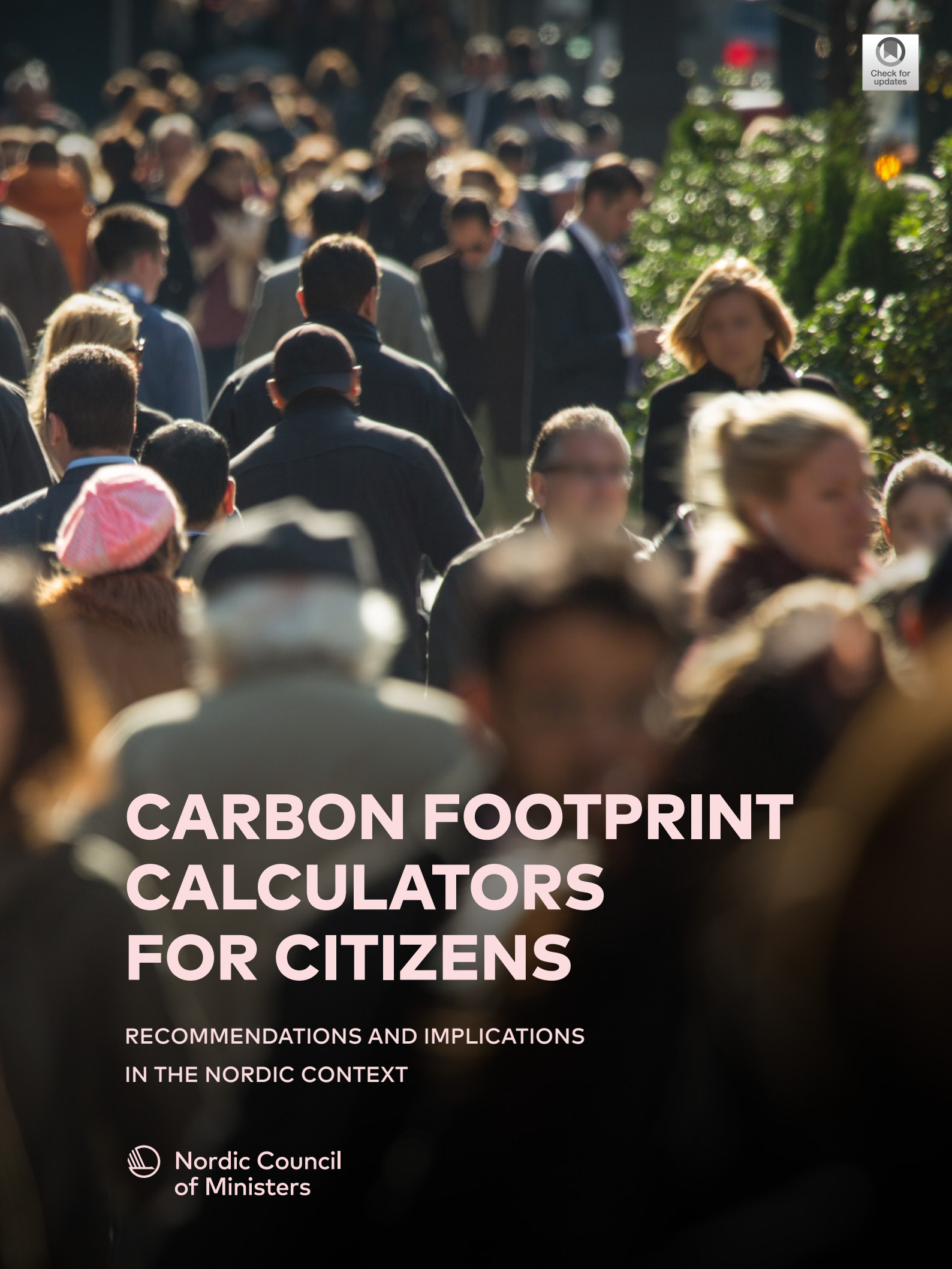

CARBON FOOTPRINT CALCULATORS FOR CITIZENS

RECOMMENDATIONS AND IMPLICATIONS IN THE NORDIC CONTEXT

Nordic Council of Ministers

Carbon footprint calculators for citizens

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Marja Salo and Maija K. Mattinen

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Nordic co-operation
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Nordic co-operation has firm traditions in politics, the economy, and culture. It plays an important role in European and international collaboration, and aims at creating a strong Nordic community in a strong Europe.

Nordic co-operation seeks to safeguard Nordic and regional interests and principles in the global community. Shared Nordic values help the region solidify its position as one of the world's most innovative and competitive.

Contents

List of abbreviations

CF	Carbon footprint
GHG	Greenhouse gas
HSC	Household sustainable consumption
NGO	Non-governmental organisation
UNFCCC	United Nations Framework Convention on Climate Change
SEI	Stockholm Environment Institute
SYKE	Finnish Environment Institute
WWF UK	World Wildlife Fund United Kingdom

Preface

Climate change mitigation calls for changes in the consumption patterns of ordinary citizens and households. Especially in the affluent societies, such as the Nordic countries, the carbon footprint of household consumption is considerably higher than the global average and the sustainable level of carbon footprint.

Non-governmental organisations, research institutes and also companies have launched personal or household footprint calculators for public use. The calculators illustrate how our ordinary everyday life, including housing, travel, food, consumption of other goods and services, contribute to the carbon footprint. Many calculators or applications provide ideas for action on how to make the footprint smaller.

In this report, we look into Nordic carbon footprint calculators and selected benchmarks from other countries. The purpose is to highlight good practices in the design and use of calculators for ordinary citizens. The report provides suggestions for the future development of existing or new calculator initiatives.

The study was carried out by the Finnish Environment Institute. The project was financed by the Nordic Council of Ministers, administrated by the Sustainable Consumption and Production Working Group and guided by a steering group consisting of representatives from Finland, Iceland, Norway and Sweden. The project team is grateful to the calculator hosts and developers for taking their time and sharing their knowledge via interviews. The interviews were valuable for gaining a more in-depth knowledge on the motivations and practical experiences of the calculator projects.

Katarina Järverup Frisk
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Chair of the project steering group
Working Group for Sustainable Consumption and Production (HKP)

Summary

Hertwich and Peters (2009) state that 72% of the global greenhouse gas (GHG) emissions are related to household consumption. The potential of mitigating climate change by changing consumption patterns with already existing solutions is modelled by Girod and colleagues (2014). The modelling results show how changes in consumption would enable the 2 °C climate target to be reached by 2050. The urgency of climate change calls for action to make our consumption carbon footprint (i.e. GHG emissions from housing, travel, food, consumption of other goods and services) smaller.

Informational measures are needed, among other policy measures, to decrease the size of the consumption carbon footprint. In this report, we present data on 10 carbon footprint calculators for public use. Based on the data, we highlight successful practices related to calculator development and use. We also discuss the challenges in developing and using the calculators in campaigns. Finally, we present recommendations for the future development and use of carbon footprint calculators.

Online carbon footprint calculators are not only developed by research and non-governmental organisations, but also by companies. The calculators can be used to introduce the consumption perspective on GHG emissions, as well as the role of consumption choices in climate change mitigation. Calculators can support learning about orders of magnitude of different consumption categories, and provide information about personal footprints, adjusted by the consumption choices and preferences.

Eight of the examined calculators were designed for a specific Nordic country. We included two examples outside the Nordics as a reference. In addition, one of the calculators has localised versions for Sweden and UK. We examined the calculators' websites, attached documentation and invited calculator hosts for a phone or Skype interview. We reached, altogether, six calculator hosts for an interview.

The existing scientific literature on footprint calculators focuses mainly on the data, methods and consistency of the calculators. In this report, we focus more on the features, recorded number of users, and experiences on using the calculators in campaigns and research projects.

The desktop study on the calculators shows how the tools visualise the composition and footprint, and many calculators seek to provide a context for the personal result. This potential of raising the awareness of the size and composition of the footprint was also noted by the calculator hosts. At the same time, the respondents referred to challenges in recruiting users, especially returning users.

In this report, we present recommendations for calculator development and use. Here, we highlight three issues important for the future development of existing or new calculators:

- Clearly define for whom, and for what purpose the calculator is designed. In the best case scenario, what do the calculator users think or do after using the calculator? Set a target for the calculator use and/or impact, as well as measures for monitoring.
- If you aim at changing consumption patterns, be realistic with the potential of the calculator alone to catalyse change. Plan and provide various forms of support and a convenient path for taking action.
- Collaborate with intermediaries who introduce the calculator to your target audience. Further, consider how your calculator and intervention can ease the workload of the intermediary.

1. Introduction

Consumption patterns and choices are important, but often neglected in terms of climate change mitigation. However, Hertwich and Peters (2009) state that 72% of global GHG emissions are related to household consumption, and the rest to government consumption and investments. The potential of mitigating climate change by changing consumption patterns is modelled by Girod and colleagues (2014), who propose that low GHG-intensive choices in housing, passenger transport, food, and other goods and services would make it possible to reach the 2 °C climate target by 2050.

