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Analysis of measured data according to SS 820 000

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Summary

In 2012 an energy labelling system was introduced in Sweden for basin and sink mixer taps. The certification has been done during a couple of years and now a sufficient number of measured data for basins and kitchen mixer taps have become available for analysis of the test method.

The main goal with the Swedish standard and the test cycle has been to reward technologies that decrease water use while still offering complete functions. Today there are two main techniques that contribute to more energy and water efficient use:

- One technique is to influence the user not to use water with routine. This technique will require that the user in some way indicates that he/she needs a larger water flow or a more heated water, otherwise the water tap will give a minimum water flow and with low temperature. This can for example be done with a tap with diverter or a two-stage tap.
- The other technique is to create a water beam with the right formation of droplets and with a specific amount of air mixed into the beam. By doing this effectively the same function - for example rinsing a plate or washing a piece of cloth - can be done but with less use of cold and/or hot water. The tap´s aerator is an important part for this technique.

The analysis shows that the test cycle and the calculation of the total score from the series of activities needs to be improved in order to actually give credit for the above mentioned objectives. In this report a new test cycle of activities is suggested while the main procedures for the tests will be the same. The suggested test cycle have been extended in the sense that it also will give credit to mixer taps with presence sensors or time control of tap flow.

However, since the products that are included in this study cannot be considered as representative for the market, further tests and analysis are recommended for any mixer taps that can be bought on the market. The Swedish standardisation committee has opened the test standard (SS 820 000) for revision and they have now the opportunity to improve the calculation of energy efficiency according to results from this study.

Even with an improved Swedish standard it is still developed with specific aspects and in Europe there might be more aspects that should be considered. On European level further investigations are needed there the Swedish standard can act as a robust basis for development of a European harmonised standard for the Eco-design requirements and European Energy Labelling systems.

A further developed Swedish standard has benefits as it will stimulate innovation towards techniques that will influence the user to use less water and energy at the same time as it stimulate techniques that offers the user a complete function of the tap.

Preface

In this work CIT Energy Management has analysed data for 58 basins and kitchen mixer taps that have been measured according to SS 820 000. Kiwa Swedcert has delivered detailed measured data from test results. However since the detailed parts of the test results are confidential only limited data is presented in this report while the main conclusions are highlighted. The Swedish Energy Agency has ordered this report.

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1 Introduction

Improved energy efficiency in the building sector has been on the agenda during the last decades in most of the European countries and during recent years more requirements are coming on energy efficiency for tap water use. Here right design of water taps plays an important role in order to reach significant reduction in tap water use and especially of hot tap water use. Both Eco-design requirements and energy labelling systems are considered to be implemented on European level by the Commission and the Parliament. How to formulate the requirements and possibility to follow up are considered. Here simple requirements of maximum tap flow is one of the suggestions. But limiting the maximum tap flow may fail in realising the existing energy and water efficiency potential. The reasons are that limiting flow:

- do not promote the efficient use of energy and water, but rather simply limit the function expected from the product,
- do not stimulate innovation towards the development of energy and water efficient products,
- simply limit the water flow without taking into consideration the function of the product, which may increase the time of use resulting in lower savings than those expected,
- jeopardise the present good trust for ecodesign and energy labelling as policy instruments from consumers and other stakeholders.

The Swedish Energy Agency has worked for the last fifteen years on incentives for the development of water and energy efficient water taps. The main aim with the work is to stimulate the development of water taps that provide the function with less energy and water use.

This have resulted in both product development but also in that, branch representatives on the market, have developed a voluntary energy labelling system for basin and sink mixer taps that was introduced in Sweden 2012. The Swedish Energy labelling system is based on a Swedish standard that describes a test method that was developed within the SIS Technical Committee 519. This standard is suggested to act as a basis for development of a European harmonised standard for the Eco-design requirements and European energy labelling systems. However, before any further work for harmonization on European level should be done the Swedish Energy Agency will make sure that the tests in the standard and its results will give credit to energy efficiency incentives and that the results is just not correlated to a reduced water flow that will be much easier to measure directly compared to the Swedish standard.

This information is needed before it clearly can be stated that the Swedish standard can be a robust basis for the development of a European harmonised standard.

1.1 The Swedish Energy Labelling System

In 2012 an energy labelling system was introduced in Sweden for basin and sink mixer taps.

The principal or overseer of labelling is Kiwa Swedcert and the labelling is done according to certification rules that are decided by an advisor group representing authorities, test laboratories, manufacturers and consumers. The main requirements of the rules are:

- Approved testing in accordance with SS-EN 817 for mechanical sink/handbasin and kitchen mixer taps
- Total energy use by water taps determined by testing in accordance with standard SS 820 000 (Sanitary tapware – Method for determination of energy efficiency of mechanical basin and sink mixing valves) at any laboratory accredited with EN ISO/IEC 17025
- EN ISO 9001 or equivalent quality management system for the place of manufacture.

The certification has now been done during a couple of years and Kiwa Swedcert have now measured data for 58 products. It is therefore now possible to do a more detailed analyse of the test method.

1.2 The Swedish test method (SS 820 000)

The test method is based on a scheme of activities that describe a normal use of a mixer tap and are intended to represent different user applications. The test methods that has been developed are repeatable, and can be described in such a way as to allow them to be reproduced and be repeated in other test laboratories. The same mixer tap has also circulated between different laboratories in Europe which have showed the repeatability.

The main goal with the test cycle has been on technologies that decrease water use while still keeping the same function. Today there are two main technical functions that contribute to this more energy and water efficient use:

- One technical function is to influence the user not to use water with routine. This technical function will require that the user in some way indicates that he/she needs a larger water flow or a more heated water, otherwise the water tap will give a minimum water flow and with low temperature. This can for example be done with a tap with diverter or a two-stage tap.

- The other technical function is to create a water beam with the right formation of droplets and with a specific amount of air mixed into the beam. By doing this effectively the same function - for example rinsing a plate or washing a piece of cloth - can be done but with less use of cold or hot water. The tap´s aerator is an important part for this function.

1.3 The Swedish standardisation work

The testing and energy labelling according to the Swedish Standard 820 000 has now been done during a couple of years. Experiences have been collected and the Swedish standardisation group has therefore opened the standard for revision. Mainly the revision is about how to improve the description of measurements.

For example in one of test the time it takes to rinse a test material with a spot of caramel colouring and a spot of caramel colouring mixed with oil is measured. In the current version of the standard the measurement is ocular but it could be improved by the use of an automatic optical equipment, similar to the one used for testing washing machines. This possibility is now discussed in the standardisation group. Another example is how many times each test procedure need to be repeated in order to give reliable results.

2 Objective

The purpose with this study is to analyse the test results from 58 mixer taps measured according to SS 820 000 with the objective to get answers on the following questions:

- Will the test method give credit to energy efficiency incentives or is the tap flow the only indicator needed to be considered to reach high scores?
- Which indicators are credited?
- Can the standard be improved in order to reach its purpose better?
- Is it possible to reduce the number of activities in the test method in order to reduce test costs?

This study does not consider how the standard can be improved in order to describe the test procedures in a better way or improve the repeatability between different test laboratories. These aspects have previously been considered with so called "round robin" tests there the same mixer tap has also circulated between different laboratories in Europe. The repeatability and other details about improving the test in the standard is done with the ongoing revision work by the SIS standardisation committee 519.

3 Method

Kiwa Swedcert has during the last years tested 58 basins and kitchen mixer taps. The present study has got access to the test results for each of the 12 activities in the test method, maximum flow, economy flow and time to fill a vessel, see description of each activity in Chapter 3.1. However since the detailed parts of the test results are confidential (normally only the final result is given on the certificate) a specific confidential contract has been written between the investigator (CIT Energy Management) and Kiwa Swedcert. Therefore the present study presents limited figures of measurements and are showing the results in graphs without scales on the axis. It has not been possible to do investigations like this before due to low number of measured data available for different mixer taps. The mixer taps that have been tested by Kiwa Swedcert are selected products that are applying for certification with a label. Not all of them has passed the test and some have chosen not to go forward with labelling since the results have not been of satisfaction. However, most of the manufacturers knows that they will get a certain label before application of certification and the selection of test products in this investigation can therefore not be considered as representative for the market as such. The test products are from at least 8 different manufacturers.

3.1 Description of test procedure

Below follow and description of the test procedure stated in SS 820 000.

Terminology

The following terminology is used:

- activity: the use of water tap in respect of adjusting the control handle, flow, mixer water temperature, supply pressure, supply temperatures and rinse time
- economy flow: the water flow that can be delivered in normal use as a result of opening the tap to its most open position by means of one single manual operation, with no further action.
- economy temperature: the water temperature that can be delivered in normal use as a result of opening the tap to its highest temperature position by means of one single manual operation, with no further action.

The one-hand action refers to operation of the mixer controls for adjusting the flow and temperature settings. The control function must be so designed that the user cannot unintentionally perform the second manual action needed to increase the flow or raise the temperature, but must actively intend to do so. Examples of current operating mechanisms that provide economy temperature and/or flow functions:

- Automatic spring return lever action that operates when the user releases the lever;
- A pushbutton (or similar) that must be manually operated in order to increase the flow/temperature

An example of a function that is not sufficient to ensure that the second or supplementary manual action can always <u>only</u> be performed intentionally: A maximum-temperature or maximum-flow stop that requires higher force in order to be passed, and which therefore can be passed simply by applying more force.

Procedure with activity scheme

The energy efficiency is calculated of the mixer taps from their measured energy use for a number of different defined activities. Each of these activities is defined in terms of the position of the control handle, the flow, the mixer water temperature (i.e. the outlet temperature), the supply pressure, the supply temperatures and the rinsing time. At each measurement the supply temperature for cold water is 10 °C and for hot water 60 °C.

Each activity is tested by moving the control handle to a defined position, and then release it and make no further physical contact with the mixer. The flow, mixer water temperature and rinsing time for each activity is noted. Each activity is independent of the other activities, and the tests can be performed in any order.

