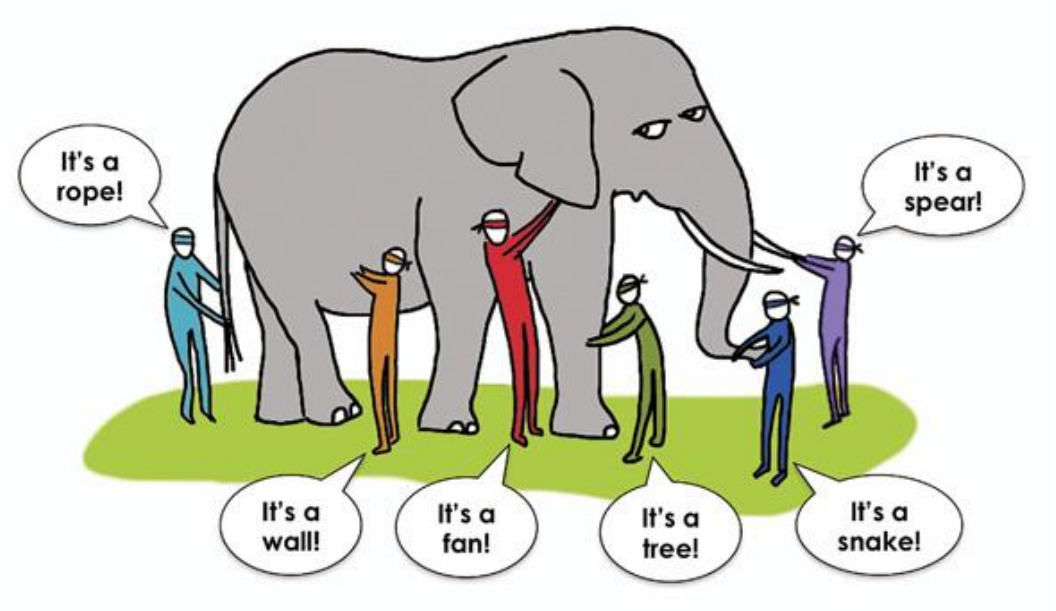
GRIDPOCKET
PERSONAL SMARTGRID SOLUTIONS

ASPROM




# BigData and Smart Grid

GridPocket **Copyrights**
Filip Gluszak, CEO, GridPocket SAS
Sophia-Antipolis, 02.04.2015
filip.gluszak@gridpocket.com, +33 679739052

# About GridPocket

- **Behavioral energy efficiency services**
- Created in 2009 at the **Telecom ParisTech** incubator in Sophia-Antipolis, France.
- Team of 12 PhDs and Engineers in France and Poland
- Supported by private investors and institutions


Award for Eco-Troks
Best customer service
Lyon 2012

Award for 5 best cleantech startups
Paris – SF 2012

World's best energy startup companies
Tokyo 2013

# Team

## Services experts

**Filip Gluszak – CEO**
Services & Technology – Philips
Start-up Experience
Research IT – Princeton USA

**Luc Juggery - MBA**
Web systems – Airbus, EADS
Embedded software – TI
MBA

## Behavioral experts

**Alexandre Delanoë - PhD**
Behavioral Expert
Start-up Experience
Marketing – Lafarge, Bayer

**Laura Draetta – PhD**
Social Dynamics Expert
Milan Uniiv, Belgium
Telecom ParisTech

## External Advisors

TELECOM ParisTech

FRANCEangels

CCI NICE CÔTE D'AZUR

capenergies

## Technology experts

**Pierre Leray – M2M**
Software specialist
Architecture open data

**Guillaume Pilot – M2M**
Energy software
Inria Research Enginner

## Energy & data experts

**Etta Grover – Master Energy**
San Francisco, Lughborgh UK
Fraunhofer Kassel,
Mines ParisTech, OKwind

**Yann Esposito – PhD**
Machine Learning expert
Web systems – AirFrance

**Yufei Han- PhD Statistics**
IFSTARR, INRIA,
Mines ParisTech
Chinese Academy of Science

**Michaela Kurejova - MS**
Energy products strategy
Usability requirements
France, Slovakia

# References

## Utilities and operators

Energa, PGNiG, Fournisseur d'électricité 100% renouvelable, es, EDF, CA Store, orange, ERDF – Électricité Réseau Distribution France