Changing consumption patterns in affluent societies, such as in the Nordic countries, is especially important. In addition to the end-of-pipe emissions of production, we should focus on the unsustainable footprint of our normal everyday life.

CF calculators have been developed by research organisations, NGOs and companies to raise awareness on carbon footprint and engage users in action. The calculators are potential tools to show the order of magnitude of actions (e.g. the importance of energy use at home), and help motivated people to focus their efforts on high impact actions. Calculators can also include features, informational or social, aimed at encouraging users to take action.

In this study, we examine a set of carbon footprint calculators. We highlight good approaches and features of carbon footprint calculators and interventions. At the same time, we discuss the shortcomings of existing approaches. Based on the examined calculators, literature and our experience as a calculator developer and a host, we make recommendations about calculator development and use in interventions aiming to reduce consumption footprint. A special focus is placed on the Nordic context and potential of collaboration in developing and using calculators.

Existing literature and research on calculators focus mainly on the methodological features: Consistency of calculators, robustness of results and data used in the calculation model. Our contribution extends the scope from methodological aspects into the user perspectives and impacts of calculators. We focus on three issues:

- How do the features of existing calculators and related interventions help users to:
  - understand the consumption carbon footprint.
  - engage in changing consumption practices.
- Targets and aims set for the calculators by developers and hosts.
- Number of end-users, and calculators' impact and measuring these two.

Our analysis is based on a sample of 10 carbon footprint calculators, off which eight are from the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden), and two benchmarks outside Nordics. In addition, one of the calculators has specific versions for Sweden and UK. The data are collected by examining the calculators and attached public documentation, peer reviewed research papers related to the calculators, interviews of calculator hosts, and additional data provided by the interviewed experts.

This report is structured, as follows: Chapter 2 presents materials and methods used in this study. Chapter 3 is devoted to the findings based on the desktop study and the interviews. In Chapter 4, we propose recommendations useful for the future development of existing calculators and new initiatives planning to make use of calculators. The report is concluded in Chapter 5.

2. Materials and methods

In this study, we use a sample of carbon footprint calculators as a material for studying calculator features, use and impact. The data consist of a desktop study and expert interviews of calculator developers or hosts. The data, their collection and use is described in the following subsections.

2.1 Examined calculators

Calculators were searched from Google by using the following key words in local languages: carbon; footprint; calculator. In addition, the authors and the steering group had lists of calculators from previous projects. We used the lists to see if there were calculators that we had not found from the Google search. Some of the calculators listed by the steering group were no longer available or were designed for other user groups than citizens or households. Also, national experts outside the steering group working in the field of sustainable consumption were consulted for their suggestions for calculators to be included in this study.

The list of calculators is not a complete representation of all calculators available for citizens in the Nordic countries. It is possible that despite of the desktop search, as well as the consultation of local experts, we have missed a certain calculator. For instance, there are many calculators provided by companies or NGO's selling carbon offsets. However, the listed calculators provide us with sufficient data to highlight good examples, discuss the experiences on using calculators in interventions and to make recommendations on how to develop and use calculators in interventions in the future.

The aim is to find comprehensive calculators, taking into account housing (including energy use at home), travel (every day and longer trips), food, and the consumption of other goods and services. During the study, calculators focusing on only some of the aspects were also included due to lack of a comprehensive calculator in a specific country, or because of features of the calculator or application were considered useful for the analysis.

In addition to Nordic calculators, benchmarks from other countries were selected. There are altogether three benchmarks. The first is the REAP Petite by the SEI Stockholm Environment Institute, which has two versions: One specific for the UK and another for Sweden. Each version has specific national data sources and slightly modified questions for each country. The second example is Climate Neutral Now by the UNFCCC, and the third, the WWF UK climate footprint calculator. Climate Neutral Now was chosen, due to its ambitious global focus. The third example, hosted by the WWF UK, was suggested by the steering group and the features (visual style,

documentation of calculation principles, tips for taking actions) make a valuable benchmark for this study.

The calculators were examined in 2016. The list of calculators is presented in table 1, where we introduce reference codes (table 1) to save space in the forthcoming tables.

Table 1: List of data sources for each calculator

Name of the calculator	Host	Country	Ref
Car comparison calculator	Orkusetur (Energy Agency Iceland)	Iceland	A
Climate Neutral Now	UNFCCC	Global	B*
Ducky	Ducky as	Norway	C
Ilmastodieetti	The Finnish Environment Institute SYKE	Finland	D
Klimatkontot	IVL Swedish Environmental Research Institute	Sweden	E
Min klimatpåverkan	SEI Stockholm Environment Institute	Sweden (+ UK)	F
WWF UK environmental carbon footprint	WWF UK	UK	G*
Kolvidur calculator	Kolvidur Fund	Iceland	H
CO2-beregneren	Energi Tjensten (Energy Agency Denmark)	Denmark	I
The Baltic Sea Card	Ålandsbanken	Åland / Finland / Sweden	J

Note: *Calculators by the UNFCCC and WWF UK were included as benchmarks outside the Nordic countries. The calculator by SEI also has a UK version.

Five of the examined calculators (Climate Neutral Now, Ilmastodieetti, Klimatkontot, REAP Petite and WWF UK calculator) aim to provide an overall footprint calculation of the respondent's lifestyle. Climate Neutral Now is designed for global use, which means that the respondent starts by choosing the country of residence, and the energy calculation is adjusted accordingly. The Baltic Sea Card is available for bank customers in Sweden, Åland and Finland. Other calculators have been designed for national audiences, with country specific data sources and calculations. REAP Petite and regional versions of Klimatkontot use sub-national data in the calculations.

The Baltic Sea Card calculation is based on purchases made with the specific debit/credit card. The calculation is provided by the Ålandsbanken as an additional service for the card. The user's consumption data are automatically fed by the service. The calculator is also publicly available online.

Ducky takes a somewhat different approach. There is no overall footprint calculation at the time of examination in 2016. The focus is more on actions to reduce ones' footprint and the social features show how others also take action. The proposed actions are related to e.g. energy saving and choosing low-carbon transport options.

The car comparison tool by Orkusetur in Iceland has a specific use case and purpose: To calculate costs and CO_2-emissions of car driving. The calculator allows choosing the type of vehicle, and adjusting cost and fuel consumption parameters.

The calculator provides information for those interested about the costs of car use and/or the emissions.

2.2 Procedure of the desktop study and interviews

For data collection purposes, we developed a framework for assessing the carbon footprint calculators. The list of data sources of each calculator is presented in table 2. We used the framework during the desktop study and interviews to capture the following five aspects:

- Basic information (name, link, host organisation, launch year, languages available, type of calculation documentation).
- Calculation principles, data and scope of the calculator.
- Calculator features to engage users.
- Campaigns and interventions.
- Use and impact.

Documentation is the key to assess the credibility of a calculator. Caeiro and colleagues (2012:80) suggest that household sustainable consumption (HSC) indicators should "provide a transparent evaluation of the HSC performance". We interpret this in a way that both non-professional users and professionals in sustainability can learn about the calculation principles (what is calculated and how). Therefore, we examined the available documentation on the calculators. Documentations were assessed from three perspectives, does the documentation:

- Help a non-professional user to understand the perspective, purpose and limitations of the calculation.
- Provide transparent and detailed documentation of the calculation principles for professionals, so that they can evaluate the calculation procedure.
- Present a procedure for quality assurance.

Table 2: List of data sources for each calculator

Name of the calculator	Ref	Calculator website	Calculator documentation	Interview	Peer reviewed publication
Car comparison calculator	A	x		x	
Climate Neutral Now	B	x	x	x	
Ducky	C	x	x	x	
Ilmastodieetti	D	x	x	x*	x
Klimat kontot	E	x	x	x	
Min klimatpåverkan	F	x	x	x	x
WWF UK	G	x	x		
Kolvidur	H	x			
CO2-beregneren	I	x			
The Baltic Sea Card	J	x			

Note: *The first author of this report has been responsible for the Ilmastodieetti calculator; the calculation model development and maintenance. The interview in this case refers to describing the calculator and the related activities, according to the same template as used for other interviews.

After completing the desktop study, all calculator hosts (see table 1 for a list of calculators) were contacted by email, and invited for a Skype or phone interview. The semi-structured interviews followed the structure of the desktop study. The notes from the desktop study of the calculator in question were emailed to the participants before the interview.

In total, six interviews were conducted by phone or Skype. Interviews lasted from 45 to 70 minutes. Altogether four calculator representatives were not available for interview. We either did not receive a reply to our request or, as in one case, there had been changes in personnel and the calculator experts were no longer working in the organisation. In addition to calculator developers, we used expert views from discussions with two Finnish specialists on environmental education to gain insights about the potential of footprint calculators in education, and awareness raising in general.