For the first three activities (a-c) the following settings for 60 seconds are measured:

a) Economy temperature, economy flow and supply pressure 100 kPa,
b) Economy temperature, economy flow and supply pressure 300 kPa,
c) Economy temperature, economy flow and supply pressure 500 kPa.

For sub-activities d to f, with a supply pressure of 300 kPa, the following settings for 60 seconds are measured:

d) Economy flow, with the control handle halfway between the centred position and the maximum hot water flow position (Figure 1). If the mixer tap control handle is at the side of the tap outlet, then "centred position" shall be taken to mean "straight upwards". (Note that requirements of sensitivity by the minimum amplitude movement for temperature control required for a limited temperature variation is given in EN 817 Chapter 10.7.)

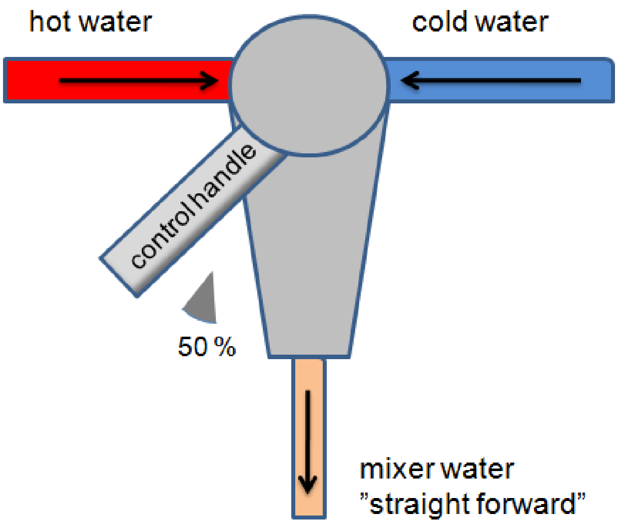

Figure 1: Schematic diagram showing the control handle halfway between the centred position and that of maximum hot water flow.

e) Economy flow, with the control handle in the centred position (90° ± 1°, see Figure 2). If the control handle is at the side of the mixer tap outlet, then "centred position" shall be taken to mean "straight upwards" or "straight downwards".

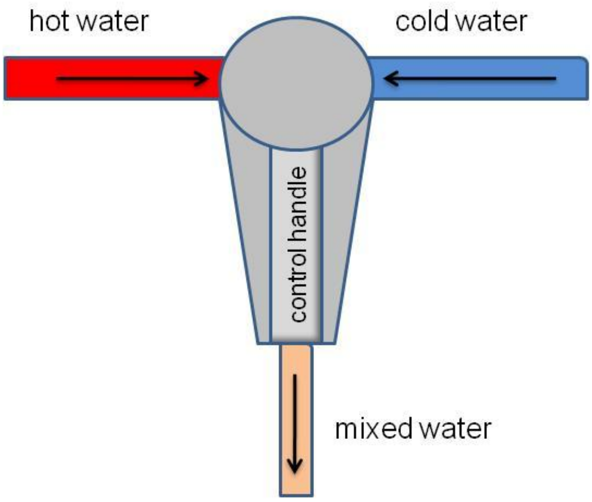

Figure 2: Schematic diagram showing the control handle in the centred position, directly above the centre of the outlet water stream

f) Economy flow and mixer water temperature 38 °C.

For sub-activities g to i, with a supply pressure of 300 kPa, the mixer water temperature to 38 °C, the rinse times are measured for the following settings:

g) Measure the rinse time at maximum flow.
h) Measure the rinse time at economy flow.
i) Measure the rinse time at 3 litres per minute for basin mixer taps, and at 5 litres per minute for kitchen mixer taps.

For sub-activities j to l, with a supply pressure of 300 kPa, the mixer water temperature to 50 °C, the rinse times are measured for the following settings:

j) Measure the rinse time for removing oil at maximum flow.
k) Measure the rinse time for removing oil at economy flow.
l) Measure the rinse time for removing oil at 3 litres per minute for basin mixer taps, and at 5 litres per minute for kitchen mixer taps.

Additionally the time for filling a 4 litre vessel at a distribution pressure of 300 kPa is measured.

3.2 Energy use for an activity

Calculate the energy use for an activity as follows:

$$Q_{activity} = \dot{q}_{v,mixer} \cdot t_{activity} \cdot (T_{mixer} - T_{coldwater}) \cdot Cp \cdot \rho / 3600$$

and

$$\dot{q}_{v,mixer} = \dot{q}_{v,coldwater} + \dot{q}_{v,hotwater}$$

where:

$Q_{activity}$	energy use for the activity (kWh);
$\dot{q}_{v,mixer}$	flow of mixed hot and cold water at the outlet from the mixer tap (m^3/s);
$t_{activity}$	time needed to perform a rinse or an activity (s);
T_{mixer}	temperature of the mixed water at the outlet from the mixer tap (°C);
$T_{coldwater}$	temperature of the distributed cold water (°C);
Cp	the thermal capacitivity of the water (4,175 kJ/[kg °C]);
ρ	density of the water (kg/m^3).

3.3 Energy use of a mixer

Calculate the total energy use of a mixer by summing the energy use values for the twelve different sub-tests. Sum the energy use of the different activities as follows:

$$Q_{\text{mixer}} = \sum_{i=a}^{f} Q_{\text{activity,i}} + 2 * \sum_{j=g}^{l} \dot{Q}_{\text{activity,j}} \quad (1)$$

where:

Q_{mixer} the energy use of a mixer tap

This equation has been taken forward by empirical testing. In order to get the rinsing tests valuated in the same size of magnitude as the 60 seconds tests the factor 2 has been added.

The energy use value (Q_{mixer}) of a basin or kitchen mixer tap is used to assign the tap to an energy class according to Table 1.

Table 1: Energy classification levels of hand basin and kitchen mixer taps

Energy class	Q_{mixer} (kWh)
A	$Q_{mixer} \leq 1.6$
B	$1.6 < Q_{mixer} \leq 2.2$
C	$2.2 < Q_{mixer} \leq 2.8$
D	$2.8 < Q_{mixer} \leq 3.4$
E	$3.4 < Q_{mixer} \leq 4.0$
F	$4.0 < Q_{mixer} \leq 4.6$
G	$4.6 < Q_{mixer}$

3.4 Delimitation

The standard refers to that the mixer tap should comply with the requirements in the European standard EN 817 "*Sanitary tapware. Mechanical mixing valves (PN 10). General technical specifications",* which means that two-lever mixers cannot be classified according to SS 820 000. En 817 also requires a minimum flow of 4 litres per minute for water saving taps, which means that taps that have a lower maximum flow cannot be classified.

Furthermore, if it is not possible to meet the exact requirements mentioned in test procedures, energy marking of the tap is not possible. This means that the mixer tap need to be able to reach mixer water temperatures of 38 °C and 50 °C. Kitchen taps must also be able to reach 5 litres per minute.

4 Results

First the total energy was plotted versus the mixer tap maximum flow and economy flow.

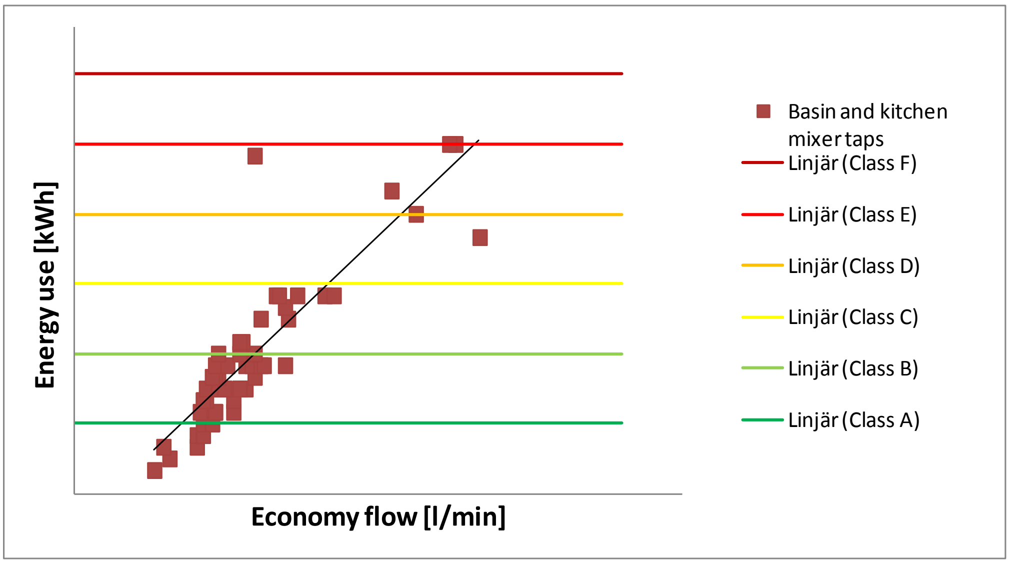

Figure 3: Energy use (Q_{mixer}) of basin and kitchen mixer taps according to chapter 6.3 in SS 820 000 versus economy flow. Note that the first three mixer taps were not able to be classified since they could not reach 4 litres per minute at 300 kPa.