## Research

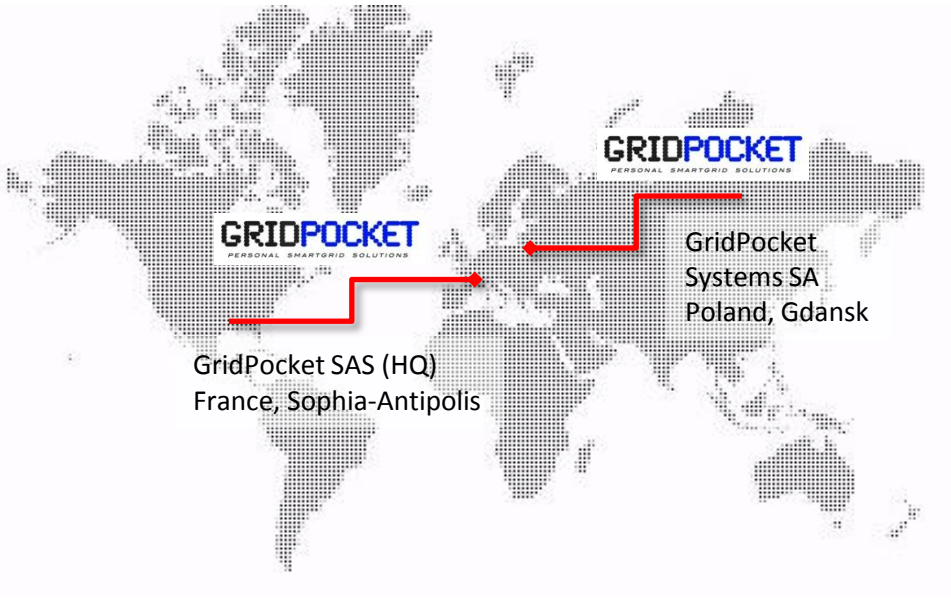
Telecom ParisTech, EURECOM, MINES ParisTech, Inria, EPFL – École Polytechnique Fédérale de Lausanne, Warsaw University of Life Sciences, Technische Universität Berlin, LAAS-CNRS

## Industry

Digi, actility, WIT, VEDIA, Itron, Sagemcom, EMC², Sierra Wireless, InterSystems, Symantec