A more detailed description of the data collection procedure, list of interviews and the outline for interviews can be found in appendix 1. The template for data collection was used for examining calculators and the related freely available documentation. After completing the desktop study, we used the template in the interviews. We followed the structure of the template, but certain items were shifted from one section to another due to consistency of the analysis. We took the special focus and type of calculators into account, and adjusted the focus and questions during the interview, when needed.

The purpose of the interviews was three-fold:

- To have calculator experts to check the desktop study's results;.
- To fill in missing data that was lacking after the desktop study.
- To discuss calculator specific topics. The general outline of the interviews followed the structure of the desktop template.

3. Findings and discussion

This chapter presents findings on calculators and their use in campaigns and interventions. First, we look into calculation principles, data and scope of calculators. Then, we focus on calculator features and user engagement. The third theme includes campaigns and interventions. Lastly, we look into a number of calculator users and their impact. In each sub-section, we present findings from the desktop study and interviews, and then discuss the results.

3.1 Calculation principles, data and scope of examined calculators

All the examined calculators use the consumption approach. This means that the calculation is based on what the respondent consumes, not on average territorial emissions per capita in a certain country. Consumption refers to emissions related to energy, materials and product manufacturing, and they are taken into account, regardless of their origin.

Describing (external) validation, e.g. a third party examination or collaboration with key stakeholders in development of the calculator can increase the credibility of the calculator. We also highlight the database aspect (saving user inputs in a database), because this allows the development of certain features for engaging users and using the data for research purposes (see chapter 3.2). Table 3 summarises findings on calculation principles and data sources. In tables, we use "X" to indicate that we identified the listed aspect in the calculator. However, the extent and quality of the listed features, e.g. the level of detail in documentation, varies. We use "?" to indicate that we were unable to define the feature based on the desktop study, and did not reach a representative for an interview.

Table 3: List of documentation and features related to calculation principles, data and scope

Calculation principles, data and scope	A	B	C	D	E	F	G	H	I	J
Documentation that introduces the calculation principles, methodology and main data sources.			X	X	X	X	X			
National data used where possible, e.g. national energy emission intensities and energy system features.	X	X	X	X	X	X	X	X	?	?
Regional data used for subnational versions or to adjust personal results.					X	X				
Introduce the concept of government consumption, i.e. footprint of public services.					X	X	X			
External quality assurance, e.g. mentioning high level professionals (professors) as examiners of the calculator or an external audit by a third party.			X				X	X		X
Inputs and calculation results are saved in a database. This allows the development of features to follow personal/group progress and use the data for research purposes.			X	X	X	X	*			**
Calculation can be easily adjusted to both personal and household levels	X	X				X				

Note: *We did not reach the calculator host for an interview, and the existence of a database was not possible to identify from the online calculator features.
** The web-site version does include a feature to save results and return to the calculator. However, the features for users with the actual Baltic Sea credit/debit card are more advanced.

Most of the examined calculators provide at least a brief documentation of the most important data sources and or calculation principles. The calculators by the UNFCCC and the Baltic Sea Card list the most important sources for data, but not the principles of the calculation. In general, we found the documentations to be limited in many calculator websites. In particular, it was difficult to get a detailed picture of the calculation principles, and how the data had been translated into the calculation model. For instance, it was unclear if the calculation only takes into account CO_2, or also other GHG-emissions, or if the calculation only includes direct or the life-cycle emissions. On the other hand, the examined calculators provide good examples, e.g. Min klimatpåverkan and Klimatkontot, on how to communicate the idea of consumption carbon footprint, calculation principles, the data used and possible use cases for the calculator.

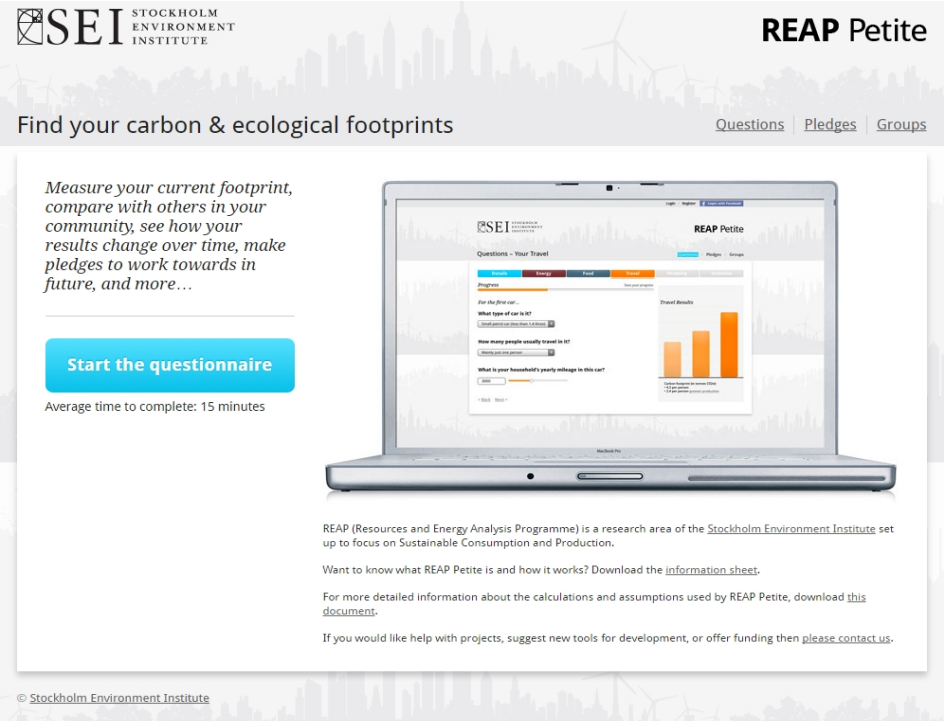
A calculator for more than one country – two examples

Typically, if you, as an ordinary consumer, try to use a footprint calculator designed for another country than our own, you may confront at least three challenges: 1) Language. It makes the use more complicated, even translation programs help to understand the questions. 2) Country-specific inputs. E.g. postal code. Even in the very beginning this might be needed to proceed. 3) Most importantly, the questions, available options and emission intensities are defined specifically for one country. Using national data and features improve the user experience and provide more accurate results and guidance. Typically, types of energy sources vary from one country to another and also

the estimated consumption.

From the calculator host perspective, the above mentioned challenges are examples of issues to be taken into account in designing a calculator for an international audience. The examined calculators include two, even if very different, examples of using or applying one calculator in more than one country. The Climate Neutral Now calculator by the UNFCCC is designed to give a result for residents around the world. To allow this, the calculator has many generalisations. The national differences are taken into account in the energy consumption estimates, but the documentation is limited to assess the level of detail.

Figure 1: The layout of the REAP Petite is similar in the UK and Swedish versions. The screen capture is from the REAP Petite UK website



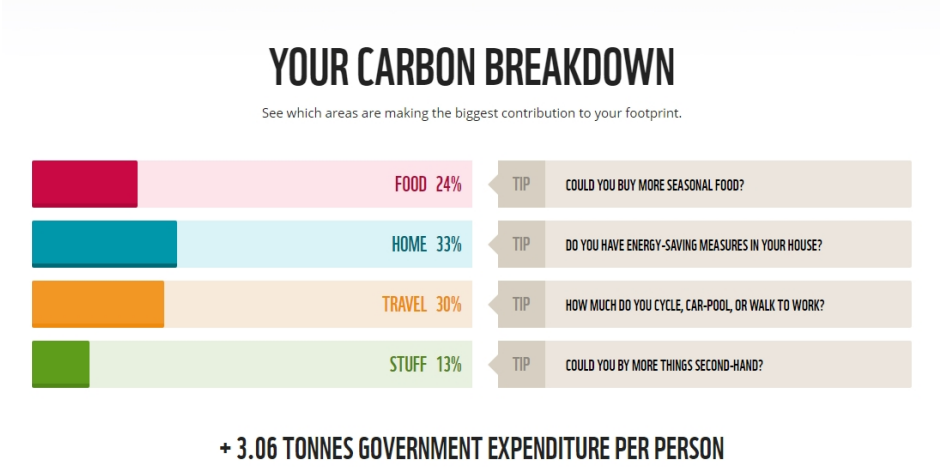
Taking a step back from the documentation to the process of setting up a calculator, we highlight the case of Klimatkontot. The case provides an example on how to engage various stakeholders with data, resources and interests in the development of and data collection for the tool. Klimatkontot was first developed in a joint project with a large number of stakeholders from various sectors and industries: The Swedish EPA, Stiftelsen Futura, E.ON, Skanska, the City of Stockholm, the City of Göteborg, Umeå Municipality, the Church of Sweden, the Swedish Association of Graduate Engineers and the Swedish Society for Nature Conservation. The project was led by the IVL Swedish Environment Institute. Participants provided funding and data, and contributed to defining the features of the calculator. Working with a large group of stakeholders took time and resources. However, it was beneficial to involve the stakeholders already in the development of the calculator.

