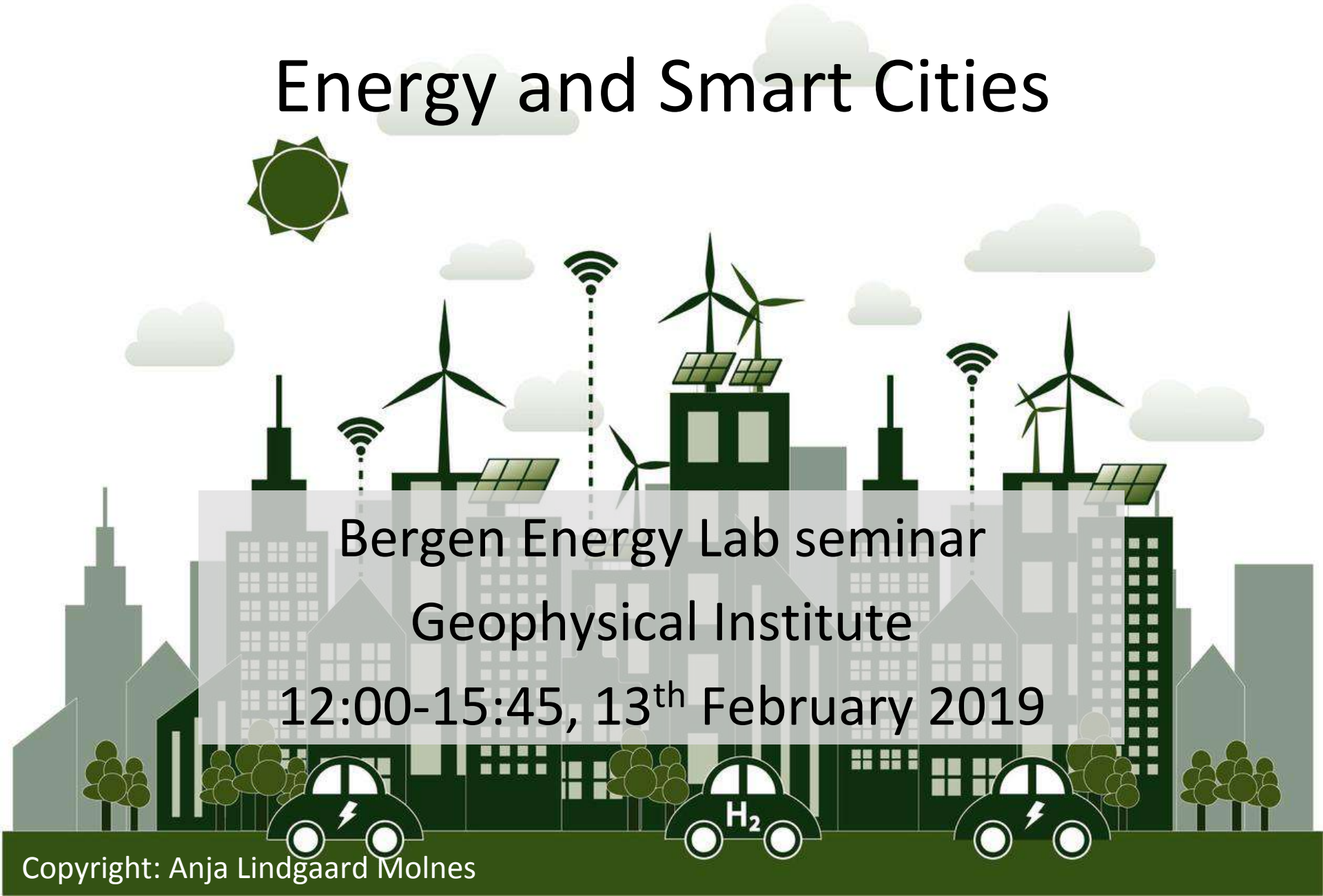
Energy and Smart Cities



Bergen Energy Lab seminar

Geophysical Institute

12:00-15:45, 13th February 2019

What is an energy-smart city to whom?

Source: https://www.pinterest.com/pin/505599495652658836/

SMART CITIES MISSION

Smart City
MISSION TRANSFORM-NATION

Ministry of Housing and Urban Affairs, Government of India

100 cities, 5 years
120 billion kroner

TAMIL NADU

Platform presents how pedestrians are hamstrung along Chennai roads

APRIL 19, 2008 00:00 IST
UPDATED: OCTOBER 09, 2016 04:50 IST

SHARE ARTICLE | PRINT | A | A | A

Affirmative action: Students of Spastics Society of Tamil Nadu audit the route from Thiruvanmiyur MRTS station to the Society on Taramani Road on Thursday as part of the "Walking Classes Unite" initiative. | Photo Credit: — Photo: Shaju John

Walking Classes Unite, Chennai 2008
Smart for whom, and who decides?

18 dead on NH2, Varanasi 2018
Smart by whom, and who pays?

Varanasi flyover collapse: 7 engineers, contractor arrested after 'technical proofs'

Varanasi flyover collapse , PTI

CANDID

Checking Assumptions aND promoting responsibility In smart Development projects

- The role of users in smart technologies
- Efforts to safeguard privacy and data protection in data-driven smart environments
- Infrastructures that sense, act, perhaps think
- Policy-related discourses of smart

PARENT stands for PARticipatory platform for sustainable ENergy managemenT. The aim of the project is to provide communities with the technology and support to help reduce energy consumption in their homes and to investigate ways in which communities can work towards more sustainable life styles. It is an ongoing three year project with pilot studies in Brussels, Amsterdam and Bergen.

What is an energy-smart city to whom? Common uses of *smart*

- Inventory of certain characteristics
- Intersecting innovations and artefacts
- Continuation of the modernising project
- Professional achievement, challenge, project
- Data-driven agency
- Shifting social and scientific relationships
- New forms of consumerism

Sustainable urban smart shifts = massive energy sector transition

- What redefinition do such transitions imply?
- *Who decides* and on *what basis*?
- Are smart city energy systems more *tech-savvy and people-friendly*?
- Do they improve *information flows and infrastructure governance*?
- What makes the *difference*, what defines this *smartness*?
- Which pieces of the puzzle are still missing?

Programme for this afternoon

12:45-14:00 Panel 1 – Camilla Moster, BKK

How do businesses contribute to low-carbon energy transitions in cities?

- Tor Krog, Nordic Director of Business and Development, Siemens
- Fredrik Seliussen, Development Director, Lyseparken, Os Kommune
- Monika Inde Zsak – Head of Innovation and BKK Grønn Invest, BKK

14:00-14:15 Coffee break

After the coffee break

14:15-14:45 Interactive session

Why are you at this seminar? Stakeholders, roles and expectations in energy-smart city-making

14:45-15:45 Panel 2 – Corina Guder, UiB

How do cities move from energy ambitions to really smart urban solutions?

- Torkell Pettersen, Smart City Coordinator, Bergen Kommune
- Håvard Haarstad, Director, Centre for Climate and Energy Transformation

SMART CITIES

THE FORCE AWAKENS

CHAPTER I:
ENERGY EFFICIENCY

Our Smart City Journey

SIEMENS
Ingenuity for life

2007

Norway's first Energy Efficiency Report:

A 20% reduction is easy to accomplish using available technologies

2008

A study of key barriers:

Financing

Competence

Owner/tenant structure

2009

Erik Solheim, minister of climate and environment:

We need a role model!

2009 - 2011

Smart City Reports

Trondheim Smart City

Bergen Smart City

Oslo Smart City

Bergen can reduce it's energy consumption by 29%

The point is the enormous global impact of buildings

SIEMENS
Ingenuity for life

41%
of all energy consumed globally

25%
of all water consumed globally

33%
of all green-house gases emissions

Sources: CommScope/IDC Energy Insights, Business Strategy: Global Smart Building Technology Spending 2015-209 Forecast Intel, Smarter Building & Homes With the Internet of Things

Where are we today?
The IEA *Energy Efficiency 2018* Report

SIEMENS
Ingenuity for life

Key Findings

It could have been much worse…

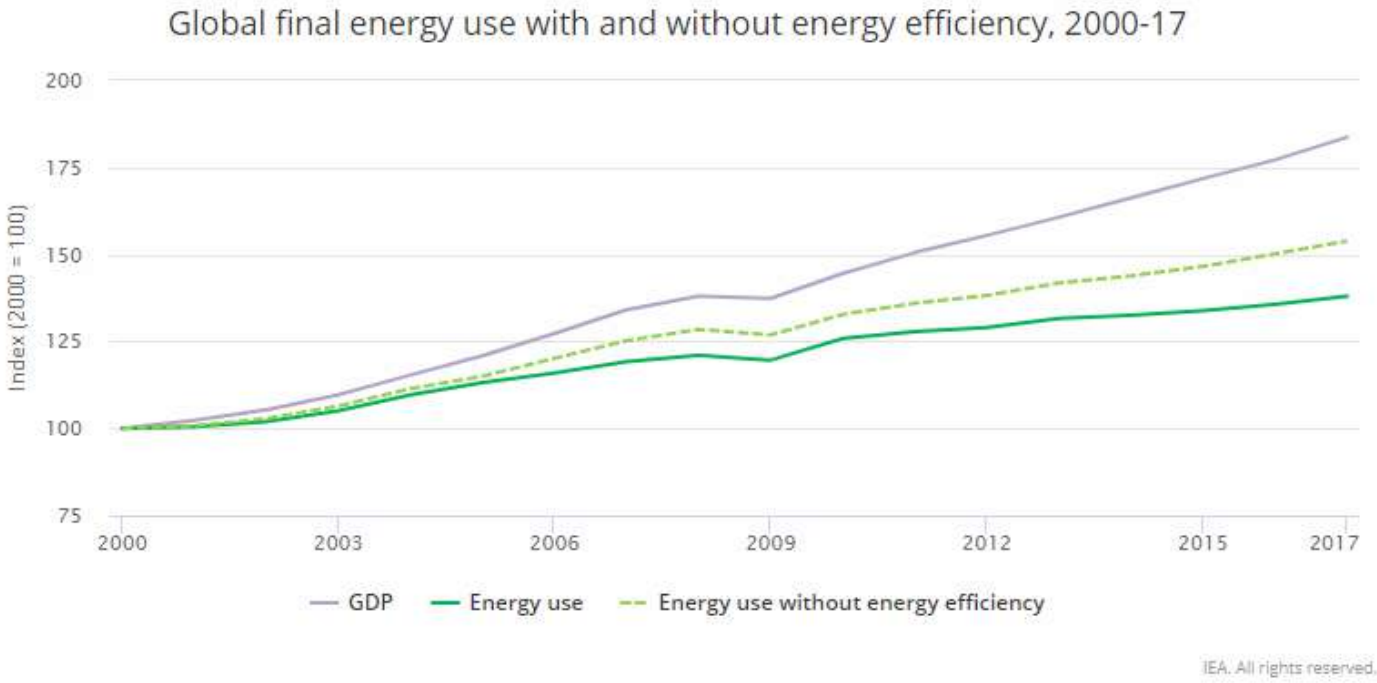
A 12% reduction from the estimated trajectory from 2000. It works!

Not enough to offset rise in energy intensive activities.

Particularly from growth in energy demand in emerging economies.

Global energy demand rose by nearly 2% in 2017 vs 0.6% in 2016.

The fastest yearly rise this decade, driven by economic growth and changes in consumer behavior.