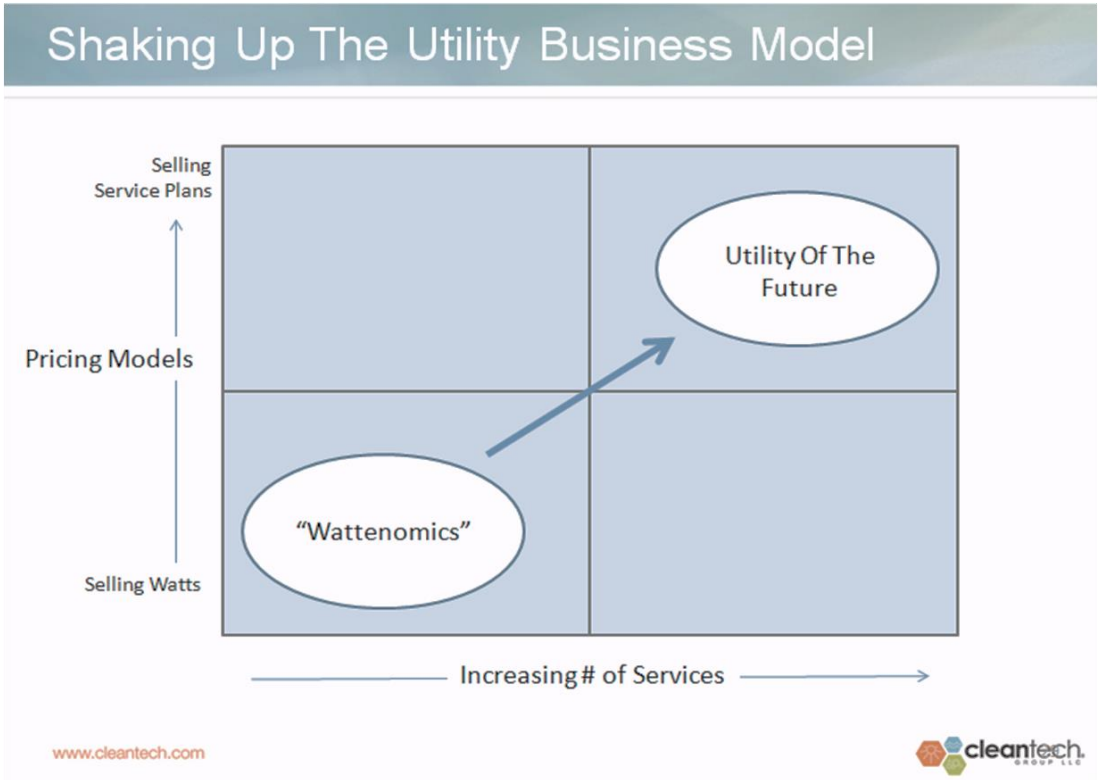
## Institutional

Région Provence Alpes Côte d'Azur, capenergies, Commission de régulation de l'énergie, oséo, ETSI World Class Standards, ADEME, CCI Nice Côte d'Azur, Seventh Framework Programme, Narodowe Centrum Badań i Rozwoju, Clean Tech Open France



# Our mission : enabling sustainable economy through added value energy services

- Environmental constraints
  - *Non growing sales volumes*
  - *Higher purchasing prices*
  - *Lower margins*
- Disruptive technologies
  - *Infrastructure investments*
  - *New business models*
  - *Telecom, IT competition*
- Deregulation
  - *New market entrants*
  - *Price competition*
  - *Customer churn up to 10-20%*

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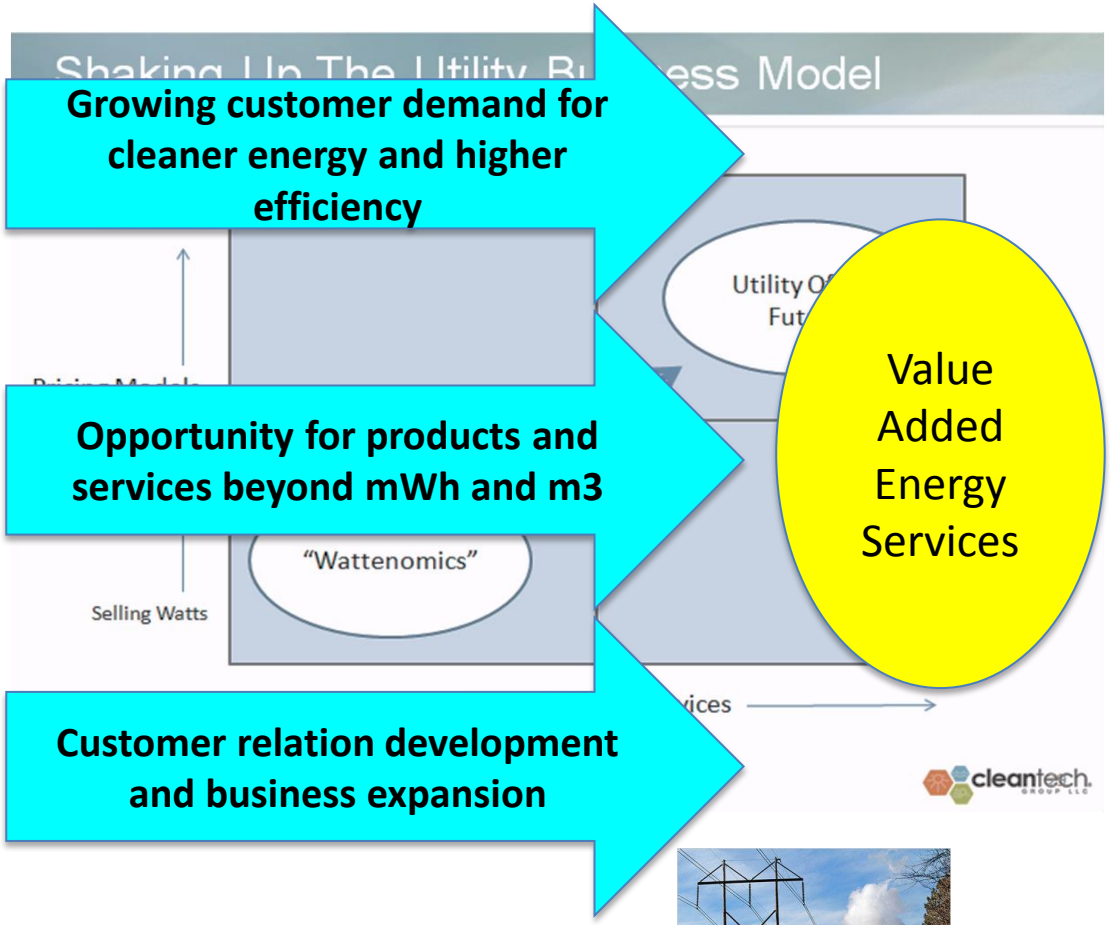
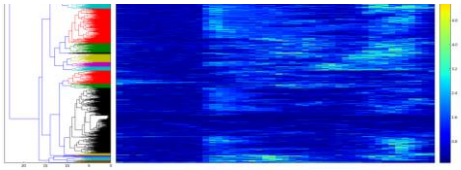



