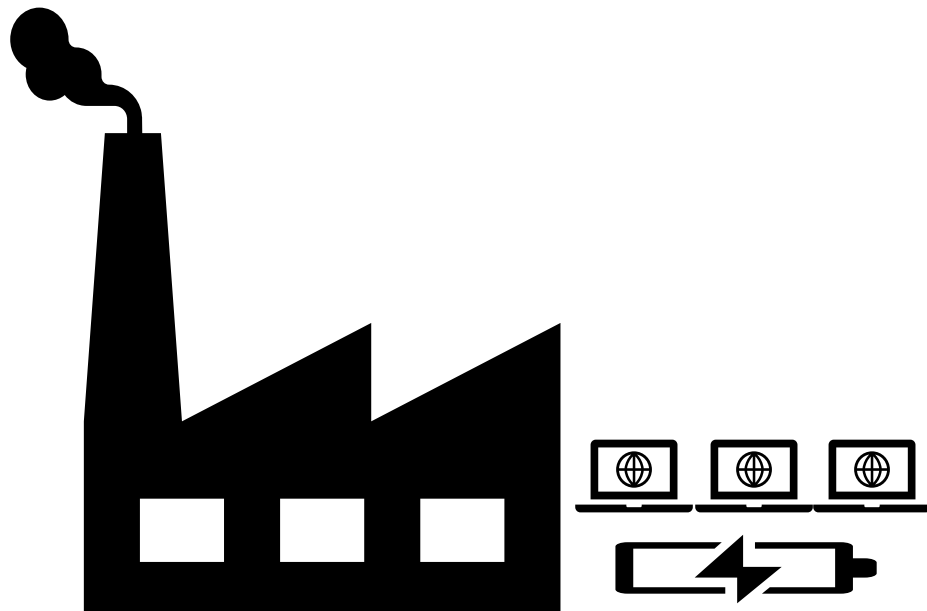


Om Bærekraftig Emballasje til Open Source Moduler

Kostnader ved IT

- Programvare kjører på maskinvare
- Maskinvare bruker strøm
- Strømproduksjon har utslipp av klimagasser
- Maskinvareproduksjon har utslipp av klimagasser
 - Vi måler klimagasser i CO₂eq



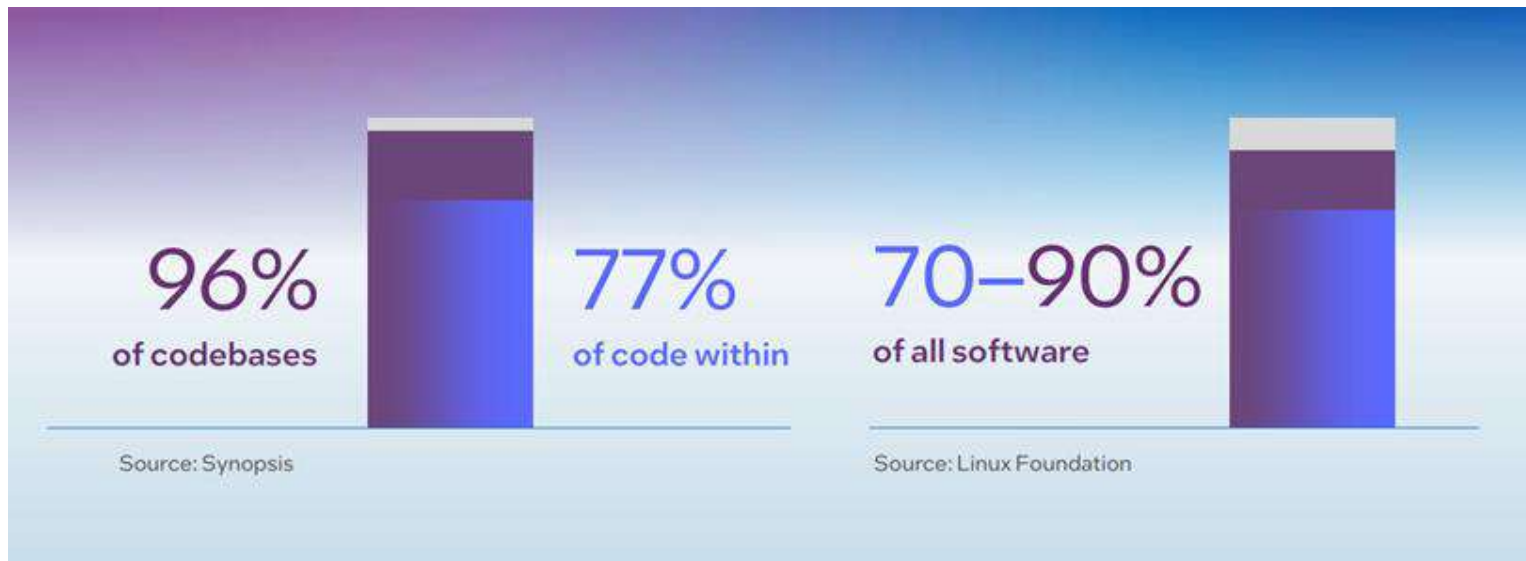
«The Internet accounts for about 3.7% of the world's carbon footprint»