Where are we today?
Key drivers for change / improvements

SIEMENS
Ingenuity for life

Legislation and policies; i.e. the 2012 EU Energy efficiency directive, COP21++ implications etc.

National and local / city targets and strategies

Innovators; Green Building Council, Powerhouse, Rieber, Lyseparken/BKK, DNB

Financial support schemes; Enova, EU, Norwegian Research Council, performance contracting

Technology innovations; automation, IoT, solar photovoltaics, battery storage etc.

Where are we today?
Sustainable investments accounting for environmental risks

SIEMENS
Ingenuity for life

A competitive building = a sustainable building

Where are we today?
Action items to explore

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Ingenuity for life

The innovations are becoming mainstream, - but visionaries and technology savvy players needed to push the envelope.

- New standards are pushing new buildings - but what about refurbishments?
- Targets are set for project results - but what about life cycle building performance & energy optimization?

Action points beyond energy efficiency and building performance:

- The building / business as an active participant in the local energy system
- Flexibility: the cornerstone of tomorrow’s power systems (IEA World Energy Outlook 2018

CHAPTER II:
ELECTRIFICATION

A turning point with clear commitments

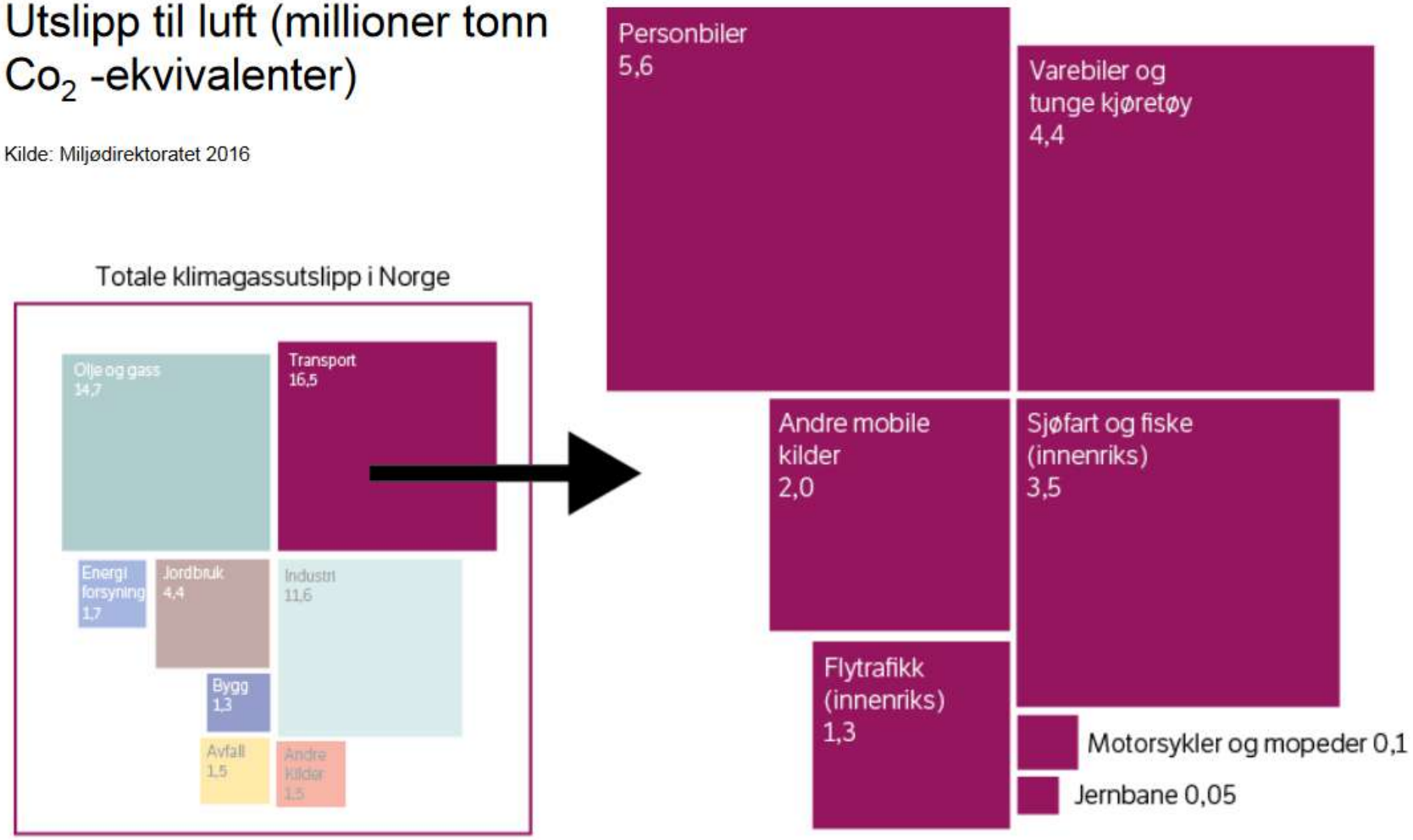
SIEMENS
Ingenuity for life

21. Juni 2016: Miljøvernminister Vidar Helgesen signerer Paris-avtalen Foto/Faksimile: Aftenposten

Reduce emissions by
40%
within 2030

Transportation counts for 30% of CO_2 emissions in Norway

SIEMENS
Ingenuity for life



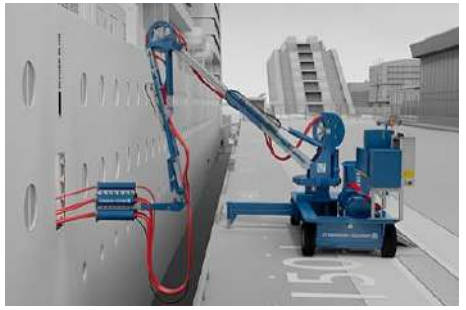
Electrification as a key driver to reach sustainability targets!

SIEMENS
Ingenuity for life








New technology driving change and enabling electrification

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Ingenuity for life

Energy storage; batteries, hydrogen

Power generation; photovoltaics

Smart grid and energy control systems

Electrical propulsion / drive systems; boat, ferry, car

A wholistic and collaborative approach is needed – across many technologies.

CHAPTER III:
DIGITALIZATION

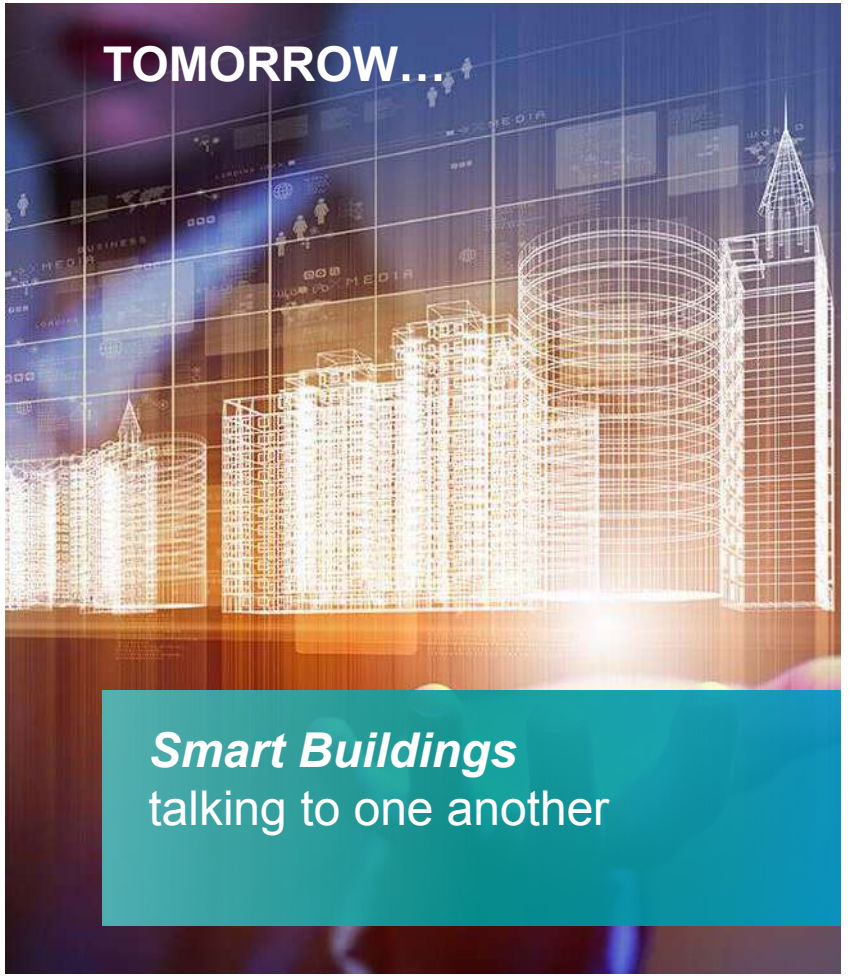
SIEMENS
Ingenuity for life

“Currently, 85% of potential assets remain unconnected...”

World Economic Forum

In the future, autonomous buildings will talk to each other

SIEMENS
Ingenuity for life



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Ingenuity for life

What does this mean for cities?

Digitalization: a disruptive force across all sectors…
Cities have the second biggest impact

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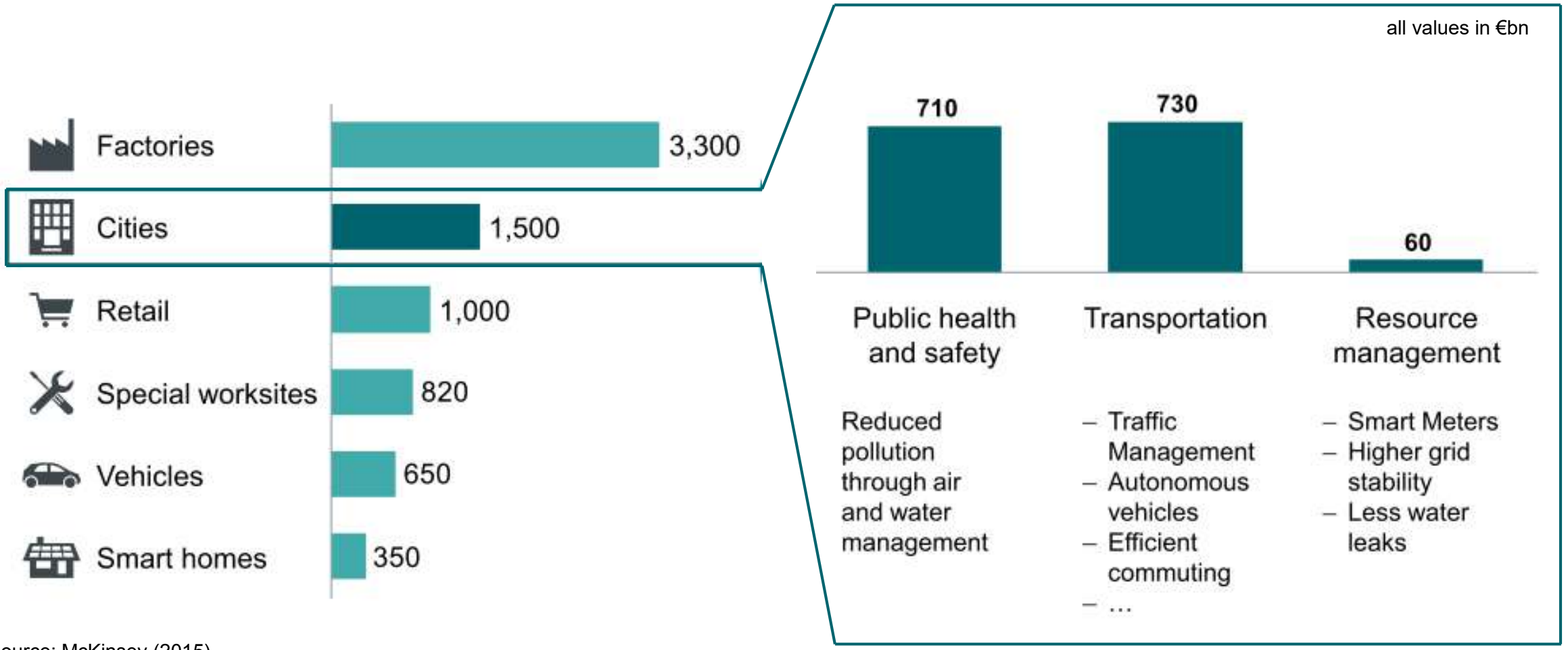
Ingenuity for life

