



Energy Informatics: overview

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Learning Objectives

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



Energy Informatics: concept

Learn the basic concepts in the new field of Energy Informatics



Electric Vehicles: an example

Understand the emerging ICT (Information & Communication Technologies) challenges related to electric vehicles as an example



More scenarios

Understand ICT problems in related scenarios through examples, including sharing economy, smart buildings, renewable energy systems, intelligent transport, and smart city

INDUSTRY INVITED TALK TODAY



Ane ELGESEM
TEAM MANAGER, STATNETT

Power Market: The Green revolution and the role of ICT

Statnett

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

Outline



Energy Informatics

Concept

Scope

Vision



Electric Vehicles

Concepts

ICT problems



More scenarios

Sharing economy, smart buildings, renewable energy sources, intelligent transport, smart cities

01

ENERGY INFORMATICS: CONCEPT

“Energy Informatics” is **NOT** about the traditional concepts

Energy



Informatics



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

Energy



GREEN
DATA CENTER



Informatics



Energy Informatics alternative terms: Internet of energy; Energy Internet



Home » Energy Internet
NATIONAL CLEAN ENERGY BUSINESS PLAN COMPETITION 2014



ENERGY INTERNET
Georgia Institute of Technology
...are platform
assets on the electricity grid. Energy Internet's utility clients
generation and consumption assets in their area of operation
The platform connects a network of residential, SMB, industrial
manage



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, 国务院常务会议听取了由能源局汇报的《关于实施“互联网+”智慧能源行动的工作情况汇报》, 对实施“互联网+”智慧能源工作进行部署。6月24日, 国新办举行“互联网+”智慧能源行动计划有关情况政策例行吹风会。国家能源局总工程师李冶等出席吹风会, 介绍《意见》主要内容, 并回答了记者提问。相关解读如下。



Germany's "Internet of Energy" vision

A new report from the German Ministry for Economics and Energy, Smart Energy Made in Germany (available in German), presents the results of five years of test projects, which demonstrate regional energy networks. These test projects have developed key technologies and business models to comprise an "internet of energy" -- dubbed *E-Energy*. Siemens is proud to be one of many companies and universities involved in these projects.