- BBC, 2020

«We have found that, if unchecked, ICT GHGE relative contribution could grow from roughly 1–1.6% in 2007 to exceed 14% of the 2016-level worldwide GHGE by 2040, accounting for more than half of the current relative contribution of the whole transportation sector.»

- Belkhir et. al., 2018

Kostnader ved Open Source



$0.7 * 3.7\% = 2,6\%$ av utslipp i verden kommer fra Open Source programvare

NB! Uten effektiv Open Source programvare ville trolig utslipp fra programvare totalt vært høyere for tilsvarende nytte.

Javascript

Repository

 github.com/debug-js/debug

Homepage

 github.com/debug-js/debug#readme

Weekly Downloads

274,735,961



Debugs Readme	Pr week	Pr year
Network: kWh/GB	0,059	
Co2 factor g/kWh	481	
Bytes	22 000	
# containers	1	
# downloads	270 000 000	
GBs	5 940	
Energy used	350,46	18 223,92
Emissions saved kg CO2eq	169	8 766
Short flights	1	50

```
→ my-app git:(main) * ls -lh node_modules/debug/*
-rw-r--r--@ 1 kent  staff   1.1K Sep 20 19:10 node_modules/debug/LICENSE
[-rw-r--r-- 1 kent  staff   22K Sep 20 19:10 node_modules/debug/README.md
[-rw-r--r-- 1 kent  staff   1.4K Sep 20 19:10 node_modules/debug/package.json

node_modules/debug/src:
total 56
-rw-r--r-- 1 kent  staff   5.9K Sep 20 19:10 browser.js
-rw-r--r-- 1 kent  staff   6.1K Sep 20 19:10 common.js
-rw-r--r-- 1 kent  staff   314B Sep 20 19:10 index.js
-rw-r--r-- 1 kent  staff   4.6K Sep 20 19:10 node.js
→ my-app git:(main) * █
```

```
[→ my-app git:(main) ✕ tail -n 26 node_modules/debug/README.md
```

```
## License
```

```
(The MIT License)
```

```
Copyright (c) 2014–2017 TJ Holowaychuk <tj@vision-media.ca>  
Copyright (c) 2018–2021 Josh Junon
```

```
Permission is hereby granted, free of charge, to any person obtaining  
a copy of this software and associated documentation files (the  
'Software'), to deal in the Software without restriction, including  
without limitation the rights to use, copy, modify, merge, publish,  
distribute, sublicense, and/or sell copies of the Software, and to  
permit persons to whom the Software is furnished to do so, subject to  
the following conditions:
```

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The above copyright notice and this permission notice shall be  
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EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF  
MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT.  
IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY  
CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT,  
TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE  
SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
```

Next.js

```
> npm i create-next-app
```



Repository

 github.com/vercel/next.js

Homepage

 github.com/vercel/next.js#readme

↓ Weekly Downloads

160,704



Bare Javascript..

