Designing the Publikvitto, a system to make government expenditure tangible

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ABSTRACT
Air transportation is essential to our society. It enables global trading, brings people together, and lets travelers explore distant parts of the world. However, flying is a highly unsustainable behavior and accounts for roughly 2% of all carbon emissions; with industry and research forecasting constant growth in the coming years. The economic benefits rhetoric often prevails over the environmental costs, though; motivating governments to give incentives to airports and airlines. The Swedish Government, despite its green goals and pro-sustainability actions, is no exception, and both municipal and federal funds support the air route network.

This thesis reports on the development of the Publikvitto, a system designed to help citizen make sense of the government's incentives to the flying industry. The process is based on research through design and inspired by reflective practices. The primary outcome are insights into the relationship between designer, social issues, and government's actions; and how these elements can be approached in order to design artifacts that motivate people to engage in political discussions.

Keywords
Citizen Engagement; Sustainability; ICT4S; Political Design; Research Through Design; Slow Technologies.

1. INTRODUCTION
Wanderlust. Noun. A strong impulse to travel, to aimlessly wander [45]. In times of social media, a common hashtag for those on vacation. This simple world encapsulates how we, as a society, perceive traveling. To go away is to explore, adventure, escape, experience. In a business context, it is to break geographical barriers and seize new opportunities. To travel is great. But not for the environment.

As reported by Gössling and Peeters [14], in 2010 the global tourism required petajoules of energy, billions of litres of freshwater, million tonnes of food, and left behind a massive carbon footprint. Moreover, if the current forecasts prove themselves to be correct, these numbers are expected to double by 2050. Simply put, traveling comes with a lot of baggage, and flying is a big part of it.

The Carbon Dioxide (CO2) from aviation accounts for roughly 2.5% of all the global emissions, and international flights are responsible for roughly 70% of it [11]. Business is thrivig, therefore these numbers are expected to grow. In a "business as usual" scenario, flying could be producing around 20% of humanity’s carbon emissions in 30 years [23].

A standard narrative to counter these numbers is that technology will save the day, with developments happening fast enough to provide the world with environmentally-friendly flights soon. However, there is no game changer in the near future. Peeters et al. [25] conclude that the "green flying" technologies, such as biofuels, solar and electric engines, new aircraft designs, and others are either too farfetched or simply technologically unfeasible. The media, they argue, is responsible for hyping small developments which, in fact, are still far in the future. This techno-myths, the authors continue, may hinge policymaking, because there is a prevailing "understanding of aviation as a sector soon-to-become-sustainable has been, and continues to be, successfully perpetuated." [Ibid. p. 40].

Therefore, if we are to tackle global warming and find solutions for environmental crisis, flying is an issue to be addressed by laws, rules, and regulations. A report released by the European Parliament [23] argues that, to reduce its climate consequences, the industry should target to cap its emissions to less than half of its 2005’s levels; while ICAO, the UN Agency dedicated to aviation that serves as an industry representative, has less ambitious goals. Its carbon reduction scheme [46] aims to establish a cap on 2020, and keep emissions stable starting in that year’s levels. However, despite the need for a drastic turn to sustainability, aviation emissions are often overlook, or even protected by international legislation. The Chicago Convention of 1944 [18] forbids ICAO members of creating extra taxes and regulations, making it harder for countries to imposing environmental fees, for example. Aviation is also excluded from the Kyoto Protocol trading system,
and has protections in the European Trading System, which limits emissions accounts to flights within EU [2] and will only apply stricter environmental measures by 2021 [47].

As a member of ICAO, the Swedish Government complies with these regulations, lifting taxes on fuel and providing subsidies the industry. However, in April 2018, the Swedish Parliament put in practice the law 2017:1200. It creates a “Flight Tax” that chargers passengers from 60 to 400 SEK depending on destination [30]. Despite the price increase, the measure was supported by 53% of the Swedish population, while 35% stood against it, and 12% did not have a final opinion. [44].

This move could indicate the Swedish State is inclined to address the environmental impact of flying. In practice, though, the government still is in many ways a great supporter of the industry. The State-owned Swedavia operates 10 airports and municipalities across the country are responsible for other 28 [16], all of which depends on taxpayers money to keep operating. According to Hamnqvist [16], in 2015 the combined aid to airports was 88 Million SEK, meaning the Swedish Government contributed with 89 SEK to each and every ticked sold in the country in the form of subsidies. To contextualize the size of the travel industry in Sweden, in 2017, there were 38.8 Million air passengers departing from Swedish airports, with 30 million of those being for International Travel, an increase of 7% compared with the previous year [26]. Stockholm's Arlanda airport is by far the busiest in the country with more than 26 million passengers departing and arriving from its gates [41], a number that Swedavia expected to grow to 70 million [42].

