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Sustainable IS Use: What IS Needed to REDUSE

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Abstract

*Facing ever-looming climate change, studying the drivers for individuals' Information Systems (IS) Use to reduce environmental harm gains momentum. While extant research on the antecedents of sustainable IS Use has focused on specific theories, interventions, contexts, and technologies, a holistic understanding has become increasingly elusive, with a synthesis remaining absent. We employ a systematic literature review methodology to shed light on the driving antecedents for sustainable IS Use among individual consumers. Our results build on findings of 29 empirical studies drawn from 598 articles retrieved from our premier outlets and a forward/backward search. The analysis reveals six salient complementary antecedents: **R**elief, **E**mpowerment, **D**efault, **U**ser-centricity, **S**alience, and **E**ncouragement. We recommend considering these concepts when developing, deploying, promoting, or regulating digital technologies to mitigate individual consumers' emissions. Along with memorable and implementable concepts, our theoretical framework offers a novel conceptualization and four promising avenues for researchers on sustainable IS Use.*

Keywords: User Behavior; Individual Consumer; Antecedents; Environmental Sustainability; IS Use; Systematic Literature Review

Introduction

"The window of opportunity to limit global warming to well below 2°C, preferably 1.5°C is closing rapidly" – with these words, the recent United Nations Environment Programme emission report opens seeking to articulate that avoiding the looming unmanageable climate risks requires urgent action by policymakers, businesses, and individual consumers (UNEP 2022, p. 1). While the fossil-fuel-driven system we live in was not created by individual consumers (cf., Bonneuil et al. 2021), we now face a situation where the majority of the world's greenhouse gas (GHG) emissions are attributable to individual lifestyles (Druckman and

Jackson 2016; Shimoda et al. 2020) – with the lifestyles of the top 10% emitters account for nearly half of total consumption-related CO_2 emissions (Bruckner et al. 2022). Globally, affluence is associated with an increase in emissions, as individual consumers from poorer regions have a much smaller footprint than those from more wealthier regions (Bruckner et al. 2022). Those with a particularly high number of digital devices per capita (Cisco 2020). However, recent studies suggest that digitalization may have attenuating effects on the affluence-emissions relation. Take, for instance, mobile broadband diffusion and GHGs (Edquist and Bergmark 2023) or smart meter-based interventions and residential energy consumption (Khanna et al. 2021).

One growing field of research is therefore concerned with the relationship between digitalization and sustainability (Veit and Thatcher 2023). Given the seemingly irreversible penetration of digital technologies in private lives, a significant strand of this field is examining how IS Use can positively impact the preservation of our planet. This strand includes empirical studies of adoption, affordances, and digital interventions (e.g., Loock et al. 2013; Sutanto et al. 2021; Tim et al. 2018; Wunderlich et al. 2019). These studies have contributed significantly to understanding how the individual use of digital technologies can help achieve sustainability goals. However, their persistent focus on specific theories, interventions, contexts, and technologies makes generalizability difficult. As a result, the body of knowledge on sustainable IS Use continues to grow while a holistic understanding becomes increasingly elusive.

This elusiveness is problematic because it is accompanied by increasing fragmentation and dispersion of the body of literature. Despite a few literature reviews on sustainability and Information Systems (IS), there is no deeper focus on individual IS Use and respective driving antecedents. Prior reviews in the field of digitalization and sustainability examined either specific themes such as artificial intelligence (Schoormann et al. 2021), nudging mechanisms (Beermann et al. 2022), the circular economy (Zeiss et al. 2021), agricultural practices (Lakshmi and Corbett 2023), etc. or covered the broader Green IS domain to analyze its multiple levels (Wang et al. 2015), research perspectives (Harnischmacher et al. 2020), etc. In addition, we observe an ongoing scholarly debate on whether digital technologies are good or bad for the planet (cf., Dwivedi et al. 2022). While prior reviews have made eminent steps toward understanding the empirically explored relations between sustainability and digitalization, and setting research agendas, there is little overview of the drivers helping individuals reduce their overall environmental impact through the use of digital technologies. We argue that this is not only a scientific problem but also for those who design, provide, promote, or regulate artifacts such as digital platforms, mobile applications, or connected devices; Thus, a framework that unifies the variety of perspectives and fundamental causalities remains absent. In light of the theoretical and practical necessities, we seek the constituents of sustainability in IS Use by posing the research question: What are the salient antecedents of sustainable IS Use among individual consumers?

In reviewing extant theory and research, we aim to "synthesiz[e] recent advances and ideas into fresh new theory" (LePine and Wilcox-King 2010, p. 508). Thereby, this paper conceptualizes sustainable IS Use, summarizes surrounding extant empirical evidence, and offers future research directions. Furthermore, the antecedents herein contribute to a more responsible digitalization by helping to innovate, market, and govern digital technologies, thereby leveraging their "transformational powers" (Recker et al. 2022, p. 2). We organize the remainder of this manuscript as follows: First, we establish some sustainability and IS Use foundations. We then describe our research method. This is followed by our results, which include descriptive profiles, emerged concepts, and identified future research opportunities. We then discuss the study's implications and limitations before making some concluding remarks.

Foundations

A Short Story of Information Systems for Sustainability

Although a few scientists warned early on about the degradation of our planet (e.g., Meadows et al. 1972), firms and politicians have long neglected or even belittled the severe threats. As a result, sustainability has received little attention for many decades. It was not until groundbreaking resolutions such as the Brundtland Report (1987) or the Paris Climate Agreement (2015), as well as growing social pressure (e.g., UNDP and University of Oxford 2021), that the topic gained momentum. By definition, IS for sustainability are "IS-enabled organizational and social practices and processes to improve the economic, social, and environmental sustainability of organizations and/or private households" (Melville 2010; Veit and Thatcher

2023, p. 7). Although broadly encompassing people, planet, and profit (Elkington 2004), we concentrate on the environmental dimension in the remainder of this paper. This practice is consistent with the literature (e.g., Elliot 2011) and follows the embedded view argument, which posits that flourishing social and economic dimensions necessitate a healthy planet to ground on (Raworth 2017; Steffen et al. 2015).