Economic impact of IoT in 2025 in €bn

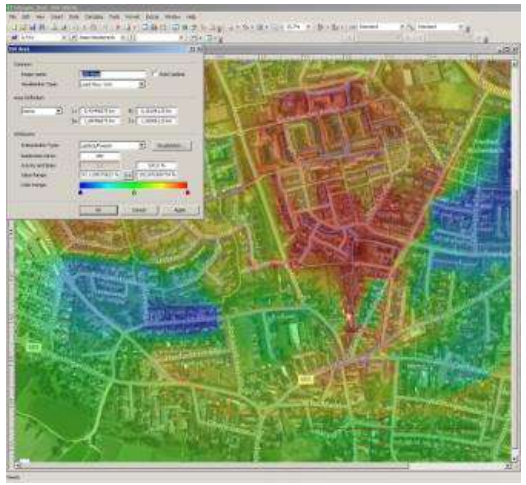


Source: McKinsey (2015)

Connecting the virtual world to the real world

Bentley SIEMENS Ingenuity for life

Plan

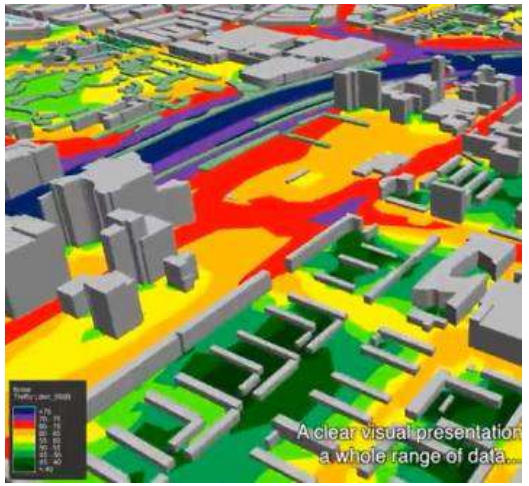


Smart 3D modeling

Design

Compare and analyze building proposals from every angle

Simulate & Optimize



Simulate the impact of design changes

Operate

IoT operating system for optimized city management

E-Mobility stress tests – how the city & utility collaborates to develop a competitive infrastructure

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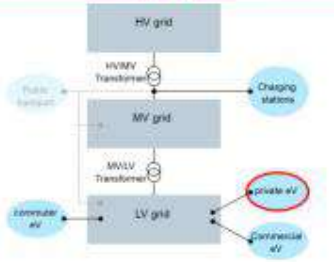
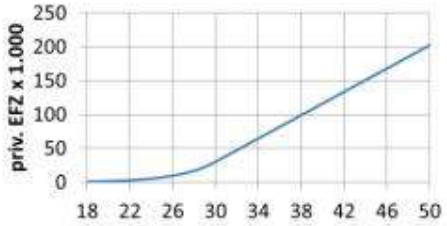
Ingenuity for life

1 Ramp-up of the basic populations

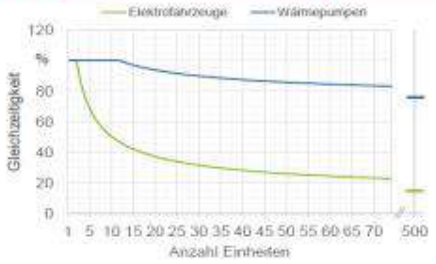




- Determination of
  - basic populations
  - dynamic of electrification
  - points of application in the grid
- Based on present situation, policy guidelines and assumptions

→Basic framework and eMobility scenarios

2 Charging capacities and diversity factors

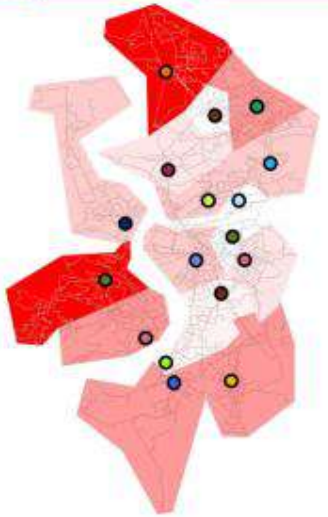


	LV grid	MV/LV Transf.	MV grid	HV/MV Transf.	HV grid
priv. eV com. eV commuter eV	50%	40%	25%	20%	20%
charging stations	-	-	-	66%	50%

- Determination of
  - Charging capacities
  - Diversity factors
- Based on present situation, publications and assumptions

→ Load development based on increasing share of EVs

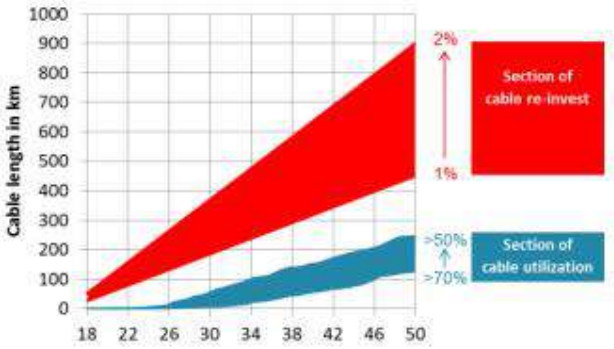
3 Distribution in grid



- Determination of
  - Distribution of the basic populations in grid
- Based on present situation, local grid information and assumptions

→ Allocation of loads

4 Simulation of ramp-up points in time



- Load flow calculations and determination of overloaded equipment
- Comparison of re-investment needs utilization due to EV vs. asset-strategy
- Results
  - No re-investment backlog with needs-based re-investment
  - Determination of the future standard cable types

Infrastructures merge horizontally

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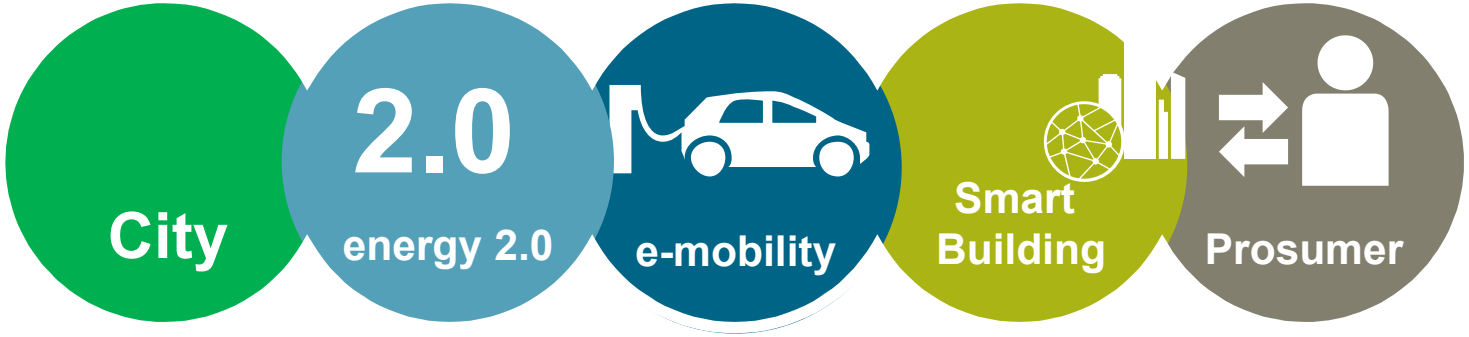

all **electric** means all **connected** means all **digital**

Key enablers to drive innovation across sectors, organizations and technology platforms

SIEMENS
Ingenuity for life

«Open data» and interoperability between cloud services and platforms

Co-creation and collaboration models, and maybe a revised glance at strategic purchasing

A new set of skills and competencies – the IT architect of the city

CHAPTER IV:
CITIZEN 4.0
– THE ENGAGED CITIZEN

SIEMENS
Ingenuity for life

How do businesses contribute to low-carbon energy transitions in cities?

Build and deliver upon a sustainability strategy: Committed to carbon-neutrality by 2030

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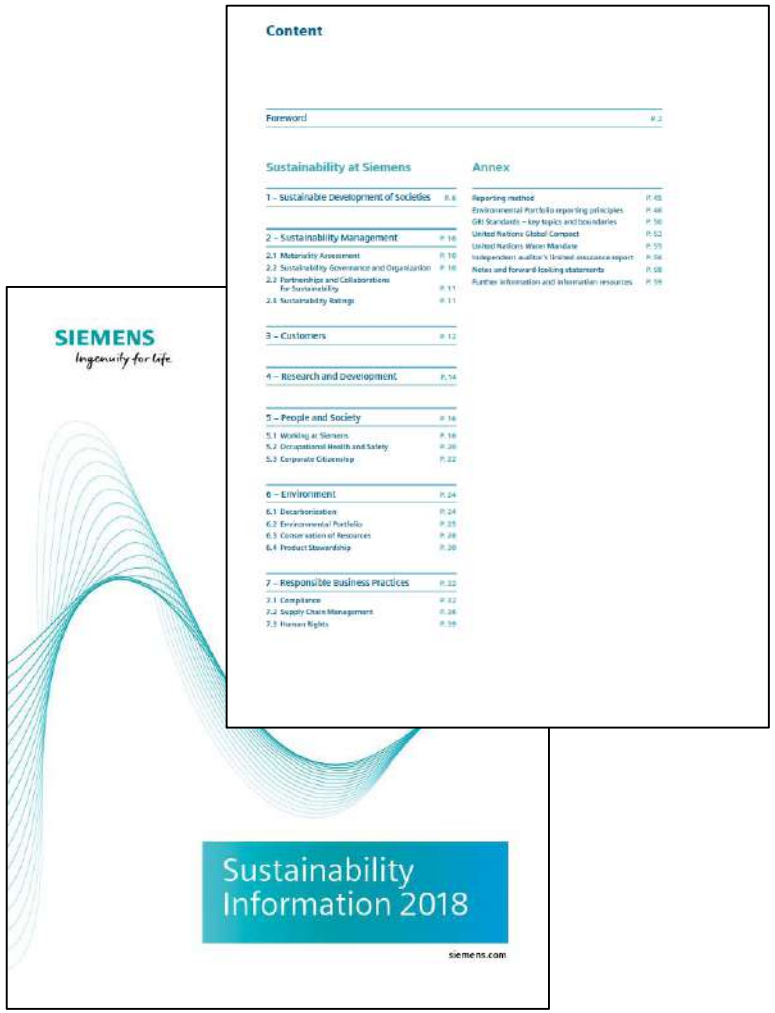

To take the lead is a competitive advantage and valued by shareholders

SIEMENS
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MEMBER OF Dow Jones Sustainability Indices In Collaboration with RobecoSAM

#1 in its Industry in 2018

↗ DJSI Website

Corporate Knights
The Company for Clean Capitalism

#1 in the Global 100 - Most Sustainable Corporations in the World within its Industry in 2019

↗ Corporate Knights Website

CLEAN200™

#1 on the 2017 Carbon Clean 200 list

↗ Clean200 Website

CDP
DRIVING SUSTAINABLE ECONOMIES

A in Climate Change, B- in Water in 2018

↗ CDP Website

MSCI

Included in the MSCI World Index since 2017

↗ MSCI Website

FTSE4Good

Member of the FTSE4Good Index Series

↗ FTSE4good Website

Corporate Responsibility Prime
rated by oekom research

Classified as „Prime" by the Oekom research AG

↗ Oekom Website

ecovadis
SUPPLIER SUSTAINABILITY RATINGS

Archived „Silver recognition level" by EcoVadis

↗ Ecovadis Website

Develop and deliver upon a sustainability strategy covering energy efficiency, electrification (mobility) and digitalization as the key enabler!

