The European Commission's science and knowledge service

Joint Research Centre

Smart meters infrastructure needs and official statistics

T. Efthimiadis
J.M. Blanco Lluna, A. Costescu
M. Ardelean, C.-F. Covrig

Statistics and big data
Hellenic Statistical Authority
Athens, Greece

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JRC's Mission and Role

... is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

JRC is the European Commission's in-house science service and the only DG executing direct research; providing science advice to EU policy.

Serving society, stimulating innovation, supporting legislation

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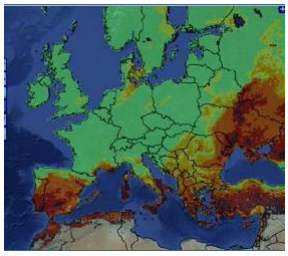

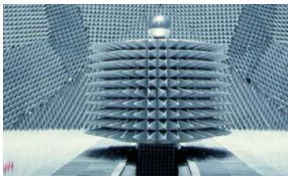

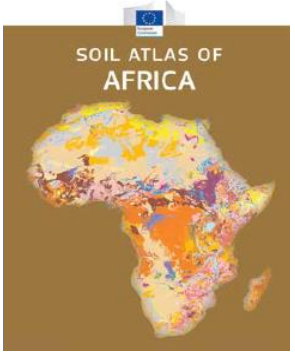

http://europa.eu/!TJ79jp

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JRC was established 1957

5 countries
Belgium, Germany, Italy, the Netherlands, Spain

over 3.000 staff

Over 1.400
scientific publications annually

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Using big data to relieve energy distribution stresses

Home use of electricity is increasing

We use almost twice as much energy as in 1980s …

despite increases in energy efficiency

Electrical vehicles are coming

- Electric and hybrid vehicles will stress electricity distribution networks

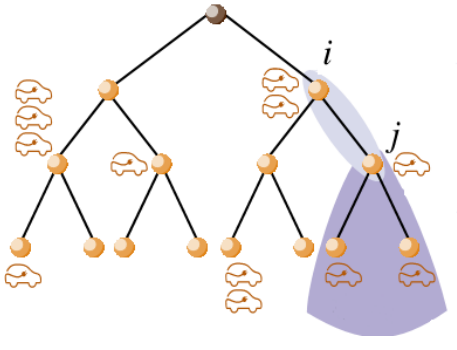
Registered electric and hybrids in the Netherlands	
2014	45.000
2015	87.700
2016:3	**96.700**

Source: Netherlands Enterprise Agency (RVO.nl)

Vehicle owners (Deloitte, 2010):
- prefer home charging,
- would consider day charging,
- are unwilling to accept a charging time of 8 hours

The problem

If too many vehicles plug-in to the network:
- charging takes too long,
- more cars arrive than leave fully charged, and
- the system goes into a **congested state**
  Carvalho et al., 2015



Our work

- To model **congestion management** for grids

Benefits:
- Less need for new infrastructure.
- Better services for consumers.
- Minimize electricity disruptions.

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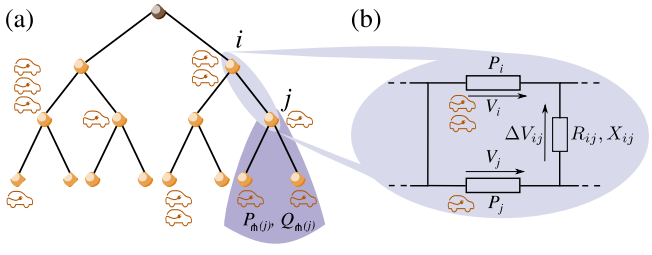
The model

Alternative congestion control mechanisms

- Max-flow: the closer, the better
- Proportional fairness*: (more) equal treatment