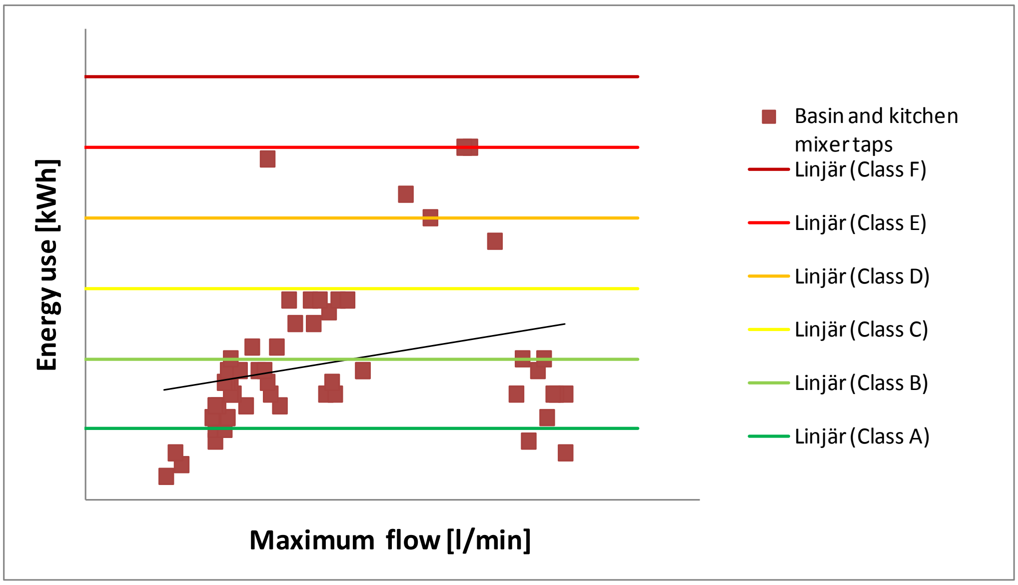

Figure 4: Energy use (Q_{mixer}) of basin and kitchen mixer taps according to chapter 6.3 in SS 820 000 versus maximum flow. Note that the first three mixer taps were not able to be classified since they could not reach 4 litres per minute at 300 kPa.

The results shows that the final energy class has a strong correlation versus economy flow but no correlation towards maxmium flow. Several mixer taps that have high maximum flow will get a class A or B. Therefore further investigations have been made on each activity individually. The activities that are maesured at economy flow is plotted versus economy flow and the activities that are maesured at maxmium flow is plotted versus maxmium flow.

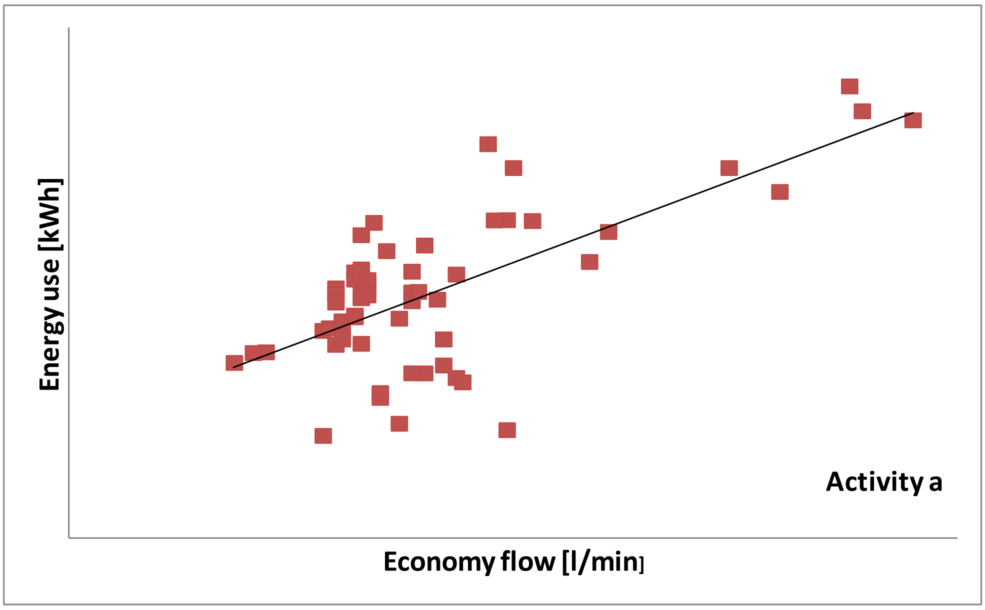

Figure 5: Energy use for activity a (economy temperature, economy flow and supply pressure 100 kPa) versus economy flow for 58 mixer taps.

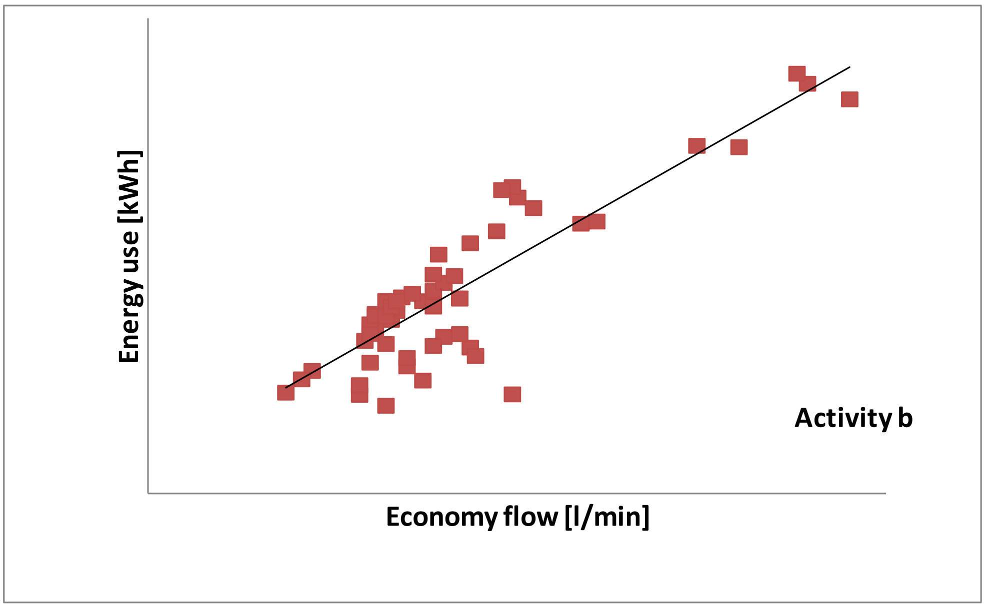

Figure 6: Energy use for activity b (economy temperature, economy flow and supply pressure 300 kPa) versus economy flow for 58 mixer taps.

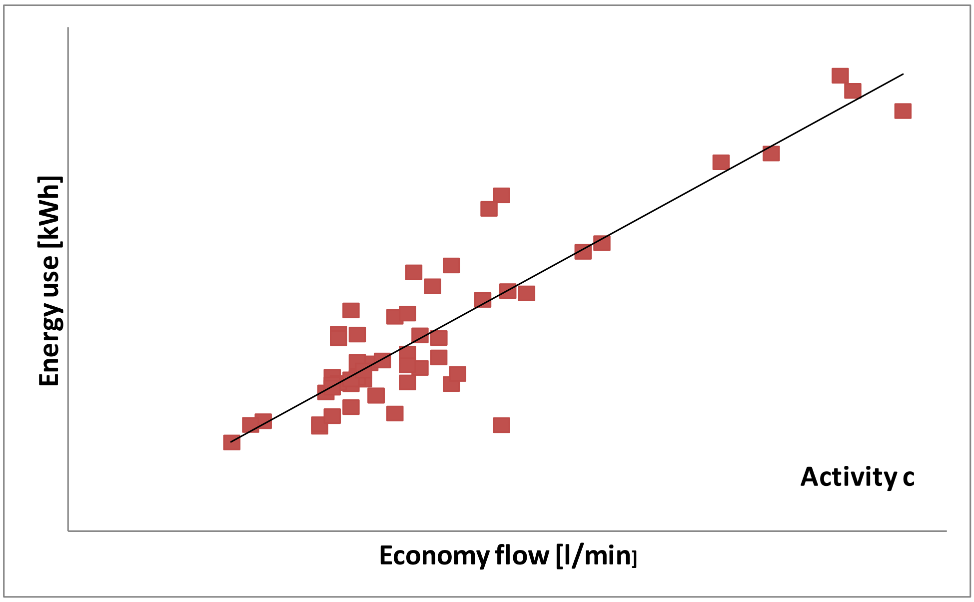

Figure 7: Energy use for activity c (economy temperature, economy flow and supply pressure 500 kPa) versus economy flow for 58 mixer taps.

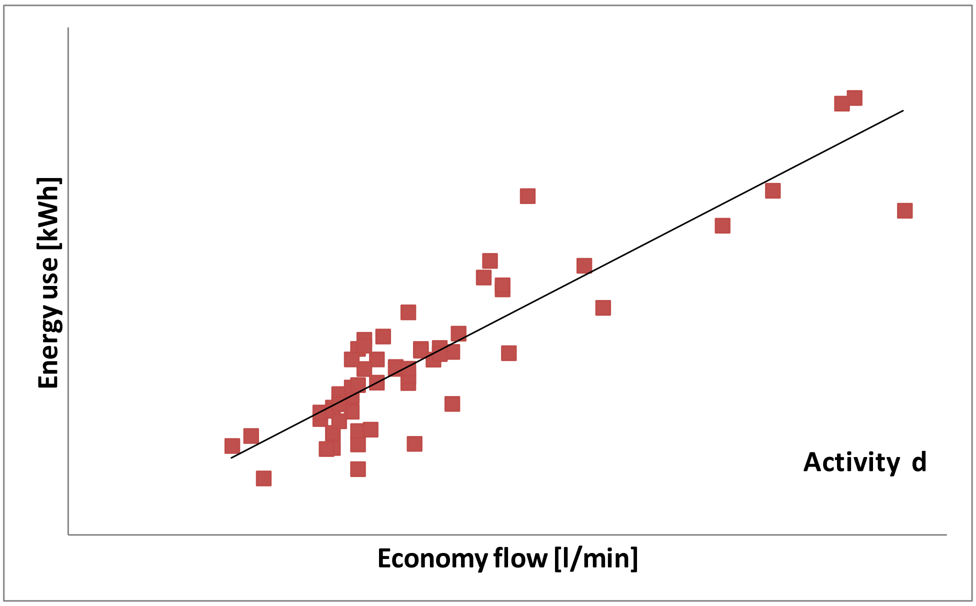

Figure 8: Energy use for activity d (economy flow, with the control handle halfway between the centred position and the maximum hot water flow position) versus economy flow for 58 mixer taps.