```
[→ ~ unzip -l newtonsoft.json.13.0.3.nupkg
Archive:  newtonsoft.json.13.0.3.nupkg
  Length      Date    Time    Name
-----
  1104      03-08-2023  07:01    LICENSE.md
  2413      03-08-2023  07:06    Newtonsoft.Json.nuspec
  8956      03-08-2023  07:01    packageIcon.png
  1963      03-08-2023  07:01    README.md
   653      03-08-2023  07:06    [Content_Types].xml
   509      03-08-2023  07:06    _rels/.rels
 580880      03-08-2023  07:09    lib/net20/Newtonsoft.Json.dll
 609898      03-08-2023  07:05    lib/net20/Newtonsoft.Json.xml
```

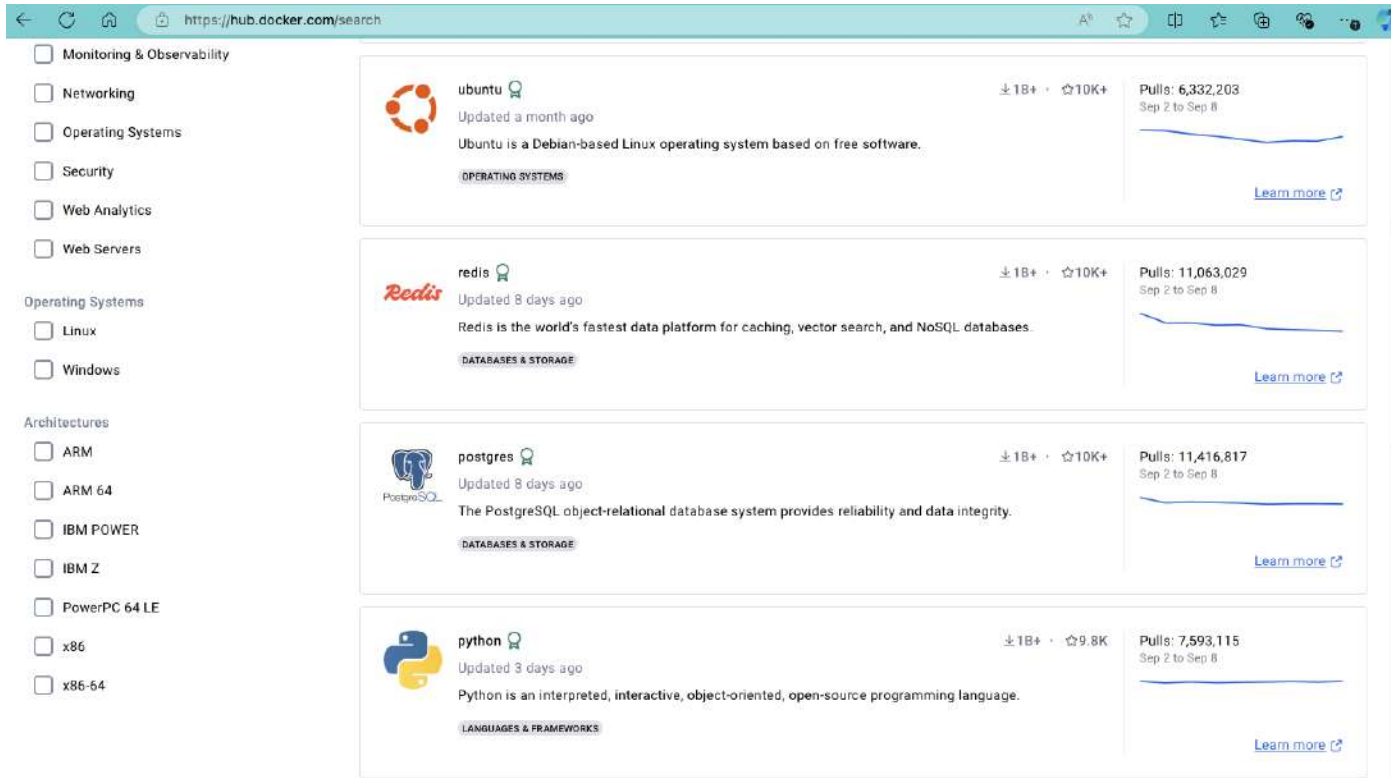
Bare Javascript..