In the late 2000s, a growing number of researchers began to address environmental sustainability and the implications of IS on the climate crisis (e.g., Watson et al. 2008). Soon, at the beginning of the 2010s, early research agendas (Watson et al. 2010), interdisciplinary reviews (Elliot 2011), and theories (Melville 2010) emerged. While early studies focused primarily on Green IT (i.e., on the life cycle of the tangible artifact), more and more research was conducted on sustainability through IS, such as changing work practices (e.g., Seidel et al. 2013) or altering private end-user behavior (e.g., Loock et al. 2013) (Loeser 2013). The latter constitutes the focus of this paper. Given the call for a greater emphasis on "lived-in reality" and ecological trade-offs - as we use digital technologies more and more in our daily lives (Dwivedi et al. 2022, p. 34) examining sustainable IS Use among individual consumers (hereafter shortened to consumers) seems an important endeavor to realize the full potential of digital technologies.

Toward a Conceptualization of Sustainable IS Use

Long before it became a central theme in research on digital technologies, *sustainable use* essentially centered around the consumption, recycling, and conservation of resources (Malhotra et al. 2013). Borrowing from the definition of sustainable development, we render sustainable use as an activity that involves any kind of resources (tangible and intangible) to “meet the needs of the present without compromising the ability of future generations to meet their own needs” (UN WCED 1987, p. 15). Ideally, the goal is to reduce anthropogenic adverse environmental impact, which often translates into mitigation or remediation. Building upon the foundation of sustainable use, we now examine use in light of digitalization phenomena before delving into the conceptualization of sustainable IS Use.

One of the most prevalent constructs for studying Information Systems is *IS Use*, that is, an actor's employment of an information system to perform some activity (Burton-Jones et al. 2017; Burton-Jones and Gallivan 2007; Straub and del Giudice 2012). Related research seeks to understand better the antecedents, processes, and consequences of IS Use (Burton-Jones et al. 2017). To name a few, topics of interest include emotions, beliefs, attitudes, designs, affordances, performances, and net benefits (Straub and del Giudice 2012). To make IS Use more delimitable, we follow recent conceptualizations focusing on the use of digital technologies, these are programmable, modular, multi-layered systems generating, storing, processing, and transmitting data (Deng and Joshi 2016; Kallinikos et al. 2013; Lehmann et al. 2022). Private consumers typically access these technologies via smartphones, personal computers (PCs), or Internet of Things (IoT) devices.

Taken together, we conceptualize *sustainable IS Use* as an individual’s employment of digital technologies such that these technologies help to reduce their adverse environmental impact when performing some activities. For the remainder of this manuscript, we confine the scope of sustainable IS Use to consumers from private households due to the abovementioned high attributability of GHG emissions to their lifestyles. Further, we consider *sustainable IS Use* as a subordinate construct of *IS Use*, with the activities performed having reduced adverse environmental impact as intended or unintended consequence. We do not focus on the general antecedents of IS Use, which refer to the conditions for employing digital technologies (cf., Burton-Jones et al. 2015; Venkatesh et al. 2012). Instead, we focus on the specific antecedents of sustainable IS Use, which refer to the conditions that make employing digital technologies conducive to reducing the environmental impact of individual consumers. While we recognize that multiple studies have implicitly investigated sustainable IS Use in empirical settings, we now turn to our study, which involves a synthesizing review to gain an overarching understanding of sustainable IS Use.

Method

To identify the salient antecedents of sustainable IS Use among consumers, we employ a systematic literature review that draws on established guidelines from management and IS. Specifically, we utilize guidelines that help us develop theory by applying recommended techniques and delineating the nature of this paper (LePine and Wilcox-King 2010; Webster and Watson 2002), but that also provide evaluation criteria to reviewers and readers, as well as transparency for replicability (cf., Templier and Paré 2018).

#	Step	Methodological Considerations	n	Comment
1	Problem formulation	**(1) Explicit research question** - What are the salient antecedents of sustainable IS Use among individual consumers? **(2) Definition of key concept** - Individual's employment of digital technologies such that these technologies help to reduce their adverse environmental impact when performing some activities	-	n/a
2	Literature search	**(1) Transparent search strategy** - Keywords: sustainab* OR environment* OR ecolog* OR eco-friendly OR green OR SDG - Category: title OR subject - Premium Outlets: AIS Senior Scholars' List of Premier Journals (DSS, EJIS, I&M, I&O, ISJ, ISR, JAIS, JIT, JMIS, JSIS, and MIS Q) OR Proceedings of the International Conference of Information Systems (ICIS) - Time horizon: 2008-February 2023 **(2) Adoption of multiple strategies** - Forward/backward (fwd/bwd) search strategy: Implemented iteratively as data extraction/analysis sparked in additional relevant papers (Webster and Watson 2002); see #5 and #6	659 598	as initial results from database searching (491 journal- and 168 ICIS papers) after removal of 61 duplicates
3	Screening for inclusion	**(1) Primary study selection** - Theme: Environmental sustainability - Level/unit of analysis: Individual consumers **(2) Primary study removal** (off-topic) - Theme: Sustainability related to enduring continuance - Level/unit of analysis: Employee, organization, society	55	after exclusion of 543 off-topic articles
4	Quality assessment	**(1) Empirical evidence** - Studies that draw on empirical behavioral data **(2) Methodological rigor** - Strict outlet selection guaranteed high-quality standards - Studies outside premium outlets were only included if they yielded substantial findings and showed similar quality	38	after exclusion of 17 study ineligible articles
5	Data extraction	**Concept matrix** (Webster and Watson 2002) - Author centric: Year, Outlet, Title, Abstract, Method details, Key findings, Future avenues - Concept centric: Six key conceptual antecedents emerged from aggregation of driving concepts	29	after inclusion of 13 fwd/bwd articles, the exclusion of additional 19 off-topic articles, exclusion of three conference papers that preceded journal articles
6	Data analysis and interpretation	**Summary and Codes** - Qualitative description of the main results and coding of the driving concepts (67 codes) **Synthesis** - Provision of study profiles - Reading, grouping into major themes, and developing an acronym (White et al. 2019) - Theorizing/ disciplined imagination (Weick 1989)		

iterative procedure

Table 1. Literature Review

(guidelines adapted from Templier and Paré, 2018)