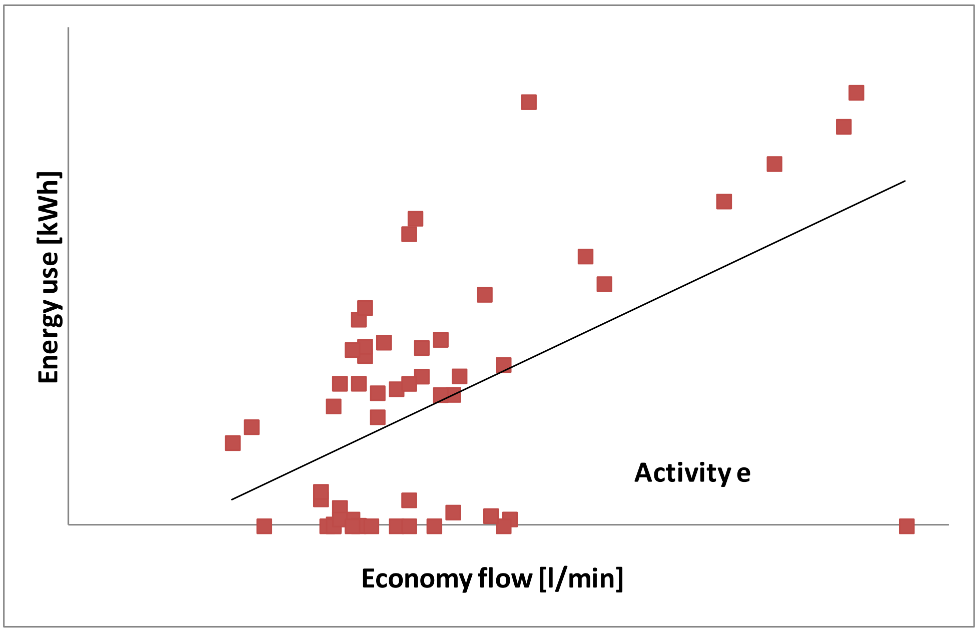

Figure 9: Energy use for activity e (economy flow, with the control handle in the centred position) versus economy flow for 58 mixer taps.

The results shows that some of the mixer taps has no energy use (zero) which means that only cold water will be delivrered with the contral handle straight forward.

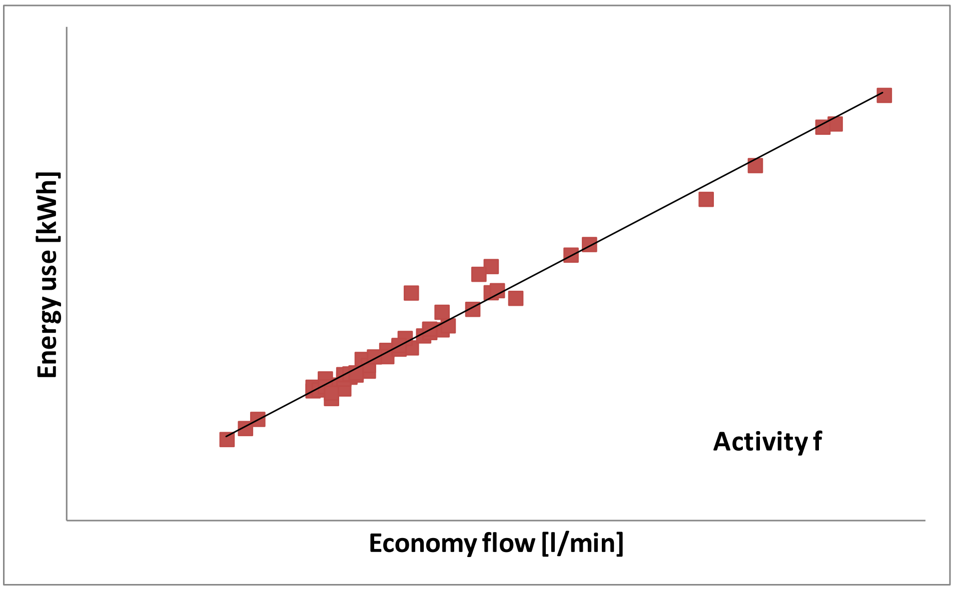

Figure 10: Energy use for activity f (economy flow and mixer water temperature 38 °C) versus economy flow for 58 mixer taps.

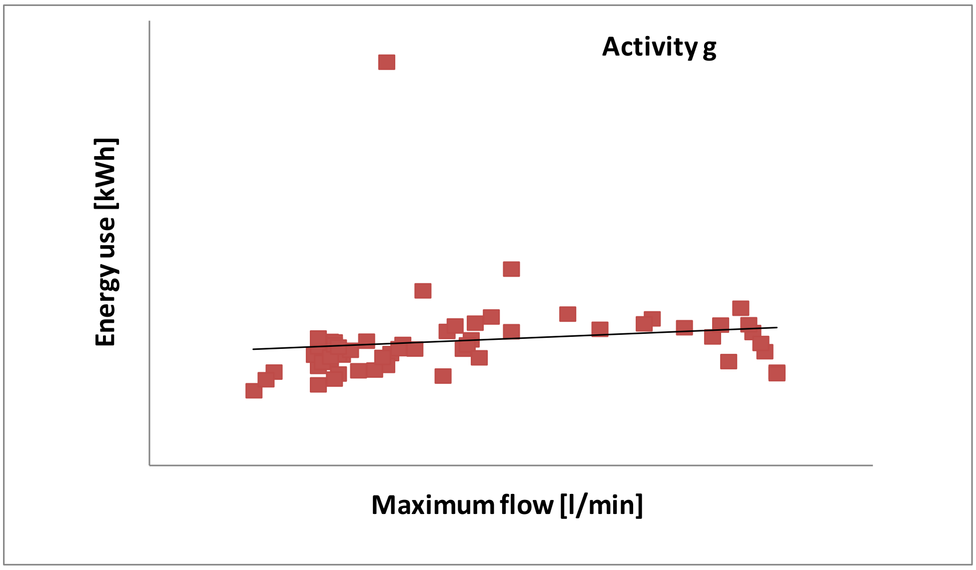

Figure 11: Energy use for activity g (rinse time at maximum flow) versus maximum flow for 58 mixer taps.

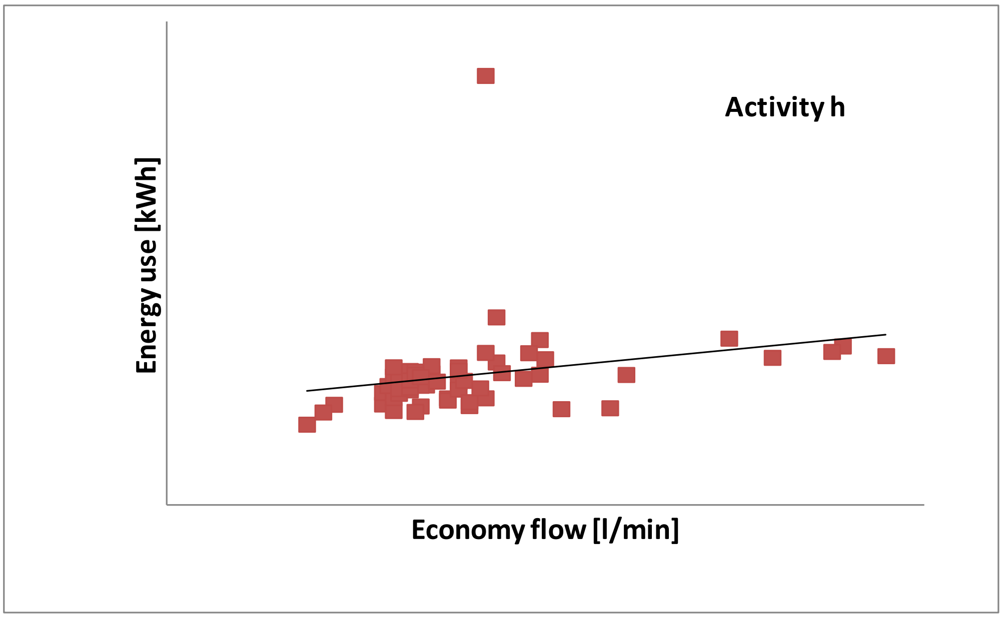

Figure 12: Energy use for activity h (rinse time at economy flow) versus economy flow for 58 mixer taps.

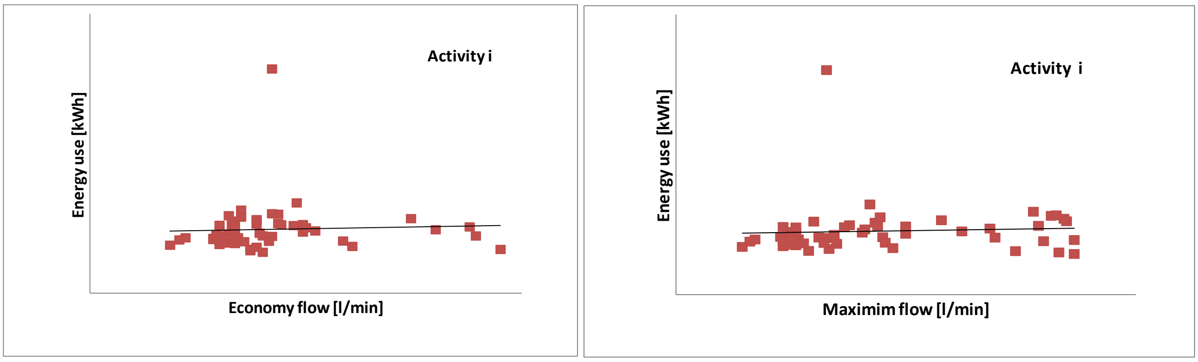

Figure 13: Energy use for activity i (rinse time at 3 litres per minute for basin mixer taps, and at 5 litres per minute for kitchen mixer taps) versus economy flow and versus maxmium flow for 58 mixer taps.