```
→ 4.12 ls -lh
total 688
-rw-r--r--  1 kent  staff   189B Aug 25 11:57 _remote.repositories
-rw-r--r--  1 kent  staff  308K Dec  4 2014 junit-4.12.jar
-rw-r--r--  1 kent  staff   40B Aug 25 11:57 junit-4.12.jar.sha1
-rw-r--r--  1 kent  staff  23K Dec  4 2014 junit-4.12.pom
-rw-r--r--  1 kent  staff   40B Aug 25 11:57 junit-4.12.pom.sha1
```

Om Kontainere



Ofte nedlastede containere



The screenshot shows the Docker Hub search results page for various container images. The browser address bar shows <https://hub.docker.com/search>. On the left, there are filter categories: Monitoring & Observability, Networking, Operating Systems, Security, Web Analytics, and Web Servers. Under Operating Systems, Linux and Windows are listed. Under Architectures, ARM, ARM 64, IBM POWER, IBM Z, PowerPC 64 LE, x86, and x86-64 are listed. The main content area displays four container images:

- ubuntu**: Updated a month ago. Ubuntu is a Debian-based Linux operating system based on free software. Category: OPERATING SYSTEMS. Downloads: 1B+, Stars: 10K+, Pulls: 6,332,203 (Sep 2 to Sep 8).
- redis**: Updated 8 days ago. Redis is the world's fastest data platform for caching, vector search, and NoSQL databases. Category: DATABASES & STORAGE. Downloads: 1B+, Stars: 10K+, Pulls: 11,063,029 (Sep 2 to Sep 8).
- postgres**: Updated 8 days ago. The PostgreSQL object-relational database system provides reliability and data integrity. Category: DATABASES & STORAGE. Downloads: 1B+, Stars: 10K+, Pulls: 11,416,817 (Sep 2 to Sep 8).
- python**: Updated 3 days ago. Python is an interpreted, interactive, object-oriented, open-source programming language. Category: LANGUAGES & FRAMEWORKS. Downloads: 1B+, Stars: 9.8K, Pulls: 7,593,115 (Sep 2 to Sep 8).

Hva er i en kontainer

```
[→ ~ docker run -it postgres /bin/sh
# cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
_apt:x:42:65534:/:/nonexistent:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
postgres:x:999:999:/:/var/lib/postgresql:/bin/bash
# █
```

Hva er i en kontainer

```
[→ ~ docker run -it postgres /bin/sh
# cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
_apt:x:42:65534::/nonexistent:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
postgres:x:999:999:/:/var/lib/postgresql:/bin/bash
# █
```

Hva er i en container

```
[→ ~ docker run -it postgres /bin/sh
```

```
# cat /etc/passwd
```

```
root:x:0:0:root:/root:/bin/bash
```

```
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
```

```
bin:x:2:2:bin:/bin:/usr/sbin/nologin
```

```
sys:x:3:3:sys:/dev:/usr/sbin/nologin
```

```
sync:x:4:65534:sync:/bin:/bin/sync
```

```
games:x:5:60:games:/usr/games:/usr/sbin/nologin
```

```
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
```

```
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
```

```
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
```

```
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
```

```
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
```

```
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
```

```
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
```

```
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
```

```
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
```

```
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
```

```
_apt:x:42:65534::/nonexistent:/usr/sbin/nologin
```

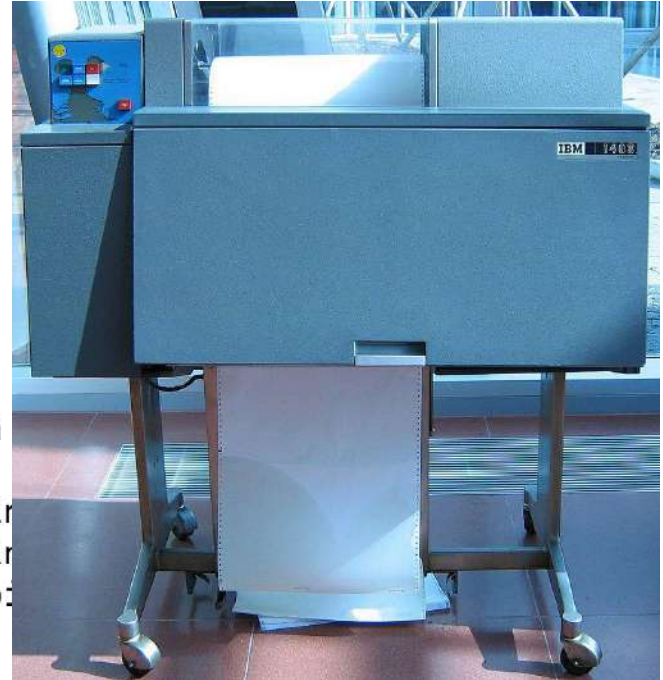
```
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
```

