Energy Informatics: overview

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Learning Objectives

Throughout this lecture, it is aimed for the students to be able to

- **Learn the basic concepts in the new field of Energy Informatics**
- **Understand the emerging ICT (**Information & Communication Technologies**) challenges related to electric vehicles as an example**
- **Understand more ICT problems in related scenarios through examples, including sharing economy, smart buildings, renewable energy systems, intelligent transport, and smart city**

Industry Invited Talk Today

- **Speaker**: Jan Bråten, *Chief Economist / Sjeføkonom, Statnett*

- **Title**: Power Market: The Green revolution and the role of ICT

- **Statnett**: Statnett is Norway's national main grid owner and operator

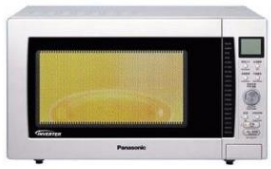
Statnett

Outline

- Energy Informatics
  - Definition and scope
- Electric Vehicles (EV) as an example
  - Concepts
  - Typical ICT problems related to EV
- Computer engineering & science problems in sharing economy, smart buildings, renewable energy sources, intelligent transport, smart cities

“Energy Informatics” is NOT about the traditional concepts

Energy



Informatics

Windows® 7

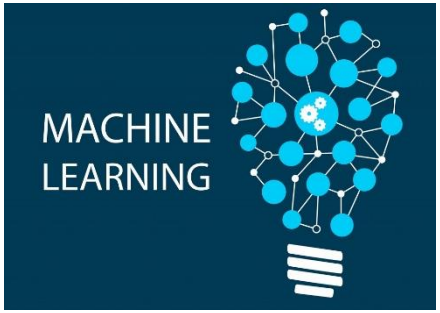
iOS

Java™

“Energy Informatics” focuses on state-of-the-art computer science for sustainable future energy systems

Energy

Informatics



Energy Informatics alternative terms: Internet of energy; Energy Internet

USA

ENERGY.GOV

PUBLIC SERV ES SC & INNOVA ENERGY SAVER BOU NERGY.GOV

Home » Ener nternet

NAT CLEAN ENERG SINESS COMPETITION 2014

ENERGY INTERNET

ogy

Energy Internet is commercializing a software platform for decentralized sch assets on the electricity grid. Energy Internet's utility clients will use our soft generation and consumption assets

The platform connects a network of capacity to offer decentralized, coo

Germany

Germany's "Internet of Energy" vision

A new report from the German Ministry for Economics and Energy, Smart Energy Made in Germany *(available in Ger sents the results of five ye s of test proje s del r ons throu the co try. T se te e key hnol es a business m dels to comprise an "internet of energy" -- dubbed *E-Energy*. Siemens is proud to be one of many companies and universities involved in these projects.

China

中国储能网 www.escn.com.cn

Et programtillegg er nødvendig for å vise dette innh

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您的位置：首页 >新闻资讯 > 能源互联网

解读：《关于推进“互联网+”智慧能源发展的指导意见》

作者：中国储能网新闻中心 来源：国新网 发布时间：2016-6-28 18:32:35

中国储能网讯：2016年2月24日，国家发改委、能源局、工信部印发《关于推进“互联网+”智慧能源发展的指导意见》，6月22日，国务院第 议审议 能源局提出的 于实施“互联网+”智慧能源行动的工作情况汇报》，对实施“互联 进行 署。6月24日， 办举行“互联网+”智慧能源行动计划有关情况政策例行吹风会。 家能源局总经济师 台等从 智 源行动和落 《指导 见》 方面进行 关政策解读。

