GRØNNE SKYTJENESTER OG AI

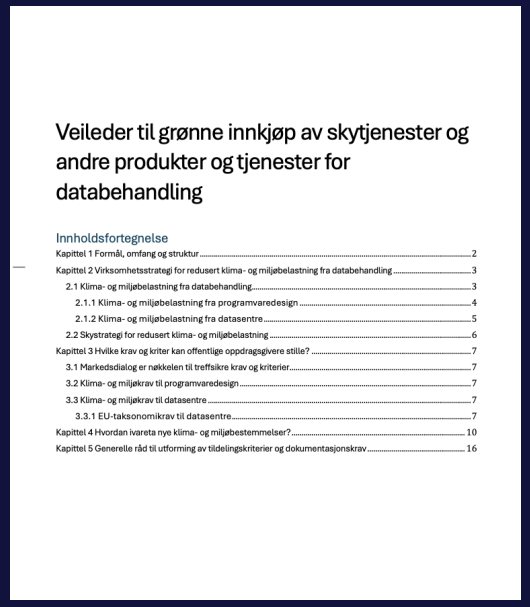
Premisser for å stille klima- og miljøkrav

Simen Sommerfeldt til NOKIOS workshop Q4 2024

bouvet

Hva jeg skal innom

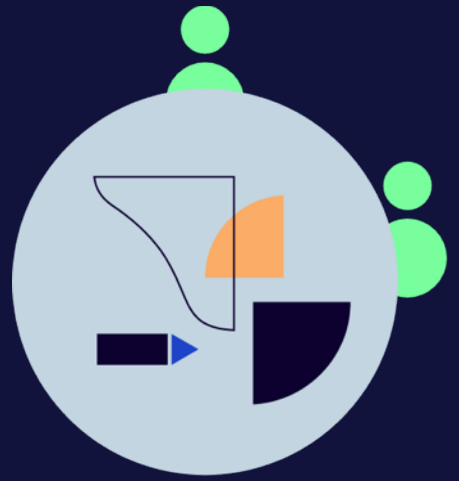
Premisser


Veileder til grønne innkjøp av skytjenester og andre produkter og tjenester for databehandling

Innholdsfortegnelse

Veilederen

bouvet



Simen Sommerfeldt - @sisomm

Bachelor of Engineering, University of Surrey
Tre barn
Role: CTO@Bouvet
En av grunnleggerne av «Lær Kidsa Koding»
Var med på å etablere GoForIT
Stedfortreder i personvernnemnda

goforIT

L K K Lær Kidsa Koding

Tekna

bouvet

Dette er Bouvet

Vi er et norsk konsulentselskap, med 19 kontorer i Norge og Sverige med over 2300 ansatte

Stor fokus på delingskultur, troverdighet og jordnærhet

Vi leverer tjenester innen kommunikasjon, rådgivning og teknologi

Visjon

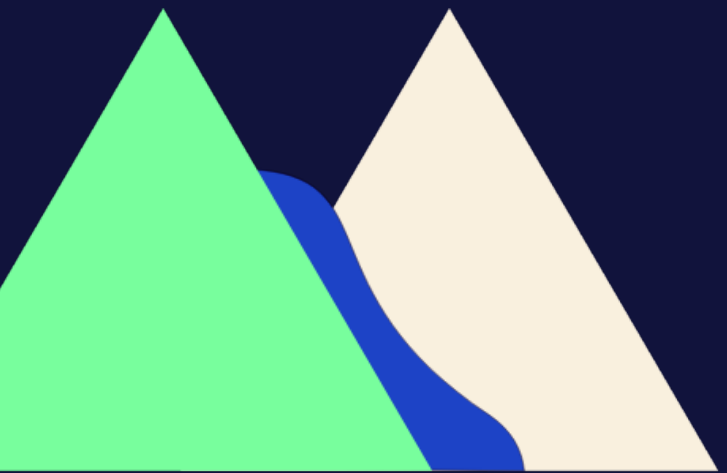
Vi går foran og bygger fremtidens samfunn

bouvet

Drømmesituasjonen

bouvet

Premisser



bouvet

Bærekraft er i en kritisk fase

- Vi rister av oss naivitet...
- Og spør «hva kan vi gjøre»
- Samtidig som virksomhetene forstår at det koster..
- ...for det handler om økosystemet: «Hvorfor skal vi gjøre det når ikke andre gjør det»
- Og dette hjelper!

bouvet

Energi - krevende..

Global trends in digital and energy indicators, 2015-2022

	2015	2022	Change
Internet users	3 billion	5.3 billion	+78%
Internet traffic	0.6 ZB	4.4 ZB	+600%
Data centre workloads	180 million	800 million	+340%
Data centre energy use (excluding crypto)	200 TWh	240-340 TWh	+20-70%
Crypto mining energy use	4 TWh	100-150 TWh	+2300-3500%
Data transmission network energy use	220 TWh	260-360 TWh	+18-64%

https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks

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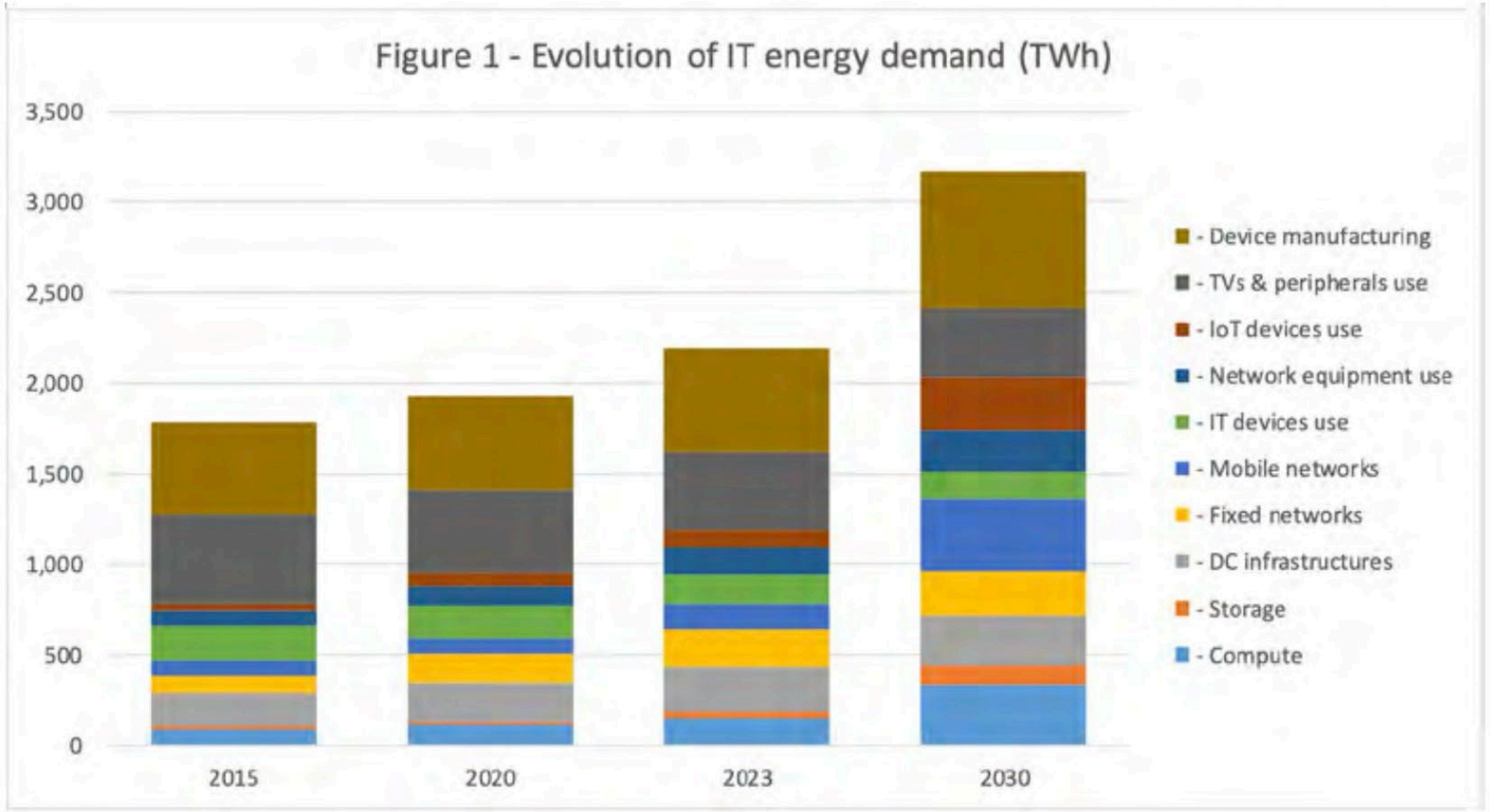
Fordeling