The main financial incentive, however, comes from tax exemptions, which when added up can reach the 8 Billion SEK yearly [13]. Of the total amount, 6 Billion is due to tax-free aircraft fuel, while the remaining is linked to the exemption of VAT on tickets. Such amount is bigger than the 2018 Swedish budget for areas like Urban Planning and Civil Construction, Energy, and International Cooperation, with around 7, 3.5 and 2 billion SEK each [5].

This project is an attempt to make this contradiction of the Swedish Government come to light: how can it self-proclaim to be committed to the environment while still subsidizing an industry as unsustainable as air transportation? It is a report on the exploration and development of a slow technology piece intended to make citizens aware of their government behavior and reflect on their own practices towards flying; not by pointing fingers or making judgments, but rather to turn the invisible tangible and help individuals can come to their own conclusions.

This report is structured in the following way. First, there is a literature review to introduce fundamental concepts. Then, the methods and processes are explained. Results are presented next, followed by learnings and insights. Finally, there is a brief recapitulation on the conclusion section.

LITERATURE REVIEW

In this next section, a brief literature review is presented, covering some key concepts relevant to this exploration. Namely, Sustainable Human-Computer Interaction (HCI), Technology-Driven Citizen Engagement, and Slow Technologies.

Sustainable HCI

The intersection between HCI, sustainability and public engagement has been the focus of many studies. For years now, researchers have investigated how technology can broaden our understanding and action regarding environmental impact. It’s a prolific field, and a comprehensive analysis was made by DiSalvo et al. [9]. The authors assessed roughly 60 peer-reviewed papers and 25 programmatic statements classified as “sustainable HCI”, to understand research objectives and approaches. One of the reported findings is the almost exclusive focus on sustainability as an individual effort, with 70% of all the investigated material targeting users as individual consumers, not as societal agents.

This commodification of sustainability is also denounced by Dourish [10:2], who argues that “HCI has often transformed the problems of sustainability into the cost-benefit trade-offs of rational actor economics, promoting sustainability as a matter of personal morality rather than industrial regulation or political mobilization.” In that sense, sustainable behavior is minimized to consumption choices, to simply buy the right things, demote of any political participation. As a response, the author calls for a change in “scale” of projects and the formation of “a form of design intervention that takes seriously the political, cultural, institutional, and spatial aspects of environmental activism” [Ibid. p. 8]. The same idea is echoed by Prost et al. [28], who argue that a narrow focus on individual actions can, indeed, motivate positive attitude regarding sustainability; but since the users are embedded in a greater societal scheme, its effectiveness is severely reduced. (Un)sustainable behavior, they note, can be motivated by different factors falling in 4 spheres: personal, social values, societal, and structural. For the HCI community to focus only on the personal factors, is to restrain its
ability to contribute to societal changes. Though a minority, efforts have been made in the direction of engaging people beyond consumerism. Some of them will be addressed in the following subsection.

**Using Technology to Engage Citizens**

Citizenship is a changing concept. If in the past it could be more or less be understood as having a passport or the right to vote; currently it is a broader idea, also associated with community engagement and sense of belonging [27]. Technology can be an useful tool in promoting participation and building citizenship, and a variety of projects prove this point. Citizen Observatories, a platform for interaction between citizens and researchers [32], are a good example. The model has been applied to a diverse range of subjects, including tracking animal species, city management, weather monitoring, and others. Crowdsourcing also provides multiple opportunities, such as reporting electoral irregularities [17] and even writing a new constitution [3].

However, when it comes to mixing citizen engagement and sustainability, the relationship needs to be deepened, and there are good reasons to do so. As Bennet et al. write in their SEED Manifesto [4:2], if the academic community wants to make a change towards a more environmentally friendly world, it "will involve politics, which means returning democracies to the people, and holding policy makers accountable to popular movements aligned around an agenda of solutions to pressing problems of the environment, economy, and democracy." That is if the Academia wants to promote meaningful changes, it needs to stop addressing consumers and start engaging citizens. And there are projects that shows this is possible.