Examples of the external quality assurance or validation of a calculation in this study include: referring to senior experts in the field that agree with the content, external third party audition, and involving an extensive group of stakeholders in the development phase. Another option, not used in any of the calculators of this study, is to provide an open access calculation model (code) for interested parties to take a look or even develop it further. For example, take a look at Eco-calculator for city planners KEKO, available (in Finnish): http://www.ymparisto.fi/fi-FI/KEKO__Kaavoituksen_ekolaskuri/Laskentakoodi

Communicating the individual and government footprints and the role of policies in mitigating climate change

The examined calculators differ in their approach on the government consumption footprint. Some focus only on the individual and household consumption and exclude the government consumption. It can be argued, that the calculator focus is on individual choices, and as the citizens cannot directly affect the government footprint, it is therefore excluded. Three of the examined calculators also introduce the concept of the government footprint. For instance, WWF UK presents the footprint of government expenditure next to the personal result (Fig. 2).This way, the users are informed about the footprint of public services that all citizens benefit from. However, none of the examined calculators provide a detailed roadmap on how the combination of personal choices and policies from global to local level help the individual reach the sustainable level in practice.

Figure 2: A screen capture from the WWF UK footprint calculator result page presenting the personal and the government footprint



Our data include examples of calculators with and without a user database. Some calculators focus on providing a simple calculation, which is not saved for later use (e.g. UNFCCC and Orkusetur car comparison tool). Others have a database that is used in certain features. The user data can be useful for the users themselves, if registered users have access to their personal data. For instance, in Ducky, seeing one's cumulative actions is an important feature. Some calculators (e.g. Min klimatpåverkan and Ilmastodieetti) have group features, and calculator hosts can analyse or provide anonymous data for intermediaries to analyse groups' results

separately. The data can be used for campaign or research purposes by the calculator host. E.g. the data of Ilmastodieetti has been used in communicating about sustainable consumption in the media with several highlights: a lower than average footprint of users, a high share of women in respondents, and how often respondents rely on the average energy consumption data, and do not use the real energy consumption in the calculation.

3.1.1 Discussion

Findings of this study related to the documentation and data are in line with previous research on how calculation approaches and documentation vary between calculators (e.g. Padgett *et al.*, 2008; Birnik, 2013). Differences in methodology and system boundaries lead to inconsistency between results of different calculators, which may be confusing to users. At the same time, limited calculator documentation makes it challenging to evaluate the accuracy of the results. More standardised calculation approaches for footprint calculators would improve the scientific quality of the calculators. However, inconsistent results from calculators can result from different system boundaries, or framing of the questions. Therefore, inconsistencies fail to indicate errors in data or calculation models. This could be briefly explained in the documentation.

While improvement in the data quality and methodologies of calculators is important, the value of the calculators lies in their ability to reach users (citizens), increase awareness, or engage in action.

The prior knowledge of non-professional users on footprint concepts varies. Some users are well aware of different footprints and methodologies, and expect detailed descriptions. At the same time, others do not make a difference between different environmental footprints and indicators. An example of this is mixing climate change with ozone depletion. It is a challenge to cater for both extremes and the professional audience seeking a description of the approach and used data.

The strength of the calculators is that they are freely available and can reach a large number of people. At the same time, researchers do not have control on how and for what purpose the calculator is used. If user data is saved into a database and will be used for research purposes, limitations of the quality of the user input data need to be considered. How well do the inserted data describe the real consumption? If users can register, save results and compare them with another calculation later on, the database provides data for tracking the change in the footprint over time. However, our data suggests that it can be challenging to engage users to visit a calculator more than once. Also, small changes in everyday life are not easy to identify in the scale of the total annual footprint. Applications with a special focus, such as Ducky, can provide a more rewarding platform for tracking smaller actions and the progress in the short term, and thus provide more immediate feedback.

3.2 Calculator features and user engagement

In this section, we summarize the findings on how calculator users can define their personal consumption patterns and put their result in a wider context (table 4). We also highlight features that are intended to create a feeling of making a difference (as a group and/or personal contribution), or making the results more meaningful with comparisons and interpretations. The features listed in table 4 are based on the features found from the examined calculators. The reader should note that we did not reach all calculator hosts for an interview. Therefore, the methods for feedback collection are missing for calculators G, H, I, and J.

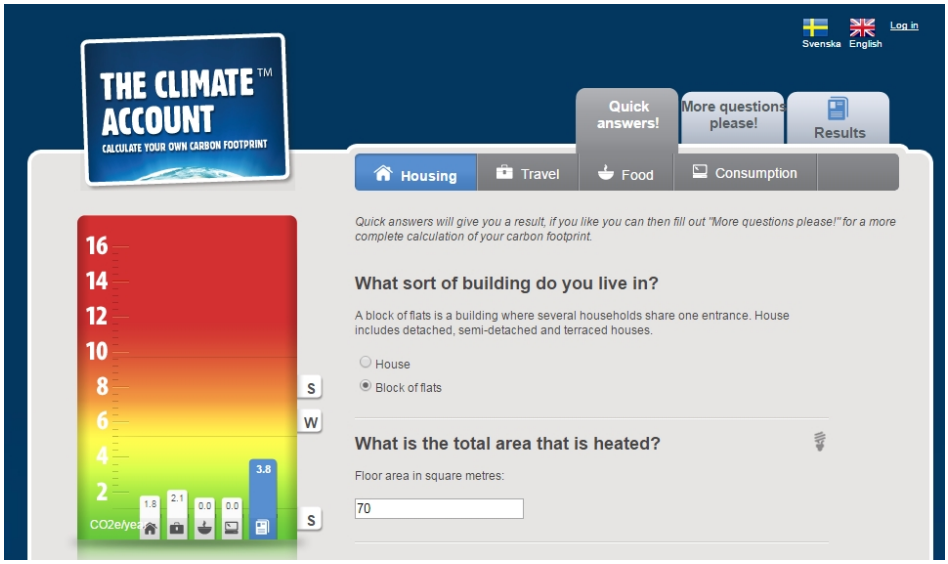
Table 4: Highlights related to calculator features and user engagement

Calculator features and user engagement	A	B	C	D	E	F	G	H	I	J*
Simple and detailed calculation alternatives allowing use of real consumption figures (e.g. units of heating energy, fuel for car) or estimate by the calculator.	X	X		X	X	X				?
Adjusted estimates based on inserted data and preferences. E.g. type of housing, used energy sources etc. used to adjust housing footprint according.	X	X		X	X	X	X	X	X	?
Taking into account low-carbon choices. E.g. energy efficiency measures in housing; using energy from renewable sources; choose a car, other than gasoline or diesel; buying second-hand items.		X	X	X	X	X	X	X	X	?
Feedback from results and suggestions for taking action. E.g. changing practices; adopting technical solutions or offset the emissions.		X	X	X	X	X	X	X	X	X
Split of the total result by consumption category to present the significance of each category.		X		X	X	X	X			?
Introduce roles of consumption choices and policy in mitigating climate change e.g. in documentation.				X	X	X	X			?
See personal progress or contribution over time.			X	X		X				?
Comparison features, e.g. the total result can be compared with: national average; similar households; sustainable global level.			X	X	X	X	X			?
A group feature to show a contribution of a certain group or the total contribution of calculator users.		X	X	X		X	X			?
Developers collect feedback from users e.g. in a form of spontaneous emails; online questionnaires; phone and face-to-face interviews.	X	X	X	X	X	X	?	?	?	?

Note: *We did not reach the calculator host for an interview and features for holders of the Baltic Sea Card can be more extensive than the features of the online calculator.

Many provide both "fast and easy" and "detailed" calculation approaches. See figure 3 for an example from Klimatkontot. This way, hosts aim to provide alternatives for different types of users. The calculator can provide estimates based on statistics and data already inserted by the user. A typical feature is that electricity consumption is estimated, but the user can insert the exact consumption if this figure is available. The user interface design of the calculator is important to make the several types of use as intuitive as possible. One of the interviewees noted that sometimes developers tend to add many features just "because we can do it".

Figure 3: Quick answers and more detailed questions. A screen capture from Klimatkontot



In this study, we found one example of using existing data on consumption patterns to calculate the consumption footprint. The Baltic Sea Card users have access to the CO_2-emissions calculation, based on their purchases (see Figure 4). The automatic data collection reduces the laborious manual data input, which is good news for users. At the same time, developers need to consider the limitation and issues of what the consumption patterns represent.

Figure 4: A screen capture from the Baltic Sea Card websites illustrates the idea of using expenditure data to calculate a footprint and to take action

All the examined calculators are designed for ordinary citizens, and to be used on a voluntary basis. Therefore, the user experiences and perceived usability and usefulness are important. Based on the examined calculators, the feedback collection (e.g. on

calculator features) and processing is mostly reactive, e.g. when the calculator is already published, users contact hosts with comments and questions about the calculator.