Schneider Electric estimates that IT sector electricity demand will grow by 50 percent by 2030, reaching 3,200TWh, equivalent to 5 percent Compound Annual Growth Rate (CAGR) over the next decade.



https://perspectives.se.com/research/digital - economy - climate - impact

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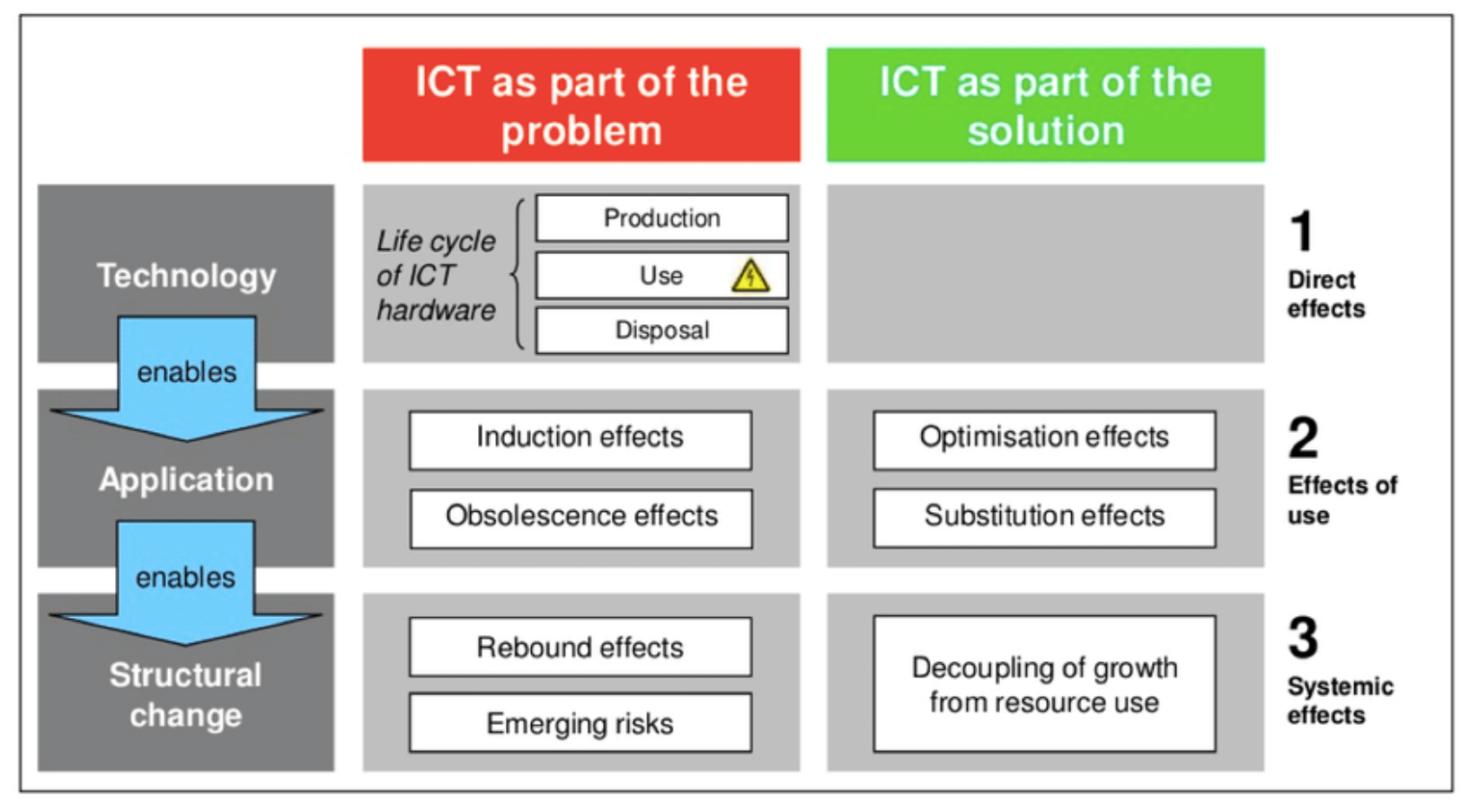
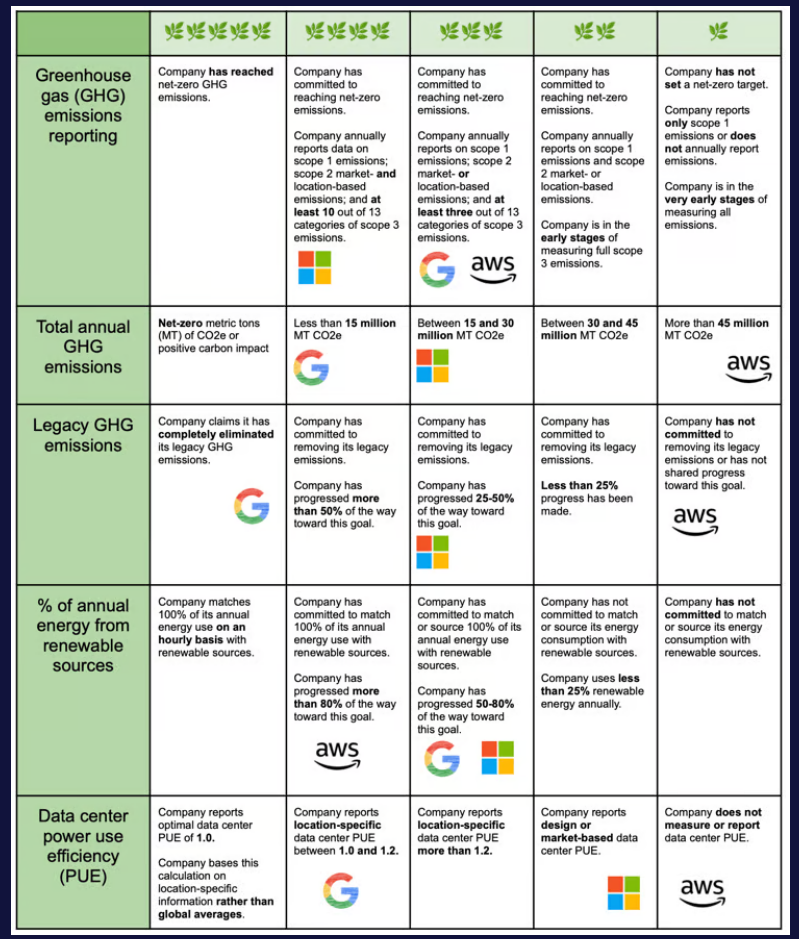
IT-systemer som problem og løsning



1.Hilty, L.M.; Aebischer, B. Ict for sustainability: An emerging research field. In *ICT Innovations for Sustainability*; Springer: Berlin, Germany, 2015; pp. 3–36.

Og hvordan tenker vi sky?