SIEMENS
Ingenuity for life

Sustainability a prerequisite for competitiveness:

Competitive buildings	→	Sustainable buildings
Competitive companies	→	Sustainable companies
Competitive cities	→	Sustainable cities

..and the engaged citizen; employee, customer, investor will push the change!

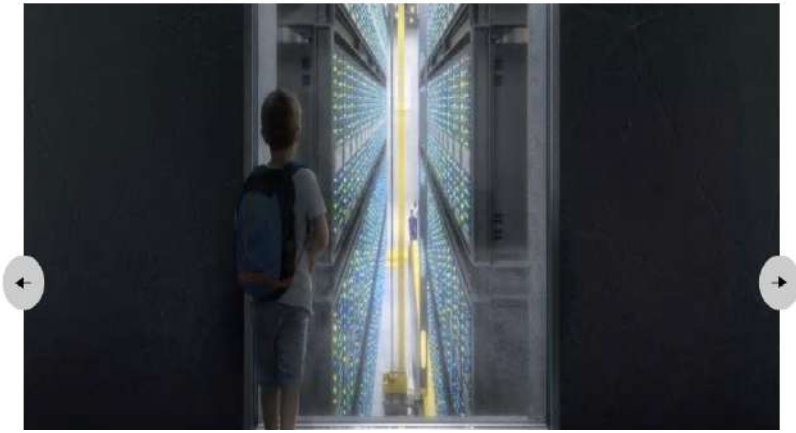
Lyseparken

Fredrik Seliussen
Director of Development
February 13th. 2019

08.20.18 | WORLD CHANGING IDEAS

This town will get its heat from an unlikely source: a data center

In Norway, the new town of Lyseparken is being designed specifically to allow homes and businesses and a central data center to work together to reduce energy usage.



"**Our first goal was to make a self-sufficient area by using local, renewable resources**," says Fredrik Seliussen, who is leading the project for the local municipality of Os, which wanted to develop the land to bring new jobs to the area. "After we had theoretically solved this . . . we decided to go further to the next level. **The goal was not to be carbon neutral–but it might be the result of our business model**.

Lyseparken

MEGATRENDS

Lyseparken

Mind Change

New Generations

Daddy,
Do you really have to drive the car?

2015: Oscar, 5 years old

Lyseparken

New technology gives new opportunities

Lyseparken

The coming flood of data

Teknologi

Nordmenns databruk på mobil fortsetter å øke

Norske kunder brukte i snitt tre gigabyte data i måneden over mobilnettet i første halvår i år. Det er en økning på 54 prosent fra året før.

0 min Publisert: 25.10.17 – 21:52 Oppdatert: ett år siden

Nasjonal kommunikasjons-myndighet

Om Nkom | Jobb i Nkom | Skjema | Lover og for

Du er her: Forsiden › Aktuelt › Nyheter › Ny fiberrekord

- Aktuelt
- Nyheter
  - Ny fiberrekord
- Høringer
- Rapporter
- Kalender
- Nkom i media

SIST OPPDATERT 30.10.2017 Skriv ut

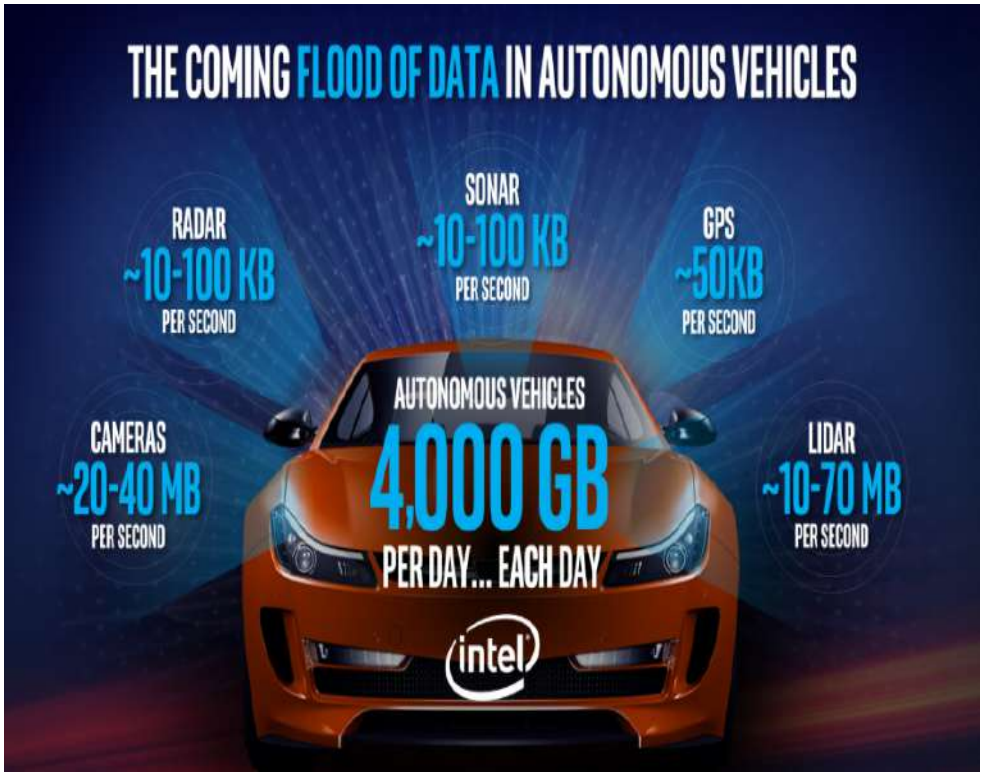
Ny fiberrekord

25.10.2017

Tallene for første halvår av 2017 viser den største økningen som er registrert i løpet av ett år for fiberbredbånd i privatmarkedet. Det viser ekomstatistikken som Nasjonal kommunikasjonsmyndighet (Nkom) la frem i dag.

NB! Se korrigert versjon av nyhet 30. oktober 2017.

Nkom innhenter tall for abonnement, trafikk og omsetning fra alle tilbydere av elektroniske kommunikasjonstjenester i Norge. Disse er tilgjengelige i portalen ekomstatistikken.nkom.no. Disse tallene viser at det ved utgangen av første halvår 2017 var 818 000 privatabonnement for fast bredbånd basert på fiber. Det er en økning på 127 000 siden utgangen av første halvår 2016.



Lyseparken

Autonomization and Electrification

Enkelte som kjenner bransjen tror vi ender på 50 prosent elbilandel i nybilsalget i 2019, ifølge OFV.

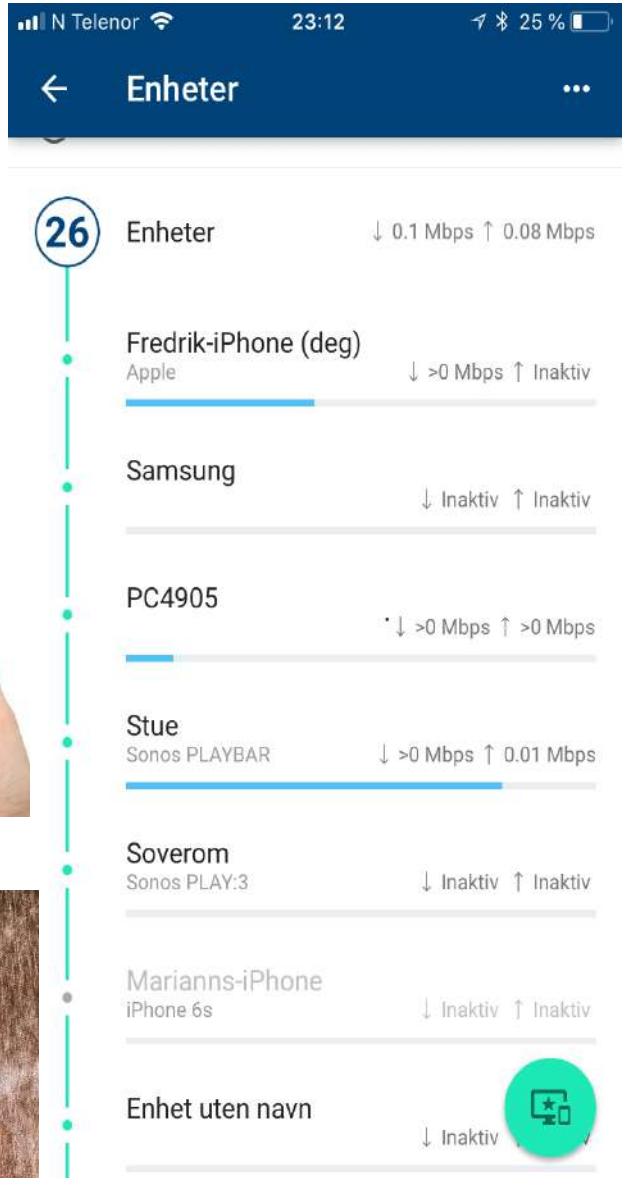
Oslo: 50 nye autonome busser + krav til elektrifisering

Yara Birkeland: Verdens første autonome skip i drift skal erstatte 40.000 vogntogturer i året

Det første el-flyet kommer til Norge senere i år.

Lyseparken

Smart Devices and sensors



Lyseparken

The world gets greener – even we want or not….

Thina Saltvedt slutter som oljeanalytiker i Nordea Markets

Den profilerte oljeanalytikeren forlater oljen til fordel for grønn energi.

FORLATER OLJEN: Thina Saltvedt går over til grønn energi og blir analytiker i sustainable finance i Nordea. **FOTO:** BERIT ROALD *NTB SCANPIX*

Ole Martin Skaug og John Thomas Aarø

(E24) Publisert: 15:02 - 15.12.2017, Oppdatert: 16:19 - 15.12.2017

Neste år går Nordea Markets' oljeanalytiker, Thina Saltvedt, over i en ny stilling i meglerhuset.

Hun skal nå jobbe med grønn energi og klimarisiko i

– De drømmer om velstand og det gode liv, men vet samtidig at det er nødvendig å legge om livsstilen, sier forsker som har snakket med ungdommer Oslo. (Foto: Thomas Brun / NTB scanpix)

Ungdom vil ha enda strengere klimaregler

Tenåringer vil at staten skal lage et lovverk på klima og miljø som stiller like strenge krav til folk som røykeloven, ifølge ny studie.