```
postgres:x:999:999:/:/var/lib/postgresql:/bin/bash
```

```
# █
```

Hva er i en container

```
→ ~ docker run -it postgres /bin/sh
# cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sb
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
_apt:x:42:65534::/nonexistent:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
postgres:x:999:999:/:/var/lib/postgresql:/bin/bash
# █
```



Hva er i en kontainer

```
[→ ~ docker run -it openjdk /bin/sh
[sh-4.4# cat /etc/passwd |grep 'lp\|games'
lp:x:4:7:lp:/var/spool/lpd:/sbin/nologin
games:x:12:100:games:/usr/games:/sbin/nologin
sh-4.4# █
```

Hva er i en kontainer

```
sh-4.4# ls /etc
GREP_COLORS      csh.login      gnupg          issue          localtime
X11              default        group          issue.net     login.defs
aliases          dnf            gshadow        krb5.conf     motd
alternatives     environment    gss            krb5.conf.d  mtab
bash_completion.d ethertypes     host.conf      ld.so.cache   networks
bashrc           exports        hostname       ld.so.conf    nsswitch.conf
chkconfig.d     filesystems    hosts          ld.so.conf.d  nsswitch.conf.bak
crypto-policies fonts          init.d         libaudit.conf openldap
csh.cshrc       gcrypt        inputrc        libssh        opt
sh-4.4# du -sh /etc
3.1M    /etc
sh-4.4# █
```

Network: kWh/GB	0,059
Co2 factor g/kWh	481
Bytes	20 000 000
# containers	100
# downloads	5 000 000
GBs	10 000 000
Energy used	590 000
Emissions kg CO2e	283 790
Short flights	1 612

Karbonkostnad for sjelden brukte bits

	Pr Week	Pr Year
Network: kWh/GB	0,059	
Co2 factor g/kWh	481	
Bytes	40	
# containers	100	
# downloads	5 000 000	
GBs	20	
Energy used	1,18	61,36
Emissions kg CO2e	0,6	29,5
Short flights	0	0

Hva er i en kontainer

```
→ ~ docker run -it postgres /bin/sh
```

```
# du -sh /var/cache/*
4.0K    /var/cache/adduser
12K     /var/cache/apt
1.8M   /var/cache/debconf
12K     /var/cache/ldconfig
8.0K   /var/cache/postgresql
# █
```