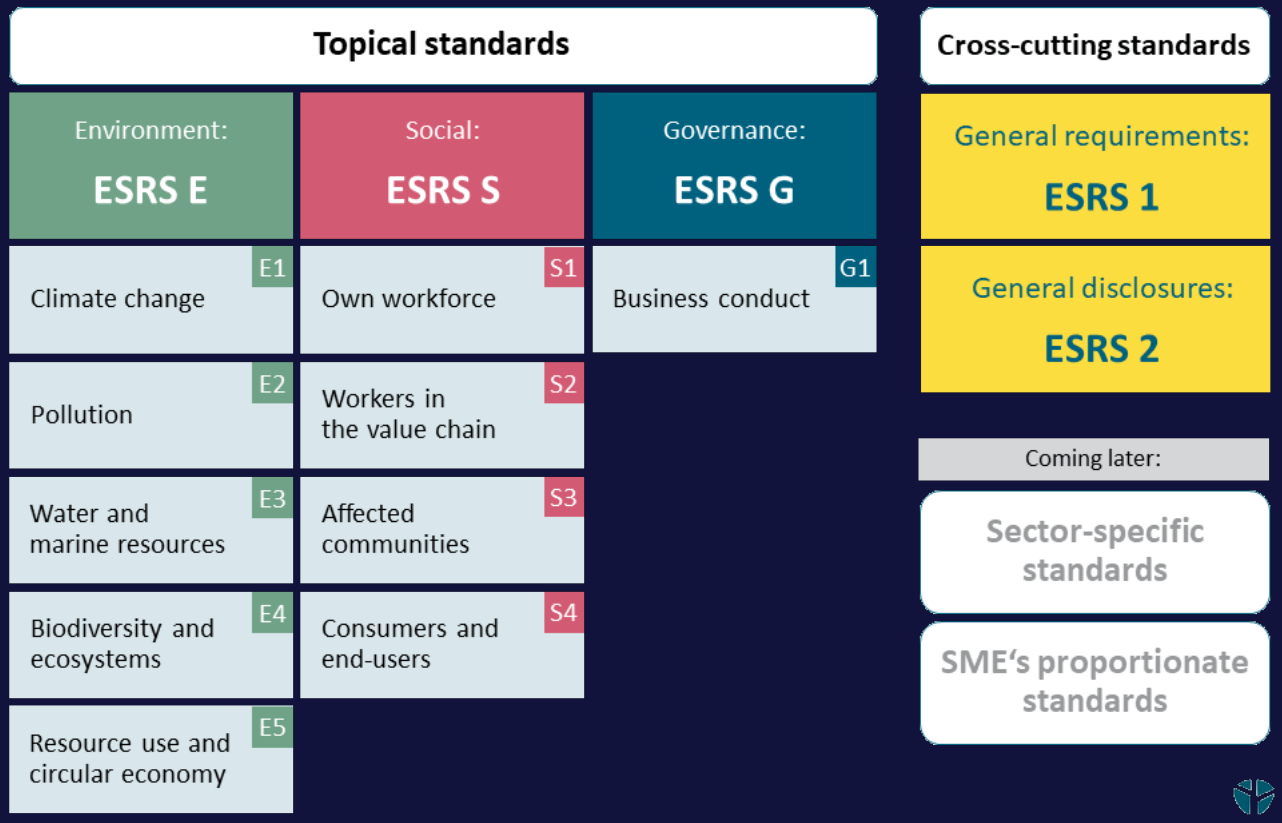
- Sky er i utgangspunktet mer effektivt
- …men kan vi sammenligne leverandører?
- Verdikjedene kan være lange
- Skytjenester kan også være ineffektive
- Nettvekstrafikk er også energi - krevende



	🌿🌿🌿🌿🌿	🌿🌿🌿🌿	🌿🌿🌿	🌿🌿	🌿
Greenhouse gas (GHG) emissions reporting	Company **has reached** net-zero GHG emissions.	Company has committed to reaching net-zero emissions. Company annually reports data on scope 1 emissions; scope 2 market- **and** location-based emissions; and **at least 10** out of 13 categories of scope 3 emissions.	Company has committed to reaching net-zero emissions. Company annually reports on scope 1 emissions; scope 2 market- **or** location-based emissions; and **at least three** out of 13 categories of scope 3 emissions.	Company has committed to reaching net-zero emissions. Company annually reports on scope 1 emissions and scope 2 market- or location-based emissions. Company is in the **early stages** of measuring full scope 3 emissions.	Company **has not set** a net-zero target. Company reports **only** scope 1 emissions or **does not** annually report emissions. Company is in the **very early stages** of measuring all emissions.
Total annual GHG emissions	**Net-zero** metric tons (MT) of CO2e or positive carbon impact	Less than **15 million** MT CO2e	Between **15 and 30 million** MT CO2e	Between **30 and 45 million** MT CO2e	More than **45 million** MT CO2e
Legacy GHG emissions	Company claims it has **completely eliminated** its legacy GHG emissions.	Company has committed to removing its legacy emissions. Company has progressed **more than 50%** of the way toward this goal.	Company has committed to removing its legacy emissions. Company has progressed **25-50%** of the way toward this goal.	Company has committed to removing its legacy emissions. **Less than 25%** progress has been made.	Company **has not committed** to removing its legacy emissions or has not shared progress toward this goal.
% of annual energy from renewable sources	Company matches 100% of its annual energy use **on an hourly basis** with renewable sources.	Company has committed to match 100% of its annual energy use with renewable sources. Company has progressed **more than 80%** of the way toward this goal.	Company has committed to match or source 100% of its annual energy use with renewable sources. Company has progressed **50-80%** of the way toward this goal.	Company has not committed to match or source its energy consumption with renewable sources. Company uses **less than 25%** renewable energy annually.	Company **has not committed** to match or source its energy consumption with renewable sources.
Data center power use efficiency (PUE)	Company reports optimal data center PUE of **1.0.** Company bases this calculation on location-specific information **rather than global averages**.	Company reports **location-specific** data center PUE between **1.0 and 1.2.**	Company reports **location-specific** data center PUE **more than 1.2.**	Company reports **design or market-based** data center PUE.	Company **does not measure or report** data center PUE.

https://www.sdxcentral.com/articles/analysis/hyperscaler-sustainability-scorecard-rating-google-microsoft-and-aws/2023/07/

Nye rapporteringskrav vil endre landskapet



CSRD: Corporate Sustainability Reporting Directive

ESRS: European Sustainability Reporting Standard

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ISO-standarder

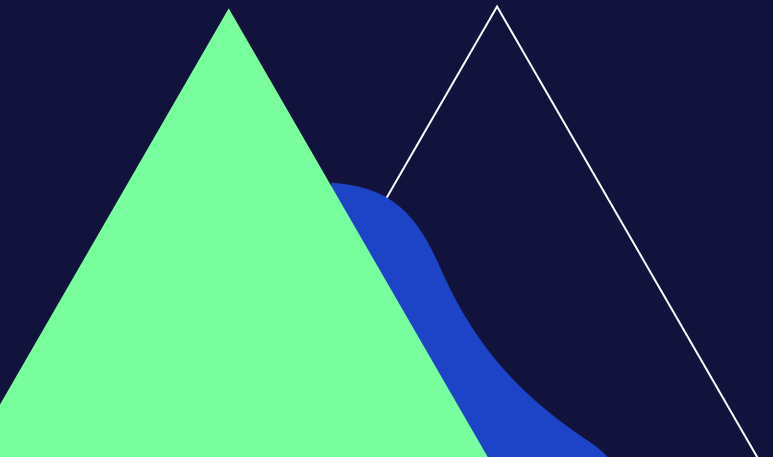
- ISO 14044: Environmental Management – life cycle assesment
- ISO 30134: Key performance indicators for data centers
- ~~ISO 14062: Environmental Management – Integrating environmental aspects into product design and development~~

bouvet

Livssyklus og mulighet til påvirkning

Aktivitet	Skreddersøm	Anskaffelser
Design/Utvikling	Direkte kontroll Krever rett kompetanse	
Drift		
Forvaltning		