** see Kelly and Yudovina, 2014*

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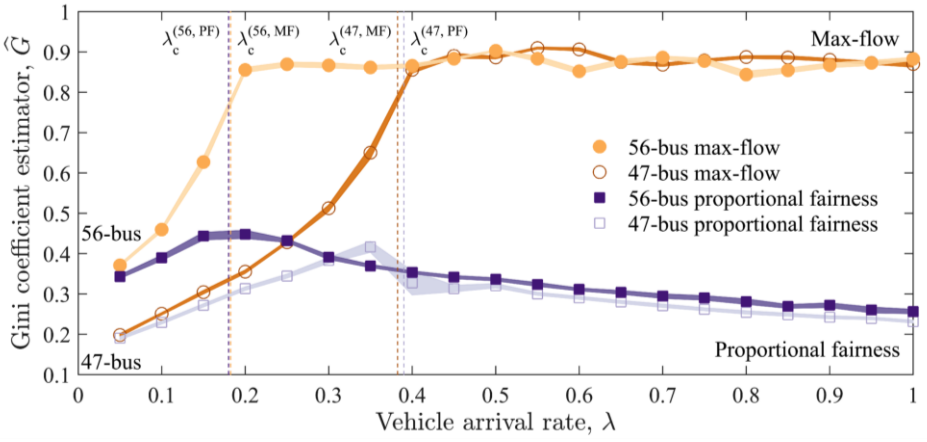
Results with simulated data

Gini coefficient (Carvalho *et al.*, 2015)



Sweden: G=0.26
US: G=0.41
Seychelles: G=0.66

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Real data for the Netherlands

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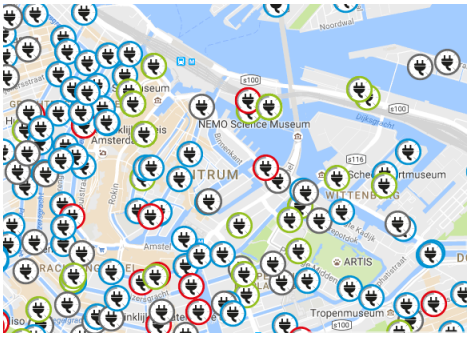
Charging stations in the Netherlands

	Public	Semi-public	Private (est.)
2014	5.400	6.400	28.000
2015	7.400	10.400	55.000
2016:2	**8.800**	**15.200**	

Source: Netherlands Enterprise Agency (RVO.nl)



Source: https://www.oplaadpunten.nl/

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The data

Data for public charging stations (~20% of total)

Main data:

- **~1.000.000 transactions** (2012 – 2016)
- ~1.800 public charging points
- ~50.000 unique cards

Secondary data:

- intra-transaction metering
- ~30.000.000 data rows

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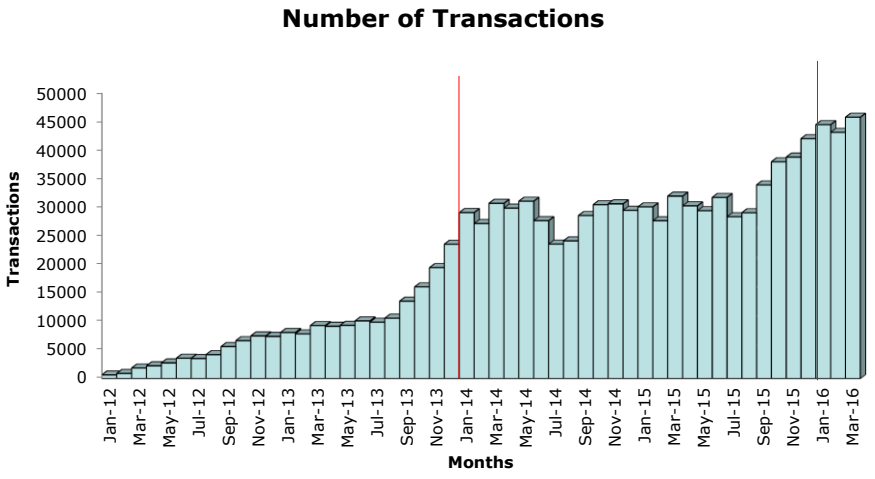
The data



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The data

Average time cars are:

- plugged-in: ~7h15
- being charged: ~2h30

- **sitting idle: ~4h40**

- Average Max Power: ~3.7 kWh
- Total energy: ~9 GWh
- Average total energy: ~8.5 kWh