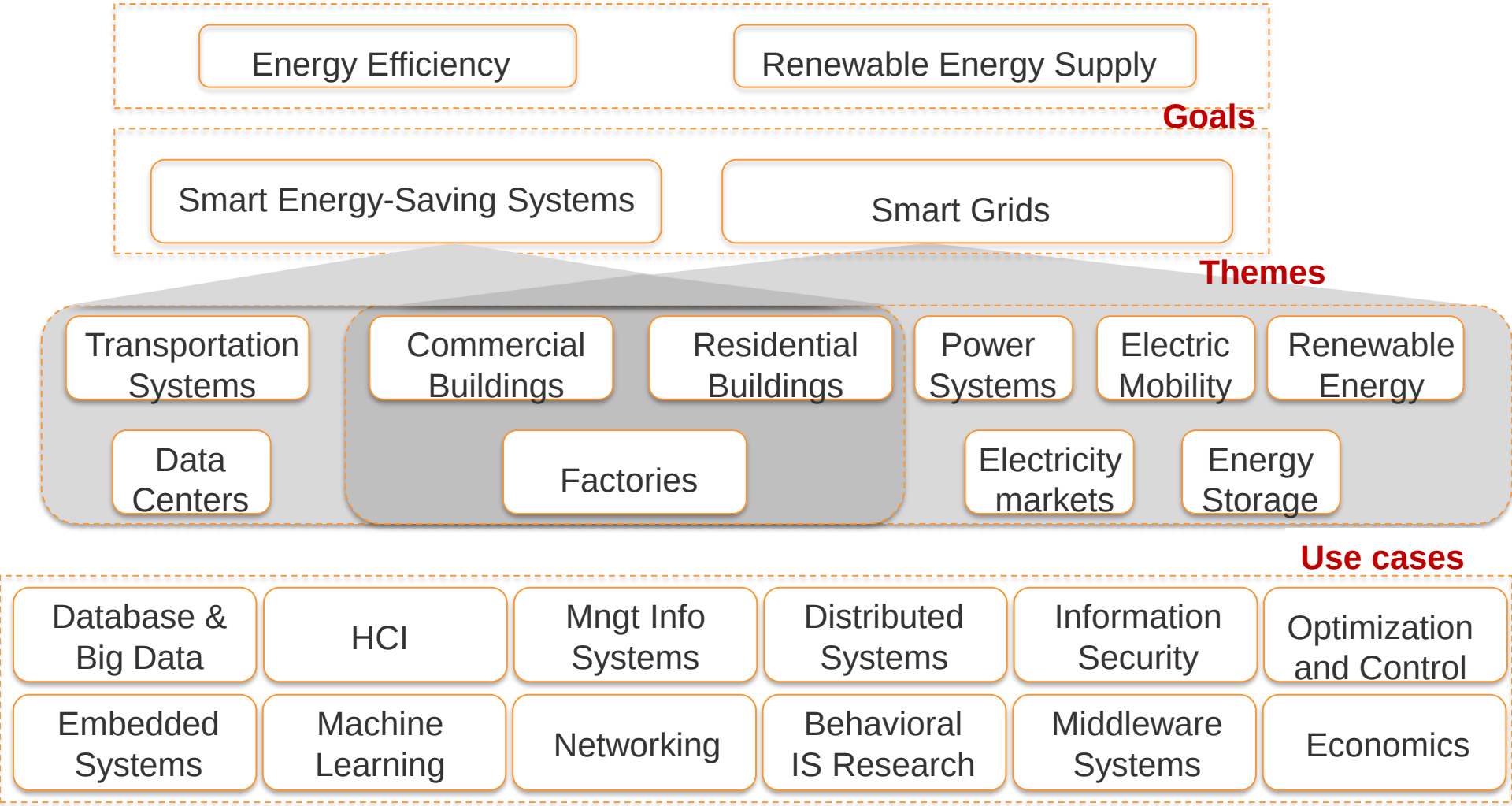
Energy Informatics: definition

A new field covering the use of ICT (Information and Communication Technology**) to address energy challenges**

Energy areas

- **Smart grid; smart energy networks**
- **Smart building**
- **Smart cities**
- **Water systems**
- **Oil/Gas systems**
- **Transport systems,**
- **Electric vehicles**
- **Vehicle-to-Grid (V2G) systems**
- **PV systems**
- **Wind systems**

Energy informatics: scope



Etter Goebel et al, Energy Informatics: Current and Future Research Directions, 2013