HVORDAN SETTE MILJØKRAV TIL SOFTWARE OG DIGITALE TJENESTER



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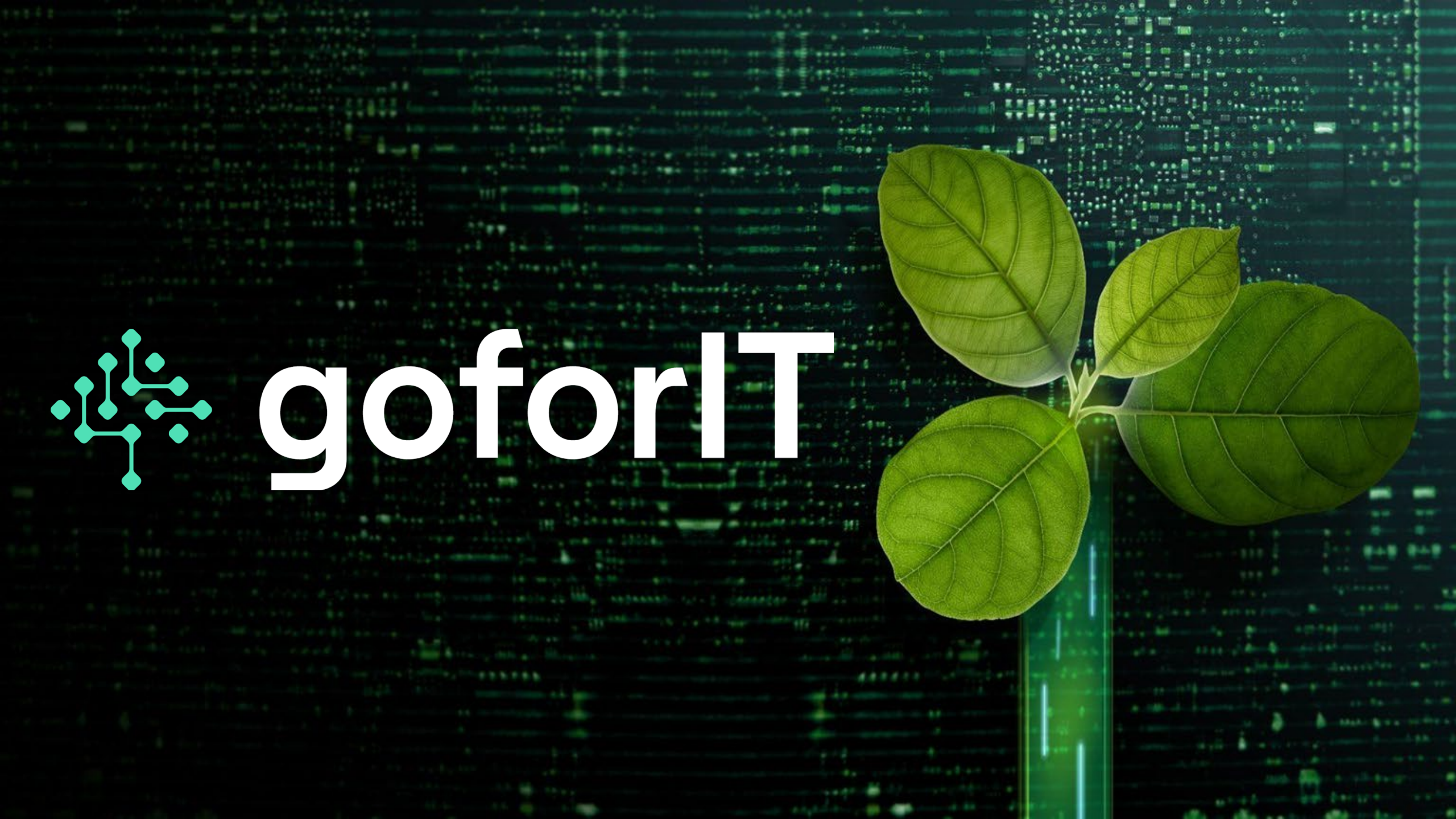
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Systemiske utfordringer

- Vi har i dag manko på 40.000 «IT folk» frem mot 2030 – **og de bør kunne bærekraft**
- Akademia famler med **bærekraft-innholdet** – også i etterutdanninger
- Arbeidslivet famler med å **finne riktig kompetanse**
- De som jobber med innkjøp **vet ikke hva de skal etterspørre**
- Og vi er **forpliktet** til å nå parisavtalens mål.

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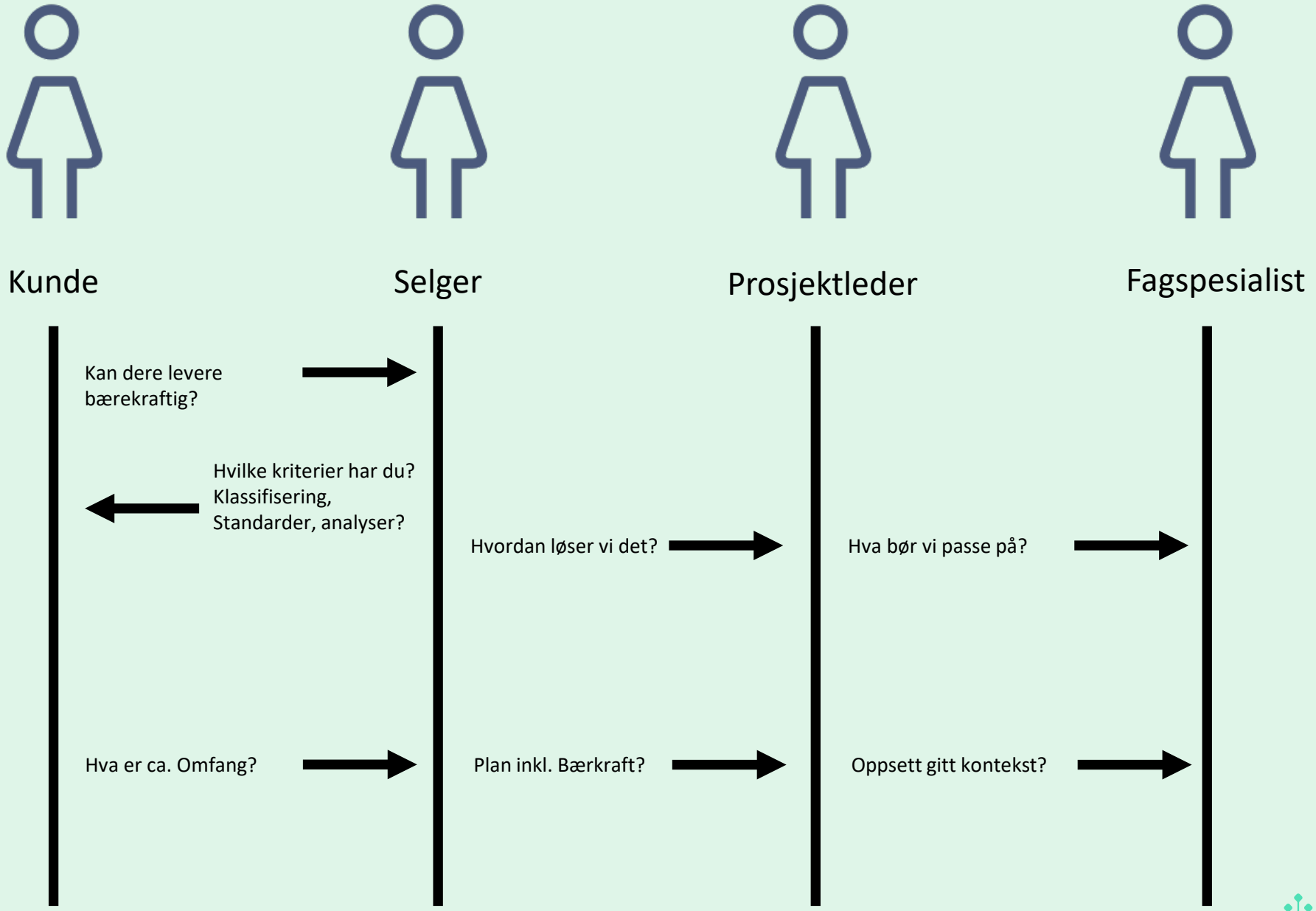
Telia
IBM
KnowBe4
computas
NTNU
SINTEF
ATEA
Norges arktiske universitet
UIT
IGM
UiA Universitetet i Agder
ITERA
USN
Universitetet i Stavanger
Tekna
Universitetet i Oslo
IKT Norge
Excited
Centre for Excellent IT Education
accenture
Capgemini
Brønnøysundregistrene
DELL
sopra steria
NMBU
Loopfront
Microsoft
BI
knowit
OSLOMET
NITO
NORSIRK
Redpill Linpro
Høyskolen Kristiania
WEBSTEP
Lånekassen
FINANS FORBUNDET
Den norske dataforening
bouvet
Witted
SpareBank 1
otte
twoday