3.2.1 *Discussion*

The list of features in table 4 should not be understood as a check list of features to be implemented in every calculator. The purpose, use context, target group and expected response of the calculator should guide the design process, and help to choose the most important features to be implemented in a certain calculator.

Before defining the key features for a specific calculator, developers need to consider if they are developing a tool that helps solve a specific practical problem (e.g. choosing an economic car, such as the Orkusetur's car comparison tool), or a tool to introduce the idea of a consumption footprint.

Another practical aspect is the intended response. Do we expect concrete actions immediately, e.g. trying to influence travel or food choices or energy consumption practices? Some of the examined calculators (Min klimatpåverkan and Ilmastodieetti) use the inserted data to tailor the tips towards taking action.

The required input from users and the provided feedback should be in balance. If we expect a user to spend e.g. 30 min filling in data, would one be satisfied with a simple result with tons of footprint and the split in consumption categories? The laborious data input may also contribute to a false perception of the level of detail and set high expectations for accuracy and feedback. However, as Kennedy and colleagues (2014, 536) put it: "A calculation of a carbon footprint is a complex yet imprecise science".

It is a challenge from the communication perspective to introduce a list of actions to make the personal footprint smaller, while at the same time, it is fairly difficult to reach the globally sustainable level of footprint with the current Nordic lifestyle. Introducing policy and climate change mitigation targets is one attempt to broaden the perspective. Showing the way forward with both personal actions and the required changes in societal level is important. Especially when the personal calculators have raised criticism on placing the burden of climate change mitigation on individual citizen-consumers (see e.g. Spaargaren, 2011:814).

3.3 Campaigns and projects to activate calculator use

In this chapter, we focus on campaigns, projects and practices to reach users and provide a use context for calculators. Strategies and interests of calculator hosts vary. In table 5, we summarize approaches identified in the examined calculators. We exclude calculators from G to J from table 5, due to missing interview data.

Table 5: Highlights related to campaigns and projects

Campaigns and projects	A	B	C	D	E	F
Calculator used in a community level projects			X	X	X	X
Calculator used with citizens in face-to-face contact			X	X	X	X
Collaborate with intermediaries (internal or external). E.g. municipal sustainability experts, teachers, UNFCCC delegates, NGOs		X	X	X	X	X

We identified the following contexts, where the calculators were developed and hosted:

- Intervention in a (research) project aiming to raise awareness on consumption carbon footprint and change consumption patterns (e.g. Min klimatpåverkan).
- Reliable source for communication material or informational campaign (e.g. Ilmastodieetti).
- Data led approach compiling and popularising existing data and providing the tool for stakeholders and intermediaries (e.g. Klimatkontot).
- Calculation to define emissions in order to encourage people (or organisations) to buy carbon offsets (e.g. Climate Neutral Now by the UNFCCC and many other calculators based on this approach are hosted by NGOs or private businesses).
- Startup company aiming at working on a commercial basis (Ducky.no). Use of existing data produced in academia to communicate and activate people to decrease their climate impact with everyday life actions. Provide a platform for a third party.
- Provide information on a specific practical question (costs of car use in the case of the Orkusetur car comparison calculator) and provide information on emissions at the same time.

The interviews in this study stress the challenge of recruiting users and, in particular, returning users. Recent research articles by West *et al.* (2015) and Salo *et al.* (2016) present similar results.

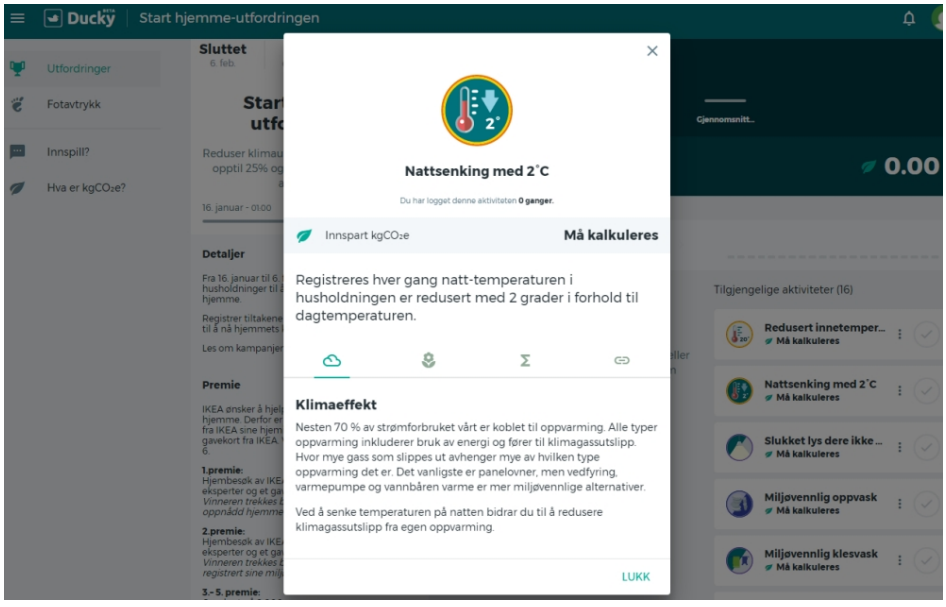
A company using research data to encourage making positive everyday actions

The Ducky.no (see Figure 5) focuses on everyday small actions, visualising the personal progress, community impact and building a community. In 2016, the Ducky platform and application does not have a full carbon footprint calculator available.

The Ducky start-up team has a different kind of professional background, compared to calculator developers and hosts in research institutes. Instead of emission data, their profession is more towards design and software development. For emission data, the team relies on a partnership with academia (NTNU, Norwegian University of Science and Technology). The tool of the Ducky.no can be a platform for campaigns for other organizations, such as companies, festivals, NGOs. The Ducky team has tested their application or platform with three campaigns, but at the time of the interview (August 2016), there were no reports or data available from the campaigns.

This type of work illustrates the possibilities of collaboration across sectors. Research organizations have the data, but it is worth considering how to arrange resources for calculator development and maintenance in the long run.

Figure 5: A screen capture from Ducky.no shows an example of a single action a user can take to reduce one's carbon footprint



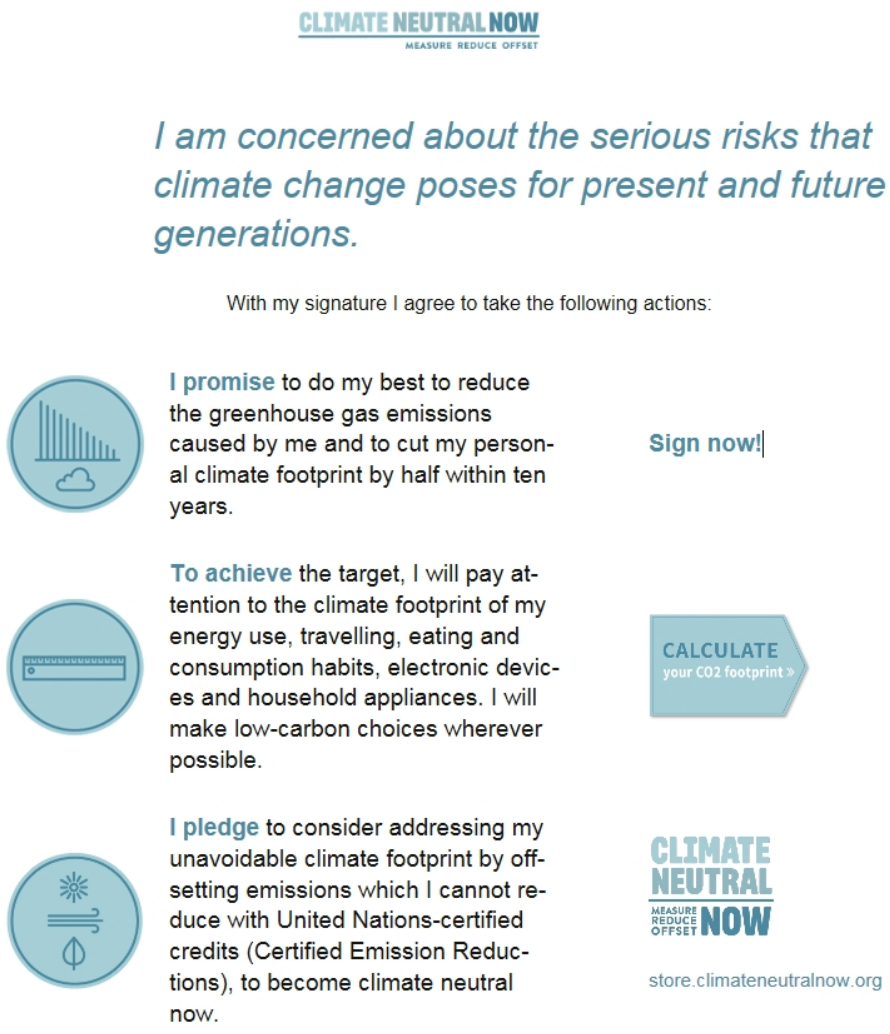
Citizens Climate pledge – encouraging citizens to calculate and halve their footprint

The Citizen Climate Pledge campaign (ilmastolupaus.fi, in Finnish English, Spanish and French) launched by a Finnish NGO called Myrskyvaroitus (Storm warning in English) demonstrates a win-win situation where the campaign benefitted from an existing footprint calculator and the calculator reached new users.