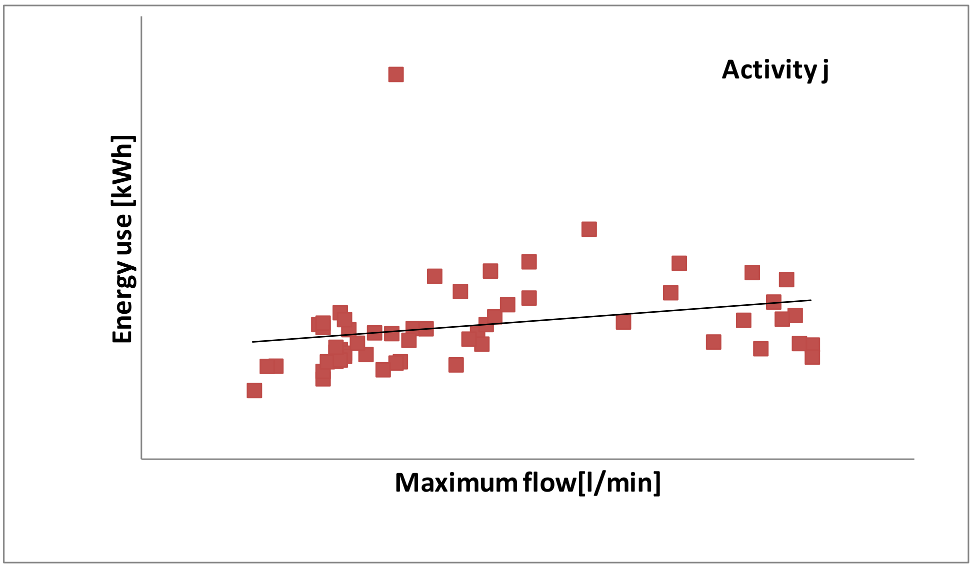

Figure 14: Energy use for activity j (rinse time for removing oil at maximum flow according) versus maximum flow for 58 mixer taps.

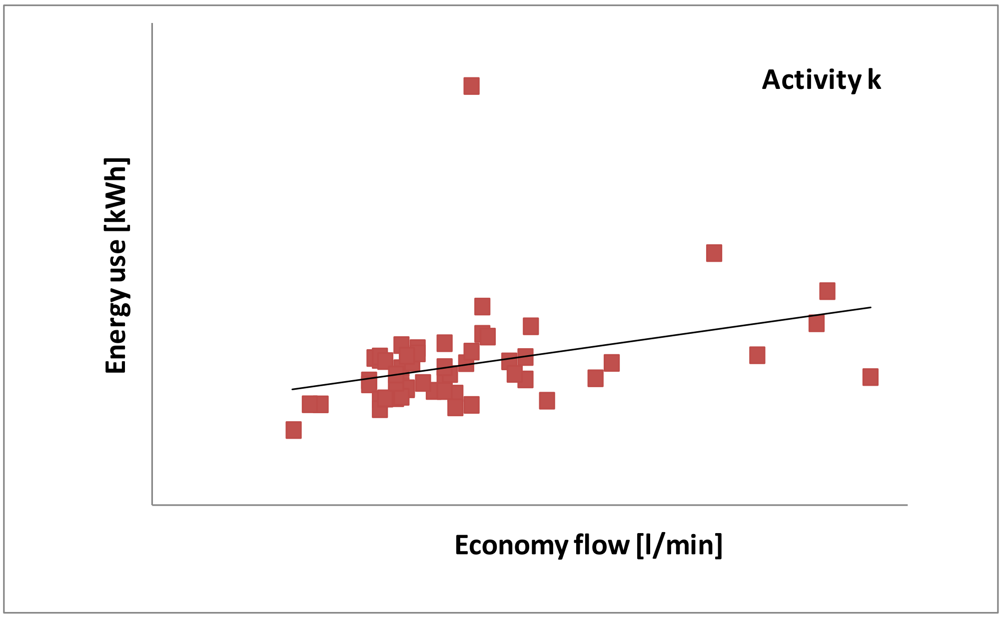

Figure 15: Energy use for activity k (rinse time for removing oil at economy flow) versus economy flow for 58 mixer taps.

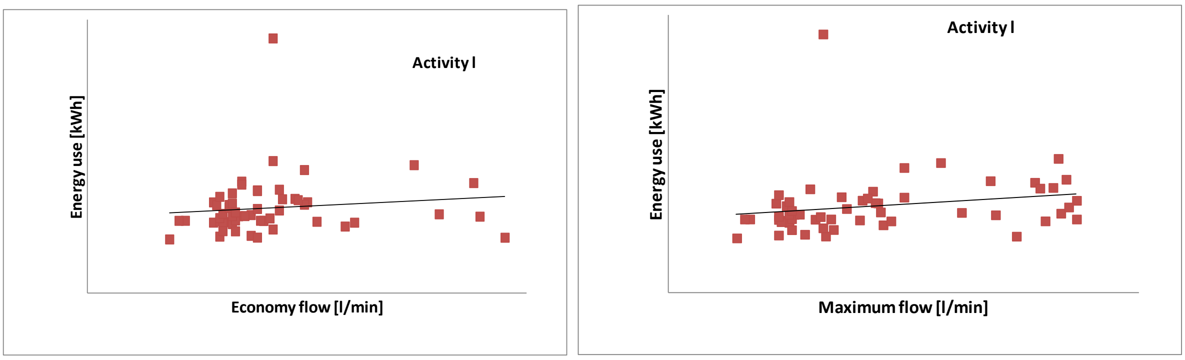

Figure 16: Energy use for activity l (rinse time for removing oil at 3 litres per minute for basin mixer taps, and at 5 litres per minute for kitchen mixer taps) versus economy flow and maximum flow for 58 mixer taps.

The results shows that activity a-d and f are strongly correlated towards economy flow while the other activities have small or non correlation with economy flow. Five of 12 activities has correlation with economy flow and in order to see how much they influence the final result each activity were plotted versus each mixer tap.

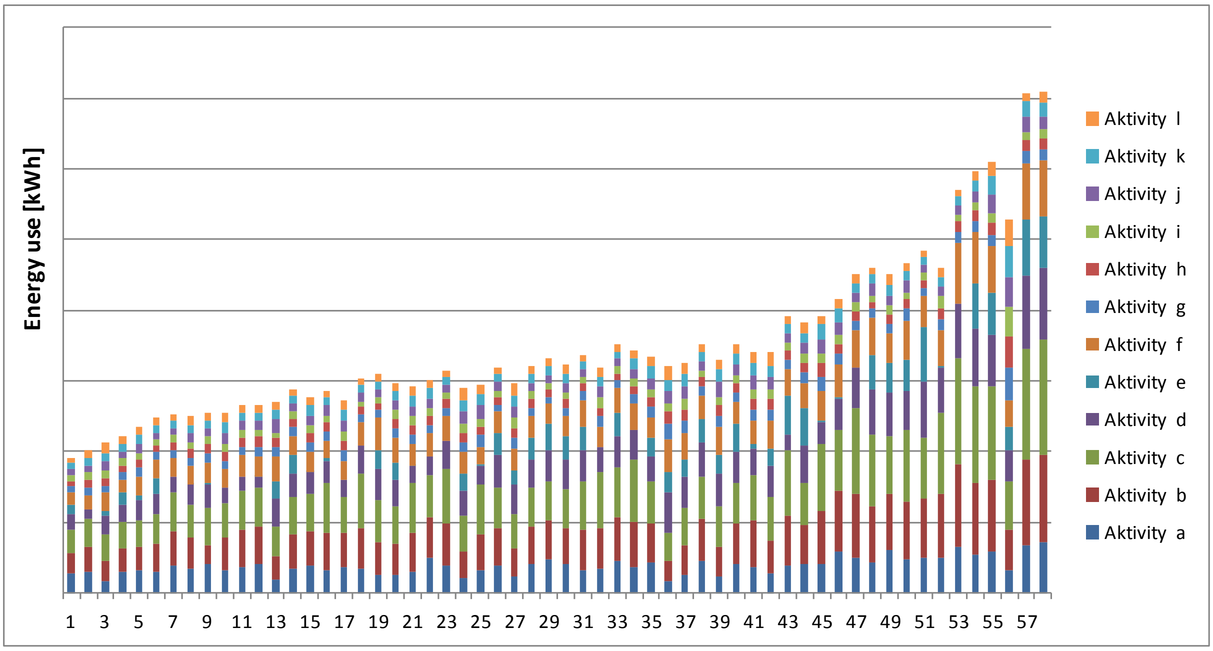

Figure 17: Energy use for each activity (according to Chapter 5.4 in SS 820 000) for each of the 58 mixer taps. The one with best label is to the left and so on. Note that the first three mixer taps were not able to be classified since they could not reach 4 litres per minute at 300 kPa.

In order to see how much influence the activitries a-f in relation to activity g-l these are plotted togehter. And according to the equation for calulating the total energy use of a mixer tap activity g-l should be calculated twice.