Germany

Energy Informatics: definition



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

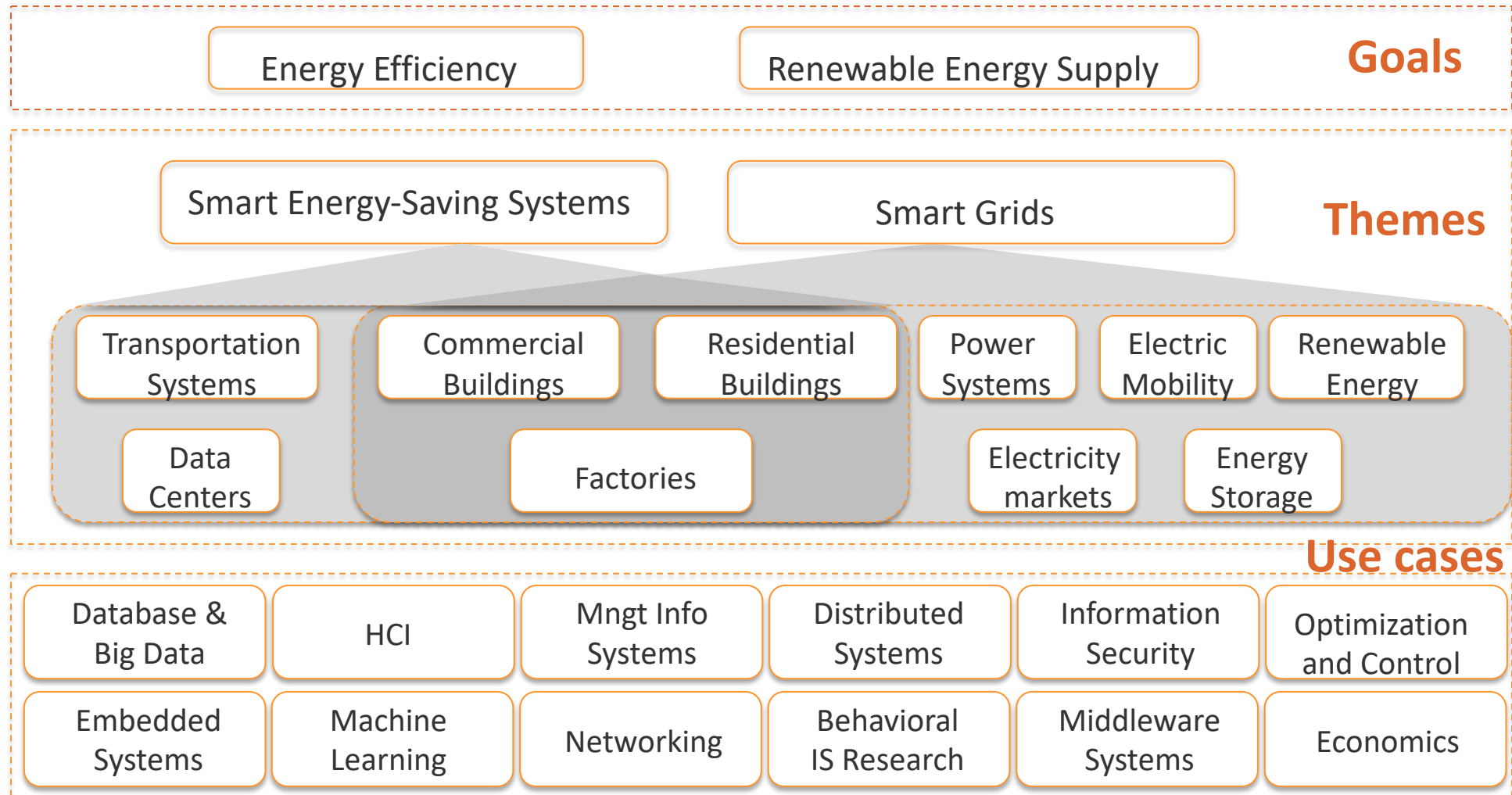


Energy Areas

- 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



02

ELECTRIC VEHICLES AS AN EXAMPLE

Electric Vehicles (EVs)



Electric Vehicles domains

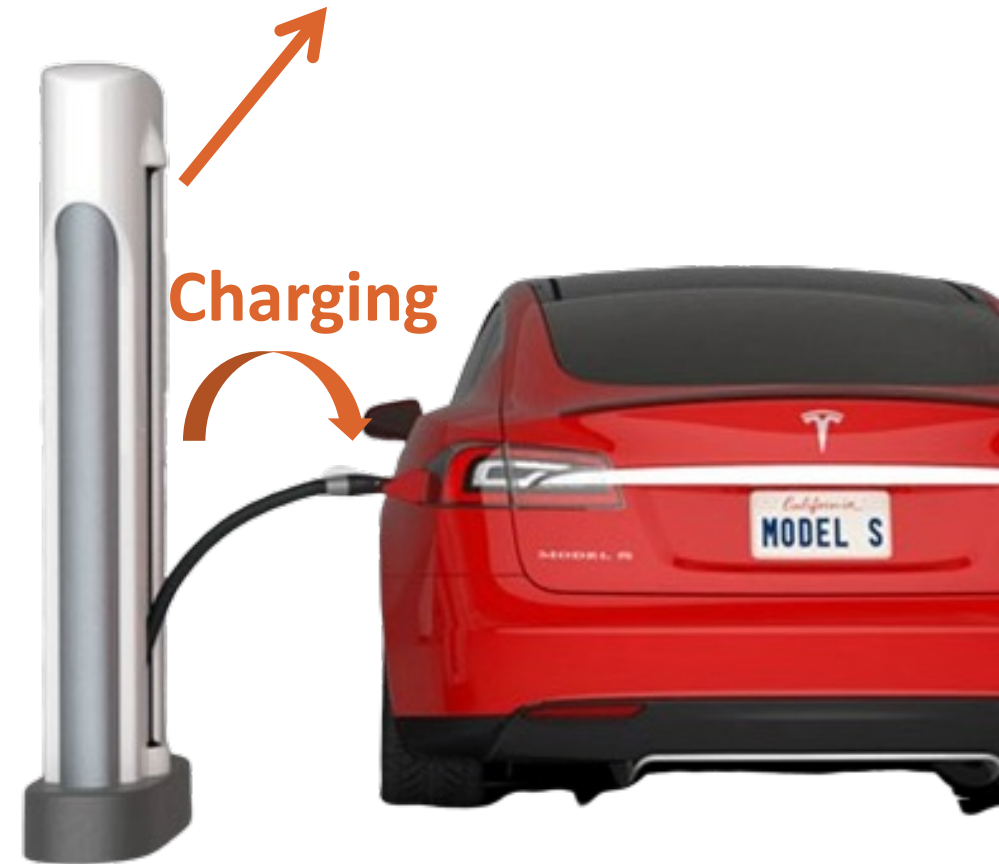
- **Energy domain:** power charging
- **Information domain:** information exchange between EVs and charging station
- **Transport domain:** running on the road