Bærekraft og mangfold skal ikke lengre være ord sjefene bruker i festtaler. Nå krever unge arbeidstagere at sjefene tar det på tungt alvor.

↑ 02.02.19 20:44

Espen Teigen
Send tips

En rykende fersk undersøkelse fra byrået Gambit H&K kommer det frem at norske bedrifter merker at nye, unge arbeidstagere stiller mye tøffere krav til sjefene og bedriftene. Bedriftene må ta det på alvor om de skal få de flinkeste hodene.

Lyseparken

Where do we expect to see the **growth in Norway?**

We believe that the future growth industries in Norway,

with the highest growth in number of jobs:

- Bio economy
- Renewable energy
- Health and welfare
- The oceans
- Smart society / Smart city
- Creative industry
- Tourism
- Big data / AI / Blockchain / 3D-printing
- Data centers / EDGE Data Centers

Data Centres – one of the world most growing industries

2015 – 2020: Estimated growth in Europe from 259 to 485 centres and the traffic will rise with 500 %

Illustrasjonsfoto. (Foto: Robert Scoble)

AWS I NORGE

Amazon Web Services åpner i Norge

–Ambisjonen er å stenge alle lokale datasentre.

AV: MARTIN BRAATHEN RØISE | SKYTJENESTER | PUBLISERT:

Torsdag åpner Amazon Web Services (AWS) sitt første kontor i Norge. Hovedkontoret vil huse løsningsarkitekter, support og salgsapparat for å møte det stadig voksende behovet i

MICROSOFT AZURE

Microsoft skal åpne to store datasentre i Norge

Har allerede signert milliardavtale med Equinor.

AV: HARALD BROMBACH | SKYTJENESTER | PUBLISERT:

Facebook 1106 | Twitter | LinkedIn

Microsoft skal åpne to datasenterregioner i Norge. Disse vil skal være i drift ved utgangen av 2019. Regionene skal være lokalisert i eller nær henholdsvis Oslo og Stavanger.

Fra datasentrene skal Microsoft tilby nettskytjenester. Dette omfatter både offentlig nettskytjenester i form av Azure, og tjenester som Office 365 og Dynamics 365.

Milliardavtale

Allerede er det klart at Equinor skal bruke Microsofts nye datasentre i Norge. Selskapet har inngått en avtale med Microsoft som strekker seg

Ledige IT-jobber | JOBB

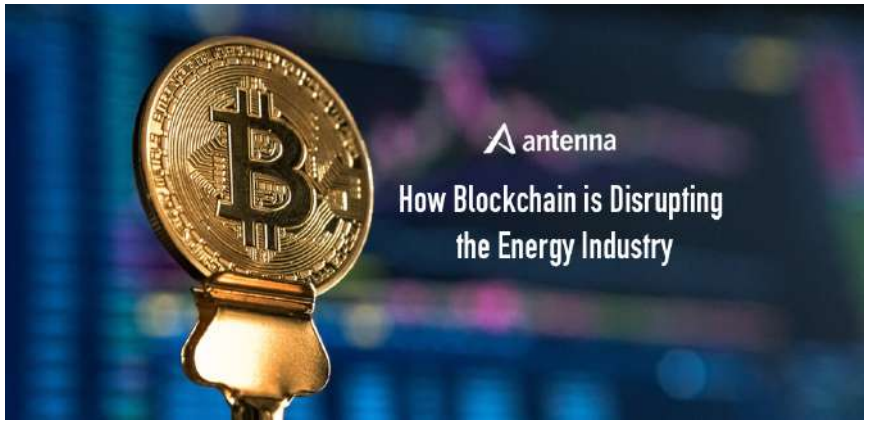
Se alle jobber innen IT

Lyseparken

….any challenges?

UMETTELIG: Bitcoins umettelige energibehov er tilsynelatende et uoverstigelig problem for teknologien: Gamle bitcointransaksjoner sikres av en stadig større mengde strøm og regnekraft etter hvert som nye transaksjoner verifiseres og legges inn i Bitcoins blokkjede. Foto: NTB Scanpix

Stopp subsidieringen av digitalgruvene



Lyseparken

….But What do we do in the Weekends?

Oscar and Prime Minister Erna Solberg collecting garbage at the beach.

Lyseparken

Concept of Lyseparken

Lyseparken

November 21st. 2018

Lyseparken

Local energy resources

Knowledge, survey and identifying

RAPPORT

Lyseparken næringsområde

OPPDRAGSGIVER
ABO Plan og Arkitektur

EMNE
Kartlegging av energiressurser

DATO / REVISJON: 24. mai 2017 / 00
DOKUMENTKODE: 617221-RIEn-RAP-001

Multiconsult

Lyseparken

Local energy resources

Knowledge, survey and identifying

Results

- Evaluations show relatively **good solar energy resources** in the business sector. Both solar cells and solar collectors can be utilized.
- Due to moderate wind resources, the potential for utilizing **wind energy** in the industrial park is considered **limited**.
- Of thermal energy resources, both **outdoor air, Vindalsvatnet** (a lake) **and thermal resources in the ground** are considered potentially **good solutions**. The conditions in Lyseparken enable the creation of a geothermal energy system for heating and cooling with a lower / middle level effect compared to what is normally measured in Norway.
- The utilization of **Vindalsvatnet** as an energy resource appears to be the most interesting solution. Calculations on water volume, temperature, water supply and evaporation show that Vindalsvatnet can cover the entire heating and cooling needs of a buildingmass corresponding to **600,000 m^2 of office buildings**.

Lyseparken

SMART GRID

SIEMENS
Ingenuity for life

Innsamling og analyse av energidata for optimalisering av energibruk og realisering av nye tjenester og forretningsmodeller

Langsiktige innkjøpsavtaler av fornybar energi fra eksterne produksjonsanlegg (PPA)*

Lokal produksjon av fornybar energi

Effektivt samspill med distribusjonsnettet for å sikre fleksibilitet og forsyningssikkerhet

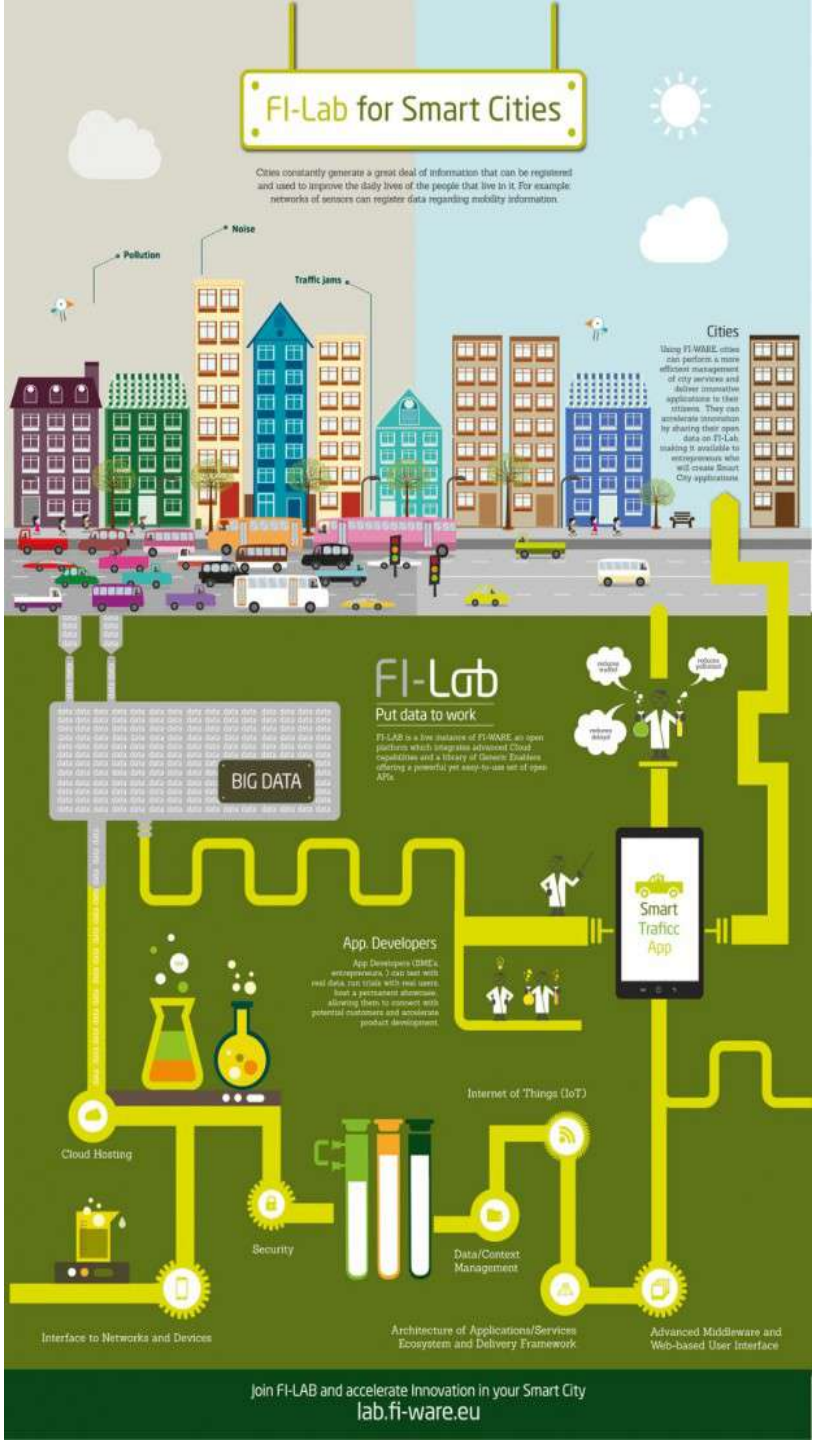
Infrastruktur for elektrifisering av transport for utslippsfri lokal- og pendlertrafikk