In an investigation of how local data about a street could be made relevant to its residents, a research group established in the United Kingdom [29,34] report how data can engage people and spark discussions about the way the environment was being affected by city-level development plans and what different citizens want for their neighborhood. The group tackled the task it with different approaches. Namely, the Bullfrog, a small voting system for local issues, and physical charts [Image 1]. A pertinent point the authors make when reporting on these projects is that, while both could be quickly developed in a digital format, they chose to make them tangible. The rationale behind such option is that the materiality of the artifacts would help engage people.

This conscious choice of how to display data is a crucial aspect if one aims to display information for non-specialists. After all, in its raw form, massive amounts of data are worthless by themselves, and its true power lies in how we can transform and present it visually [36]. Therefore, “[c]ommunicating with data [...] requires the ability to ask the right questions, find or collect the appropriate data, analyze and interpret that data, and visualize the results in a way that can be understood by broad audiences.” [Ibid. p. 1]. In conclusion, if the goal is to create data-driven projects to engage citizens and inspire public participation, one needs to go beyond pure numbers, charts and tables. A powerful and narrative must be built, so people can get interested, understand what is being shown and discuss it with peers. In this the goal is to design an artifact that inspired this level of engagement related to flying and its environmental impacts, a task to be approached with a Slow and Calm technology mentality, concepts to be explained in the following subsection.

![Image 1: the Bullfrog and the physical charts](29)

**Calm and Slow Technology**

Physical visualizations have been used to display information for centuries, but with the rise of digital media and the massive data it generates, they have been left aside in favor of virtual representations [33]. One might question why to invest time and effort into making something tangible while virtual visualizations can often encode more information and are easily spreadable. The project by Regan et al. [29:273] mentioned in the previous section, make a good
argument in favor of physicality. The authors say that their simple, yet physical, charts were a response to the increasing sophistication of virtual data displays and also an attempt to create "both a spectacle and forms of data that people find compelling and want to engage with." Additionally, some studies have shown evidence that physical representations inspire people to engage with data in more ways than its digital counterparts [33].

In this project, the idea to design a physical artifact was approached with the Calm and Slow technologies/design philosophies.

Calm Technology can be defined as technology that acknowledges that attention is a limited resource and therefore aims to allow users to achieve their goals with the lowest mental cost possible [8]. This is reached by designing things that "move easily from the periphery of our attention, to the center, and back" [35:4]. Calm Technology, then, are tools and artifacts that are always ready to provide information but do not require our full attention, that is, they "can be used with uninterrupted focus on a central task while new outside information is easily perceived and processed peripherally" [6:31]. To design for calmness is to be informative, but not demanding.

The second design philosophy is slow technology. It contrasts with "fast technology" because it is not thought to be efficient and optimal. Pieces of slow technology are those that use time as a design variable, meaning that the user needs to invest time to learn how and why it works [15], inviting people to reflect on the activity they are performing.

Calm and slow technology are useful to this project because they appeal to ponderation. By not being straightforward and attention-intensive, they require users to take their time and investigate the technology they are engaging with. Now that key concepts of Sustainable HCI, Citizen Engagement Technologies, and Calm and Slow Technology have been presented, the following section this exploration’s methods and process will be discussed.

3. METHODS

Design Methodologies

Mainly three methodologies were used in this exploration, aiming to create a tangible artifact to inspire reflection on the government’s expenditure. They will be briefly explained in this following section. This project was primarily approached with a Research Through Design mentality. According to Zimmerman et al. [37], it is a research framework where design researchers combine knowledges from several areas, e.g. engineering, behavioral science and anthropology; and repeatedly reframe the problem they have in hand, constantly creating new design situations. Through multiple iterations, they argue, designers generate both a "concrete problem framing" and an idea of how the situation could be improved, via "models, prototypes, products, and documentation". An additional point is made by Fallman [12] is that there is a distinction between Design-oriented Research and Research-oriented Design. The former, he argues, aims to generate knowledge from the process of creating an artifact or the interaction with the artifact itself. The final product, then, is not the most important thing, but "takes on a philosophically interesting role as a kind of middle ground between a thought experiment and a real thing." [Ibid., p. 3] As for the latter, research knowledge is used to generate a new product, which is the ultimate goal.

This project approaches its challenges with the Design-oriented Research mindset, as it aims to investigate the process and generate knowledge, rather than produce a viable product. It can also be described as "constructive design research" [21], that is, research in which the construction of an artifact is seen as the primary tool to produce new knowledge.

Another relevant framework for this project is Design as a Reflective Practice, as described by Schön [31]. In summary, it is the recognition that design knowledge is tacit and can be only accessed by doing. Moreover, argues Zimmerman et al. [37], the designer works by seeing a design situation, acting over it, pondering over results, and making a new move, restarting the process. This, argues Schön, is highly subjective and personal routine with the designer's judgments over his/her choices taking a central role.