In autumn 2015, prior to the Paris climate negotiations, the above mentioned NGO launched a campaign targeted at citizens to encourage ordinary people to pledge to halving their carbon footprint over the next ten years. To start with, people were encouraged to measure their current carbon footprint with the Ilmastodieetti.fi calculator and list their pledge on the campaign website. The pledge is also available in English, Spanish and French. Visitors from other countries than Finland are redirected to start with the UNFCCC Climate Neutral Now calculator. This is a first step of collaboration between the UNFCCC Climate Neutral Now and the Climate Pledge (see figure 6).

In Finland, the campaign reached people from top level politicians, the current and retired presidents to widely recognized people from all spheres of society from business to academia and culture. This resulted in more than 1,500 user sessions on the first day of November 2015 and 6,800 sessions during the whole month in the Ilmastodieetti.fi calculator. These are the all time highest numbers of sessions per day and per month in the calculator's history, since the launch in 2010. The example shows how well-networked intermediaries and campaigns can make use of the calculators.

Figure 6: A screen capture from the Climatepledge.global website published in cooperation with the UNFCCC and the Finnish Climate Pledge



3.3.1 Discussion

The challenge to recruit users raises questions from two perspectives. First, do we use the correct media and messages to recruit users? Second, what is the practical problem that the potential users can expect the calculator is going to solve?

Considering the first point, the role of intermediaries is important. This is especially important if the calculator is hosted by a research organization. Who can support the calculator host to reach end-users i.e. the public audience?

The second point: The calculator should provide something valuable or be interesting for both the end-users and the intermediaries. Further, how can the calculator and related activities help the intermediary in doing something they are already working on?

Previous studies illustrate the trade-off between the number of people reached in a campaign, and the level of engagement. The expert advice is reported to support participating families and persons to interpret their data, learn about their consumption practices (Salo *et al.*, 2016). At the same time, this is very resource intensive, if an expert spends several hours with one family to get a glance at their consumption data, prepare suggestions and discuss them with the family.

3.4 User statistics and impact of the examined calculators

In this section, we present findings on the expectations that developers and hosts have set for the calculators, how many people have used them and has there been a measured impact on actual consumption patterns. In table 6 below, we present a summary of the number of visitors of the examined calculators. Figures were provided by the interviewed experts, therefore, data for calculators lacking the interview data are not included in the table.

Table 6: Number of users or visits per calculator (note differences in time frames)

Calculator	Number of visits	Time frame	Notes
(A) Car comparison tool	not available		
(B) Climate Neutral Now	21,500	15th Sept. 2015 until mid-July 2016	16,400 unique users
(C) Ducky	2,000	Since launch in 2014, until August 2016	
(D) Ilmastodieetti	122,000	March-2010 until mid-August 2016	102,000 unique users
(E) Klimatkontot	20,000	Per year	Unique users per year
(F) Min klimatpåverkan *	2,050	Since launch in 2013 until November 2016	
(F) REAP Petite UK *	approx. 1,000	Since launch in 2013 until November 2016	Number of users (persons)

Note: *The REAP Petite UK calculator is the localized UK version with the same calculation principles and user interface design as Min klimatpåverkan in Sweden. Both versions are developed and hosted by the Stockholm Environment Institute.

Techniques of keeping track of users include Google Analytics, and user logs from servers. How does the number of visitors compare to the popularity of other websites? For instance, in Finland, the Ilmastodieetti calculator has had approximately 400 visits per week on average. As a reference, according to the TNS-Gallup's listing, the top three web-sites in the visit ranking in Finland are those of newspapers and TV-channels, and the number of visits per week is measured in tens of millions and some local newspaper websites reach 300–600 visits per week.

The Ducky team was the only among the interviewed organizations to have set a numerical target for its number of users. This is required for their business plan. Other interviewees said that no detailed targets were set for their number of users. In general, research organizations were more interested in making use of their existing data and knowledge to create a tool for public use. One interviewee from a research organization put it this way:

> "No, I am fairly certain that it wasn't [a target for e.g. number of users] simply because that's not how we work. We have a kind of lack of, I mean, that's more of a profit driven business idea…"

While the number of users is easy to track, it is more difficult to measure the real impact of the calculators on actual consumption patterns. In principle, some of the examined calculators have databases including results and data for a certain user over the time. As discussed in chapter 3.1, the process of data collection is not always controlled. This means that researchers cannot be sure if changes in the input data and footprint indicate changes in real consumption patterns. Other cases than the that described by West *et al.* (2015) didn't include data on changes in the footprint.

Using a calculator in a community level project – experiences on recruiting users

The REAP Petite and Min klimatpåverkan tool (West *et al.* 2015) have been used in community-based interventions focusing on consumption footprints. In a new housing estate in Yorkshire UK, 28 of 64 households participating in the project completed a footprint calculation. The number of households calculating their footprint more than once was 12. The campaign also included a prize draw (value of 50 GBP) to encourage calculating the footprint.

In Sweden, the tool was used in a community sustainable lifestyles project in the Hökarängen suburb. At the time of the research paper (West *et al.* 2015) was published, 75 of the total 3,000 households had calculated their footprint. The initial idea in both of the initiatives was that people would fill in their data again over time, in order to track changes.

In Yorkshire, the changes in individual footprints varied in volume and direction. For three respondents, the difference between the first and the last calculation showed an increase in the footprint and lower footprint in nine cases. The footprints are based on data reported by the users, not measured consumption data (e.g. real energy consumption). In both case studies, the average footprint of respondents was lower, compared to the national average.

In the interview for this report, the representative of the Swedish case highlighted the importance of the communications partner, if the target is to reach a large number of users.

Figure 7: A screen capture from the Ilmastodieetti.fi calculator

Potential of real household level consumption data – learning and research perspectives

The Ilmastodieetti calculator (Figure 7) was used in a project in which 17 Finnish households got a personal "eco-trainer", and their consumption data, such as electricity consumption, and carbon footprint was measured before and after the meetings with the trainers. The main purpose of the data was to provide material for the training sessions, not to produce data for research purposes. While the measured data was useful for the families, the setting was not controlled enough to claim that changes in consumption over time were related to the training and use of Ilmastodieetti.fi and other tools. It appeared that the process of measuring and reflecting the results with the support of a professional adviser was beneficial to better understand the areas of impact and how to tackle them.

From the data perspective in the above mentioned Finnish project, there was before-and-after data collected on e.g. electricity consumption. However, there were many changes between the first and the second measurement that affect the result, in addition to the changes families made in their consumption patterns. Other changes include e.g. the number of people staying at home, weather conditions, time spent at home.

During the interviews, we asked the calculator developers and hosts about their perceptions on the potential, and the context where the calculators could play a role in making consumption more sustainable. Respondents noted that it is not easy to change consumption patterns. Information and awareness play a role in the process, and footprint calculators can help in this part. At the same time, information as such is not by itself enough to change consumption. As one interviewee said:

> "A great tool to make people aware and understand….what impact their lifestyle has on the environment. But, obviously, it is just one part of the process. … But then to have people actually change their meat consumption … it's about norms, cultures behaviour etc."

Respondents highlighted the potential in providing a tool to help in practical everyday decision making, e.g. when buying something. On the other hand, another respondent with experiences of a calculator with a pledges feature was thinking about leaving out this feature in future versions. This was because pledges were thought to have such a small impact on the big picture, the total yearly footprint:

> "…we feel that the pledges section is a challenging one. … reality is a bit depressing. Even if you change a lot of things, your footprint will be way too high. We feel that we have not sort of managed to give people the right kind of encouragement. If you do this, it will take you this far…. A great deal of the impact we have is already built into the way we live."

All in all, the interviews indicate that footprint calculators are used in communicating the footprint, but their impact on actual consumption patterns is rarely measured systematically.

3.4.1 Discussion

Calculators provide numeric data on consumption. It can be interesting to look into the users' consumption data and the changes over time to see if the calculators have delivered changes in the consumption patterns. However, it does not need to be the only purpose of the data and calculators.

Based on the expert interviews of this study, calculator developers and hosts saw the calculators as a means of communicating and visualising the size and composition of the carbon footprint to ordinary citizens. However, more precise targets or aims (e.g. number of users, completed tests, change of consumption patterns over time) were not defined in most cases. We propose that setting targets and monitoring them would help in clarifying the practical purpose and focus of each calculator.