Energilagring for å håndtere lokal overskuddsproduksjon og variasjoner i forbruk

Lyseparken

Up-Side-Down City

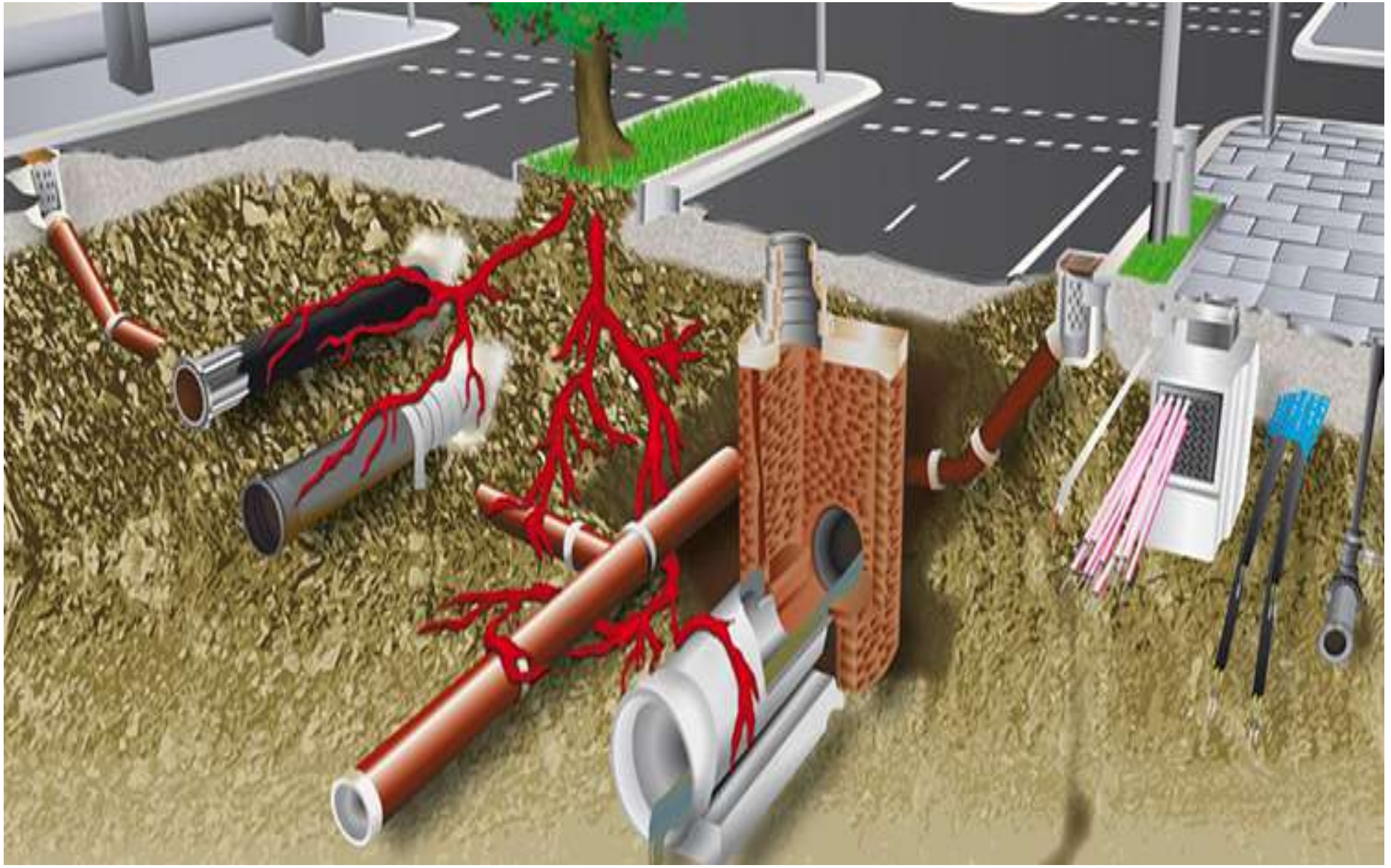
Lyseparken



Lyseparken

Planning of all Pipeline Infrastructure in the underground

Coordinated and well planned in relation to what to be built



Summer operations – an example

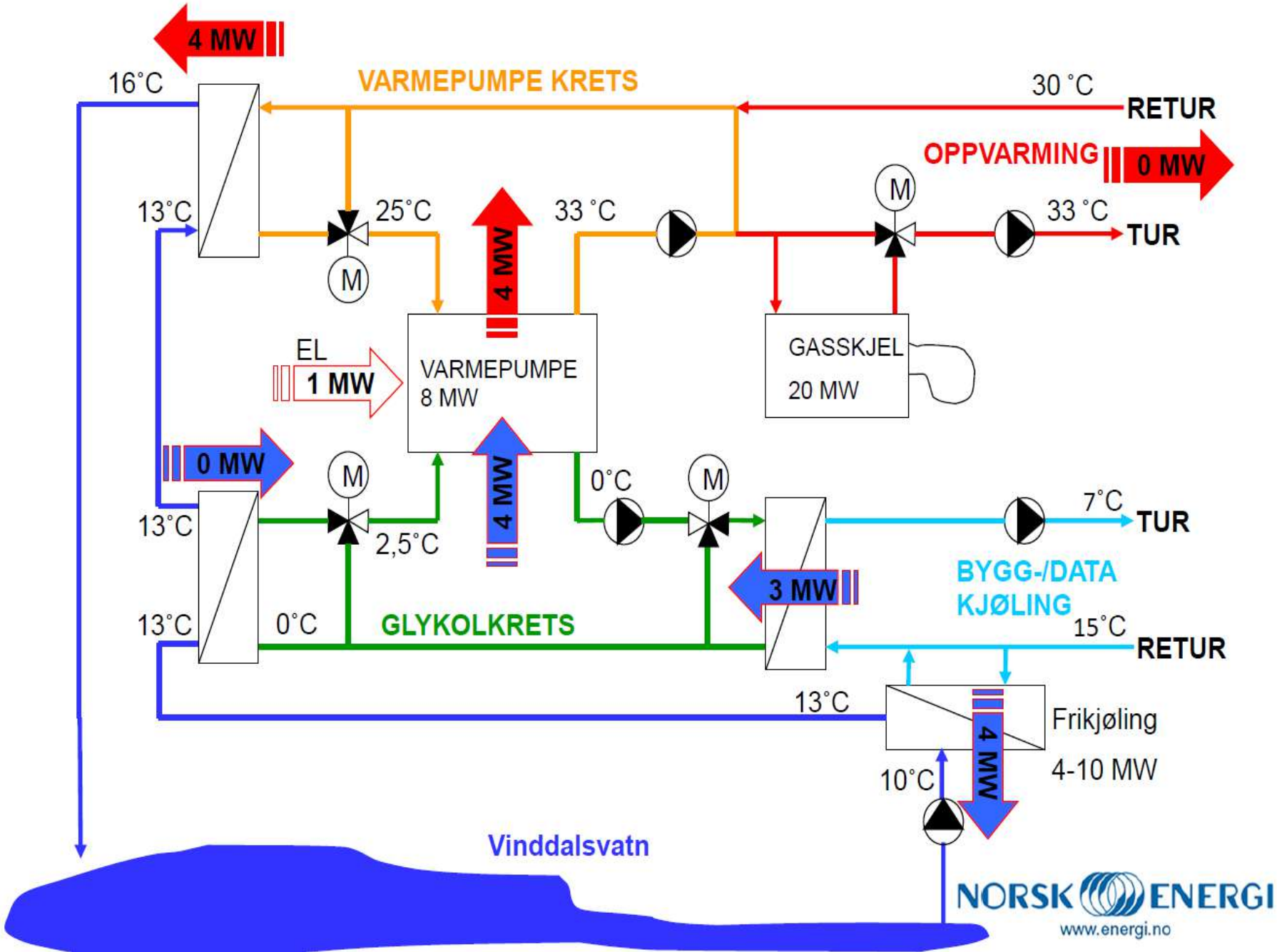


Illustration **Lyse**parken 2017

Lyseparken

REUSE AND “RE-REUSE” OF ENERGY”

Lyseparken


INSPIRERER


BKK


SIEMENS
Ingenuity for life


MIRIS

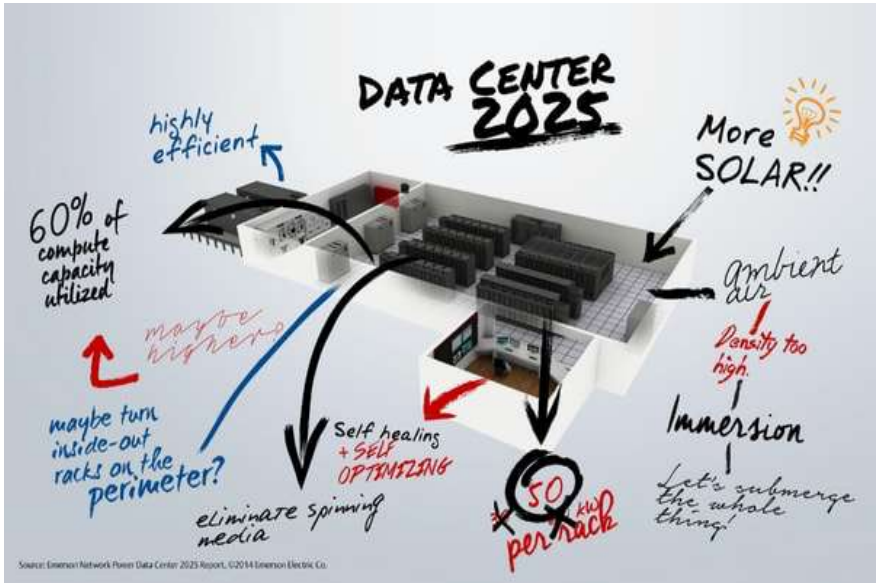

Snøhetta


NOKIA
Connecting People


SINTEF

Lyseparken

Key focus when creating SPARK



- ✓Sustainability
- ✓Space effective
- ✓New innovations
- ✓Create local value
- ✓Strong local cooperation
- ✓Attract new industry and technology

Lyseparken

Data storage as part of value chain for energy

and integrated collaboration for building optimization

Lyseparken

Internal market and flow of ENERGY

Lyseparken

The Business Model?

INSPIRERER

The Owners of the Buildings

LYSEPARKEN

LOCAL ENERGY

The Businesses / Industry

The Data Center

The Technology Suppliers

The Power Company

Lyseparken

Fredrik Seliussen
Director of Development

How do businesses contribute to low-carbon energy transitions in cities?

13. februar 2019 – Monika Inde Zsak

BKK

Heating/ cooling

Renewable Energy

Fiber

Local Energy Systems

Energy Services

BKK

E- Mobility

Grid

The future is electric

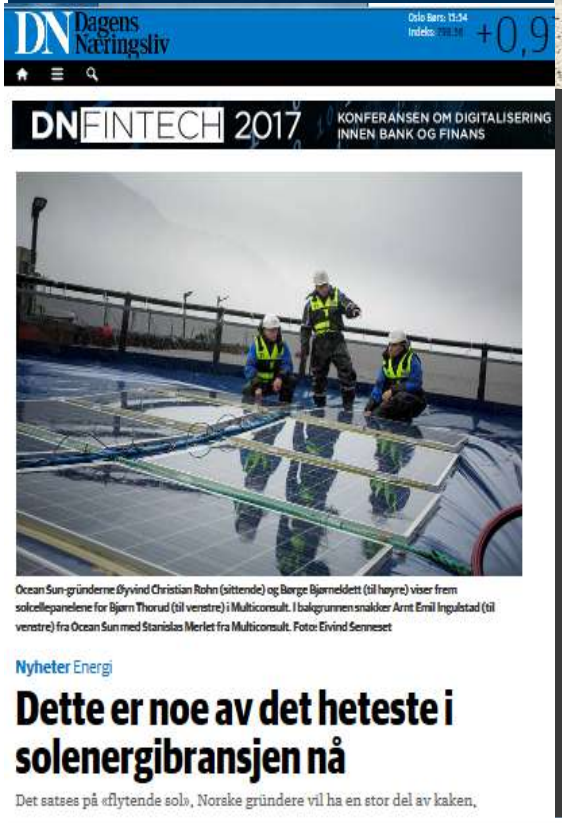
BKK

Foto: Visit Flåm


Establishing Europe’s largest onshore power supply in Bergen
BKK
Foto: Bjørn Erik Larsen/Bergens Tidende