Kunde
Selger
Prosjektleder
Fagspesialist
Kan dere levere bærekraftig?
Hvilke kriterier har du? Klassifisering, Standarder, analyser?
Hvordan løser vi det?
Hva bør vi passe på?
Hva er ca. Omfang?
Plan inkl. Bærkraft?
Oppsett gitt kontekst?

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Akademia redder dagen

FOCUS: THE FUTURE OF SOFTWARE ENGINEERING

Requirements: The Key to Sustainability

Christoph Becker, University of Toronto

Stefanie Betz, Karlsruhe Institute of Technology

Ruzanna Chitchyan, University of Leicester

Leticia Duboc, State University of Rio de Janeiro

Steve M. Easterbrook, University of Toronto

Birgit Penzenstadler, California State University, Long Beach

Norbert Seyff, University of Applied Sciences and Arts Northwestern Switzerland

Colin C. Venters, University of Huddersfield

// Software's critical role in society demands a paradigm shift in the software engineering mind-set. This shift is driven by requirements engineering. //

SOFTWARE SYSTEMS are a major driver of social and economic activity. Software engineering (SE) tends to focus on the technical elements—artificial systems with clear boundaries and identifiable parts and connections, modules and dependencies. But software systems are embedded in other technical systems and in socioeconomic and natural systems. This embedding is obvious when the interaction is explicit, such as environmental monitoring or flight control software.

However, software-intensive systems have become so essential to societies that the resulting sociotechnical systems' boundaries and interactions are often hard to identify. For example, communication, travel booking, and procurement systems influence the socioeconomic and natural environment through far-reaching effects on how we form relationships, how we travel, and what we buy. The engineering process rarely makes these effects explicit. Their lack of visibility makes assessing a software system's long-term and cumulative impacts difficult.

Designing for sustainability is a major challenge that can profoundly change SE's role in society. But what does it mean to establish sustainability as a major concern in SE? As software engineers, we're responsible for our software's long-term consequences, irrespective of the primary purpose of the system we're designing. Requirements are the key leverage point for practitioners who want to develop sustainable software-intensive systems. Here, we present two examples that illustrate the changes needed in SE and show how considering sustainability explicitly will affect requirements activities.

Sustainability in Software Engineering

Sustainability is the capacity to endure, so a system's sustainability describes how well it will continue to exist and function, even as circumstances change. Sustainability has often been equated with environmental issues, but it's increasingly clear that it requires simultaneous consideration of environmental resources, societal and individual well-being, economic prosperity, and the long-term viability of technical infrastructure.

A technical system's sustainability differs considerably from that of a socioeconomic system. Software

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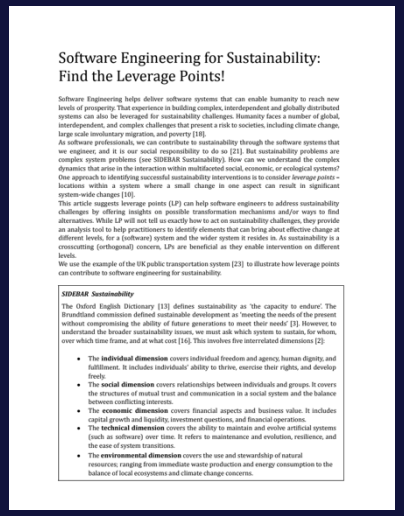

Software Engineering for Sustainability: Find the Leverage Points!

Software Engineering helps deliver software systems that can enable humanity to reach new levels of prosperity. That experience in building complex, interdependent and globally distributed systems can also be leveraged for sustainability challenges. Humanity faces a number of global, interdependent, and complex challenges that present a risk to societies, including climate change, large scale involuntary migration, and poverty [18].

As software professionals, we can contribute to sustainability through the software systems that we engineer, and it is our social responsibility to do so [21]. But sustainability problems are complex system problems (see SIDEBAR Sustainability). How can we understand the complex dynamics that arise in the interaction within multifaceted social, economic, or ecological systems? One approach to identifying successful sustainability interventions is to consider *leverage points*—locations within a system where a small change in one aspect can result in significant system-wide changes [10].

This article suggests leverage points (LP) can help software engineers to address sustainability challenges by offering insights on possible transformation mechanisms and/or ways to find alternatives. While LP will not tell us exactly how to act on sustainability challenges, they provide an analysis tool to help practitioners to identify elements that can bring about effective change at different levels, for a (software) system and the wider system it resides in. As sustainability is a crosscutting (orthogonal) concern, LPs are beneficial as they enable intervention on different levels.

We use the example of the UK public transportation system [23] to illustrate how leverage points can contribute to software engineering for sustainability.

SIDEBAR Sustainability

The Oxford English Dictionary [13] defines sustainability as 'the capacity to endure'. The Brundtland commission defined sustainable development as 'meeting the needs of the present without compromising the ability of future generations to meet their needs' [3]. However, to understand the broader sustainability issues, we must ask which system to sustain, for whom, over which time frame, and at what cost [16]. This involves five interrelated dimensions [2]:

- The **individual dimension** covers individual freedom and agency, human dignity, and fulfillment. It includes individuals' ability to thrive, exercise their rights, and develop freely.
- The **social dimension** covers relationships between individuals and groups. It covers the structures of mutual trust and communication in a social system and the balance between conflicting interests.
- The **economic dimension** covers financial aspects and business value. It includes capital growth and liquidity, investment questions, and financial operations.
- The **technical dimension** covers the ability to maintain and evolve artificial systems (such as software) over time. It refers to maintenance and evolution, resilience, and the ease of system transitions.
- The **environmental dimension** covers the use and stewardship of natural resources; ranging from immediate waste production and energy consumption to the balance of local ecosystems and climate change concerns.

Sustainability Quantification in Requirements Informing Design

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***Abstract*— Sustainability has been defined with different perceptions and from diverse dimensions making it an ambiguous concept to objectively engineer and integrate into software development lifecycle. Although a large body of knowledge already exists on what sustainability is and isn't, little research has explored how to quantify sustainability. How can the definitions and perceptions of sustainability from software engineering and other fields be turned into requirements, effective measures that quantify sustainability and most importantly can inform a "sustainability by design" approach? What are the measures and measurement scale of sustainability? Our long-term research goal is to answer such questions and similar ones. In this position paper, we summarize our investigations and pave the road for a theoretical ground of sustainability quantification in software development and measurement. The goal is to foster research and standardization initiatives on sustainability as a quality attribute and sustainability by design.**

Keywords: *Software Sustainability, Sustainability Requirements, Software Measurement, Software Development, Sustainability Metrics, Software Design*

I. Introduction

In a broad sense, sustainability is "the capacity to endure" [1]. In software engineering, sustainability has been introduced from different dimensions with diverse perceptions and definitions. Sustainability can be differentiated into several dimensions including environmental, human, social, and economic. According to Becker et al. [2] sustainability dimensions are interdependent and cumulative - first, second and third order effects from each dimension will bleed into each other. Sustainability consideration as a non-functional requirement like security, usability, reliability can help reduce a software system's first order impacts which will also aid reduction of second and third-order impacts of software systems. By doing so, developers have the potential to considerably improve software systems sustainability from the requirement engineering stage onwards [3]. This also requires measures informing how well the development process produces sustainable software [4].