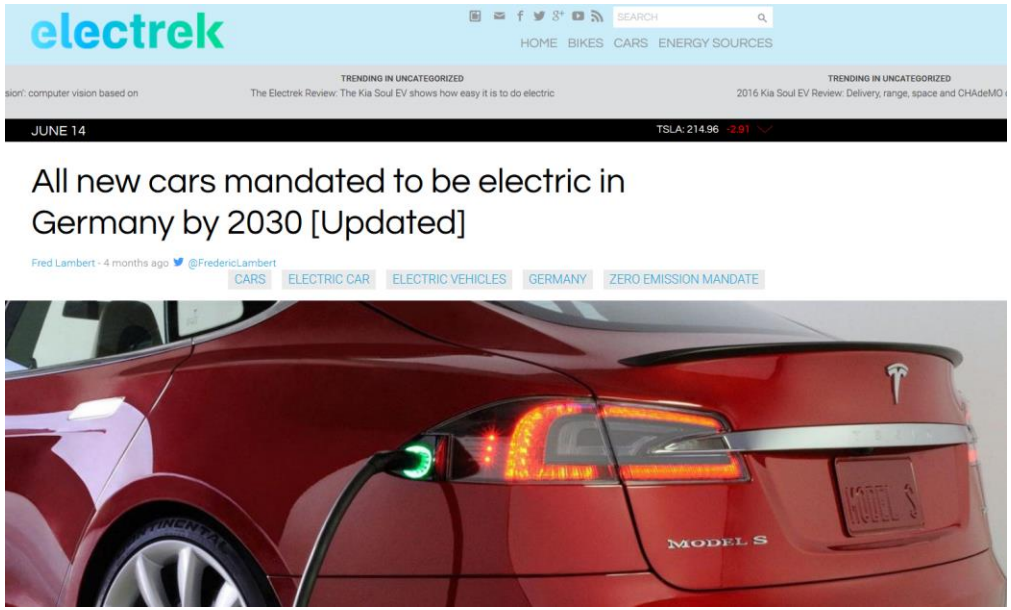
ELECTRIC VEHICLES AS AN EXAMPLE

Electric Vehicles (EV)

Charging Station

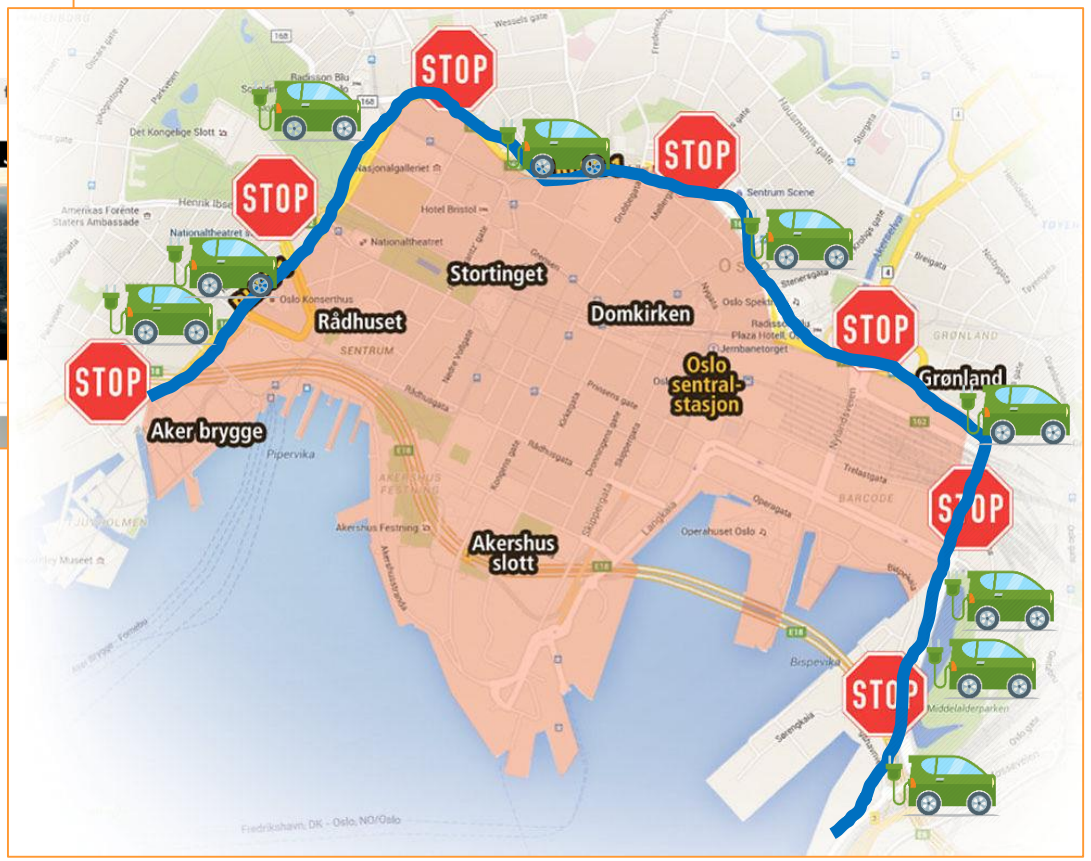
In 10-15 years, only Electric vehilces will be sold over the world