Additionally, during the course of this project, autobiographical design was also a source of inspiration. As explained by Neustaedter and Sengers [24:514], it is "design research drawing on extensive, genuine usage by those creating or building the system," on which the researcher/designer own experiences are at the core of the design and exploration. More than that, as researchers/designers "build the system, they use it themselves, learn about the design space, and evaluate and iterate the design based on their own experiences." Autobiographical design is relevant here for a couple of reasons, First, I myself live far from my family, and can only return to my home country by plane. Also, I am embedded in a culture that values traveling and long-distance tourism, as explained previously. Therefore, to design and
explore the relationship between air travel, environmental issues, and the government's role in it; is to design, in a way, against regular trips back home and to critically ponder if I should indeed visit all the places I ever dreamed of.

**The Process**

The ideation and development work was performed between March and May of 2018, and in collaboration with Rise Interactive Eskilstuna, a Swedish design studio/research group.

The first step consisted of an intensive preparation process. Given my lack of knowledge regarding planes, the air travel industry, and its environmental impact, any attempt at designing something that would spark discussion on the matters was impossible. Therefore, the starting point was to ground myself by reading news on Swedish airports and the new Flight Tax [41,44]; air travel industry reports [18,39]; and the environmental impact of flying [1,7,47].

The learnings of this first phase were essential to start the next one, brainstorming. The primary goal was to find ways to translate the knowledge I acquired during grounding and research into a tangible artifact that citizens could understand. At the same time, I also started exploring data provided by Swedavia, the state-owned company that runs Arlanda and other airports, to understand the Swedish air traffic reality in a more profound way than what is shown in the news.

The brainstorming stage consisted of a mix between searching for data representations, tangible interfaces, and public engagement tools references in a variety of fields, design, advertising, arts, among others; and trying to come up with new solutions in drafts and drawings [Image 2]. Four of them, deemed with potential for further development, were turned into conceptual images. They all will be presented in the Results section.

These four concepts were reflected upon and analyzed, so one was chosen and developed into a functional prototype. This choice was a consequence of both objective and subjective parameters.

The objectivity factors are mostly related to time and abilities constraints. The time span was short, a matter of three or four weeks, so the idea should be at the same time simple to be put into practice, yet impacting to be relevant. Technical aspects also played a major role. Given my shallow programming skills, if any software would be involved, it could not be complex.

As for the subjective elements, they can be summarized into personal liking, a perception of innovation, and capacity to stand out. Although these are personal opinions, they were shared and discussed with third parties.

The grounding, brainstorming and development phases were marked by multiple feedback sessions with RISE Interactive researchers and designers and Royal Institute of Technology (KTH) teachers and students. These session were informal and unstructured, often with myself sharing and discussing findings from literature and initial sketches. Further, once the final prototype was done, it was displayed at a small student exhibition at the University. Such dynamic of informal assessments was crucial in the generation of the learnings and insights, which will be discussed in an upcoming section.

**Image 2:** drafts and brainstorm concepts.

### 4. RESULTS

The grounding phase of the project was key to gathering knowledge to fuel the brainstorm sessions. These sessions were fruitful, and in the end, four ideas were turned into conceptual images, one of which was chosen to be developed. This results section will present and discuss these ideas.
**Design Concepts**

One of the first ideas [Image 3] was a wooden map of Europe with strings connecting Arlanda to destinations throughout the continent, with the thickness of the string signifying the amount of carbon emissions on that specific flight. Each time a plane departed its string would vibrate, creating a day-long melody. It was left aside for mainly two reasons: complexity in the making and the high level of abstraction, since the only information it gives is the resonating notes.

![Image 3](image3.png)

*Image 3: the strings connect Arlanda to other airports, and resonate when a plane departs.*

A second approach, inspired by the work of Zapico and Hedin [22], was to create a scale on which citizens could compare the emissions of their flights with daily activities. It would consist of a 3D printed models of planes, with their sizes representing emissions to specific destinations, and other models of behaviors, e.g., meat consumption, traveling by car, and shopping [Image 4]. The users would be asked to equalize their travel decisions with daily routines. This was a more educational approach, with the intention of showing people how hard it is to "offset" flights with green habits. This idea was dismissed because the 3D printing material is too light, requiring the planes to be too big; and due to the fact there it could sound like a justification to daily unsustainable behaviors, a thought that will be elaborated further in this report.