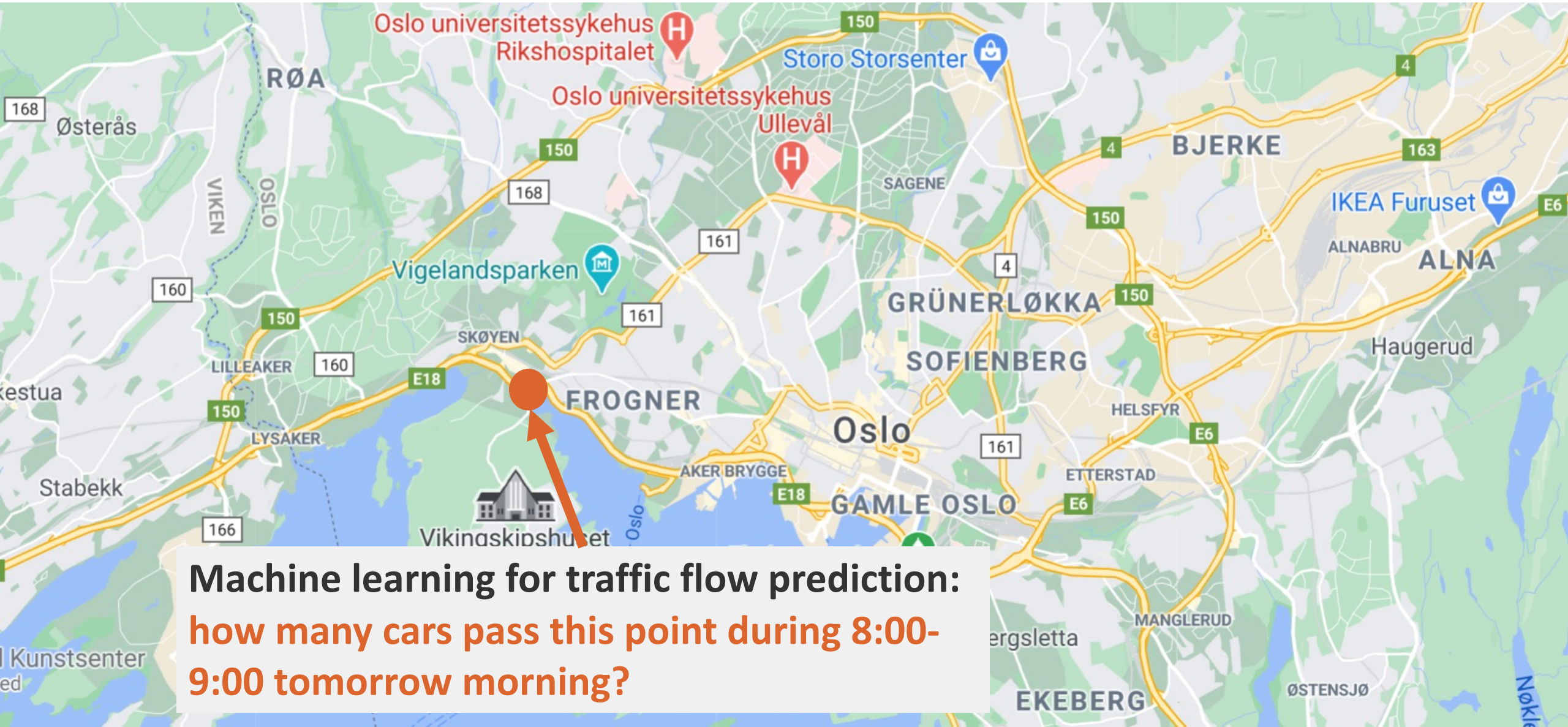
Electric Vehicles roles

- **Energy consumer**
- **Energy storage**
- **Energy provider**

Charging Station



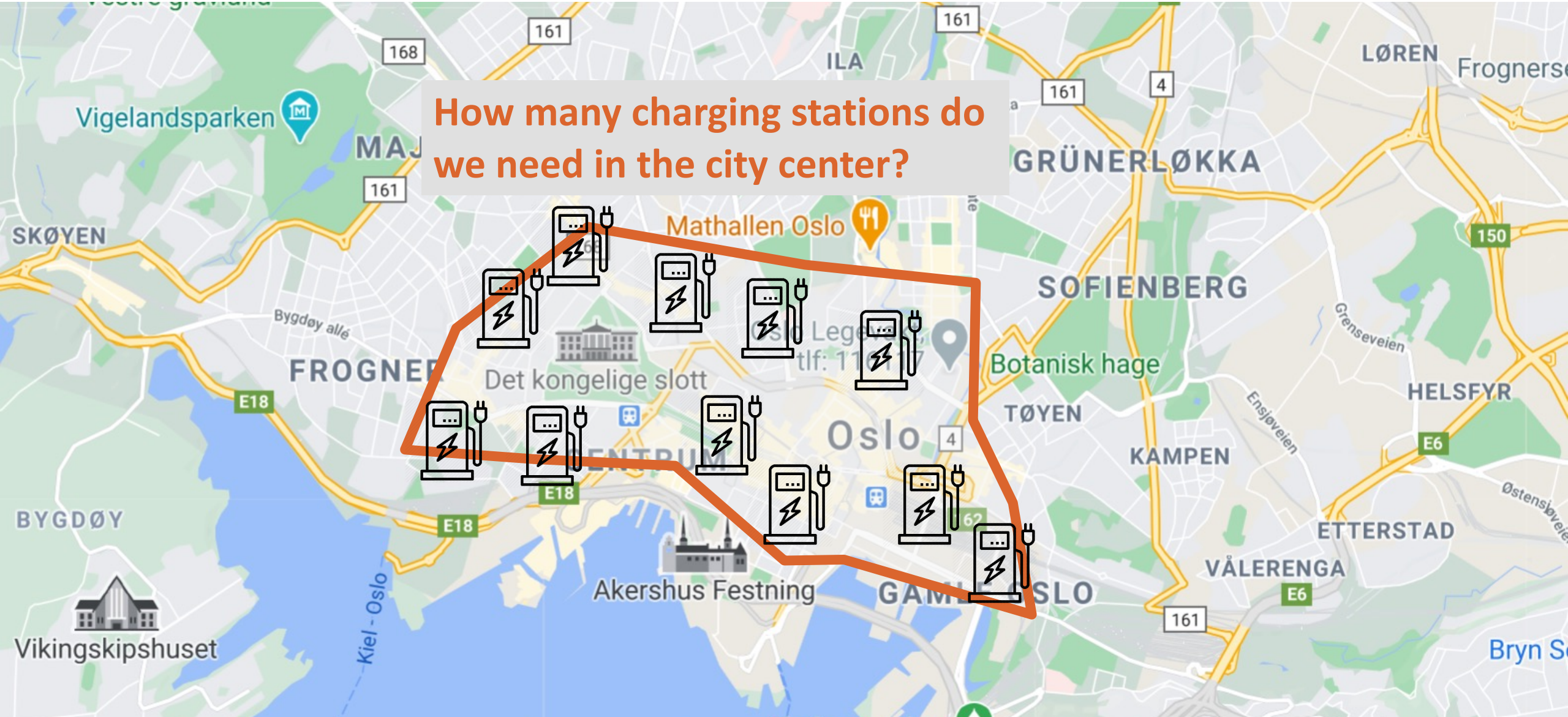
An important computer engineering “traffic flow” problem



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

An important computer engineering “urban planning” problem

How many charging stations do we need in the city center?



Another problem: how to protect your privacy?