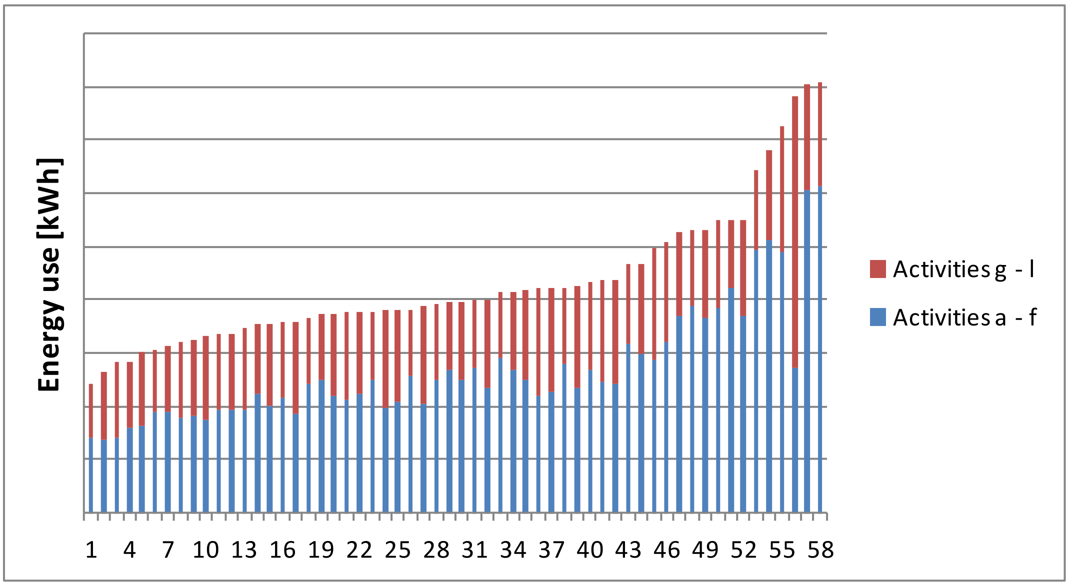

Figure 18: Energy use for activities a-f (activities during 60 seconds) and activities g-l (rinse tests) twice according to the equation of calculating the energy use of a mixer tap (chapter 6.3 in SS 820 000). The one with the best label is to the left and so on. Note that the first three mixer taps were not able to be classified since they could not reach 4 litres per minute at 300 kPa.

One can clearly see that activities a-f have a strong impact on the final result. But also that activities g-l are important to work with in order to reach high scores.

Activities g-i and j-l are for three differnt flows economy, maximum and 3 resp 5 l/min for basin and kitchen mixer taps respectively. In order to investigate if the flow is crucial for the results the 6 activities were investigated only for mixer taps that have both an economy and a maxmium flow.

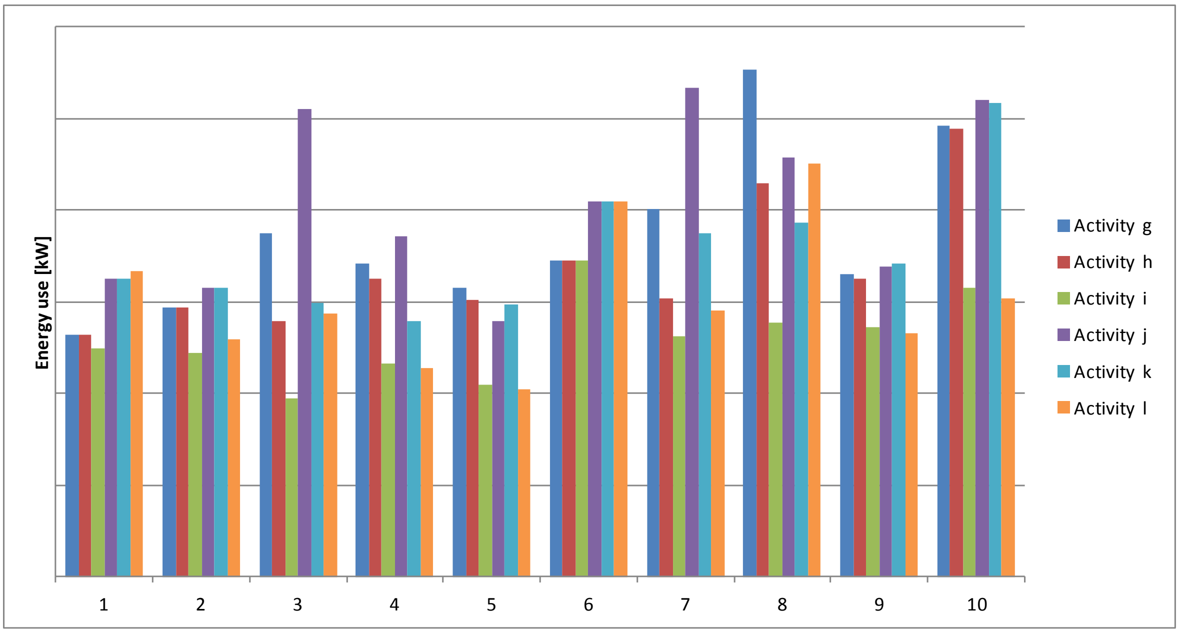

Figure 19: Energy use for activities g-l (rinse time at maxmium flow, economy flow and at 3 or 5 litres per minute for rinsing without (g-i) and with oil (j-l)) for basin mixer taps that have both an economy and a maximum flow.

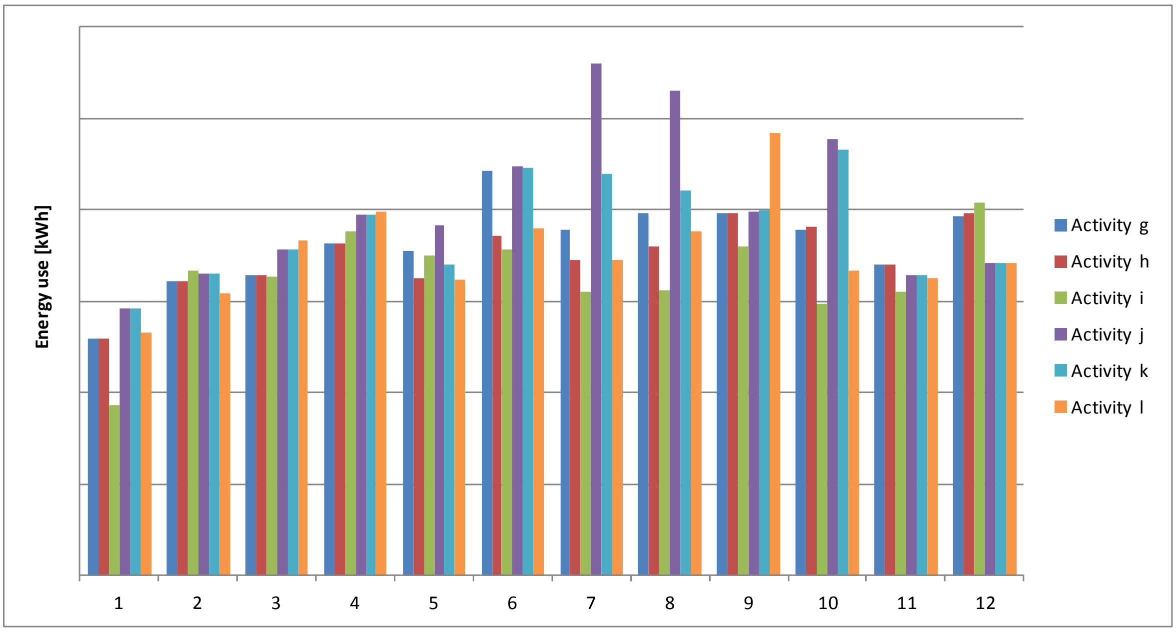

Figure 20: Energy use for activities g-l (rinse time at maxmium flow, economy flow and at 3 or 5 litres per minute for rinsing without (g-i) and with oil (j-l)) for kitchen mixer taps that have both an economy and a maximum flow.

The results show that flow is not the dominating reason for a result. In order to get low energy use other qualities of the mixer tap need to be considered.

Comparison with water label

A comparison has also been made with the labeling system called water label (www.europeanwaterlabel.eu), see Figure 21. In water label the different classes are set after the mixer taps maxmium flow at 300 kPa.

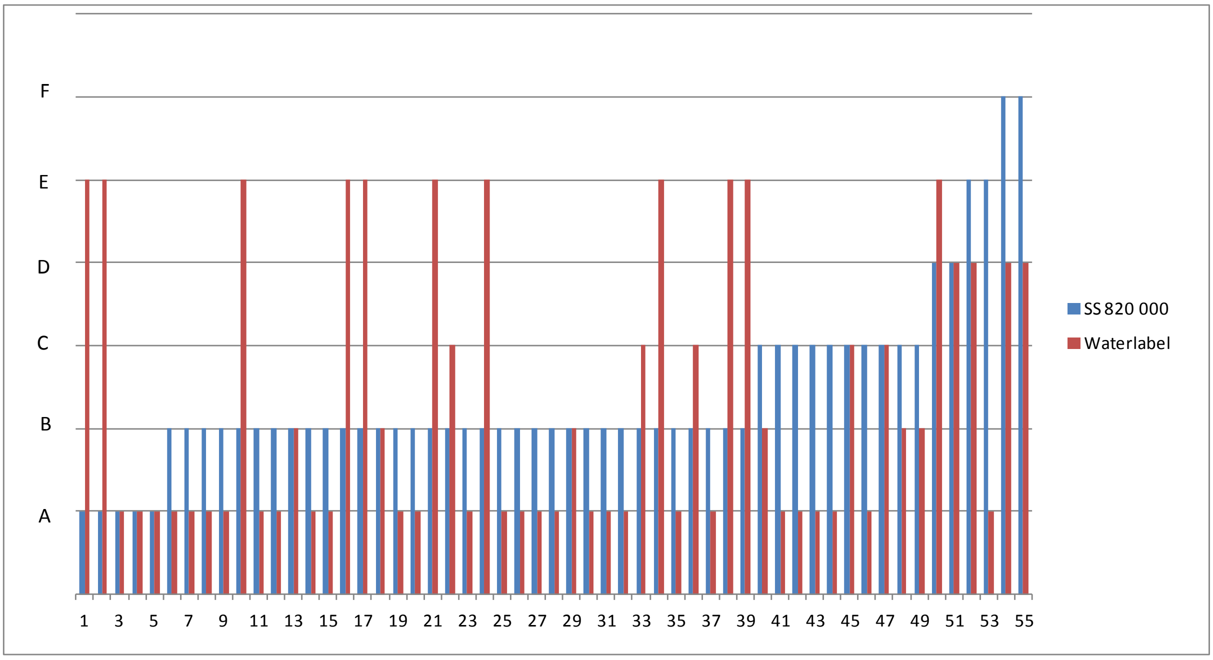

Figure 21: Energy class for all mixer taps according to SS 820 000 in comparison with water label classification.