![Image 4](image4.png)

*Image 4: one of the ideas used scales so people could understand the carbon impact of their travel choices.*

A third idea was to play with the hidden costs and invisible subsidies that one have when flying. This would be achieved by having a terminal on which users could select their dream destination and get a ticket [Image 5]. This ticket would contain more information than displayed at first, either with UV reactive ink or optical illusions. Three approaches could fit in this idea: monetary, that is, showing the price ticket without government subsidies; ecological, providing the carbon emissions and environmental costs of flying; and personal, printing all the things people would need to abdicate to offset that flight. This approach was not taken further due to the lack of open data on the flight prices and the difficulty of making the information invisible.
The fourth idea turned into a conceptual image can be seen in Image 6. It was later chosen to be developed further and given the name of Publikvitto, an amalgamation of two Swedish words: "publik" and "kvitto", which can be translated to “public” an “receipt”, respectively. The name is also an explanation of its functionality. The Publikvitto [Image 7] is a system that prints a receipt for each flight departing from Arlanda Airport, in real time. The printed receipt contains flight number, departure time, final destination, estimated CO2 emissions, estimated tax cuts provided by the government, and total subsidies for flights given until that time of the day.

**Publikvitto, the chosen idea**

The receipt analogy is considerably straightforward and designed for easy and quick understanding. It can be seen in Image 2. A receipt signifies that you, the receiver, had just paid for something; and in this case that you, as a citizen, helped in paying the bill for other's air travels, whether you want it or not. Such analogy, though, even if it involves money is not the same as treating people merely as consumers, as DiSalvo et al. mention [9]. What the Publikvitto does is to offer you insight on where your "citizen contribution," i.e., taxes, is being spent. It is correct to say, then, that in this situation the Government, or those who are flying, are consumers; while those who interact with the Publikvitto are not. The latter is indeed "paying the bill," but put in a position of reflection, not consumption.

Even though tax exemption on fuel is not the only...
incentive the government offers for this industry, it was chosen here due to the centrality taxes often have in the public discourse. Election after election, the ammount citizens pay and how the government is spending such contribution is a point of debate. Therefore, aiding citizens to realize how much of their money is being given to a specific industry is a political exercise.

It is relevant to clarify that the Government does not actively give fuel incentives, but rather avoids emission taxes. Given such charges are applied to other means of transportation, such as cars and gasoline, this is considered a subsidy.

The Publikvitto was designed with the principles of Slow and Calm Technology in mind. It is an artifact designed for peripheral attention and to blend into the environment, not to demand constant attention from the users. A clear demonstration of that is the complete lack of commands: the user can't control the outcome, it "just happens" every time there is a plane departing the city. The absence of screens or displays resonates that. The Publikvitto gives auditory and visual cues, but only when it is printing. The artifact, however, does not beg for attention, instead conquer it slowly, as it generates an ever-growing paper trail each time a flight takes off. Given Arlanda's Airport traffic, between 300 and 400 departures on any given day, the printer is active on a regular basis. Therefore, by staying near the Publikvitto, citizens can start to grasp how steady air traffic is.

The Publikvitto was chosen for a variety of reasons. Naturally, one of the factors was feasibility. It is a simple and straightforward system, which software consists of combining information requested from APIs and simple mathematical operations. Physically, the artifact consists of a microprocessor and a "plug and play" printer, designed to operate with it. These characteristics made it simple enough to become a reality in just a pair of weeks. Beyond being viable, other aspects justify this choice.

First, the analogy itself, printing "public tickets" was considered an innovative approach to the subject. There is a unique interplay between format and content: the simplicity of the receipt and the provocativeness of the tax analogy. This is not the typical tactic to deal with public and governmental expenditures.

Additionally, the Publikvitto is a changing artifact, that is, its paper trails grow throughout the day, regardless of public interaction or not. This was thought to give the piece more strength when compared to other ideas. The scale and tickets both depended on user behavior, on someone to interact with them; as for the map always appear the same despite the time of the day. This autonomy is considered an attention-grabbing attribute, therefore valued by me.

Lastly, the Publikvitto is considered to be both direct and not guilt-driven. That is when in contact with it, the public is supposed to understand its point easily and see what problem it is referring to (government expenditures). At the same time, it does not focus on individual action; it doesn't point fingers to the user for flying, but instead is designed to invite for reflection.
Technical Aspects
The Publikvitto consists of a Photon microprocessor connected to an Adafruit Mini Thermal Printer. The software behind it was built on Node-Red\(^1\), using the an API from Swedavia, the Swedish state-owned company responsible for airports, to monitor the status of each flight and Distance24.org API\(^2\) to get the distance between Arlanda and final destination.