```
→ ~ docker run -it postgres /bin/sh
```

```
# ls -lh /sbin/
total 8.8M
-rwxr-xr-x 1 root root 3.1K Mar 26 2023 addgnupghome
lrwxrwxrwx 1 root root 7 May 25 2023 addgroup -> adduser
-rwxr-xr-x 1 root root 1.1K Jul 28 2023 add-shell
-rwxr-xr-x 1 root root 48K May 25 2023 adduser
-rwxr-xr-x 1 root root 132K Mar 28 09:52 agetty
-rwxr-xr-x 1 root root 2.2K Mar 26 2023 applygnupgdefaults
-rwxr-xr-x 1 root root 67K Mar 5 2023 badblocks
-rwxr-xr-x 1 root root 67K Mar 28 09:52 blkdiscard
-rwxr-xr-x 1 root root 195K Mar 28 09:52 blkid
-rwxr-xr-x 1 root root 131K Mar 28 09:52 blkzone
-rwxr-xr-x 1 root root 131K Mar 28 09:52 blockdev
-rwxr-xr-x 1 root root 67K Mar 28 09:52 chcpu
-rwxr-xr-x 1 root root 71K Mar 23 2023 chpasswd
-rwxr-xr-x 1 root root 131K Mar 28 09:52 chmem
-rwxr-xr-x 1 root root 71K Mar 23 2023 chpasswd
-rwxr-xr-x 1 root root 67K Sep 20 2022 chroot
lrwxrwxrwx 1 root root 4 Mar 23 2023 cpgr -> cppw
-rwxr-xr-x 1 root root 73K Mar 23 2023 cppw
-rwxr-xr-x 1 root root 67K Mar 28 09:52 ctrlaltdel
-rwxr-xr-x 1 root root 266K Mar 5 2023 debugfs
```

Karbonkostnad for sjelden brukte bits

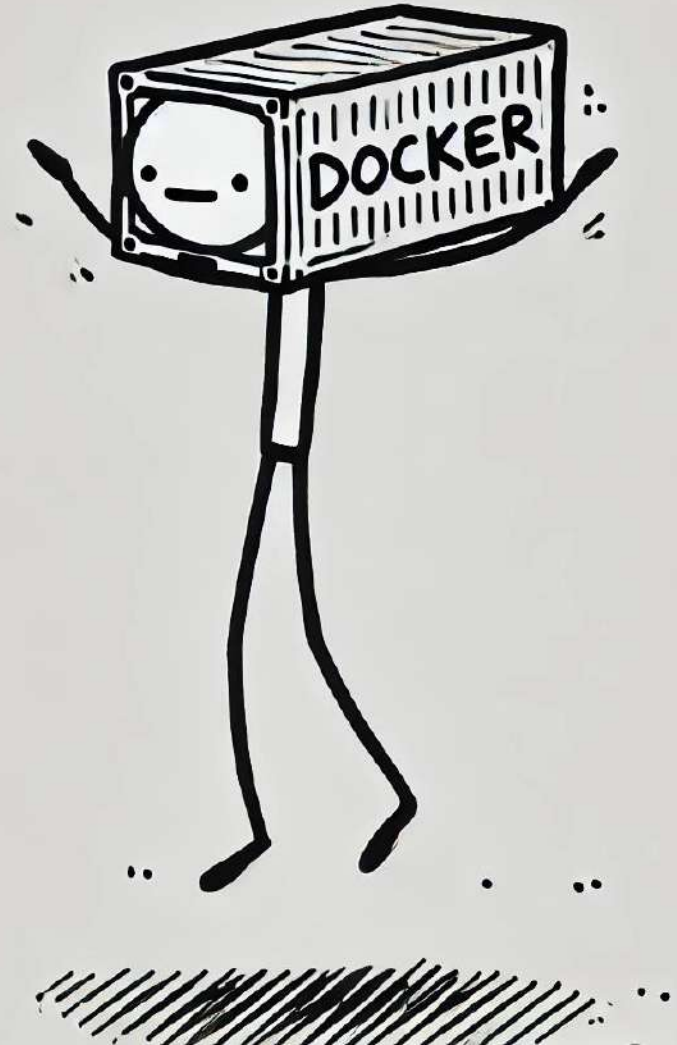
	Pr Week	Pr Year
Network: kWh/GB	0,059	
Co2 factor g/kWh	481	
Bytes	100 000	
# containers	100	
# downloads	5 000 000	
GBs	50 000	
Energy used	2 950	153 400
Emissions kg CO2e	1 419,0	73 785,4