- **Norway**: Stoppe salg av bensin- og dieselbiler i 2025
- **Germany**: all new cars must be electric by 2030
- **China**: all private cars will be electric vehicles by 2030



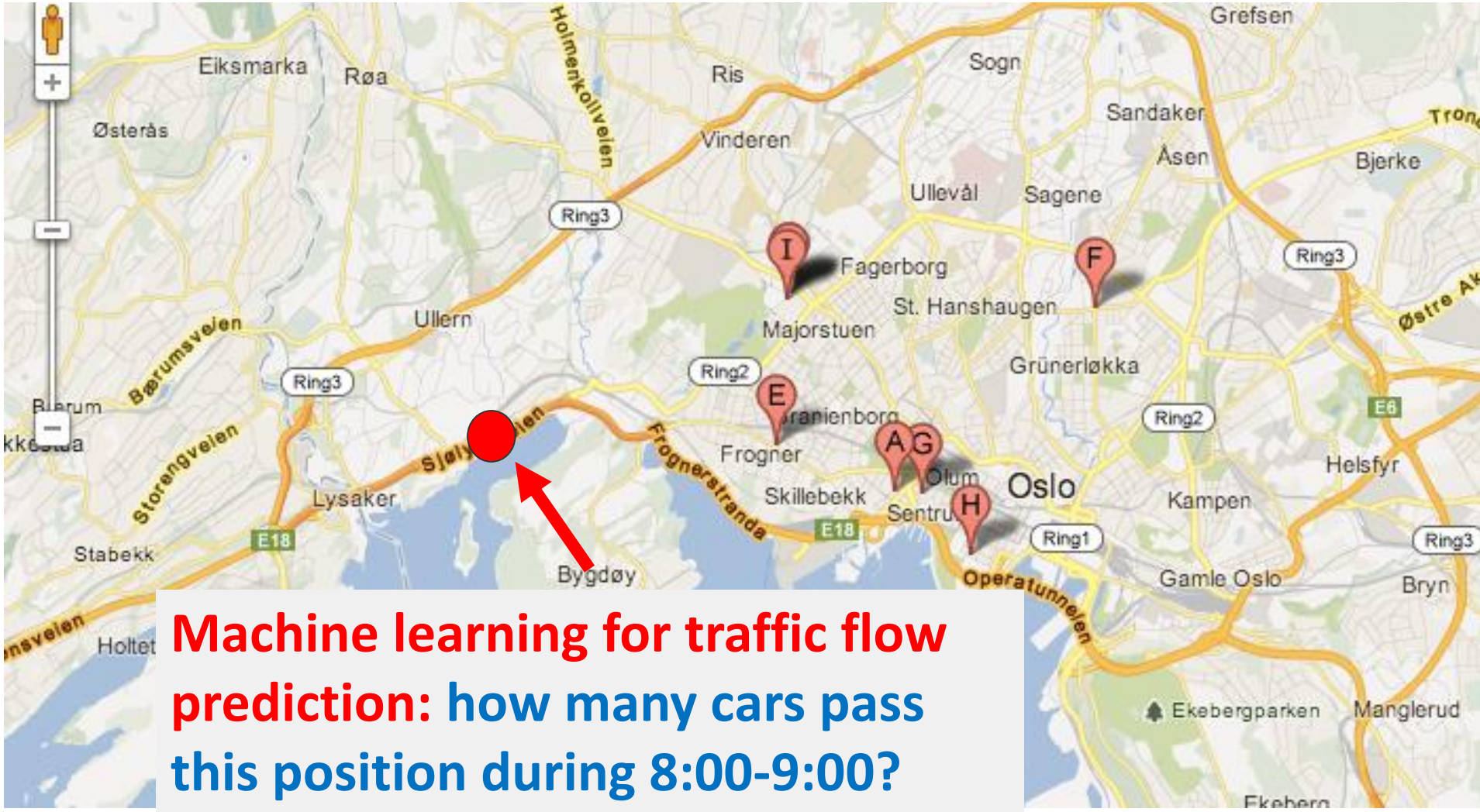
“Bilfritt i Oslo Sentrum innen 2019

Private cars (incl. EVs) will be banned in the Oslo center by 2019.