The CO2 Emissions was based on the following equation:

\[
\text{Avg. N} \times \text{Distance} \times \text{CO2} = \text{Total Flight Emissions}
\]

Where Avg. N. is the average aircraft seat occupation, 120 passengers, and CO2 is 0.257 for flights shorter than 483km and 0.148 otherwise. More details on these numbers will be added on the following subsection.

As for the tax cuts provided by the Government, it was calculated the same way as Friström does [13], which uses a emission factor of 2.24kg per liter of fuel and 6.5 SEK\(^1\) per liter (the same as car fuel taxes). Therefore, the final equation is as given:

\[
\frac{\text{Flight Emissions}}{2.24} \times 6.5 = \text{Total Fuel Subsidies}
\]

Limitations
As any design artifact, the Publikvitto has limitations. The first of them is regarding the way CO2 emissions are calculated. It is a complex task, as it involves a wide range of variables such as the number of passengers, weight of the aircraft, engine fuel efficiency and others [39]. Given the near impossibility of finding actual data for every plane leaving Arlanda in real time, this project used the Lipasto Model [38]. Such a model, though, has some particularities. It is based on Finnish Air Transportation, and its last update was a decade ago. Other aspects of the calculation also needed to be generalized, as the type of aircraft and number of occupied seats. For the first, the Boeing 737 was used as it is one of the most common commercial passenger airplanes. Moreover, for the Load Factor, the number of 80.4% of occupancy provided by IATA in 2017 [43] was used. Multiplying the average number of seats of a 737 by the load factor, the average number of passengers used in this project was 120.

The scope of the Publikvitto is also limited. Whilst the government provides a variety of subsidies, both in direct financial contributions and tax exemptions, this project addresses only the latter.

Naturally, planes have increased in efficiency in the past decade [1], and there are a variety of aircrafts in the European Fleets, with multiple load factors. These limitations and inaccuracies are acknowledged, but given the purpose of the project, they are accepted. The goal here is not to audit government expenditures or to scrutinize the Swedish tax system, but rather to invite people to reflect about them. Therefore, exactness was not considered a primary requirement to engage citizens in the discussion.

5. LEARNINGS AND INSIGHTS
This project was conducted with a reflective approach, which means that internal dialogues and personal deliberation were keys to gather knowledge. Discussions and feedback sessions also played a significant role in the process. This section will present the learnings and insights that both internal and external conversations generated.

\(^1\) https://nodered.org/
\(^2\) http://distance24.org/api.xhtml
\(^3\) Circa €0.6
On The Invisibility Of Unsustainable Behaviors
Something that became clear throughout this exploration is the invisibility of flying. Despite its tons of metal, planes often fly over our heads unnoticed; which can make it rarer for citizens to think about their environmental impact. To put in another way, there are other unsustainable behaviors that people relate to routinely. To drive a car or not, to eat meat or not, to recycle or not: these are all decisions made on a daily basis, while flying is not. It is, to most of the people, a sporadic experience. However, if evenly distributed, there is roughly one departure from Arlanda every 5 minutes. Also, even in a minor airport, such as Bromma Airport, which also serves the city of Stockholm, the situation is similar. I myself had this realization when sitting close to this smaller airport, and seeing around eight planes prepare to land in roughly an hour. The takeaway here is that, if a designer/researcher wants to make people reflect about the environmental impact of flying, he or she needs to find ways to make the flights themselves visible. This same logic might apply to other unsustainable behaviors that are simply hidden in our daily routines. To bring them to light and help people reflecting on it, can be a mean of instigating debate and influence specific policies that affect such behaviors.

On Approaching Sensitive Issues
Another problematic point in our relationship with flying is that, when it becomes visible, and we do need to make a choice, it is almost always associated with positive experiences. Therefore, as Juvan and Dolinar show, there is an attitude-behavior gap when it comes to tourism and sustainability, and even environmentally-conscious people tend to maintain vacation habits that are bad for the environment. Some of the standard justifications for such gap are that "vacations are an exception," i.e., a reward, and that "I am doing more good than bad," suggesting that there is an idea that sporadic flying can be offset by daily "green habits." Buckley [7:1] argues in the same direction, saying that "[m]ost people in developed nations are aware of attempts to reduce greenhouse gas emissions, including those from air travel, by mechanisms including emission taxes and offset programs [...]. Even so, they continue to travel on vacation to distant destinations, even those at particular risk from climate change". In his study, only 30% of the interviewees showed any intention of reducing flying habits, while the other 70% would often give justifications that are "morally and socially acceptable," i.e., visit relatives or reward children. This relationship with flying was made visible when I discussed my explorations with peers and colleagues. Despite their varied interest in sustainability and eco-friendly behavior, they would quickly get defensive when discussing the matter, repeating some of the arguments pointed by previous research [7,19].