BKK Grønn Invest

Working with startups to buld the future sustainable energy system

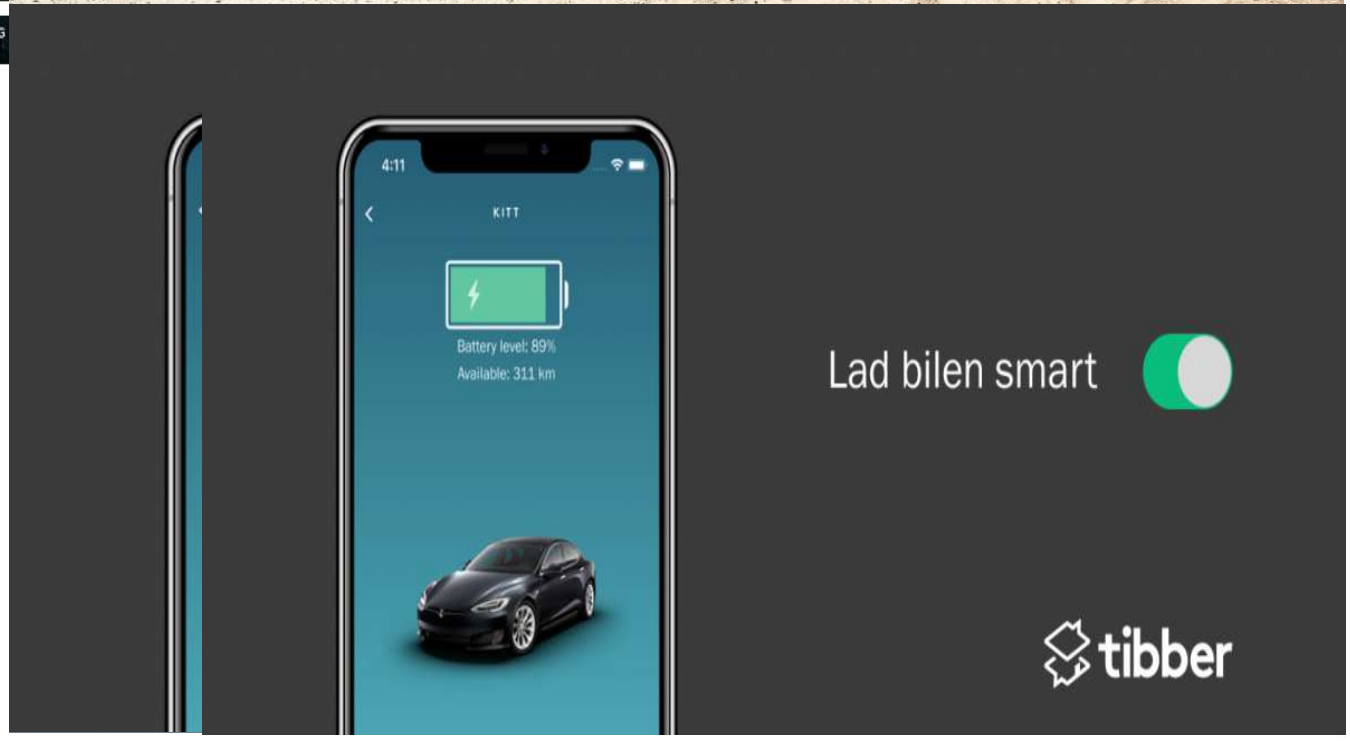


Ocean Sun-gründerne Øyvind Christian Rohn (sittende) og Børge Bjørneldett (til høyre) viser frem solcellepanelene for Bjørn Thorud (til venstre) i Multiconsult. I bakgrunnen snakker Arnt Emil Ingulstad (til venstre) fra Ocean Sun med Stanislas Merlet fra Multiconsult. Foto: Eivind Senneset

Nyheter Energi

Dette er noe av det heteste i solenergibransjen nå

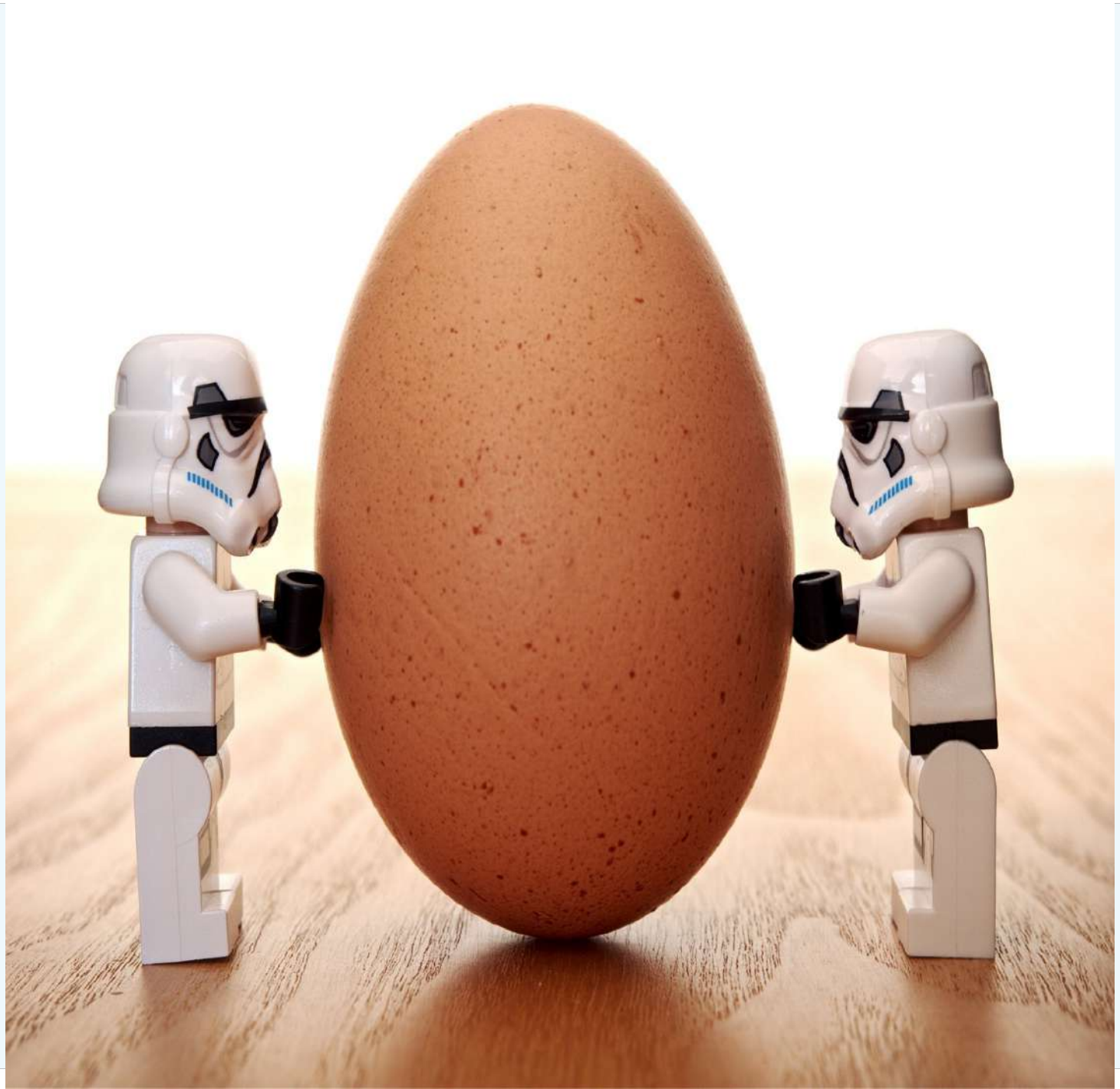
Det satses på «flytende sol». Norske gründere vil ha en stor del av kaken,



Energimarked 2.0 – Pilot project testing smart technology and customer value

"Investments in Grid infrastructure could be reduced with 40 mrd."

"Ola Normann has the equipment but is not able to join a market for flexibility"




BKK

How do businesses contribute…

… to low-carbon energy transitions in cities?

After the coffee break

14:15-14:45 Interactive session

Why are you at this seminar? Stakeholders, roles and expectations in energy-smart city-making

14:45-15:45 Panel 2 – Corina Guder, UiB

How do cities move from energy ambitions to really smart urban solutions?

- Torkell Pettersen, Smart City Coordinator, Bergen Kommune
- Håvard Haarstad, Director, Centre for Climate and Energy Transformation

Why are you at this seminar?

Stakeholders, roles and expectations
in energy-smart city-making

What is an energy-smart city to you?
What is your role in making it happen?
How do you think we can get there?

CITY OF
BERGEN

THE SMART & LEARNING CITY

13.02.2019

Ambitions

A fossil-free city by 2030.

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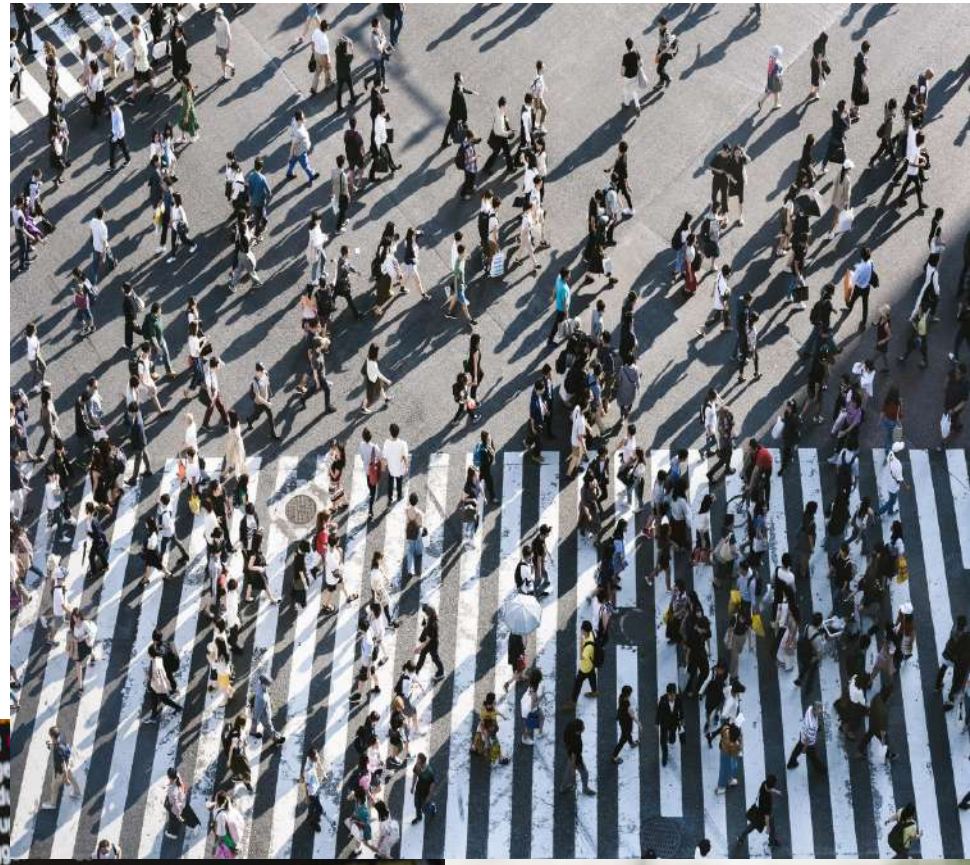
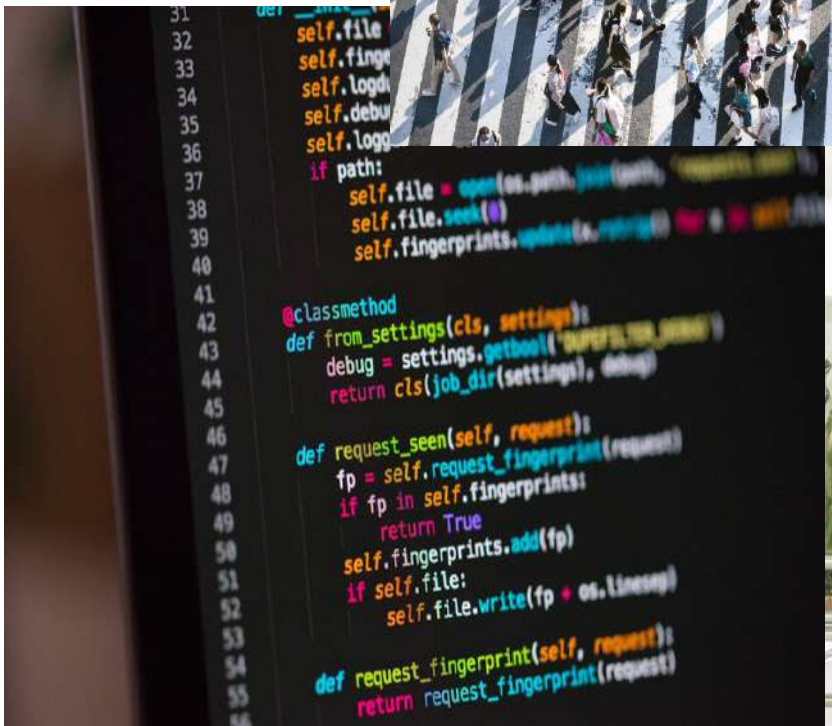
Our way