We describe our review closest to a synthesis, aiming to unify extant theories and research evidence to create an integrative view that helps readers to develop a comprehensive understanding (LePine and Wilcox-King 2010, p. 509). We also include elements from descriptive or theory-developing reviews (Templier and Paré

2018). Our overarching methodological strategy follows the six-step approach suggested by Templier and Paré (2018). Our initial literature identification is restricted to premier IS outlets and papers referring to sustainability or related terms. We limit our selection to empirical articles focusing on consumers and environmental sustainability. The development of our Boolean search string and acronym is inspired by the framework development of White et al. (2019). Table 1 provides methodological details of the search criteria, extraction- and analysis techniques. The "comment" column summarizes the search, screening, and selection activities involved, and the "n" column indicates the stepwise number of studies.

Results

Our analysis sparked six salient conceptual antecedents, in short concepts, which we summarize with the acronym REDUSE: *Relief, Empowerment, Default, User-centricity, Salience*, and *Encouragement*. These concepts will help to grasp the conditions for consumers to employ digital technologies so that these technologies help to reduce their adverse environmental impact when engaging in some activities. In other words: We present below the key drivers that drive individuals from private households to reduce their environmental impact when using digital technologies. The findings of our literature review consist of a descriptive analysis outlining the study profiles, the identified concepts, and future research opportunities. Below, we describe our 29 analyzed studies, then elaborate on our six concepts before articulating four research avenues.

Study Profiles

The studies included in this review date from 2012 to 2023, are predominantly published in premier IS outlets, utilize different theories and methods, examine various contexts and technologies, and correspond to at least one conceptual antecedent. Table 2 provides a descriptive summary of the included studies with their profiles in terms of authors, publication year, outlet, major theoretical underpinning(s), applied method (i.e., EXPeriments, SURVeys, MIXed-methods, and CASE studies), contexts, underlying technology, and concepts labeled REDUSE. It should be noted that the concepts presented here were mainly studied in a relatively isolated setting. However, they all share the leitmotif of sustainable IS Use. Before we detail the concepts, we follow the recommendations of (Templier and Paré 2018) and elaborate briefly on the study profiles below.

Our leading outlets have limited coverage of sustainability concerning individual IS Use. We could draw on only five of the 11 senior scholars' list of premier journals for this review (i.e., EJIS, ISJ, I&M, JAIS, and MIS Q). In contrast, we saw many more publications at our conferences, and in recent years in particular, this strand was often closely associated with the central conference themes (e.g., ICIS 2021, ECIS 2022). This suggests that research in sustainable IS Use can be considered a "hot" research topic with increasing maturity to be expected.

In terms of theory, most of the literature is based on adoption theory or interventions from behavior change theory (e.g., nudging or persuasion). This is mirrored in the choice of methods, with most studies relying on purely quantitative evidence. Our sample comprises mainly experimental studies conducted to measure specific interventions' effects. Only a fraction included inductive, qualitative methods (e.g., CASE, MIX). We provide more background on theoretical and methodological approaches along with the analysis of each concept.

Regarding context and technology, we encountered two challenges when critically analyzing the study's appropriateness: First, the phenomenon under study should be sufficiently attributable to digitalization, and second, the benefit for our planet (i.e., enhanced sustainability) should be sufficiently conceivable. At present, we have found shortcomings in both respects. However, we refrained from limiting the selection of studies to native digitalization phenomena (e.g., social media, IoT) or proven sustainability benefits (e.g., life cycle assessments, net savings) because of the currently sparse number of studies available. We believe, though, that as the research strand matures, there is more evidence to come.

Reference	Outlet	Theory/ Underpinning	Method	Context	Technology	Concepts					
						R	**E**	**D**	**U**	**S**	**E**
Winkler von Mohrenfels and Klapper (2012)	ICIS	Branding, communication	EXP	Grocery shopping (brick and mortar)	Mobile tagging	-	-	-	-	x	-
Loock et al. (2013)	MIS Q	Feedback, goals, defaults	EXP	Energy/resource consumption (electricity)	Web-application	-	-	x	-	-	x
Oakley and Salam (2014)	COMP HUM BEHAV	Social norms, green consumerism	SURV	Influencers	Social media	-	-	-	-	-	x
Wacker et al. (2014)	ICIS	Adoption, user clustering	SURV	Transportation	Electric vehicles	-	-	-	x	-	-
Brauer et al. (2016)	ICIS	Adoption, persuasion	SURV	Eco-IS	Mobile application	x	-	-	-	-	x
Lossin et al. (2016)	ECIS	Motivation, incentive alignment	EXP	Energy/resource consumption (electricity)	Web application	-	-	-	-	-	x
Warkentin et al. (2017)	JAIS	Privacy, security, adoption	EXP	Energy/resource consumption (electricity)	Smart metering	-	-	-	-	-	x
Dahlinger et al. (2018)	ACM CHI	Feedback, construal level	EXP	Transportation (fuel)	Vehicles	-	-	-	-	x	-
Hildebrandt et al. (2018)	BISE	Agency conflicts	EXP	Transportation (car sharing)	Vehicles	-	-	-	-	-	x
Karmakar and Webster (2018)	ICIS	Personalization	EXP	Green IS practices	n/a	-	-	-	x	-	-
Tiefenbeck et al. (2018)	MS	Feedback, salience	EXP	Energy/resource consumption (showering)	Smart metering	-	-	-	-	x	-
Tim et al. (2018)	ISJ	Affordances	CASE	Social movements	Social media	-	x	-	-	-	-
Diederich et al. (2019)	ICIS	Planned behavior, social response	EXP	Transportation (e-bike booking)	Conversational agent	-	-	-	-	-	x
Shevchuk et al. (2019)	ICIS	Gamification, persuasion, cogn. absorption	SURV	Sustainable activities	Social media	-	-	-	-	-	x
Tiefenbeck et al. (2019)	NAT ENERGY	Feedback intervention, salience	EXP	Energy/resource consumption (showering)	Smart metering	-	-	-	-	x	-
Wunderlich et al. (2019)	MIS Q	Adoption, motivational psychology	MIX	Energy/resource consumption (electricity)	Smart metering	-	x	-	x	-	x
Berger et al. (2020)	ICIS	Nudging	EXP	Grocery shopping	Web store	-	-	x	-	x	-