The lesson here is that designers and activists should be careful when approaching the public to discuss the impact of flying. It is often seen as an activity which benefits surpass the costs, primarily because the benefits are highly personal, a reward for a long work year, seeing family again, etc.; while the costs are more abstract and distant, such as climate change and global warming. To be careful does not mean not to be thought-provoking or bland; instead, it is not to instill guilt, condemn or directly criticize people. The Publikvitto does that by turning the focal point to the government and its investments, not to individual flyers. It is not intended to tell people to avoid flying but to inspire them to reflect if they should. However, if people seem to acknowledge the environmental impact of flying but find ways to justify it; the same cannot be said about the governmental support towards the industry.

On Knowing About The Government Behavior
During the development of the Publikvitto, when discussing the project with a variety of people, both the fact that the government provides incentives and the amount of it was often received with surprise. This despite the country-wide debate over the recently implemented Flight Tax in Sweden created to reduce the climate impact of aviation and which is supported by roughly half of the population [44]. Interacting with the Publikvitto, one citizen had a sudden realization that the Swedish Government has higher taxes on food items, around 10%, than on flight tickets. The role of International Law was also unknown, and the fact that there is a supranational rule preventing countries to regulate air travel better was received with awe. This type of insight is what the development of the Publikvitto aimed for.

The learning here is that there is a lack of information regarding Government Behavior. Therefore, if one wants to design for citizen engagement, he or she needs to bridge such gap. The issue, then, is not that people are not interested in holding the government accountable, but rather that its actions are not completely clear. Designers and researchers, then, have an opportunity to act, looking for ways to help citizens learn about their government’s actions.

On How To Display Information
The issue of how to display information is intimately
connected to this. As only a minority of people are data literate and can deal with numbers and sheets, it is not enough for government agencies to be transparent and promote data access. It needs to find and develop better tools for citizens to engage with and understand what is being display. The building of the Publikvitto proved itself to be an exploration of how to find interesting and engaging analogies. Several approaches were thought of such as comparing the emissions from a single flight to the number of trees needed to neutralize it; or converting it to kilometers in car trips, or kilograms of meat consumption. However, different problems arise from different approaches. Translating the emissions from air travels to trees, for example, would often result in absurd numbers, in the thousands. This makes it complicated for people actually to grasp, after all, it is hard for people to realize what a thousand trees really mean and space they take. Now, comparing the emissions of a flight with other behaviors, comes up with another issue. Putting two negative behaviors side by side can be seen as a justification of one of them. It might lead people to believe that, if they do not eat meat or drive, it is OK for them to fly, or the other way around, if they do not plan to fly, they can eat as much meat and drive as much as they feel like. As the Publikvitto is also intended to inspire personal reflection regarding flying, this could be a unwanted side effect of the artifact.

Analogies based on monetary values are often discouraged, as they appeal to self-enhancing values and hinder pro-environmental behavior [20]. However, I argue here that this is a particular case. The Publikvitto does not engage with money in the sense of personal wealth, instead in a civic level. The currency here is public money, and the reflections are about how the government spends taxes. It does not entail consumer choices or promotes financial benefits, rather it prompts the question: _do I agree with how the government is investing?_ Moreover, in that sense, this analogy fits with what the Publikvitto was intended to do: inspire people to think about government expenditures. The effectiveness of this analogy and its impact on public participation, though, would require a deeper user study, what is beyond this project’s scope.

The tangible aspect of the Publikvitto was also relevant for harnessing people's attention. The fact that it is physical and the paper trail it leaves behind was more than once mentioned as a reason for people to learn more about it. The fact that it uses paper, though, was a point of discussion, as some people considered it to be "ironic" that the design was intended to motivate sustainability reflection while "wasting" paper. If the paper is actually being wasted is a point of debate, but it is relevant to notice that, when designing for the public, every decision might come under scrutiny and be criticized.

The lesson here is that analogies need to be thought-through and must be aligned with the designer's goals. Most importantly, the designer must conceive analogies to ease the public's understanding, not for purely aesthetic reasons.