5 Analysis

The objective with the test method is to give credit for technolgies that decrease water use while still keeping the same function. The first technical functions that contribute to this more energy and water efficient use is to influence the user not to use water with routine. This technical function will require that the user in some way indicates that he/she needs a larger water flow or a more heated water, otherwise the mixer tap will give a minimum water flow and with low temperature. These functions are primarily credited with activity a-e. Different flow possibilities will also influence activity g, h, j and k.

The second technical functions is to create a water beam with the right formation of droplets and with a specific amount of air mixed into the beam. By doing this effectively the same function - for example rinsing a plate or washing a piece of cloth - can be done but with less use of cold or hot water. This function is credited with activity g-l.

In Table 2 the different techniques that will get credit in each activity are indicated.

Table 2: Different techniques that will influence the score for each activity. (+ means that the score will be better with low flow or low temperature, x means that the flow will influence the score but it can be either positive or negative).

Activity	Low economy temperature	Low temperature straight forward	Low economy flow	Maximum flow	Maximum temperature
a	+		+		
b	+		+		
c	+		+		
d		+ (45°)	+		
e		+	+		
f			+		Possible to reach 38°
g				x	Possible to reach 38°
h			x		Possible to reach 38°
i				Possible to reach 3 resp. 5 l/min	Possible to reach 38°
j				x	Possible to reach 50°
k			x		Possible to reach 50°
l				Possible to reach 3 resp. 5 l/min	Possible to reach 50°

The first 3 activities all give credit to low economy temperature and low economy flow. This means that these techniques give three times score for the same techniques. Usually the flow are more or less correlated to the pressure. Furthermore in activity a the score will become better with as low flow as possible but it is not neassary to give credit to extream flow at 100 kPa. On the contrary it is important to make sure that the flow is raesonable also at 100 kPa when efforts has made to lower it at 300 and 500 kPa. One improvment of the standard could be to exclude activity a and to take the mean value of activity b and c to the total score.

Activities d and e gives credit to techniqes that consider low use of temeperature by routine and are therefore valid. However activity f does not give any meaningful results since it is totally correlated to the economy flow again (the same thing that got scores in activity b to e) and therefore could this activity be excluded. The only thing thar this activity prove is that it is possible to reach 38°C. However, this is tested in activity g-i.

Activities g-i and j-l give different results and the manufacturer need to consider that it should be possible to rinse the spot with all different flows. An improvment to give credit to good design of economy flow and economy temperature should be to change activity h and k to be done with economy flow and economy temperature instead of 38 respectively 50°C since these temperatures are tested in activities i and l.

Furthermore, for some mixer taps the possibility to get maximum flow give worse score than for taps that do not have any maximum flow. The only point that give credit to high maximum flow is to fill the vessel but this is not included in the total energy use calculation. One can also question if it is important to rinse the spot with maximum flow since it easier with economy flow. It could therefore be an option to exclude also activities g and j. However, future techniques may have a design there maximum flow will be easier to use and with less energy in order to rinse the spot.

Activities d and e gives credit to techniqes that consider low use of energy (flow and temperature) by routine. Another technique is to have a presence sensor that only gives water flow as long as the hands are below the mixer tap or a time limitation of the flow after turn on. The two test activities could be formulated in another way to also give credit to these techniques.

The standard SS 820 000 indirect requires that a minimum flow of 4 litres per minute must be possible to reach for classification. It would therefore be more reasonable to change the rinse test for activities i and l to be performed with 4 litres per minute for basin mixer taps and at 6 litres per minute for kitchen mixer taps. This will also increase the possibilities to classify taps with presence sensor.

6 Discussion

The main goal with the test cycle has been on technologies that decrease water use while still keeping the same function. Today there are two main technical functions that contribute to this more energy and water efficient use:

- One technical function is to influence the user not to use water with routine. This technical function will require that the user in some way indicates that he/she needs a larger water flow or a more heated water, otherwise the mixer tap will give a minimum water flow and with low temperature. This can for example be done with a tap with diverter or a two-stage tap. It can also be a sensor or a push tap.
- The other technical function is to create a water beam with the right formation of droplets and with a specific amount of air mixed into the beam. By doing this effectively the same function - for example rinsing a plate or washing a piece of cloth - can be done but with less use of cold or hot water. The tap´s aerator or the showers head are important parts for this function.

Suggestion of new test cycle

In order to improve the standard to actually give credit for the above mentioned purpose the follwing test cycle is suggested:

A. Energy use for economy temperature, economy flow during 30 seconds and supply pressure of 300 kPa.

B. Energy use for economy temperature, economy flow during 30 seconds and supply pressure of 500 kPa.

C. Energy use for economy flow during 30 seconds, with the control handle halfway between the centred position and the maximum hot water flow position. If the mixer tap control handle is at the side of the tap outlet, then "centred position" shall be taken to mean "straight upwards". The water flow should be opened with one single manual operation and thereafter the hands should be removed and then no further action should be taken. (This means that a presence sensor controlled mixer tap will have zero flow within a few seconds and a time limited controlled mixer tap will continue to have a flow for the set time period.)

D. Energy use for economy flow during 30 seconds, with the control handle in the centred position (90° ± 1°). If the control handle is at the side of the mixer tap outlet, then "centred position" shall be taken to mean "straight upwards" or "straight downwards". The water flow should be opened with one single manual operation and thereafter the hands should be removed and then no further action should be taken. (This means that a presence sensor controlled mixer tap will have zero flow within a few seconds and a time limited controlled mixer tap will continue to have a flow for the set time period.)

E. Energy use corresponding to the rinse time at economy flow and economy temperature.

F. Energy use corresponding to the rinse time at 4 litres per minute for basin mixer taps and at 6 litres per minute for kitchen mixer taps.

G. Energy use corresponding to the rinse time for removing oil at economy flow and economy temperature.

H. Energy use corresponding to the rinse time for removing oil at 4 litres per minute for basin mixer taps, and at 6 litres per minute for kitchen mixer taps.

I. Energy use for filling a vessel during 60 seconds with maximum flow (up to 15 litres per minute) at a distribution pressure of 300 kPa.

Calculation of energy use for a mixer

Sum the energy use of the different activities as follows for calculation of the total energy use of a mixer:

$$Q_{\text{mixer}} = \sum_{i=A}^{D} Q_{\text{activity},i} + 3 * \sum_{j=E}^{H} Q_{\text{activity},j} - Q_{\text{activity},I} \qquad (2)$$

where:

Q_{mixer} the energy use of a mixer tap

A new scale for energy classes for the total energy use (Q_{mixer}) of a hand basin or kitchen mixer tap is given in Table 3.

Table 3: New suggestion of energy classification levels of hand basin and kitchen mixer taps

Energy class	Q_{mixer} (kWh)
A	$Q_{mixer} \leq 0.6$
B	$0.6 < Q_{mixer} \leq 0.9$
C	$0.9 < Q_{mixer} \leq 1,2$
D	$1.2 < Q_{mixer} \leq 1.5$
E	$1.5 < Q_{mixer} \leq 1.8$
F	$1.8 < Q_{mixer} \leq 2.1$
G	$2.1 < Q_{mixer}$

Analysis of new test cycle

The different techniques that will get credit in each activity are indicated in Table 4 for the new suggested test cycle.

Table 4: Different techniques that will influence the score for each activity in the new suggested test cycle. (+ means that the score will be better with low flow or low temperature, x means that the flow will influence the score but it can be either positive or negative).

Activity	Low economy temperature	Low temperature straight forward	Low economy flow	Maximum flow	Maximum temperature	Time limited or presence sensors
A	+		+			
B	+		+			
C		+ (45°)	+			+
D		+	+			+
E	x		x			
F				Possible to reach 4 resp. 6 l/min	Possible to reach 38°	
G	x		x			
H				Possible to reach 4 resp. 6 l/min	Possible to reach 50°	
I				+ must be 4 l/min		

A comparison between classes for the investigated mixer taps according to the SS 820 000 and according to the new suggestion of test cycle is made in Figure 22. The calculation of total energy use is according to measured values except for activities E, F, G and H. The test results for energy use corresponding to the rinse time for activities E and G are for temperatures of 38 °C and 50°C respectively instead of economy temperature and activities F and H are for 3 and 5 litres per minute respectively instead of 4 and 6 litres per minute. Furthermore it has not been possible to check if any of investigated mixer taps has time limitations or presence sensors.