Short flights	8	419

Hva kan vi gjøre med det?



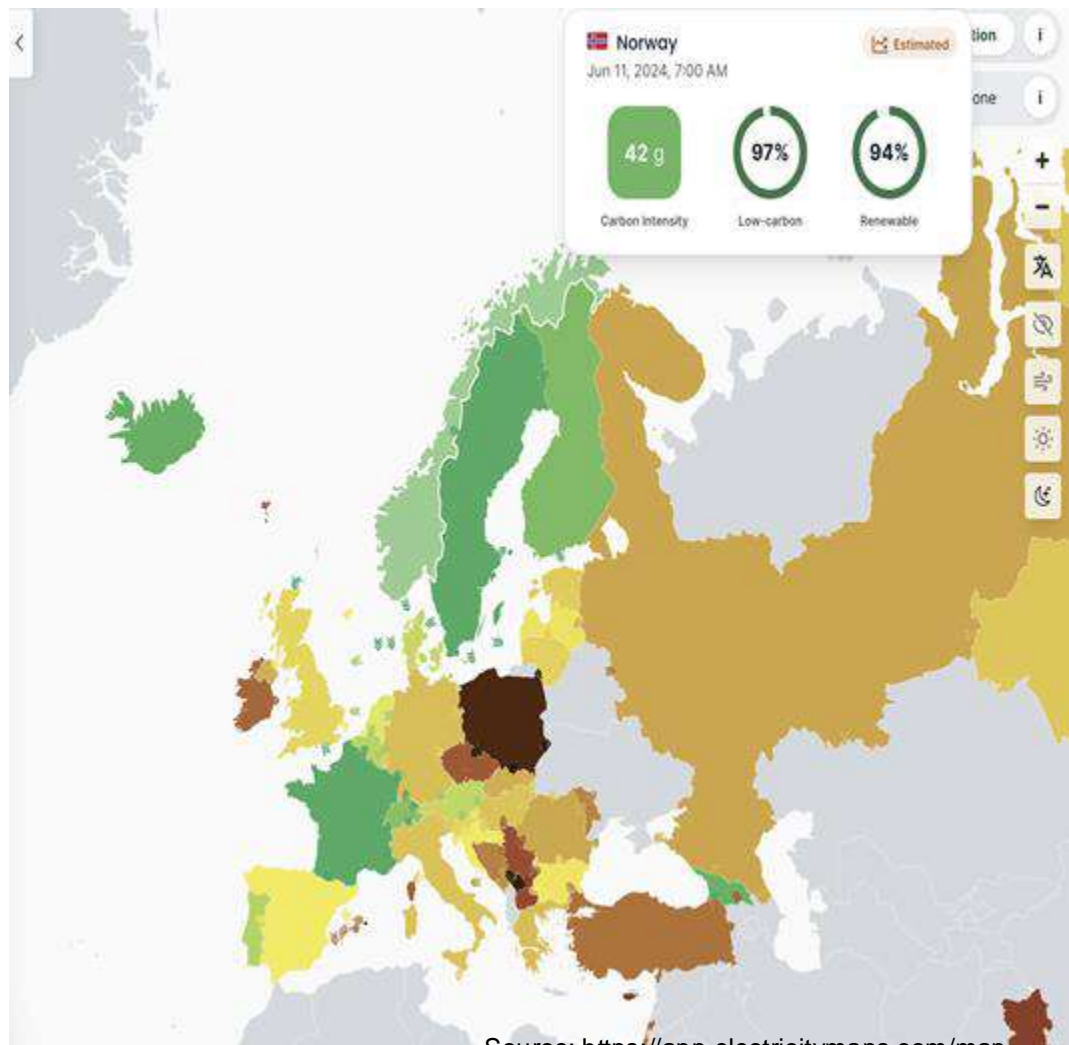
Thank you

 tietoevry



Kostnader ved IT

- Programvare kjører på maskinvare
- Maskinvare bruker strøm
- Strømproduksjon har utslipp av klimagasser
- Maskinvareproduksjon har utslipp av klimagasser
 - Vi måler klimagasser i CO₂eq



Hva kan vi gjøre med det?



Hvorfor har containeren min brukeren “lp”?

- Intro (1 min)
 - Om bærekraft I IT
 - Om Open Source sitt ansvar
- Om containere
- Om kostnadene til data og nettverk trafikk ifm energi og karbon
 - Hvorfor våre containere burde være bærekraftige
- Mye brukte containere
 - Ting de inneholder: brukere (2 min)
 - Beregninger av kostnadene av brukere (2 min)
 - Ting de inneholder sjeldent brukte binære filer (1 min)
 - Oppdaterte beregninger inkludert binære (1 min)
- Konklusjoner og hva som kan gjøres (2 min)
 - Tips til hvordan fjerne ubrukte data fra dine containerbilder
 - En siste oppfordring
- Moderne open source moduler pakkes ofte inn i Docker containere, NPM, Maven eller Nuget pakker. Dette gjør jobben fryktelig mye mer lettvis for både programvare- og plattform utviklere. Likevel, fører disse pakkene med seg en del overhead. I denne presentasjonen vil vi se på implikasjonene for bærekraften til programvaren vår og hva vi eventuelt kunne gjort med det.