Table 2. Concept Matrix

Reference	Outlet	Theory/ Underpinning	Method	Context	Technology	Concepts					
						R	**E**	**D**	**U**	**S**	**E**
Mamonov and Koufaris (2020)	IJIM	Adoption	MIX	Energy/resource consumption (heat)	Smart thermostats	-	-	-	x	-	-
Seidler et al. (2020)	ICIS	Gamification, goal framing	EXP	Energy/resource consumption (computing)	Search engine	-	-	-	-	-	x
Sheffler et al. (2020)	EJIS	Framing, gamification	EXP	Transportation (bicycle commute)	Web application	-	-	-	x	-	x
Staudt et al. (2021)	ICIS	Nudging, social comparisons	EXP	Donations (eco-projects)	n/a	-	-	-	x	-	x
Sutanto et al. (2021)	ICIS	Persuasion, Fogg's behavioral model	EXP	Grocery shopping	Web store	-	-	-	x	-	x
Wendt et al. (2021)	ICIS	Goals, evaluative standards	EXP	Energy/resource consumption (heat)	Smart metering	-	-	-	-	-	x
Whittaker et al. (2021)	IJIM	Flow psychology, gamification	EXP	Eco-IS (sustainability game)	Mobile application	-	-	-	-	-	x
Hsu (2022)	I&M	Motivational psychology, gamification	SURV	Recycling (curbside)	Web site	-	-	-	x	-	x
Meske et al. (2022)	IT&P	Nudging, anchors/mapping	EXP	Aviation (flight booking)	Web site	-	-	-	-	x	-
Leidner et al. (2022)	HICSS	Information transparency	EXP	Grocery shopping	Web store	-	-	-	-	x	-
Luan et al. (2023)	I&M	Framing, regulatory focus, self-construal, temporal	EXP	Green consumer products	n/a	-	-	-	x	x	x
Sim et al. (2023)	JAIS	Adoption, cognitive dissonance	SURV	Energy/resource consumption (electricity)	Smart metering	-	-	-	x	x	-

Table 2. (cont'd)

The Antecedents of Sustainable IS Use

Figure 1 summarizes our findings at the end of this subsection. In an effort to "develop a logical approach to grouping and presenting the key concepts [..] uncovered" (Webster and Watson 2002, p. xvii), our data analysis comprised 67 codes that crystallized into six salient concepts. Abbreviated with REDUSE, we provide an acronym for our six concepts that relate to reducing GHG, resource use, and environmental damage while alluding to the use of IS. Our inductive endeavor comprised an iterative process (cf. #5 and #6 in Table 1). The coding helped to synthesize the results of 29 empirical studies and aggregate the extant literature. We resort to conceptual terms such as "default" or "salience" when these leaped out generically. Recognizing concepts with less clear terminological boundaries, we have endeavored to find an apt concept that best reflects the unique relationship between digitalization and sustainability. Below we list the emerged conceptual antecedents and their key characteristics in detail. Note that most studies focus on the user, the provision of salience, or the encouragement of the user. In turn, less evidence was found for the concepts relief, empowerment, and default - not to suggest less relevancy herein.

Relief

With relief, we refer to making individual lives easier as using digital technologies helps them to reduce their adverse environmental impact. Thereby, we draw on the convenience conceptualization of (Berry et al. 2002), which states that it is about facilitation in terms of perceived time and effort. Further, as the literature suggests that reducing physical and mental effort favors sustainable behaviors (Hummel and Maedche 2019), we distinguish two facets of relief, which, however, often go hand in hand when applied: On the one hand, relief refers to the facilitation of the physical activities with reduced adverse environmental impact (*physical relief*). On the other hand, relief refers to facilitating mental loads stemming from engaging in these activities (*mental relief*).

To grasp the essence of *physical relief*, extant literature on IS Use, such as effort expectancy (Venkatesh et al. 2012), can be utilized. Smart thermostats, for instance, are digital technologies that perform and control functions to save consumers time and effort while reducing their environmental impact (Andraschko et al. 2023). It is noteworthy that only a few studies have explicitly focused on this issue (Brauer et al. 2016), although the inherent social welfare element in sustainable IS Use differentiates from typical contexts of IS Use aimed at personal efficiency (Melville 2010). To grasp the essence of *mental relief*, we identified one study investigating respective support for sustainability-enhancing activities. Brauer et al. (2016) drew on persuasion theory's primary task support to show that users are more willing to use when the technology helps "the user in breaking down complex behavior such as CO_2 reduction, resource conservation, or sustainable nutrition into single easy-executable tasks" (Brauer et al. 2016, p. 13). Thus, the relief concept also relates to dialog support as digital reminders and suggestions relieve consumers' mental load and ultimately enable them to behave more sustainably (Brauer et al. 2016). Interestingly, Shevchuk et al. (2019) found no significant evidence in this regard. Yet, the specific facets of relief remain under-researched but hold a unique relationship between personal efficiency and sustainability impact (Andraschko et al. 2023).