The fundamental question is how to quantify sustainability not only for software products, systems and services but also for the entire digital ecosystem created by the system of software systems? This research aims to serve different communities, though there is still need to conduct empirical studies to validate these benefits. Quantifying sustainability in software systems will encourage software engineering community to develop processes, tools and new metrics to assess sustainability of software system like the other quality attributes. It will help companies, organizations and individuals to easily adopt and operationalize sustainability in their maintenance, software development and management process, assess objectively the cost-benefit while creating a business model associated with sustainability of their software system.

Furthermore, it will guide standardization bodies like ISO and governmental agencies to enact standards and policies for software system sustainability. For example, what is the minimum sustainability level of a software system to get certain accreditation like we do with security today? It will also make the society and people more aware about the impact of software systems when developing and using it, one example is the categorization of a fridge based on its level of greenness (energy usage) such as A+, A++. Can we adopt a green approach in software engineering?

Kocak et al. [5] stated that software development industry is now getting pressure from regulators to consider green certification. As an answer to this pressure, green attributes of software products should be defined as quality factor. Then, the biggest challenge facing companies is how to integrate sustainability into their engineering practices when knowing the lack of consensus on what sustainability means in software systems and how it can be quantified and measured.

Quantification of sustainability requires that it should be considered among the six divisions in ISO standards SQuaRE Model such as: Quality Management Division, Quality Model Division, Quality Measurement Division, Quality Requirements Division, Quality Evaluation Division, SQuaRE Extension Division [6]. By including sustainability in such standardization framework, sustainability may be considered more effectively in the industry. This is not really the case today. One starting point towards this, is to turn the current meanings, perceptions, and beliefs into requirements, factors, measurable criteria and tangible measures.

This paper presents the early results of an ongoing research that aims to build a theoretical ground for

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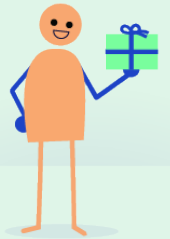
Likheter og forskjeller mellom bærekraft og informasjonssikkerhet

- De er store og komplekse fagfelt
- Det er en tilleggs -kompetanse for de fleste
- Kompetansebehovene og krav avhenger av fagfelt og rolle
- Det er viktig med et felles vokabular for å kunne jobbe effektivt
- Viktig forskjell: Sikkerhet er forstått, med standarder og klare innkjøpskriterier
- Kompetanse -> man kan lage ting og kjøpe ting

bouvet

Verktøykassen for bærekraft

- Felles **vokabular**
- Beskrivelser av **tilleggskompetanse** som nødvendig for å utføre en oppgave, **spisset for fagprofesjoner**
- Artikler, eksempler, videoer, caser, med linker til nett
- Den er inndelt i **perspektiver**, tilpasset fagprofiler
- Basert på **anerkjente publikasjoner**
- **Ikke** bare IT-fag, selv om vi startet der.. og
- ...den utvikles av arbeidslivet og akademia **i felleskap**.



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Verktøykassen for bærekraft

Personlig oppfølging

Kommunikasjon

Utdanning og etterutdanning

Offentlig og private anskaffelser

Tjenesteutvikling

Rolledefinisjoner

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Requirements Engineering

- Natural language requirements
- Modeled requirements
  - graphs → UML diagrams (e.g.)
  - formulas → mathematical repr.
  - code → pseudo code / early proto
- Artifact-based RE
  - ↳ goals
  - ↳ stakeholders
  - ↳ constraints

Birgit Penzenstadler

bouvet

bouvet

Det handler ikke bare om miljøet

Innenfor digitalisering betyr dette fokus på sikkerhet, personvern, arbeidsmiljø og universell utforming – samtidig som vi ivaretar finansielle og lovmessige krav.

Kravhåndtering med bærekraft

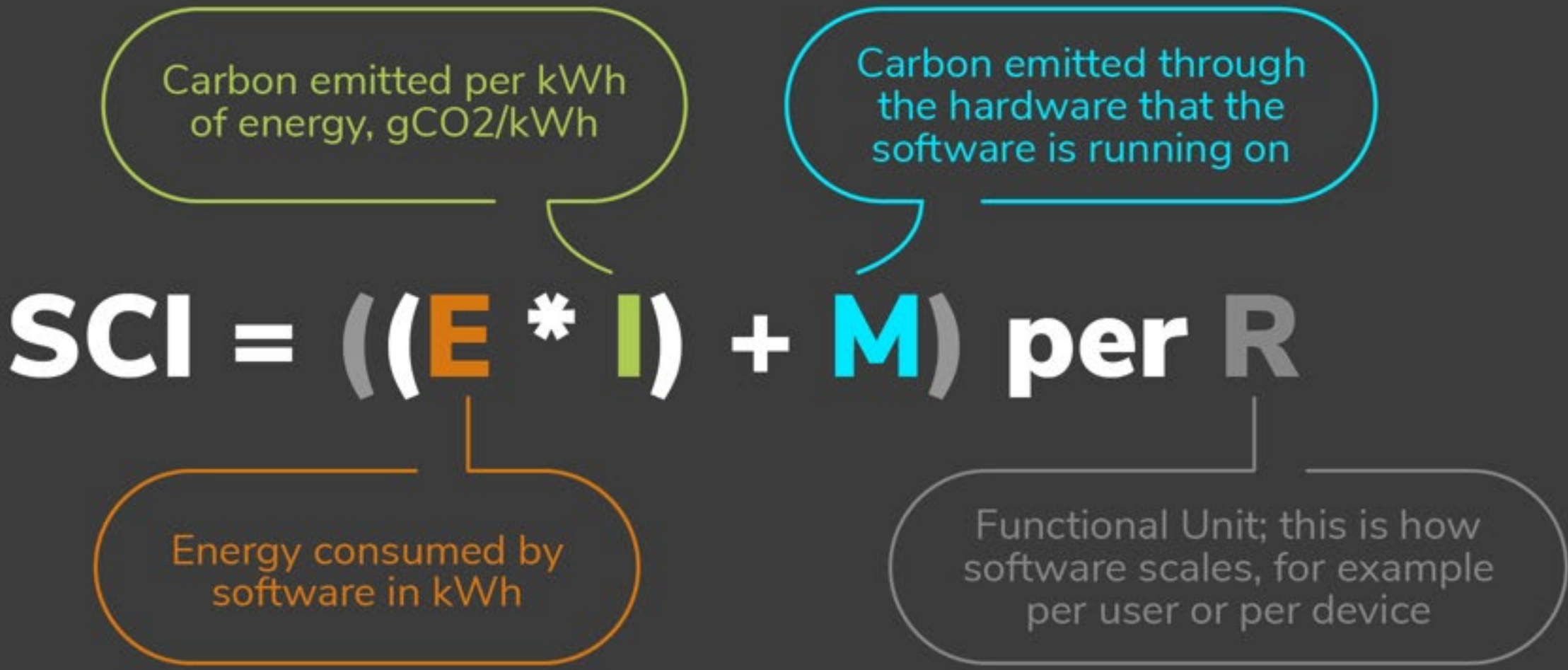
- Systemisk fremgangsmåte via f.eks. SUSAF
- Gjengangere: Energi - effektivitet, etikk, vedlikeholdbarhet , personvern, sikkerhet, Universell utforming
- Let etter kvantifiserbare krav
- ...vi beskriver noen typiske i verktøykassen...