The interview data indicates that calculators can provide new information for users, especially about the order of magnitude of different consumption categories. It is valuable to raise awareness on: introducing the magnitudes of emissions from different consumption categories; the impact of government spending, in addition to private consumption; introduce globally sustainable level of footprint; and the role of both household consumption and policy. The information can help users to understand, accept, and call for policy measures to mitigate climate change. The wider perspective is also related to the scale of the contribution of individual actions, and how they are often insufficient to reach a sustainable footprint. This can lead to frustration, but with a carefully designed communication, the calculation results can be used to introduce the role of policy, in order to reach ambitious reductions in GHG emissions.

As highlighted in the quotes earlier in this chapter, our consumption patterns are not only realisations of rational decisions. The availability and convenience of low carbon options, available infrastructure (e.g. housing and transport), everyday life constraints, habits and routines, and social environment affect our decisions. The multiple dimensions influencing our consumption patterns should be recognised and accepted. What kinds of actions are realistic to expect as a result of calculator use? In all, what other (policy) measures do we need in order to change consumption patterns and how can calculators support the policies?

4. 10+1 recommendations

In this chapter, we present 10+1 recommendations, based on calculator data of this study, literature and practical experience on working with calculators for citizens. While we have focused on CF calculators in this report, the recommendations apply to other environmental footprint calculators too.

4.1 The purpose, intended response, and target group(s)

4.1.1 *Recommendation 1: Define the purpose and the intended response of the calculator*

The purpose, use context and target group of the calculator should guide the design of the calculator features and the related activities and material outside the calculator.

The following questions can be helpful in focusing the calculator development:

- In the best case scenario, what will the users think or do after using the calculator?
- Consider the intended response. Why do you think a calculator is the best tool and means to achieve the response?
- Set a target e.g.: Number of visitors; real change in consumption; increase in awareness or other, and a plan on how to monitor it.
- Do you intend to solve a practical problem, or help people to learn about their consumption and related GHG emissions?
- How much effort, e.g. what length of time and what kind of data, are needed to complete the calculator?

4.1.2 *Recommendation 2: Define the main target group(s) for the calculator*

- Who do you wish to reach, what is their everyday life like? What are their constraints related to changing consumption patterns?
- What kind of knowledge and perception on consumption carbon footprint do the users already have?
- Specify the target group by: age, type of residence, consumption preferences, environmentally minded and informed or not informed etc.

4.2 Calculation principles, data and scope

4.2.1 *Recommendation 3: Provide transparent and credible documentation about calculation principles*

For the credibility of the calculator among the end-users (citizens) and the scientific and professional community, provide documentation to describe calculation principles and the key data sources:

- Does the documentation introduce the concept of consumption footprint for a non-professional audience?
- Does the documentation list the most important data sources and explain how they are used?
- Does the calculation explain the system boundaries (e.g. if life-cycle or only direct emissions are included)?

4.2.2 *Recommendation 4: Help users to set their expectations at a right level*

Calculators for citizens present rough estimations, and this limitation should be explained in the calculator or in the related documentation:

- Think how you can help users to set their expectations right. On the very first page, can you, for instance, present a question that the calculator provides an answer?
- Think about what kind of impression the front page or an advertisement of the calculator gives for the potential users? Do they expect to get advice towards reducing their footprint or just the result?
- Consider providing an estimate of the time required to fill in the calculator. It would be even better to provide measured data e.g. "On average, our users spend 5 min to calculate their footprint."

4.2.3 *Recommendation 5: Make use of automatically collected personal consumption data to help users avoid laborious manual data input*

Manual data input has at least two downsides: It takes time to fill in and users may not know their actual consumption. Both aspects may lower the interest to use the calculator or give up before finalising the calculation:

- Can you make use of data that are already collected for another purposes e.g. real-time energy use, consumed money, travel data etc.? Also consider limitations and representativeness of the data.

- Can you collaborate with a partner who is already collecting consumption data?
- What is the added value for the partner that collects the data or the people whose data is collected?

4.2.4 *Recommendation 6: Consider saving user inputs in a database*

Setting up a database to save the user inputs and managing the database takes some resources. Depending on the purpose of your calculator, you need to decide if you should invest in managing the database:

- Do you think that the calculator users would be interested in accessing their data afterwards, or follow up their personal or group development?
- Do you intend to design features that require access to responses (e.g. average footprint of users)?
- Do you have research interests that the database could provide data for?
- Take into account the privacy issues and related regulations on saving user inputs in a database.

4.3 Calculator features and user engagement

4.3.1 *Recommendation 7: Get users involved in the calculator development*

The data of this study suggest that the targeted users of the calculators are engaged very little in the development of the calculators. The collection of feedback is based on reactive feedback from the users considering the existing version of the calculator:

- How can you engage the target group in the calculator development and make use of their feedback already in the development?
- If your expertise lies in environmental data and research, which stakeholders could you partner with to benefit from the expertise of involving users in the development process?
- After the launch, how can you make it easy for users to provide their feedback in a useful format?

4.3.2 *Recommendation 8: Focus on the features most important for the intended response*

Resources are limited in calculator development. Similarly, the resources of the users (the time and effort for calculator use) are limited, too. Therefore, provide fewer, but well-designed and -focused features:

- Think from the users' perspective, or even better - have a test group of users to provide input, what are the most important features needed for delivering the intended response?

4.3.3 *Recommendation 9: If you aim at changing consumption patterns, provide various forms of support and a convenient path for taking action*

- Can you provide tailored feedback for users, based on their footprint results and data input?
- Help users to interpret the results and provide an easy-to-follow path for taking action. Can you help users to find a person to help them interpret the results and suggested actions?
- How could you provide information at the point when the person is planning for or making a decision that will have an impact on the footprint?
- Consider raising awareness of low-carbon options and practices in the calculators, even if they are not yet mainstream.
- What other parallel measures are needed with the calculator to support changes in consumption patterns?

4.3.4 *Recommendation 10: Which type of device do you need to focus on, mobile devices or computers?*

The question "where to use" has also implications for calculator design and if use with mobile devices is expected. Web-based tools should be designed, so that they are conveniently usable with mobile devices too. Developing a specific mobile application should be considered if there is a use case when there is added value of using a mobile device (e.g. collecting data to be used in the calculator or keeping a track of your action on the go):

- Where is the calculator used? Optimise the design accordingly.
- Consider the required data input, is it needed or convenient to use the calculator with a mobile device?

4.4 Campaigns and projects to activate calculator use

4.4.1 *Recommendation 11: Collaborate with partners that help you to reach the target audience*

Research organisations have valuable data to provide a basis for the calculator. However, launching a calculator is the first step. If you aim to create a calculator for ordinary citizens, how do you reach them and with whom?

- Can you partner with intermediaries who can help users to interpret the calculator outputs and make them more meaningful?
- What kind of added value can your calculator provide for the intermediary, and how can the calculator help them in their own work? Do you need to get them involved in the planning and design of the calculator?
- Can you find a media partner to help you to reach the intended audience?

4.5 Nordic implications

In chapter 3.1, we describe examples of calculators that have an international target audience or which have two slightly different versions modified to country specific conditions. Following this, we ask if and when should calculators be built in collaborative Nordic or other international projects in the future? The answer depends on the specific aims and planned life span of the calculator. When there is a viable, long-term vision of the practical application and resources for maintenance and updates, localised versions based on one platform can be a good option.

Collaboration of experts from different countries and institutions can be beneficial for the quality of the calculator. However, localised versions and their maintenance take more resources and coordination than optimising for one specific purpose and location. This could be a case for a campaign with a limited scope, audience and time.

The advantage in the Nordic context is that many features of the energy- and transport system are similar, even if the emission intensities of electricity and district heat can vary. There are three aspects to be considered in country specific versions:

1. Language versions. Content is needed in all languages for the launch and in each update or modification of texts. Ensure resources for this.
2. National datasets and modifications of the calculation model. Detailed calculation features may require country specific calculations, in addition to replacing e.g. energy emission intensities.
3. Modifications of the user interface. Sometimes the national specialities in energy or transport options may require modified questions, images or explanations in the user interface.

Calculators often apply environmentally extended input-output data and models, and life-cycle assessment data. Collaborative research projects developing and strengthening these databases and methods also support the development of calculator databases. For instance, the development of multi-regional input-output datasets would increase the accuracy of footprints of imported products, when embodied emissions of imported goods would take into account the countries of origin, instead of global averages.

This report is one step compiling and sharing experiences from previous projects. Sharing is relevant, especially in the Nordic context, due to similarities in society and

institutions. Future Nordic collaboration could include the research and development of data, methods and localised versions of calculators. Collaboration could also focus on calculator use: expectations and outcomes.

5. Conclusions

The calculators examined in this study and a number of similar initiatives indicate that they are seen as potential measures to popularise research, raise awareness, and engage people in action.