**On the understanding the public debate**

Another discussion and investigation needs to take place before this one, nevertheless. A recurrent rhetoric on the news and debate over flight taxes and environmental concerns regarding the industry is purely financial. The argument goes that regional flights are crucial for a strong economy, as one can see in the Förenningen Svenskt Flygs, the Swedish Aviation Industry Association, statements opposing the new flight taxes. According to the organization [48], the new tax will "have a negative impact in a number of areas, including air connectivity, Sweden’s competitiveness, regional development and the willingness of airlines to establish routes to and from Sweden." It is not clear the means by which the Organization reached such conclusions, but they are debunked by the report written by the Finance Department of the Swedish Government [40], which states the new tax should reduce the number of passengers by around half a million; having only marginal impacts on connectivity to sparsely populated areas, and virtually no impact on employment and competitiveness. It is true that the same document estimates only a minor reduction in total CO2 Emissions, between 0.08 and 0.2 million tonnes when the change to other transportation modes are accounted for, but if the Swedish experience proves itself positive it can inspire changes on other parts of the world, which could lead to real impact.

The takeaway here is that, if one wants to engage the public in a meaningful debate, he or she must be get past the economic rhetoric. This is no small feat, as our society is often wired to a growth-centered view of the world, but is a goal to be pursued.

**On Acknowledging The Societal Context**

Finally, the development of the Publikvitto was also a process of personal learning and discovery. By digging into the question of the environmental impact of flying, I was confronted with my own personal desires to travel, visit distant places, and take part in career-relevant events. Moreover, living abroad, ten thousand kilometers away from home, flying is a crucial mean of transportation if I want to meet family
and close friends. Therefore, the question I was often faced with was if to point out this while still planning to fly was not hypocritical behavior. Naturally, one cannot be completely carbon neutral, but to present him or herself as a sustainability researcher while still desiring to engage in unsustainable habits is an inner contradiction that one needs to deal with.

This internal debate can be motivational, nevertheless. It is an example of how structurally embedded unsustainable behavior is. To engage in environmentally-friendly habits, citizens need to make considerable effort, and sometimes there is just no alternative. Take the academic world, for example. For one to thrive in this area, he or she is required to take part in multiple conferences and events around the world; while still be active in his or her University. This situation makes flying almost a requirement for such career.

The takeout here is that, if one wants to design for Sustainability, he or she must acknowledge that our society is wired towards unsustainable behavior. As a consequence (a) the designer will always engage at some level with unsustainable behavior, and that is not his or her flaw; and (b) sustainability should not be viewed as a design feature, but as a political statement: if our society is leaned to unsustainability, promote environment-friendly solutions is a civic act. This second insight resonates with Dourish [10] and his call to an HCI Community that deals with issues on a greater scale.

6. CONCLUSION

This article reported on the conception and building of a design solution to help citizens to understand one of the Swedish government's contradiction: the dissonance between the public discourse of sustainability and its support to the Air Travel industry. The result was the Publikvitto, an artifact that prints in real time the tax exemptions given by the Swedish Government to each flight that departures from Arlanda. This exploration was focused on the learnings and insights generated by the process itself, rather than on the final outcome; therefore much can be improved on the Publikvitto. For example, data streams from other Swedish airports can be added to give a bigger picture, as well as other sources of governmental subsidies to flying.

However, even this first iteration of the project was already capable of generating learnings and insights that can be used as initial reflections in future projects. The issues of visibility are one of them. As explained, given flying is not such a regular activity, the number of flights and their environmental impact are often disregarded. The same happens with governmental support, which is most of the times just not apparent. That is to say; if one wants to motivate political debate, public transparency is a requirement.

How to engage people in such discussions is also a point of attention. To travel is frequently high regarded, and flying is a critical element of traveling. Therefore, to help people to reflect on the matter, one needs to be careful so people will not get defensive about it. It is essential to design not to criticise or condemn individual behavior, but to inspire reflection.

The way we perceive travels is related to how institutionalized unsustainable behavior is. For an individual to act in an environmentally-friendly manner, he or she needs to find ways to detach him or herself from a bigger societal context, because structures as the government facilitate access, and often promote unsustainability. This might be the biggest challenge to the HCI and Design communities. If researchers and designers do not only want to have an engaged discourse but also take effective actions; it is crucial to help people to not only see how their actions matter but how there are also a bigger context that that hinder true sustainability.

The Publikvitto is only an attempt to explore how such issues can be approached. Much can and need to be done if we, as a society, are to actually adopt a sustainable lifestyle.

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