Kategorier og forslag til målbare krav

Category	Metric	Description
Technical	BMI=Number of problems close/number of problems arrival *100	Backlog Management index (BMI) is a workload statement for software maintenance. It is related to both the rate of defect arrivals and the rate at which fixes for reported problems become available.
	Rework Metric	The total number of functions modified per commit related to adding a new feature/function. The "extensibility" of a system is generally the ability of the system to tolerate additional features or functionality with little or no required rework.
Economy	BMI=Number of problems close/number of problems arrival *100	Same as the above BMI
	Defect Density= Total defects/Size	The value of the total defects which are known to the size of the software product

Category	Metric	Description
		calculated.
	Net Cost	The Budgeted Capital - Total Capital Spent
Environment	BMI=Number of problems close/number of problems arrival *100	Same as the above BMI
	Defect Density= Total defects/Size	Same as the above Defect Density
	Energy efficiency	Useful work done/Used Energy
Social	Gateway metric (1=Task success and 0= Task failure)	The amount of successful task completed
	Defect Density= Total defects/Size	Same as the above Defect Density
	Net working hours	Budgeted hours - Total working hours
Individual	Gateway metric (1=Task success and 0= Task failure)	Same as the above Gateway metric
	Defect Density= Total defects/Size	Same as the above Defect Density

Conference paper september 2017: Sustainability Quantification in Requirements Informing design (Penzenstadler et al)



Green Software Foundation

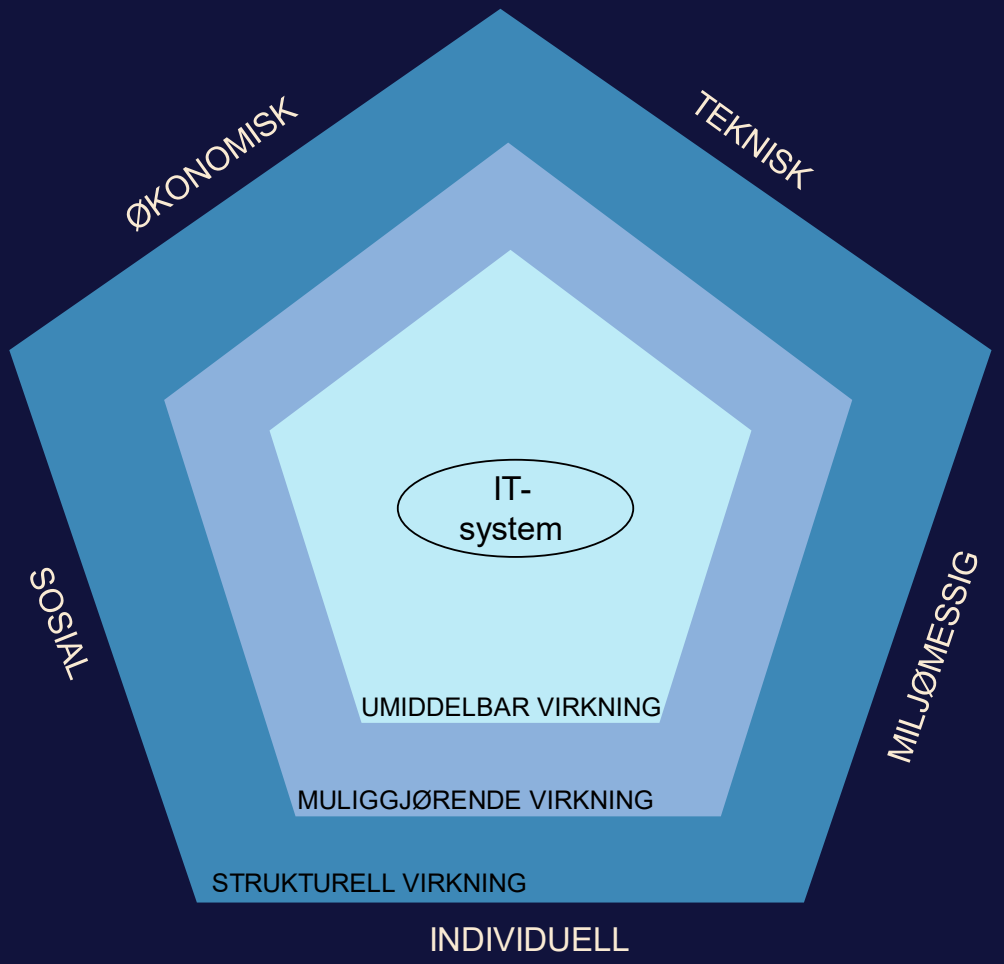
greensoftware.org

https://learn.greensoftware.foundation/measurement/

bouvet

Sustainability Awareness Framework

- Innfører «Systems thinking »
- En sosioteknisk analyse
- Umiddelbar, muligjørende og strukturelle effekter
- I fem dimensjoner
- Endrer fokus fra avgrensning til inkludering
- Er sentral for GoForIT



https://www.suso.academy/en/sustainability-awareness-framework-susaf/

https://www.youtube.com/watch?v=3y4VH02I6v0

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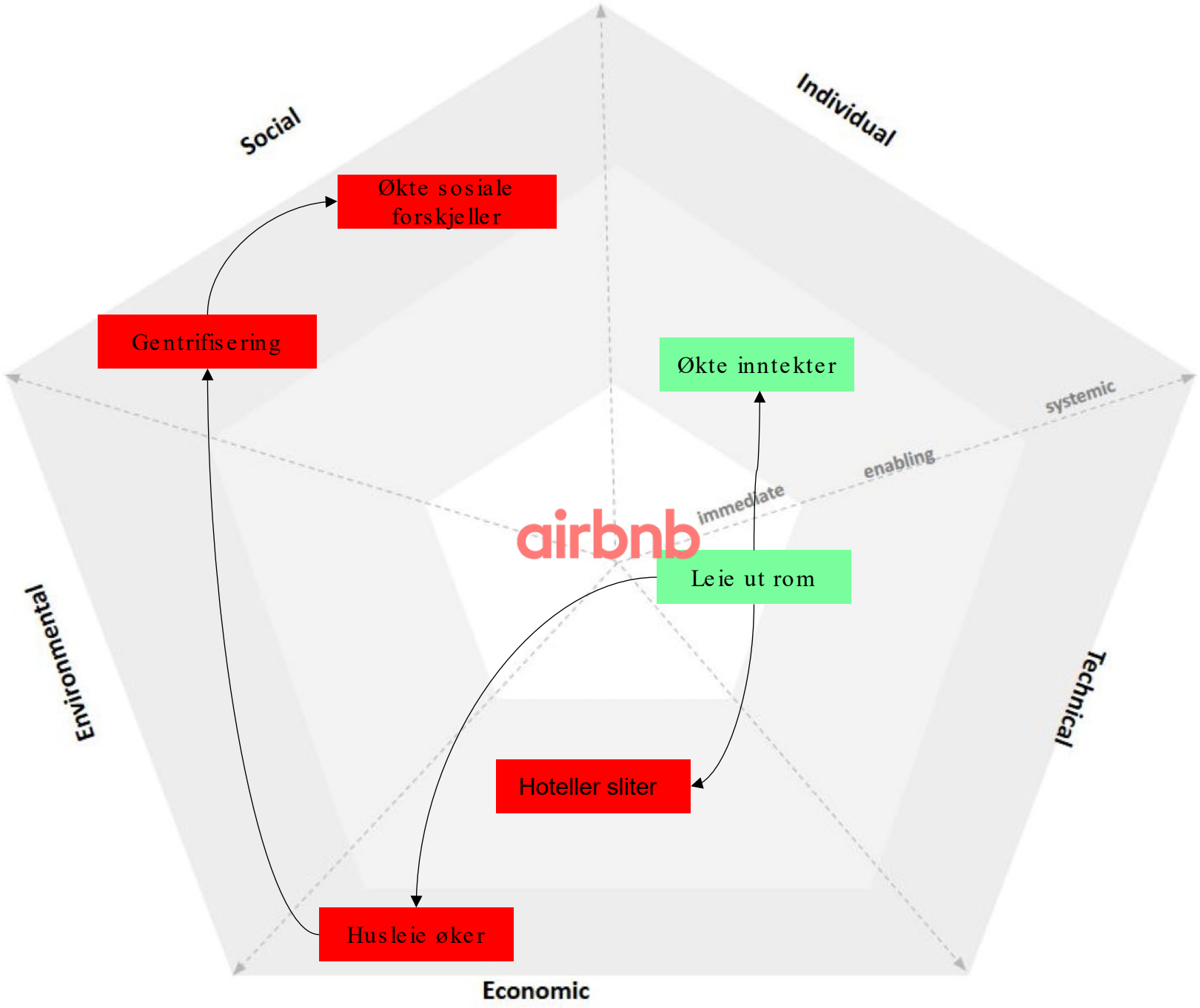