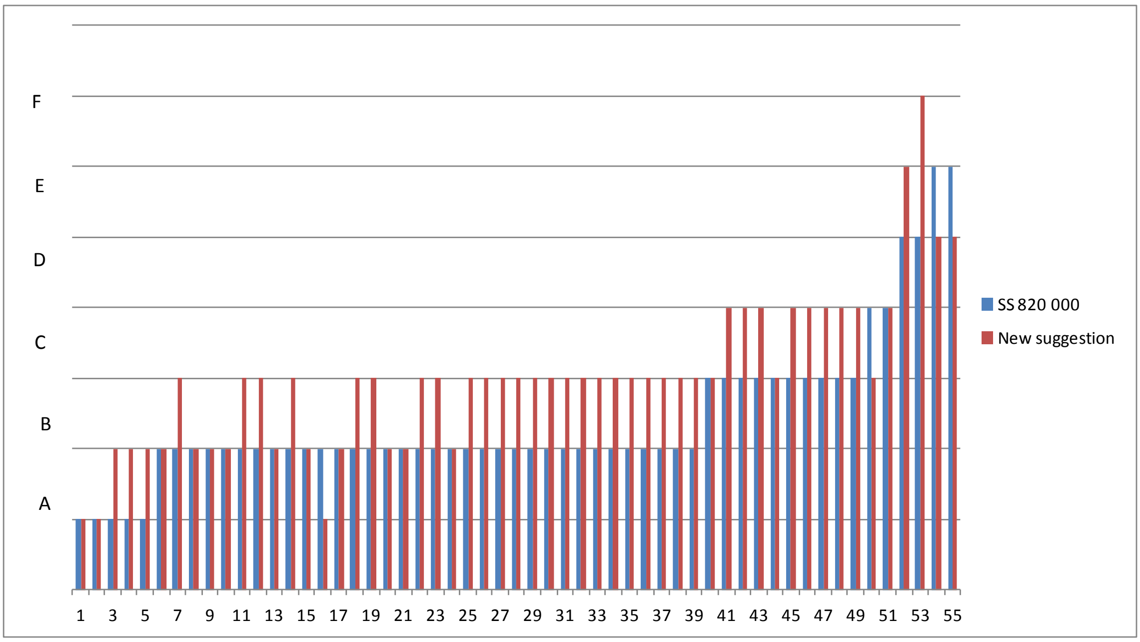

Figure 22: Energy class for all mixer taps according to SS 820 000 and in comparison with the new suggestion of test cycle according to eguation 2 and Table 3.

The energy use of each mixer tap were finally checked versus economy flow in Figure 23. We can see that the correlation is much more balanced now between activity tests for regulated flows and for rinsing tests compared with Figure 3. Furthermore a comparison between activities during 30 seconds and rinse tests is made in Figure 24, that can be compared with figure 18.

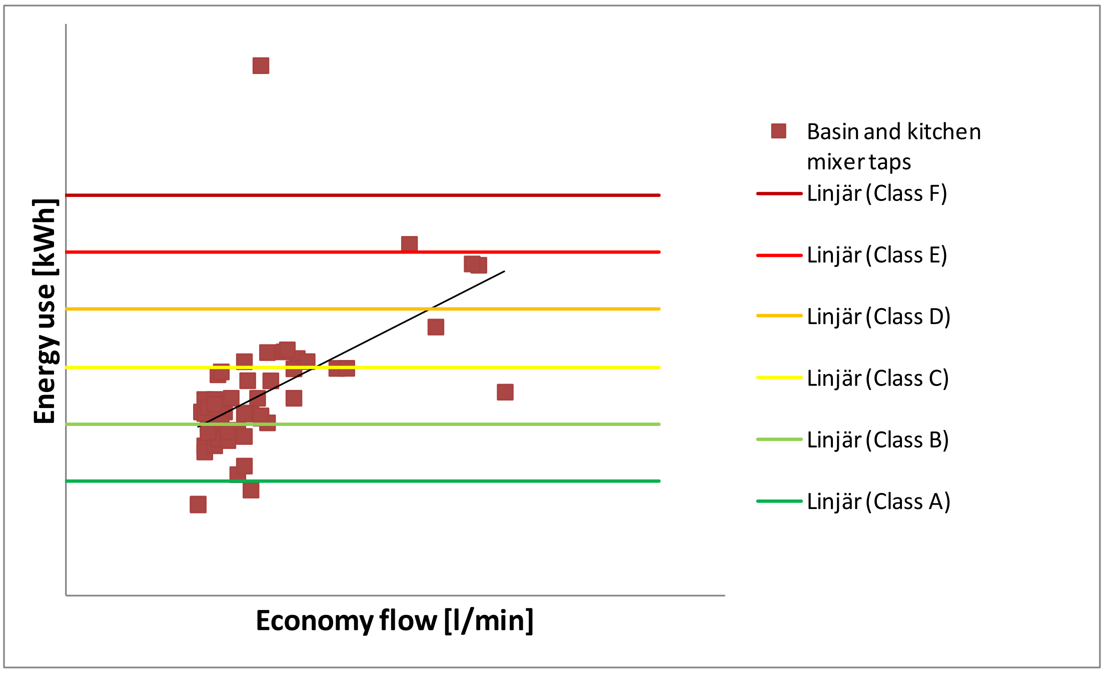

Figure 23: Energy use (Q_{mixer}) of basin and kitchen mixer taps according to the new suggested test cycle and Equation 2.

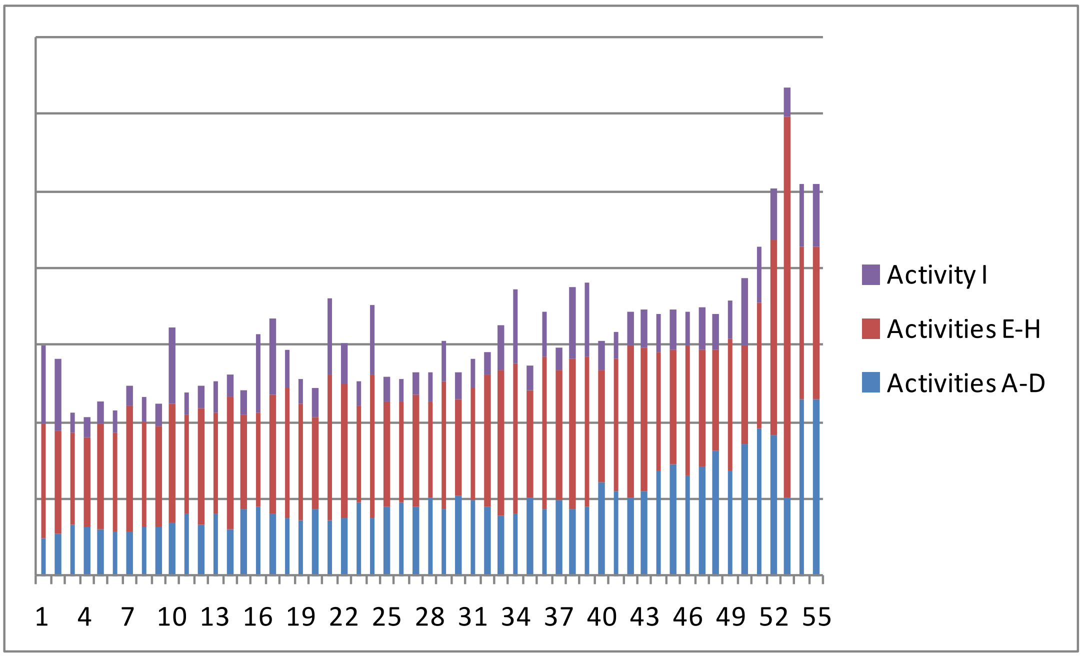

Figure 24: Energy use for activities A-D (activities during 30 seconds), activities E-H (rinse tests) three times according to the equation 2 of calculating the energy use and activity I (fill a vessel). Note that activity I is drawn as positive in the figure while it is a reduction according to equation 2.

Improvement of test procedures

With the suggested improvements of the test cycle the Swedish standard will get the possibilities to give credit to energy efficiency incentives there the tap flow is not the only indicator needed to be considered to reach high scores.

At the same time it is possible to reduce the number of activities in the test method in order to reduce test costs. In SS 820 000 measurements are made for maximum flow and energy use for 12 different activities, there 6 of the activities (rinse tests) are repeated 19 times. This means that totally 127 measurements points are needed for SS 820 000. The Swedish standardisation committee 519 has opened SS 820 000 for revision and they have noticed that in order to keep the same accuracy it would be possible to reduce the number of repetitions by half for the rinse tests. With the new suggested test cycle and the reduction of repetitions for the rinse test totally 45 measurements points are needed. This means that the test procedure has been rationalized with 65%.

7 Conclusion

The functions needed for a mixer tap are for example to fill a vessel, rinse a plate or wash a piece of cloth. Some functions are more advanced and requires a certain amount of energy (amount of water with a certain temperature) while other functions are more simple and just requires a small amount of water (cold or hot).

A tap with only limitations of water flow and temperature will decrease use of energy then the user use water by routine for simple functions that are not requiring a specific energy use while it will be more time consuming and difficult to perform advanced functions that requires a certain amount of energy. A European regulation only allowing such taps might be experienced as negative by the consumers.

However, a mixer tap may be designed with technical functions that if the mixer tap is just used by routine a small amount of energy (small water flow with a low temperature) will be used but if the user need to do an advanced function that requires a certain amount of energy it will be possible with just one more action. Furthermore, a mixer tap may be designed with techniques that forms the water beam with the right formation of droplets and amount of air mixed into the beam that will reduce the amount of energy needed to perform the function.

The main purpose with the Swedish Standard SS 820 000 is to promote technologies that decrease water use while still offer complete functions for the user. This means that it should be possible to perform an advanced function that requires a certain amount of energy without increasing the time of use. It also means that limited energy should be used when a simple function is performed that just requires a small amount of water. And finally it means that the water beam should be formed in a way that energy use to perform a function should be reduced.

The Swedish standard SS 820 000 has now been on the market with an Energy Labelling System in a few years. Several products have been marked during that time and it has now been possible to evaluate the content in the standard, which have been done in this study.

The results shows that the test cycle and the calculation of the total score from the series of activities needs to be improved in order to comply with the objectives. One suggestion is made in this report but since the products that are included in this study cannot be considered as representative for the market further tests are strongly recommended for any mixer taps that can be bought on the market before the new test cycle can be decided. Thereafter it is recommended that the Swedish Standardisation committee 519, that recently has opened SS 820 000 for revision, should improve the test procedures of energy efficiency.

Even with an improved Swedish Standard it is still developed with specific aspects and in Europe there might be more aspects that should be considered. On European level further investigations are needed there the Swedish Standard can act as a basis for development of a European harmonised standard for the Eco-design requirements and European Energy Labelling systems.