio.t/year]	1,38
	Stock number of washing machines in 2030	124.311.800
	Average annual energy consumption of new washing machines (all BAT) in 2030 [kWh/year]	52,45
	Average annual water consumption of new washing machines (all BAT) in 2020 [m^3/year]	20,75
	Total incremental investment costs [discounted] between 2021 and 2030 (end-user perspective) [€]	893.261.050
	Total economic benefit until 2030 [discounted] (end-user perspective) [€] scenario B vs. scenario A	3.916.070.487

	Total economic benefit until 2030 [discounted] (societal perspective) [€] scenario B vs. scenario A	362.293.675
Lifetime data for appliances purchased until 2030	Total savings electricity, scenario B compared to scenario A [TWh]	42,06
	Total savings water, scenario B compared to scenario A [km^3]	6,85
	Total GHG emission reductions scenario B compared to scenario A [Mt]	27,21
	Total incremental investment costs [discounted] (end-user perspective) [€] scenario B vs. scenario A	2.400.999.517
	Total incremental investment costs [discounted] (societal perspective) [€] scenario B vs. scenario A	3.003.130.094
	Total economic benefit [discounted] (end-user perspective) [€] scenario B vs. scenario A	5.751.808.658
	Total economic benefit [discounted] (societal perspective) [€] scenario B vs. scenario A	2.039.586.463

Source: Own calculation; WEC 2009 and IEA 2010 for current electricity consumption and population data 2008

3 Glossary

Cost of conserved energy	The cost of conserved energy is an investment statistic developed by Alan K. Meier. For any given conservation measure (e.g. purchasing a BAT appliance instead of a nonBAT appliance) it calculates the price for saving one unit of energy. To derive this statistic the capital cost are divided by the annual energy savings and multiplied by the capital recovery factor.
Net Present Value	A measure of the economic attractiveness of an investment. For instance, it is used to assess whether choosing the more energy-efficient alternative is economical. Within the model calculation the purchase of the more energy-efficient appliance (BAT) is considered an investment. The cash outflow in period 0 is the difference between the cost of the BAT appliance and the cost of the nonBAT appliance. The cash inflow in the subsequent periods is the financial value of the conserved energy.
Total economic benefit	Within the model calculation, the total economic benefit is the net present value of an investment in the more energy-efficient alternative times the number of additional cases, in which the more energy-efficient alternative has been chosen due to policy. It only includes the benefit created because individuals are incentivized or obliged to choose an investment, which in most cases is economical in itself (i.e. the more energy-efficient alternative). It however does not consider the benefit due to the avoidance of social costs, especially by avoiding GHG emissions. This economic benefit is considerably higher, but not quantified within the model.

4 References

Faberi, S. / Presutto, M. / Stamminger, R. / Scialdoni, R. / Mebane, W. / Esposito, R. (2007): Preparatory Studies for Eco-design Requirements of EuPs (Tender REN/D1/40-2005), LOT 14: Domestic Washing Machines and Dishwashers Final Report, Draft Version, Tasks 1 -2, www.ecowet-domestic.org

Fridley, D. / Aden, N. / Zhou, N. / Lin, J. (2007): Impacts of China's Current Appliance Standards and Labeling Program to 2020, Lawrence Berkeley National Laboratory Environmental Energy Technologies Division March 2007

GfK Retail and Technology Asia (2011): Washing Machine Sales Spur Growth of the Major Domestic Appliances Sector in Southeast Asia: GfK Asia, July 21, 2011, Singapore, http://www.gfkrt.com/asia/news_events/news/news_single/008395/index.en.html

International Energy Agency (IEA) 2010: Key World Energy Statistics. Paris, France.

IEA-4E (2011A): Efficient Electrical End-Use Equipment, Documents related to the mapping and benchmarking of Domestic Washing Machines, http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=3

Josephy, B. / Bush, E. / Nipkow, J. / Attali, S. (2011): Washing Machines, Key Criteria for Best Available Technology (BAT), Topten International Services (Paris, France), http://www.topten.eu/uploads/File/039_Barbara_Josephy_final_Washing.pdf

Pakula, C. / Stamminger, R. (2010): Electricity and water consumption for laundry washing by washing machine worldwide, Energy Efficiency (2010) 3:365–382 DOI 10.1007/s12053-009-9072-8, http://www.springerlink.com/content/f6197608u2761084/fulltext.pdf

productivity.in (2009): Productivity & Competitiveness of Light Electrical Industry in India – Report 1, Main Report, Department of Industrial Policy & Promotion (DIPP), Ministry of Commerce and Industry, Government of India, study submitted by the National Productivity Council, Economic Services Group, http://www.productivity.in/knowledgebase/DIPP%20Sponosored%20Studies/1.%20Light%20Electrical%20Industry%20in%20India/1.Main%20Report.pdf

RECS (2009): US Residential Energy Consumption Survey 2009, carried out by the U.S. Energy Information Administration, EIA, http://www.eia.gov/consumption/residential/data/2009/

World Bank (2008): Residential consumption of electricity in India, documentation of data and methodology, Background Paper India: Strategies for Low Carbon Growth, DRAFT, July 2008, The World Bank, http://moef.nic.in/downloads/public-information/Residentialpowerconsumption.pdf

World Energy Council (WEC) 2009: World Energy and Climate Policy: 2009 Assessment. Geneva, Switzerland.

bigEE

Your guide to energy efficiency in buildings.

bigee.net

bigEE is an international initiative of research institutes for technical and policy advice and public agencies in the field of energy and climate, co-ordinated by the Wuppertal Institute (Germany). Its aim is to develop the international web-based knowledge platform bigee.net for energy efficiency in buildings, building-related technologies, and appliances in the world's main climatic zones.

The bigee.net platform informs users about energy efficiency options and savings potentials, net benefits and how policy can support achieving those savings. Targeted information is paired with recommendations and examples of good practice.

Co-ordinated by

Wuppertal Institute for Climate, Environment and Energy

Partners to date

中城深科 CSUSIBR

sonedi

cscp

Financial support

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Dr. Stefan Thomas • bigee@**wupperinst.org**

Wuppertal Institute for Climate, Environment and Energy • Doeppersberg 19 • 42103 Wuppertal • Germany • Phone: +49 (0)202 2492-129