Empowerment

Empowerment is "a mechanism by which people, organizations, and communities gain mastery over their affairs" (Rappaport 1987, p. 122). In our review, we discovered two nuances of empowerment in relation to sustainable IS Use: *Activation*, i.e., when the use of digital technologies enables consumers' abilities to perform environmentally beneficial activities. *Advancement*, i.e., when using digital technologies, enhances consumers' abilities to perform environmentally beneficial activities.

The case study of Tim et al. (2018) covers both. Through affordance theory, the authors examine how consumers convene to an environmental movement using social media. While the preceding conference paper explicitly relies on an empowerment lens (Leong et al. 2015), the journal paper mainly draws on affordances. There, the authors show that using digital technologies activates and advances information democratization, network effects, and self-organization that help individuals to contribute to collective outcomes (i.e., ultimately a contribution to sustainability) (Tim et al. 2018). Besides affordances, another critical perspective in IS Use is adoption research, which is concerned with a form of empowerment by adoption. Although not explicitly labeling it as empowerment, we find studies that report the sustainability-enabling facets of technologies. For instance, Wunderlich et al. (2019) outline how the technology empowers consumers as it gives the "possibility of identifying ways to save energy, enhanced efficiency through better management options, and a set of innovative services and applications" (p. 674). However, we also note that not all technologies studied are self-evidently digital and sustainable (e.g., Wacker et al. 2014); here, drawing on life-cycle assessments or equivalent research would increase the validity of extant work. Although much can be *activated* and *advanced* through digital technologies, empowerment, as such, has so far only received little explicit attention. We believe contrasting the presence of digital technology with its absence offers some exciting avenues, e.g., to deepen the problem-solution debate (Veit and Thatcher 2023).

Default

By definition, defaults occur when digital technologies "make a selection automatically in the absence of a choice made by the user" (Meriam Webster 2023). With a long tradition in nudging literature, defaults are considered one of the most effective building blocks of choice architecture; examples include enrollment in health care plans or double-sided printing (Sunstein 2014). The application of these techniques, in the use of digital technologies, has two facets, which we coin *set to forget* and *set to note*. The first involves

automatically setting sustainable choices aimed at preventing consumers from moving to unsustainable choices. The second involves automatically set salience, personalization, or encouragement mechanisms that aim to persuade consumers to engage in sustainable activities. Note that these mechanisms are not mutually exclusive.

Regarding *set to forget*, Berger et al. (2020) provide evidence of default's effectiveness for online shopping behaviors across multiple scenarios. The authors state that "[d]efault rules are thus a suitable one-size-fits-all solution for fostering sustainable food shopping" (Berger et al. 2020, p. 12). Consequently, online vendors could get many customers to remain with more sustainable options if the less sustainable one requires an opt-out. Regarding *set to note*, Loock et al. (2013) provide evidence that including goal-setting mechanisms per default can reduce consumers' domestic energy consumption. However, the main problem the authors point out with defaults set to note, here goals, is that these can easily be ignored or even have a detrimental effect if, for example, the goals are set too high or too low. Thus, the study suggests preset goals on a medium level or leaving it to the user to set their own goals (Loock et al. 2013). In this case, we assume the user will forget to scrutinize whether one needs goals at all to perform the underlying activity but follow instructions. In this regard, an empirical evaluation remains to be done. Although enhancing sustainability with digitally set defaults appears straightforward, research indicates that the challenges remain in the design details.

User-centricity

One widely studied area of IS Use focuses the users themselves. Following this line, scholars argue that "[i]f the desired improvement conflicts with what people are motivated to do, a system alone will not solve the problem. There are only two alternatives: one is to change people's incentives, in which case a system may not be needed; the other is to build a system that conforms to incentives" (Markus and Bjorn-Andersen 1994, p. 24). Thus, designs should be user-centered. Consistent with the prevailing view that digital technologies should somehow center the user's needs, we have identified several aspects that appear particularly relevant to researchers in the strand of sustainable IS Use. Our review revealed two facets of research that touch on user-centricity: On the one hand, research focuses on specific *individual characteristics* of the users (i.e., the consumers). On the other hand, research focuses on the *personalization strategies* organizations designing digital technologies employ to leverage the aforementioned user characteristics for sustainable IS Use. We discuss these two facets below.

First, much research focused on salient consumer *characteristics* such as traits, demographical factors, or user behaviors. Not surprisingly, studies provide evidence that consumers with environmental consciousness or similar attributes show significantly more sustainable behaviors in IS Use than those without (Hsu 2022; Leidner et al. 2022; Sim et al. 2023; Staudt et al. 2021). However, focusing only on environmentally conscious consumers will not reach the masses. Thus, other causal relationships between personality and sustainable IS Use have also been identified. For example, Wunderlich et al. (2019) show that a tendency to use novel technologies (i.e., innovativeness) influences the adoption of sustainable technologies (i.e., smart meters). The authors further identify demographic variables, such as age and income. Another way to examine the sustainable user is to pay attention to their behavior. For example, Sheffler et al. (2020) find that some encouragement mechanisms' effectiveness depends on the frequency of use. However, the behavioral user-differences of sustainable IS Use still received little scholarly attention. Another user-characteristic refers to the type of self-construal which impacts how environmental information is perceived and eventually influences relevant activities. Whereas promotion-oriented framings work more with independent individuals, prevention-oriented framings are more effective with interdependent individuals (Luan et al. 2023). This effect is even reinforced if the activity is more distal (Luan et al. 2023). In sum, many differences across consumers allude to sustainable IS Use, which might be strategically utilized as discussed in the following. Second, research examines *strategies* to target specific consumers or groups. For instance, Wacker et al. (2014) provide an example of different user types. The authors provide evidence of how various clusters of consumers show different adoption behaviors. Here, a distinction is made between "[c]onservative technology users, high-tech enthusiasts, technophobic environmentalists, environmentally unconscious consumers" (Wacker et al. 2014, p. 11). While such clusters provide an initial idea of aggregation, there is still a lack of more detailed and configurational understanding. Given the growing amount of data and technical possibilities, the idea of targeting consumers toward increased sustainability is quite apparent. The study of Karmakar and Webster (2018) provides an example of personalization and sustainability. This research shows that sustainable behaviors

are more likely to occur when digital technologies expose consumers to framings that align with their self-scheme (i.e., animal lovers, asthmatics) (Karmakar and Webster 2018). Although plenty of promising paths exist, our results indicate little research has been done in this area.