- **Q:** How many charging stations do we need in Oslo in the blue “Charging Zone”?

An important computer engineering problem: how many electric vehicles to the city center?

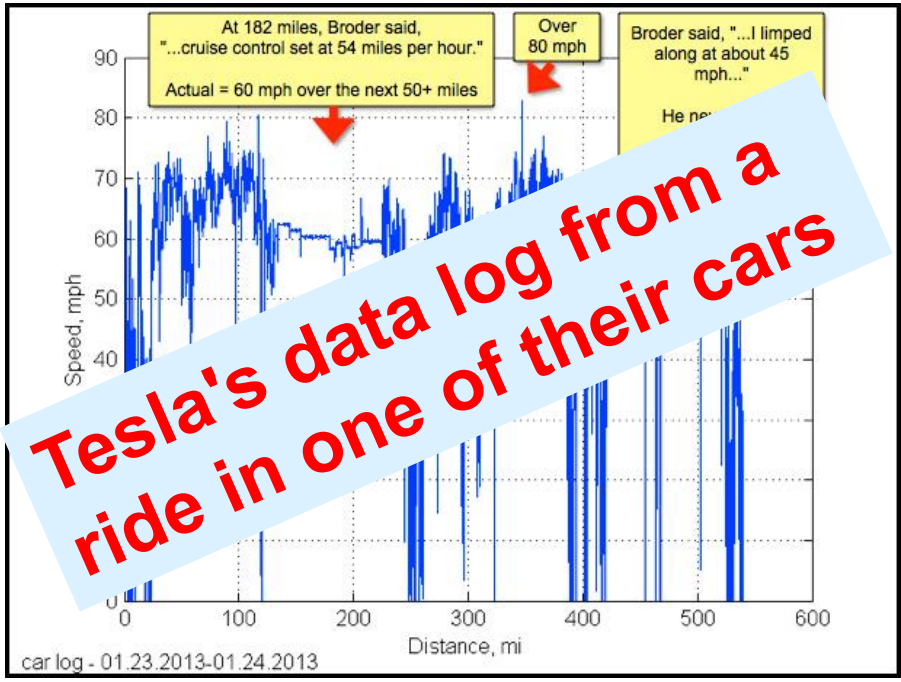


Machine learning for traffic flow prediction: how many cars pass this position during 8:00-9:00?

Another problem: how to protect your privacy?