Social
Individual
Økte sosiale forskjeller
Gentrifisering
Økte inntekter
systemic
enabling
immediate
airbnb
Leie ut rom
Environmental
Technical
Hoteller sliter
Husleie øker
Economic

Forslag til generelle arkitekturspørsmål

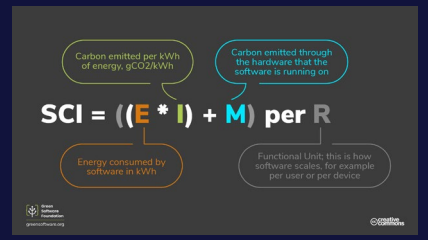
- Hvor mange **watt-timer** bruker vi pr. user story?
- Holder vi nettverkstrafikk, parsing og formattering til et **minimum** ?
- Hvis det er **forbruksvarer** : Er de reparérbare? Hvordan ser verdikjeden ut?
- Er det mulig å **vedlikeholde** systemene?

https://www.digi.no/artikler/debatt-blockchain-forsinker-baerekraftig-utvikling/501926

bouvet

Hva man kan utfordre leverandører på

- Hvordan blir vesentlighetsanalysen deres **operasjonalisert** i denne leveransen?
- Hvilke **ESRS-relaterte** risikoer og muligheter har de?
- Ved innleie: Hvilken konkret bærekraft-relatert **kompetanse** besitter de?
- Hva kan **kvantifiseres og måles** ?
- Kan de hjelpe dere med å **tallfeste** forbruk, energiforbruk og effektivitet per enhet?



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Hvorfor inkludere andre ESG -krav

- CSRD
- Alle rammverk tar utgangspunkt i ESG
- AI Act

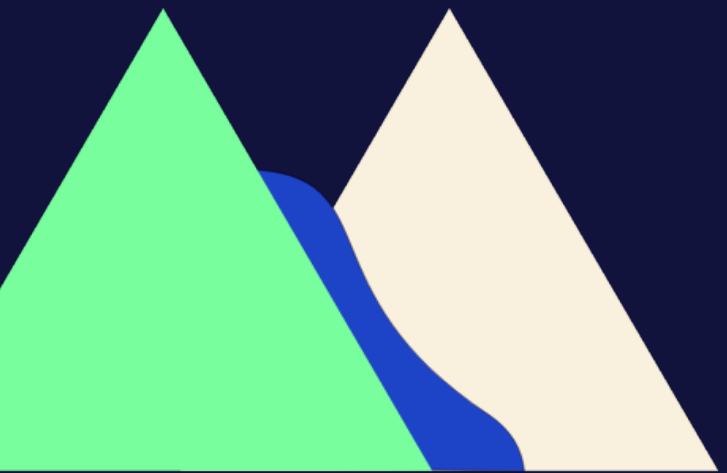
bouvet

Feil formuleringer i anskaffelser kan…

- Gi færre tilbydere
- Resultere i en dårligere leveranse
- Skape konflikt mellom kunde og leverandør
- Ikke nødvendigvis ende opp i bedre miljøregnskap

bouvet

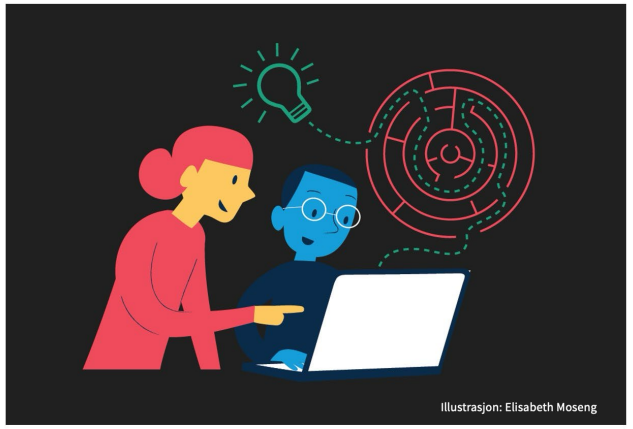
Veilederen



bouvet

Dette er en stor forbedring

VEILEDER TIL NYE REGLER OM SKJERPET IVARETAKELSE AV KLIMA- OG MILJØHENSYN I OFFENTLIGE ANSKAFFELSER



Illustrasjon: Elisabeth Moseng

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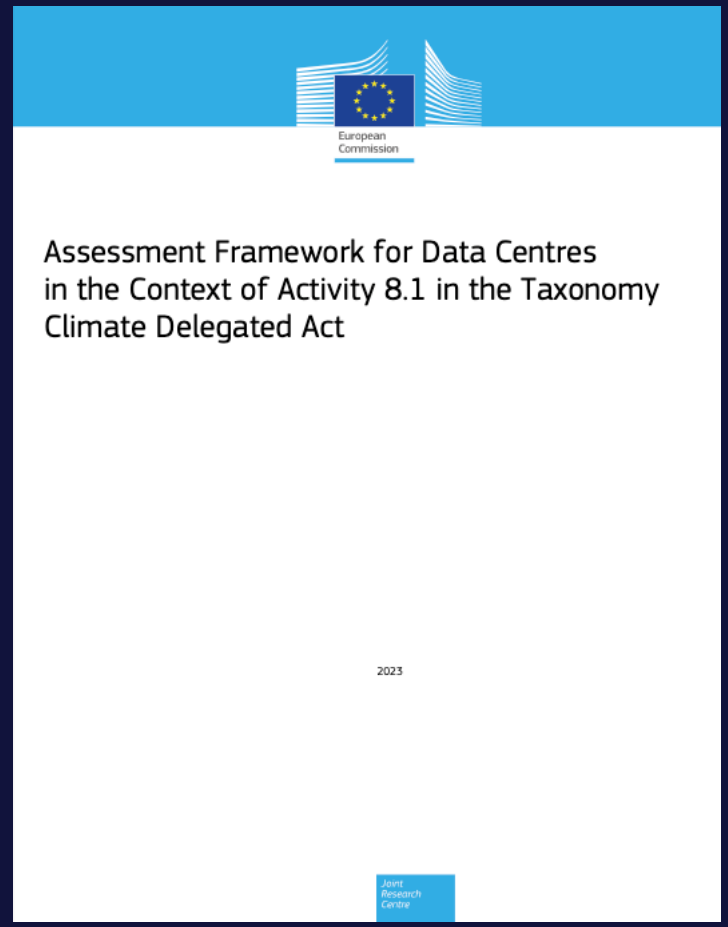
Veileder til grønne innkjøp av skytjenester og andre produkter og tjenester for databehandling

Innholdsfortegnelse

Nøkkelpunkter

- Lar oss bruke krav i stedet for tildelingskriterier for skytjenester
- Baserer seg på EUs taksonomiens rammeverk for datasentre
- «Kravet er dynamisk» 🤗
- ...men kravene er fortsatt ikke **kvantifiserbare?**
- Tabellen i kap. Fire er flott!



Drømmesituasjonen

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Tenk **forholdsmessighet** når du skal bruke AI. Vil bli spesielt aktuell for bruk av store språkmodeller

Ønskeliste

- Standarder som er anerkjente og kan etterprøves
- Etterprøvbare energiforbruk - målinger for sammenlignbare størrelser
- Anerkjente kompetanse - og metoderammeverk for fagprofesjoner
- At vi bygger kompetanse!

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Takk for meg!

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Video: Compressorhead (https://www.youtube.com/watch?v=3RBSkq-_St8)