Salience

Salience can be understood as "something about a stimulus event that occurs on exposure, without a prior set for a particular kind of stimulus, that draws attention selectively to a specific aspect of the event (Higgins 1996, p. 135). One feature of digital technologies is about creating and conveying salience. While digital-driven salience is conceivable in almost all areas of life, it can also be directed toward greater sustainability. Research in this area is yielding exciting findings.

We noted salience in sustainable IS Use in two ways: Information availability and clarity. For information *availability*, we found a study by Winkler von Mohrenfels and Klapper (2012), which uses digitally extended packaging to provide consumers with more information. The authors found that the extra information influences the willingness to pay (Winkler von Mohrenfels and Klapper 2012). Further, Tiefenbeck et al. (2018) provide evidence in several field experiments that the plain presence of real-time consumption feedback during showering reduces water and energy consumption. Interestingly, this effect was even demonstrated among hotel guests without financial incentives (Tiefenbeck et al. 2019). In these studies, the participants were exposed to plain consumption information and illustrations of melting ice shelves with polar bears on them, thus bringing us to the topic of *clarity*. In this regard, Berger et al. (2020) report that simplifying complex issues, such as climate impact, can encourage consumers to adopt more sustainable behaviors. Another example that combines availability and clarity is a study on flight booking (Meske et al. 2022). In an online lab experiment, the authors found that labeling flights with emission figures (visual representation) and providing clear/comprehensive emission equivalents of an average household in days (understanding mapping) encouraged sustainable booking behaviors (Meske et al. 2022). All in all, it can be argued that when digital technologies draw selective attention to consumption, it can significantly reduce consumers' adverse environmental impact.

Encouragement

Encouragement is the "process of facilitating the development of a person's inner resources and courage toward positive movement" (Dinkmeyer and Losoncy 1995, p. 7). To facilitate this process, environmental psychology distinguishes three types of influences: *Intrapersonal, interpersonal*, and *external factors* (Gifford et al. 2011). Yet, much IS research focused on moving individuals toward a desired outcome or increased engagement, drawing on motivational, nudging, persuasion, or gamification theories. Just as the concept of encouragement may be found across many research domains, we have likewise identified several studies addressing sustainable IS Use. Because of the "social welfare element" that sustainability brings to IS Use, user encouragement differs from typical contexts of IS use where personal efficiency can often be considered a driving antecedent (Melville 2010). For instance, research shows that internal, introjected, and external perceived loci of causality (PLOCs) are the driving motivational adoption factors of sustainable technologies (Wunderlich et al. 2019). Thus, a collection of intrinsic motivation, social values and obligations, as well as external rewards drive consumers (Wunderlich et al. 2019). Based on the triad outlined above, we will examine the encouragement concept and its mechanisms in more detail below.

Intrapersonal factors relate to affective, hedonic, or altruistic motives. For instance, Seidler et al. (2020) provide evidence on how affective framings can motivate consumers to be more sustainable: "Thanks for behaving eco-friendly, collect your points and let your crop grow" (p. 8). Similarly, engaging messages such as "That's a great choice! People all over the world are really benefiting from this!" (Sutanto et al. 2021, p. 14) or anthropomorphic designs (Diederich et al. 2019) can digitally promote sustainable behaviors as well. The study by Warkentin et al. (2017) emphasizes a motif associated with altruism. The authors show that pursuing shared benefits (i.e., avoiding power grid brownouts) influences individual behavioral intention. Emphasizing the gaming aspect, some of the literature focuses on goal-setting theory or symbolic rewards. One study shows that the simple implementation of goals in a home energy management system can challenge the user to be eager to achieve the goals (Loock et al. 2013). Another aspect that seems to drive individuals internally refers to symbolic rewards (Hsu 2022; Sheffler et al. 2020). But while these studies mainly relate such rewards to the intrapersonal aspect, they also find that including social reference, self-expression elements, or competition has a significant influence, leading to the second theme (Hsu 2022; Sheffler et al. 2020). For addressing *interpersonal factors*, digital technologies are used to create a kind of

social pressure, obligation, or a feeling of desired actions. Staudt et al. (2021) provide an example of the functioning of norms and social comparisons. Consumers tend not to want to do worse when contrasted with other people. Similar results are provided by Wendt et al. (2021) with evaluative standards. The external factors refer to the creation of incentives to encourage the consumer. This involves two facets, creating incentives for adoption on the one hand and during the use phase on the other. In the Loock et al. (2013) study, customers were given bonus points to exchange for material goods later. On the other hand, Lossin et al. (2016) show that using financial incentives during the use phase also influences the intensity of use. Interestingly, the authors find no significant influence on the height of the financial incentives. In contrast, the height of the non-monetary/virtual incentive (e.g., praising badges) had a significant influence (Lossin et al. 2016). Overall, although research on encouragement already provides some evidence of the effects and causalities of how sustainable IS use is induced, little remains known about how these factors combine.