Tesla's Autopilot

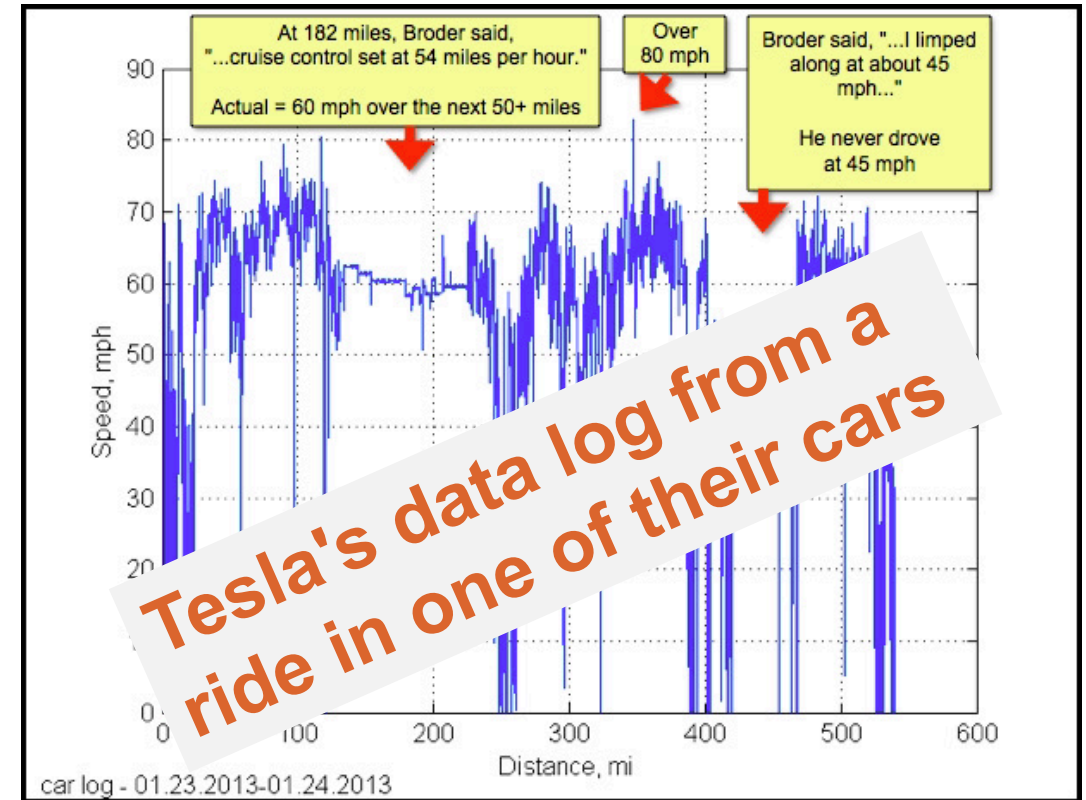


- Self-driving cars, Tesla's autopilot is the future
- **Q: how does Tesla's autopilot system build?**
"Tesla's sensors are constantly recording information about its environment and how the driver is navigating through it." (qz.com)