- Self-driving cars, Tesla's autopilot driving are the future

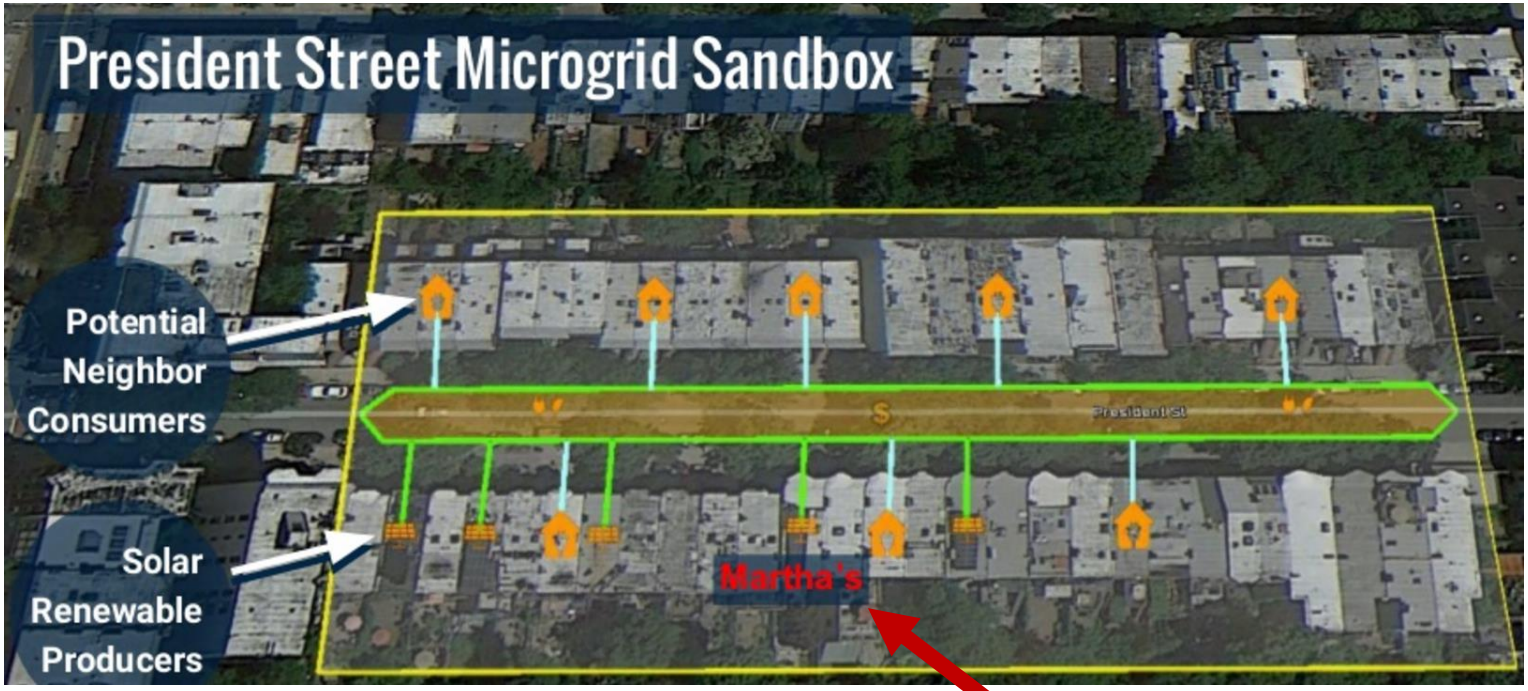
- **Q:** how does Tesla's autopilot system build?
  - "Tesla's sensors are constantly recording information about its environment and how the driver is navigating through it." (qz.com)
- This is typical privacy intrusion of modern digital life.



https://www.tesla.com/blog/most-peculiar-test-drive

MORE ICT CHALLENGES IN ENERGY SECTORS

Energy Sharing: Selling your power to neighbors in US



- **Brooklyn Microgrid:** In your house roof, you have solar power. The power can be used by yourself. If you are not able to use all power, you can sell to your neighbors.

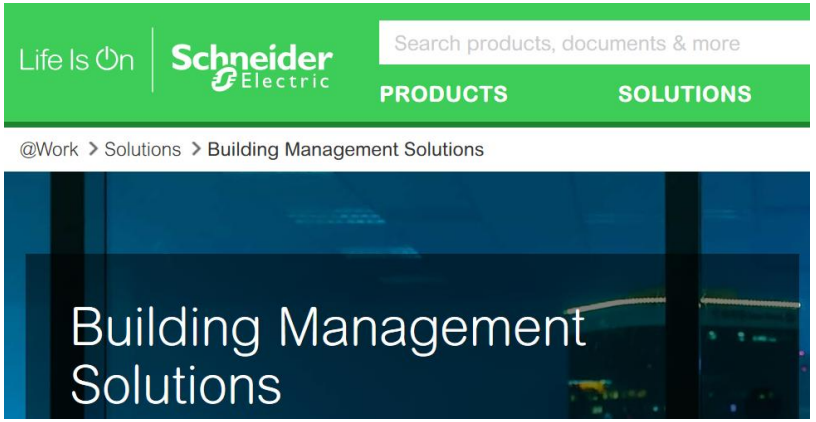
- **A typical computer engineering problem**: how to decide the energy selling price?