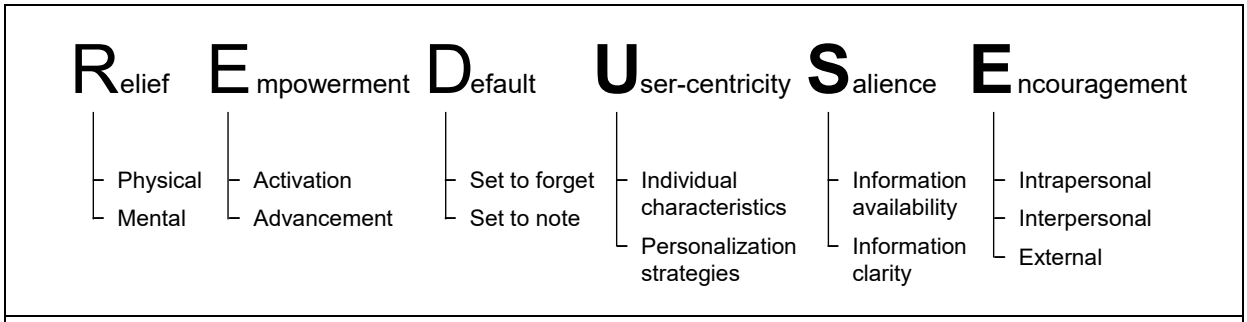

Figure 1. Conceptual Summary

Future Avenues

Suggesting opportunities for future research is an essential component of literature studies (Templier and Paré 2018). Seeking to find the antecedents of sustainable IS Use among consumers, we noticed several distinctive but intertwined research avenues. In the following, we outline some possibilities to inspire researchers entering untraveled territories, thereby contributing to the emerging literature strand of sustainable IS Use. Besides from our inferences, the avenues are also derived from analyzing the studies' "future research" sections. We extracted the researchers' suggestions and distilled them in four avenues. What follows is a presentation and a discussion of these avenues calling for further investigation: Individual boundaries, surrounding boundaries, temporal boundaries, and methodological remedies.

Individual Boundaries

First, examining individual boundaries in sustainable IS Use is about finding out the nuances of situational and personal sensitivities. Researchers in this domain propose understanding the effects of incentive type and size in more detail (Lossin et al. 2016; Sutanto et al. 2021). Others emphasize a better understanding of user differences (Sheffler et al. 2020). Winkler, for instance, suggests looking at the personal situation of consumers using a specific technology. Warkentin et al. (2017) suggest examining IS-enabled sustainable behaviors from the perspective of political affiliations. Typically research in the realm of individual boundaries addresses "who", "why", and "which personal conditions" questions.

Researchers on this avenue could start from the concept user-centricity and investigate how these relate to some of the other concepts relevant to consumers so that they use digital technologies in ways that reduce their adverse environmental impact. For instance, future research could be conducted on the independent vs. interdependent self-construal (Luan et al. 2023) to examine which type of relief is important to whom.

Surrounding Boundaries

Second, examining the surrounding boundaries is about zooming out to better understand how the personal environments, contexts, and types of technology influence sustainable IS Use. One under-explored area relates to cultural and regional differences (Wunderlich et al. 2019). Comparative country studies, therefore, would provide valuable insights. A similar path relates to the market environments (Sim et al. 2023). Since the energy sector (one of the most critical sustainability levers) exhibits considerable

regulatory differences (e.g., subsidies), future studies might reveal national specifics (Sim et al. 2023) and thus identify where and how sustainable IS Use evolves. By surrounding in a broader sense, we mean to draw attention to the ever-increasing variety of digital technologies. Researchers propose to study the effects of design elements, specific green features, or technologies (Luan et al. 2023; Oakley and Salam, 2014; Sheffler et al. 2020). Prospective studies may pose "how", "why", and "which contextual conditions" kinds of questions.

Researchers seeking to leverage surrounding aspects for new insights could focus on the different facets of encouragement and determine how they are related to sustainability-inducing concepts such as relief, default, or salience. Aside from the often studied financial incentives, clarifying when it is more of personal responsibility and when it is more of a limitation on an individual's choices by the surrounding to act sustainably may yield some highly relevant insights, and thereby also follow the recent calls (Recker et al. 2022; Veit and Thatcher 2023). Here, surrounding configurations that target specific consumers (Karmakar and Webster 2018; Wacker et al. 2014) or their feelings when the technology tries to persuade them to be more sustainable could be examined (Shevchuk et al. 2019). In sum, pursuing this avenue raises some unresolved socio-technical questions that deserve to be investigated.

Temporal Boundaries

Third, examining the temporal boundaries is a recurring issue of IS Use generally but also specifically in the context of sustainability. Besides a few longitudinal intervention studies over shorter periods (e.g., Tiefenbeck et al. 2018), most research is cross-sectional. Hence, researchers repeatedly emphasize the importance of examining whether effects persist over time (Hsu 2022; Leidner et al. 2022; Tiefenbeck et al. 2018) and of comparing short- and long-term patterns (Loock et al. 2013; Seidler et al. 2020). Another exciting path paves the flow-oriented approach (Mousavi Baygi et al. 2021). This approach is not about researchers observing periods but more of a genealogical investigation (Mousavi Baygi et al. 2021) that might help to retrospectively understand how sustainable IS Use evolves along a flow of action. Given the scarcity of research on temporal boundaries, we suggest that this avenue reflects on the "how becomes", "how long", and "when" questions.

Researchers on this avenue could examine the relations between digitalization and sustainability over time across different contexts. Thereby a temporal perspective could provide additional insights into the conditions and extent to which digital technologies help (not) to reduce adverse environmental impact. For instance, one could utilize an empowerment perspective to compare this impact with and without digital technologies such as social media (Tim et al. 2018).

Methodological Remedies

Last, the methods and research designs employed to investigate sustainable IS Use are related to some shortcomings. While most studies are quantitative, only a fraction of the evidence is based on qualitative data, although being considered helpful in addressing the problematic intention-behavior gap (e.g., Diederich et al. 2019). Qualitative studies are also suitable for identifying the best possible designs, e.g., employing interviews (Brauer et al. 2016). Further, research has mainly focused on particular settings (Hildebrandt et al. 2018). Future studies could instead reflect on the "challenge of multifaceted digital phenomena" by revealing how causes combine into configurations to produce desired (i.e., sustainability) outcomes (Park et al. 2020, p. 1493). In addition, we also identified two shortcomings regarding quantitative studies of sustainable IS Use: On the one hand, when field data has too much noise (e.g., actual driving behavior), researchers should examine observed effects in laboratory isolation (Dahlinger et al. 2018), and on the other hand, when laboratory data suffers from too little ecological validity (e.g., fictitious online shopping), it alludes to tests in the field (Berger et al. 2020).