Privacy



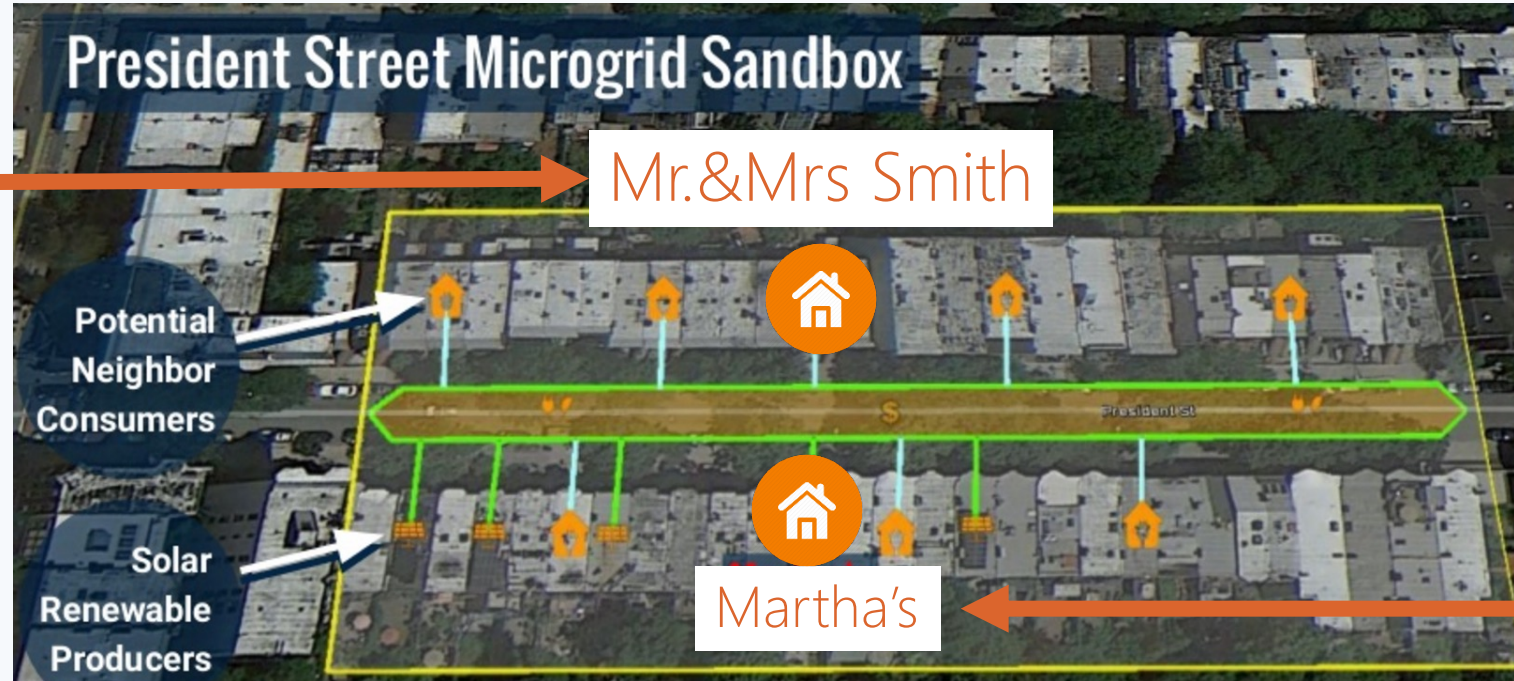
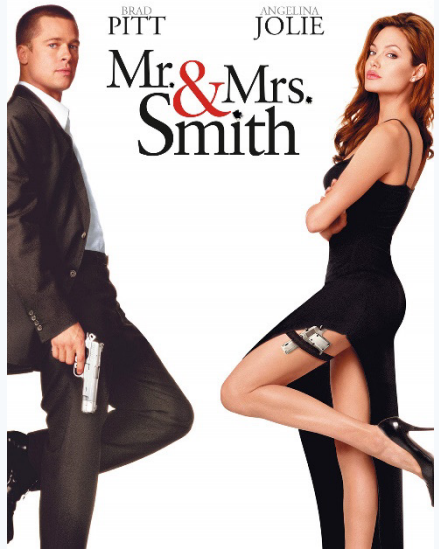
- Typical privacy intrusion of modern digital life.
- EU GDPR (General Data Protection Regulation):
July 8, 2019, British Airline faces 183 Million GBP fines



03

MORE ICT CHALLENGES IN ENERGY SECTORS

Sharing Economics: Selling your power to neighbors (I/II)



- **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, e.g., Mr.&Mrs Smith and their 6 kids.
- A typical computer engineering problem: **how to decide the energy selling/buying price?**

Sharing Economics: Selling your power to neighbors (II/II)



- Energy Peer-to-Peer (P2P) Sharing Networks: Each person can buy/sell energy from her/his neighborhood.
- Very similar as P2P networks in Internet that share information/data/movie

Energy Sharing: Selling your power to neighbors in Norway

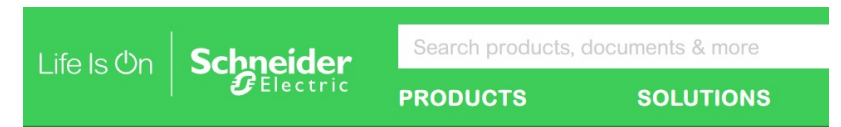


- Halden: a small town at the border between Norway and Sweden

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? → machine learning method is very promising!



@Work > Solutions > Building Management Solutions

Building Management
Solutions

Self-driving Cars and Intelligent Transport Systems

Transport systems use power



- Electric vehicles
- Signal
- Road infrastructures

Computer science problems



- Real-time information exchange for accident avoidance
- Information exchange for power management



Wind Power becomes a strategic development in Norway

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