- It is a method

Focus: **externally**

Delivery: **potential**





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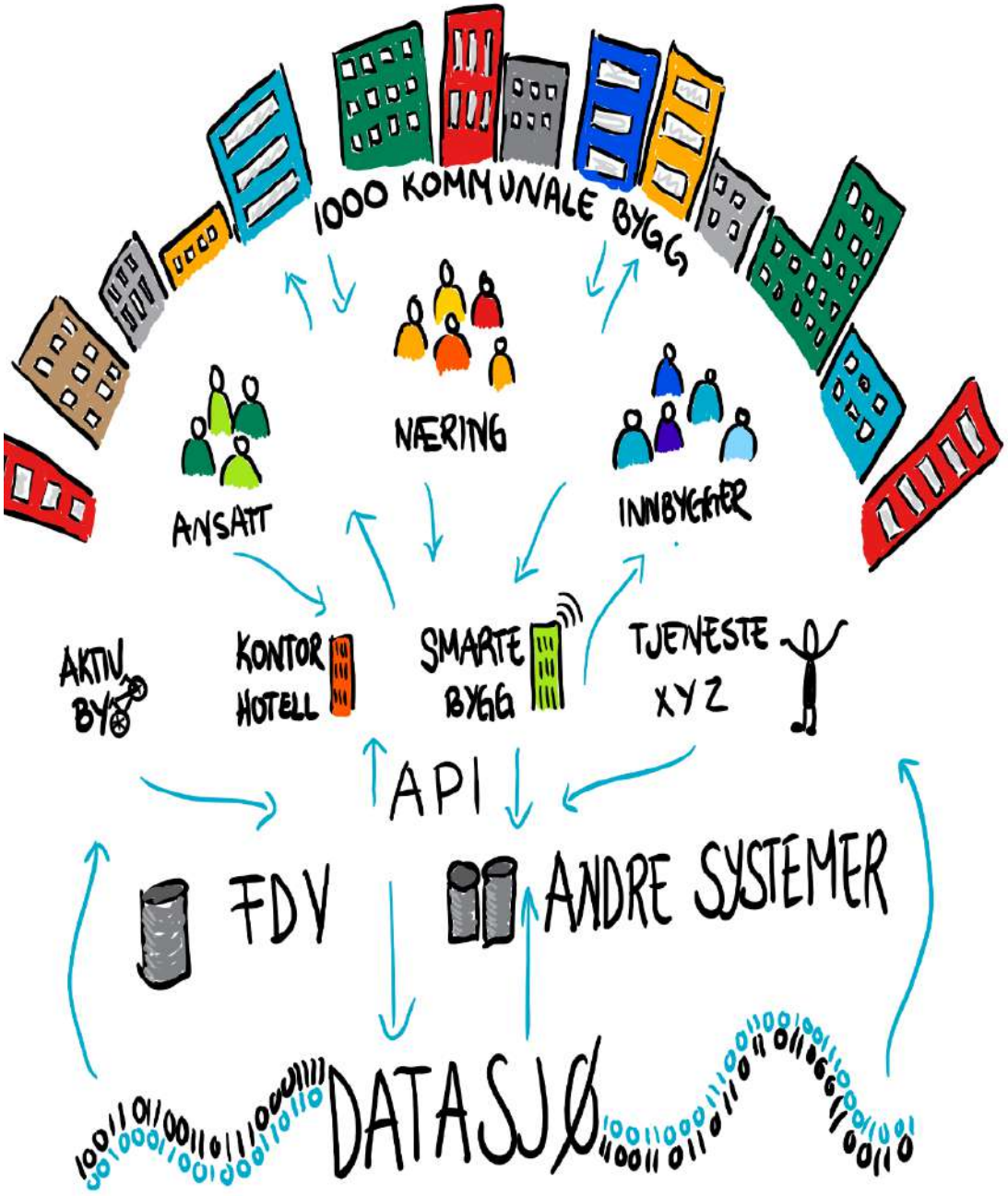
A sea of data:

Lungegårdsvannet

1000 buildings:
10.000 opportunities



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City planning in an energy context

Create and simulate PEDS.

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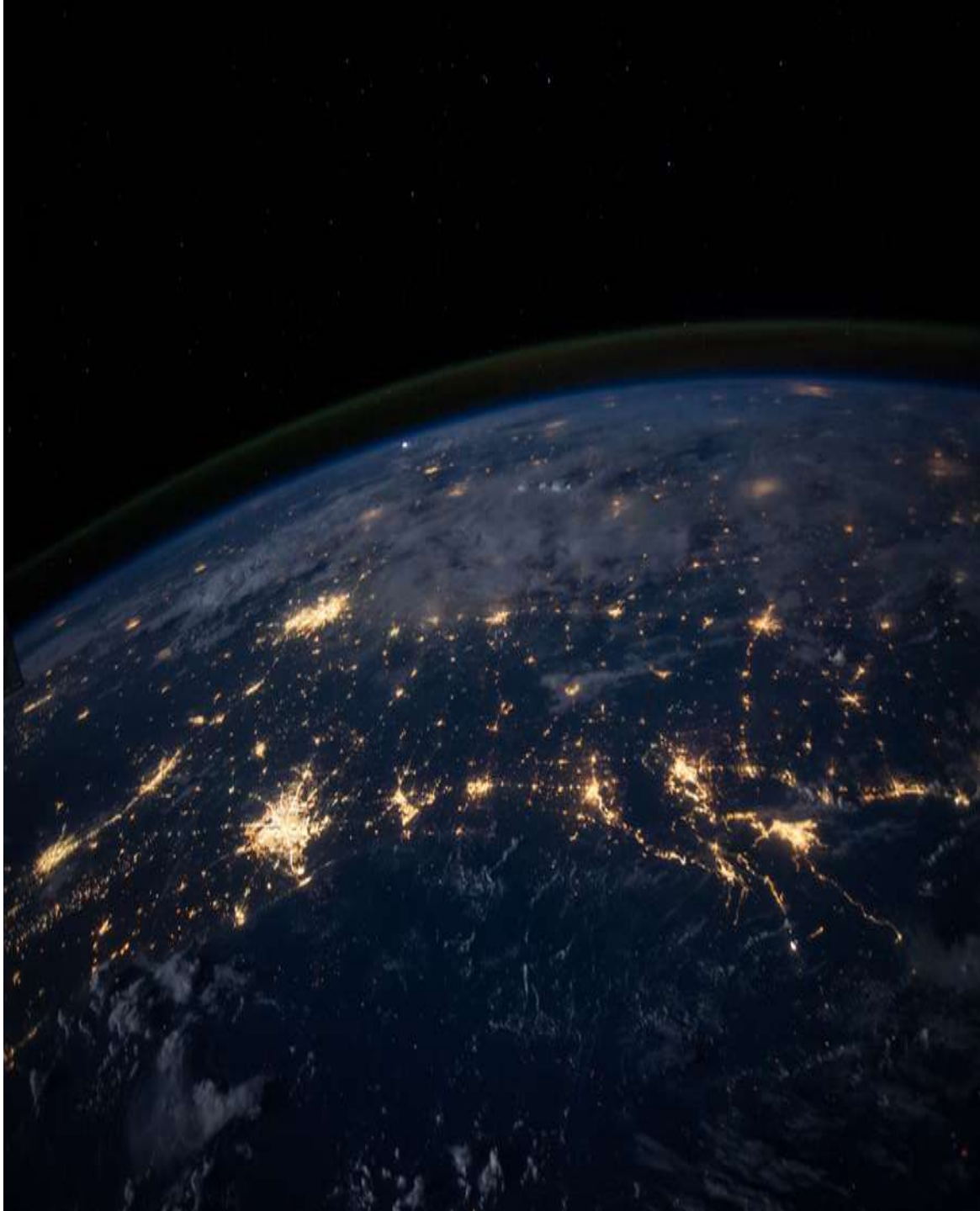
City driven

Planning



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Buildings

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Mobility

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IcT - IoT

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Sectoral processes - streamlined

Planning
Buildings
Mobility
ICT/IoT

= PEDS

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Centre for Climate
and Energy Transformation

Realizing the smart city

Håvard Haarstad
Professor, Department of Geography
Director, Centre for Climate and Energy Transformation

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The ‘smart city’ wave

- EU Horizon 2020 funds ‘Lighthouse cities’
- EU goal of financing 300 smart cities within 2020 (various programmes)
- Lighthouse cities should develop replicable/scalable solutions

Smart city strategies encompass:

- A method, not an end-state
- Holistic and cross-sectorial collaboration on urban and social development
- Use of technology to solve urban challenges

Are smart city projects catalyzing urban sustainability?

Field work in three EU Horizon 2020 Smart cities

- Nottingham
- Stockholm
- Stavanger

GrowSmarter

triangulum

DEMONSTRATE·DISSEMINATE·REPLICATE

BERGENS FORSKNINGS STIFTELSE

Case study: Stavanger

triangulum

DEMONSTRATE · DISSEMINATE · REPLICATE

Lighthouse-project

Smart city strategy

Smart city office, with smart city coordinator

Smart city conference

NORDIC EDGE Smart City Innovation Cluster

Smart city cluster

Lessons on smart city strategies

1. The main challenge is ‘silos’
2. Smart cities must build on actual challenges and goals
3. Large ‘room for maneuver’ locally to shape what the smart city should be
4. Good solutions are not necessarily high-tech
5. Success is dependent on dedicated effort, responsibilisation

Possibilities for Bergen?

- **Better coordination across units in the municipality**
  - Smart city coordinator. Road map? Overarching strategy?
  - Coordinate digitalisation, innovation, cross-cutting projects
  - User involvement

Possibilities for Bergen?

- **Facilitate experimentation and testing**
  - Make it easier to test, experiment and study
  - Sustainable transport is an potential entry point
  - ByLab, MUST

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BERGENS
FORSKNINGS
STIFTELSE

CET Centre for Climate
and Energy Transformation

Miljøfyrtårn®

How do cities move…

… from energy ambitions

to really smart urban solutions?