Energy Sharing: Selling your power to neighbors in Norway

- **Halden: a small town at the border between Norway and Sweden**

Smart Buildings

- A computer has an operation system, e.g., Windows, iOS
- Smart building has its own “Operation Systems” to monitor and management the infrastructure



- **A typical computer engineering problem**: how to adjust the temperature in the building with both energy-efficiency and people’s comfort considerations

Self-driving Cars and Intelligent Transport Systems

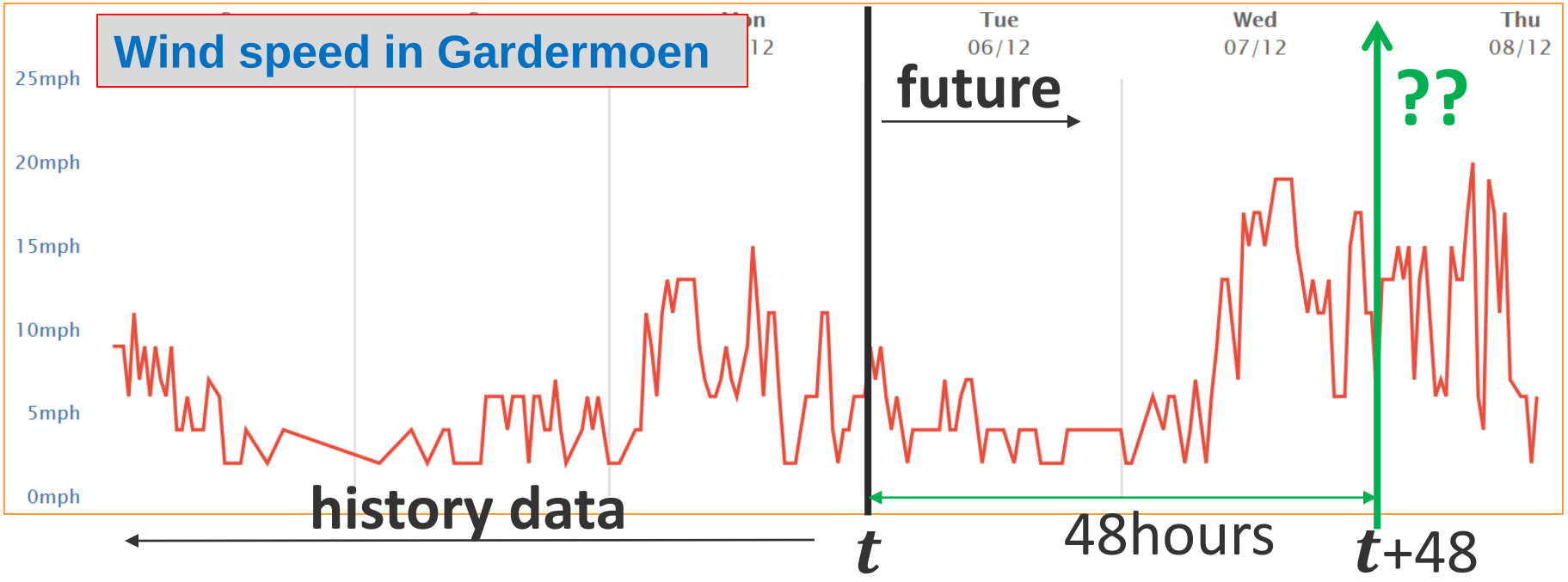
- Transport systems use power
  - Electric vehicles
  - Signal
  - Road infrastructures
- Computer science problems
  - Information exchange for accident avoidance
  - Information exchange for power management

https://robotik.dfki-bremen.de/en/research/robot-systems/eo-smart-connecting-1.html

Wind Power

- Equinor (originally Statoil) puts enormous investment in offshore wind power.
- Wind power is highly dependent on weather. **Machine learning and Data Analytics** for wind power forecast is an important computer science problem

https://www.equinor.com/en/what-we-do/new-energy-solutions/our-offshore-wind-projects.html



Thank you!