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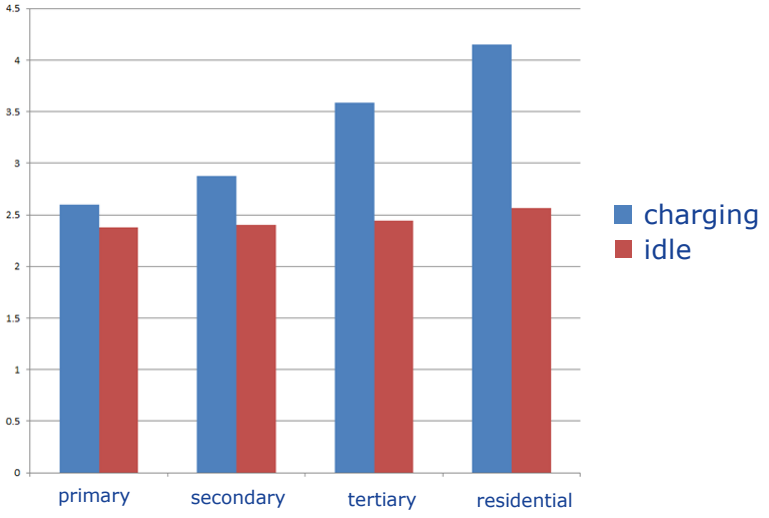
Differences per road type



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Big data from smart grids

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Big data

Number of smart meters in Europe:
- **150 million by 2017**
- 240 million by 2020

Each smart meter can generate more than **100,000 values** per year

Challenges:
- **Data standards** and **metadata**
- New statistical methodologies
- Combining with other information (e.g. weather patterns)
- Storing, processing, and **analysing**

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Data standards

sdmx

Statistical Data and Metadata eXchange (SDMX)
- Standards to facilitate the exchange of statistical data and metadata

BIS eurostat OECD

INTERNATIONAL MONETARY FUND

THE WORLD BANK

More: **sdmx.org**

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Example: Frequency

CODE	DESCRIPTION
A	Annual
M	Monthly
D	Daily
Q	Quarterly
W	Weekly
H	Half-yearly
B	Business

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Example: Economic statistics

2.1 Macroeconomic statistics
2.2 Economic accounts
2.3 Business statistics
2.4 Sectoral statistics
2.4.1 Agriculture, forestry, fisheries
2.4.2 Energy
2.4.3 Mining, manufacturing, construction
2.4.4 Transport
2.4.5 Tourism
2.4.6 Banking, insurance, financial statistics
2.5 Government finance, fiscal and public sector statistics
2.6 International trade and balance of payments
2.7 Prices
2.8 Labour cost
2.9 Science, technology and innovation

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Example: 2.1 Macroeconomic statistics

Macroeconomic statistics – all activities that are dealing with economy wide statistics at macro level that go beyond, or are different from National Accounts, whether annual, quarterly or monthly.

Examples are macroeconomic databases that combine national accounts and other macroeconomic indicators like Main Economic Indicators (OECD), Principal European Economic Indicators (Eurostat), etc.; business tendency and consumer opinion surveys, economic growth, stability and structural adjustment, cyclical indicators, statistics for business cycle analysis.

Excludes:
- methodology and frameworks of national accounts (2.2.)
- collection and dissemination of national accounts and productivity data not linked to other macroeconomic statistics (2.2)

INSPIRE

INfrastructure for **S**patial **I**nformation in **E**urope

Directive (2007/2/EC) came into force in 2007, full implementation required by 2021

- EU legislation
- Common standards for 34 spatial data themes:
  - **Administrative units**
  - **Elevation**
  - **Energy resources**
  - **Natural risk zones**
  - **Transport networks**
  - **Protected sites**
  - **….**

http://inspire.ec.europa.eu

INSPIRE

- Metadata
- Data Specifications
- Network Services
- Data and Service Sharing
- Spatial Data Services
- Monitoring and Reporting

INSPIRE is binding for Member States

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