Researchers seeking to gain new insights through the design of their studies are encouraged to utilize approaches that are typically associated with more in-depth and foundational understanding. While the majority of studies have relied on deductive testing of outside theories, employing *inductive*, open-ended approaches, e.g. qualitative research, may spark additional insights into digitalization phenomena and consumers' adverse environmental impact reduction.

After all, research on sustainable IS Use seems to be in a maturing phase — the four avenues proposed above aim to provide orientation for further developing sub-strands. We now turn to the implications of our results.

Discussion

This review contributes to the IS sustainability literature (Elliot 2011; Malhotra et al. 2013; Melville 2010) as it synthesizes different streams, mechanisms, and underlying causalities involved in consumers' use of digital technologies. By departing from specific contexts and technologies, the herein-emerged concepts (see Figure 1) offer a collection of perspectives that will help researchers and practitioners envision sustainability and IS Use in a more general and integrated way, as we further discuss below.

Theoretical Implications

The concept of sustainable IS Use and its antecedents can become cross-cutting in studying digitalization phenomena. As far as we know, this is the first endeavor toward conceptualizing sustainable IS Use: Explicitly in the foundation section and implicitly through surveying previously examined technologies and contexts (see Table 2). While prior work has drawn on outside theories such as nudging, persuasion, norms, etc., in contrast, our work draws on native IS theory (Burton-Jones et al. 2017). We believe our adopted IS Use perspective offers a more holistic understanding as it helps to bridge the gap between reviews of narrow topics and broader Green IS research. Thereby, it inherently addresses the unique nexus between digital technologies, human behavior, and the quality of our planet (Elliot 2011). Because our conceptualization refers to a notion that "is different from typical contexts of IS use (e.g., for personal efficiency) in that there is a social welfare element at play in which users may display altruism" (Melville 2010, p. 12), *sustainable* IS Use and its specific antecedents offers novel derivatives of one of the most widely studied constructs, *IS Use* (Burton-Jones et al. 2017). Thereby, sustainability may move closer to the center of our discipline - rather than being treated as just another research topic.

As the body of literature continues to grow, we believe that the elucidated six concepts (REDUSE) represent a unique consolidation and form a bracket over the pertinent facets of sustainable IS Use. By aggregating the siloed empirical findings, this paper contributes to the maturation of research that seeks to understand whether and how individual sustainability and digitalization go hand in hand (Dwivedi et al. 2022; Veit and Thatcher 2023). Researchers will move on by pursuing questions derived from the future avenues developed in this work. We believe more generalizable insights will be generated by addressing multiple unit-specific, contextual, thematic, and methodological shortcomings.

This paper provides a framework for individual-level sustainable use of digital technologies that complements theories such as Affordances of Sensemaking and Sustainable Practicing (Seidel et al. 2013), Sustainable Technology Adoption in the Residential Sector (STARS), or Unified Theory of Acceptance and Use of Technology of consumers (UTAUT2) (Venkatesh et al. 2012). After all, noting that only five of our 11 premier journals have published papers on sustainability, IS Use, and consumers, we recommend that author teams and editorial boards catch up.

Limitations

Although we followed established rigorous guidelines (Templier and Paré 2018; Webster and Watson 2002), we must consider some limitations when reading our results. While we believe in having covered a solid foundation through the quality restriction of only searching the senior scholars' list of premier journals and ICIS proceedings, we cannot rule out that other researchers would have identified further relevant studies in the ensuing forward-backward search. That said, we also believe that multidisciplinary and critical insights outside the IS can lead to a richer understanding. Note that the six concepts, aiming to unify extant evidence, originate from various studies; thus, universal applicability exists only theoretically to date. Future research might alleviate this limitation by empirically investigating how the compiled concepts influence behavior. Certainly, interactions might spark exciting results. In addition, it would also be interesting to extend this framework to organizational settings or the social sustainability dimension.

Practical Implications

This paper offers a guide to combine different facets and techniques of digital technology employment such that these technologies help to reduce consumers' adverse environmental impact. One way that firms and regulators ensure sustainable IS Use involves the application of REDUSE as a checklist. This makes it easy to evaluate which aspect has been considered, not considered, or may not be applicable. Practitioners

should combine these concepts by debating questions such as: How can we empower users? How can we make sustainability less burdensome? Where can we preset? Where can we inform users? How should we encourage users? How does sensitivity vary among users? Etc. Thereby, firms can better help to combat the climate crisis, responding to mounting political and societal pressures. Our concepts easily stay in mind and help developers, marketers, and regulators tie digital technologies more closely to sustainability.

In addition, our results offer interesting pedagogical concepts. We provide a collection of 29 empirical studies that students can refer to when, for instance, discussing or innovating IS solutions for sustainability (Corbett 2023). In sum, the antecedents identified are self-explanatory and, combined with the underlying rich empirical examples, can form valuable course material for higher education.

Concluding Remarks

Motivated by the urgent need for action and supported by early seminal readings, research on sustainability and IS Use has experienced an upsurge over the past 15 years. This study is the first to produce a distilled account of empirically backed theoretical perspectives and intervention techniques for sustainable IS Use at individual level. Although this research strand is still in its adolescence, we have delineated the body of literature to draw on. Our work emphasizes that understanding why consumers use digital technologies to contribute to sustainability goals is pivotal to reducing the lion's share of global emissions. That said, promoting consumers' GHG reduction/neutrality should become a maxim when developing and employing digital technologies. We hope that this paper has provided some inspiration for this becoming.

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