Even though the very general aim of reducing the size of the consumption footprint with the help of calculators and interventions is clear and understandable, we need more detailed targets for designing calculators and interventions, and monitoring if the initiatives fulfil the expectations. However, the value of the calculators can be more or different than delivering immediate changes in consumption patterns.

We have highlighted good examples and approaches found from the existing calculators. We hope that the examples inspire calculator developers and hosts. While we found many positive examples, we noted that there are challenges in recruiting users and the modest number of returning users.

Based on the findings, literature and our experiences on working with the Ilmastodieetti calculator, we presented 10+1 recommendations and added helpful questions for calculator developers to consider. The full list is presented in chapter four. Here, we highlight the top three recommendations:

1. Clearly define for whom, and for what purpose the calculator is designed. In the best case scenario, what will the calculator users think or do after using the calculator? Set a target for the calculator use and/or impact and measures for monitoring.
2. If you aim towards changing consumption patterns, be realistic with the potential of the calculator alone to catalyse change. Plan and provide various forms of support and a convenient path for taking action.
3. Collaborate with intermediaries who will introduce the calculator to your target audience. Further, consider how your calculator and intervention can ease the workload of the intermediary.

Methods, databases and data collection development provides enhanced possibilities for calculator development and use. On the other hand, the value of footprint calculators for citizens lies in applying and popularising research in a way that directly influence consumption patterns, or raise awareness, and encourage users to ask for more sustainable products from companies and policies from decision makers.

Informational measures, including calculators, are part of the policy mix of sustainable consumption and production. Calculators and other informational initiatives are not alone sufficient to change our consumption patterns. Therefore, they should be used together with other policy measures to ensure a sustainable way of living.

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List of calculator websites (click hyperlinks to access), the screen captures are taken on 8.3.2017

Car comparison calculator (Iceland)

Climate Neutral Now (Global)

CO_2-beregneren (Denmark)

Baltic Sea Card calculator (Finland, Sweden, Åland)

Ducky.no (Norway)

Ilmastodieetti.fi (Finland)

Klimatkontot.se (Sweden)

Kolvidur.is/carbon-calculator/ (Iceland)

Minklimatpåverkan.se (Sweden)

REAP Petite (UK)

WWF UK footprint calculator (UK)

Sammandrag

Enligt Hertwich och Peters (2009) kan 72 % av de globala utsläppen av växthusgaser kopplas till hushållens konsumtion. En modell för möjligheterna att begränsa klimatförändringarna genom att förändra konsumtionsmönster med befintliga metoder har gjorts upp av Girod och kollegor (2014). Resultaten av modellen visar hur förändringar av konsumtionen kunde göra det möjligt att nå klimatmålet på 2 °C före år 2050. Klimatförändringen är ett akut hot som kräver åtgärder för att minska konsumtionens koldioxidavtryck (det vill säga de utsläpp av växthusgaser som kan kopplas till boende, resor, mat samt konsumtion av andra varor och tjänster).

För att minska konsumtionens koldioxidavtryck krävs både informationsåtgärder och andra politiska åtgärder. I denna rapport presenterar vi information om 10 koldioxidavtrycksräknare avsedda att användas av allmänheten. Utgående från denna information lyfter vi fram framgångsrika metoder för utveckling och användning av dessa räknare. Vi diskuterar även de utmaningar som utvecklandet och användningen av räknarna i kampanjer medfört. Slutligen ger vi rekommendationer för framtida utveckling och användning av koldioxidavtrycksräknare.

Många koldioxidavtrycksräknare som finns på nätet har utvecklats av forskningsinstitutioner eller icke-statliga organisationer, men en del har också utvecklats av företag. Räknarna kan lyfta fram ett konsumtionsperspektiv på utsläppen av växthusgaser och betydelsen av konsumenternas val i kampen mot klimatförändringar. Räknarna kan användas för att lära sig om olika konsumtionskategoriers storleksordning. De kan också ge information om användarens personliga koldioxidavtryck med tanke på val och preferenser gällande konsumtion.

Åtta av de räknare som granskades var utformade för ett specifikt nordiskt land. Vi har inkluderat två exempel från länder utanför Norden som referens. En av räknarna finns dessutom i lokala versioner för Sverige och Storbritannien. Vi granskade de webbplatser där räknarna finns och den tillhörande dokumentationen samt bjöd in de aktörer som upprätthåller räknarna till intervjuer per telefon eller via Skype. Vi lyckades ordna intervjuer med totalt sex aktörer som upprätthåller koldioxidräknare.

Den befintliga vetenskapliga litteraturen om koldioxidavtrycksräknare fokuserar främst på räknarnas data, metoder och överensstämmelse. I denna rapport fokuserar vi mer på räknarnas egenskaper, det registrerade antalet användare samt erfarenheterna av användning av räknarna i kampanjer och forskningsprojekt.

Vår analys av informationen om räknarna visar hur verktygen visualiserar koldioxidavtryckets sammansättning, och många räknare strävar efter att ge en kontext för det personliga resultatet. Möjligheterna att öka medvetenheten om koldioxidavtryckets storlek och sammansättning noterades även av dem som

upprätthåller räknarna. Samtidigt nämnde de tillfrågade att det har varit utmanande att rekrytera användare, särskilt återkommande sådana.

I denna rapport presenterar vi rekommendationer för utvecklingen och användningen av räknarna. Här lyfter vi fram tre frågor som är viktiga för den framtida utvecklingen av befintliga eller nya räknare:

- Definiera tydligt vem och vilket ändamål räknaren är avsedd för. Vad kommer användarna i bästa fall att tycka eller göra efter att de använt räknaren? Ställ upp ett mål för användningen av räknaren och/eller dess effekt samt vidta åtgärder för uppföljning.
- Om målet är att förändra konsumtionsmönster, var realistisk när det gäller själva räknarens potential att utlösa denna förändring. Planera och tillhandahåll olika typer av stöd och ett bekvämt sätt att vidta åtgärder.
- Samarbeta med mellanhänder som kan introducera räknaren för målgruppen. Fundera också på hur räknaren och ditt ingripande kan minska mellanhandens arbetsbörda.

Appendix 1. Outline for the desktop study and the interviews

We compiled a framework for the desktop study to examine the calculator websites and documentation systematically. The framework was also designed to cover themes for the interview. E.g. the number of users was not expected to be found from the website of the calculator. We used an Excel-sheet to collect data from the website and documentation. The Excel-sheet with preliminary data and the blank fields for the interview were sent to the interviewees before the discussion. We interviewed the following calculator experts:

- Orkusetur Icelandic Energy agency, developer of the calculator.
- Stockholm Environment Institute SEI, project manager implementing the Swedish version (Min klimatpåverkan) of the REAP petite calculator.
- United Nations Climate Change Secretariat, project officer involved in the Climate Neutral Now calculator development and campaign.
- IVL Swedish Environmental Research Institute, project manager involved in Klimatkontot calculator development.
- Ducky As, member of the team (co-founder).
- The Finnish Environment Institute, the first author of this report answered the questions on behalf of the Ilmastodieetti calculator.

The data collection template (Excel-sheet) was designed from the perspective of a comprehensive calculator, including sections for housing, travel, food, and other goods and services. While the calculators and applications were different from one another, the interview followed the template, but we applied the questions according to the calculator in question, if needed. The template covered the following issues:

- *Basic information* of the calculator, such as: name, website, languages available, year of launch and updates, organisation responsible for hosting the calculator, target audience, description of documentation.
- *Methods, data and scope*: calculation methodology, data sources, covered footprint categories, covered consumption categories, type of consumption input (how can users specify their consumption patterns and choices).

- *Calculator features to engage users*: type of feedback and results, proposals for action, type of information, possibility to see ones' progress over time, social features (e.g. group features, share buttons for social media).
- *Marketing and interventions (campaigns and projects)*: description of campaigns to increase the number of visits, interventions (e.g. research projects, campaigns) in which the calculator has been used, user feedback collection and use.
- *Calculator use and impact*: the number of users in the calculator (e.g. in a certain year, since launch) and description changes over time, target for the number of users (if any), data on the calculator impact on consumption patterns (if any).

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CARBON FOOTPRINT CALCULATORS FOR CITIZENS

In this report, we look into Nordic carbon footprint calculators and selected benchmarks from other countries. We present data on 10 carbon footprint calculators for public use. The focus is on the features, recorded number of users, and experiences on using the calculators in campaigns and research projects. The purpose is to highlight good practices in the design and use of calculators for ordinary citizens which can be used to introduce the role of consumption choices in climate change mitigation. The report provides suggestions for the future development of existing or new calculator initiatives.

The study was carried out by the Finnish Environment Institute, financed by the Nordic Council of Ministers, administrated by the Sustainable Consumption and Production Working Group and guided by a steering group consisting of representatives from Finland, Iceland, Norway and Sweden.

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