# GridPocket energy value added services platform

Consumers engagement

Usage optimization


Low carbon transport infrastructure



Analysis, supervision and prediction


Energy information sharing

Multi-fluid management for smart cities

# BIGDATA BASICS

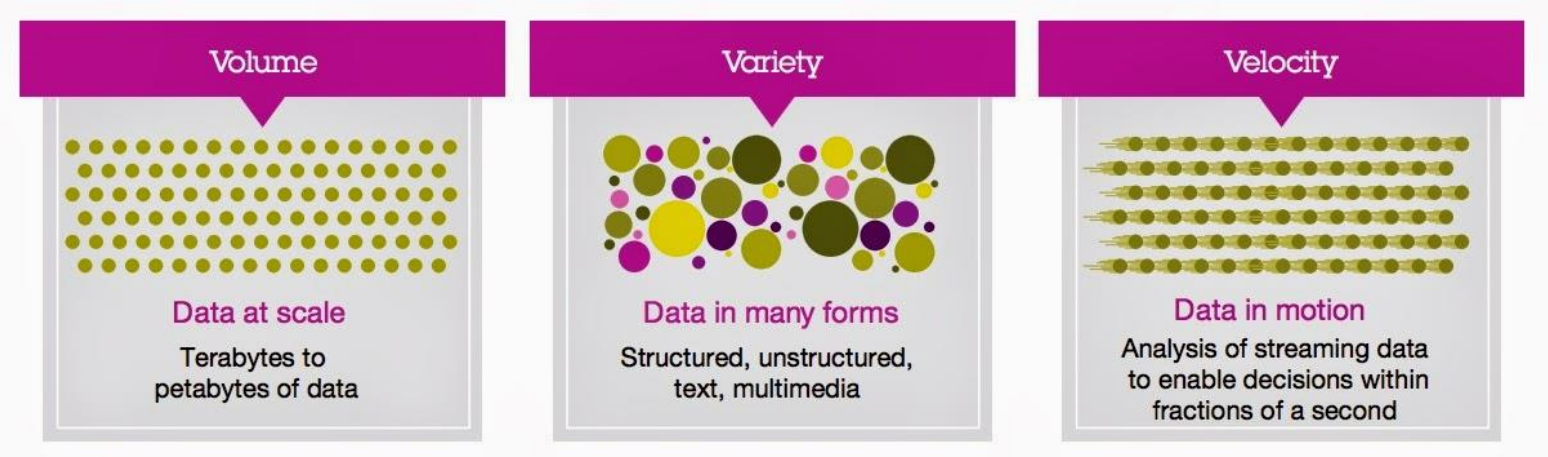
# BigData definition

Big data is **high-volume**, **high-velocity** and **high-variety** information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making.


Gartner

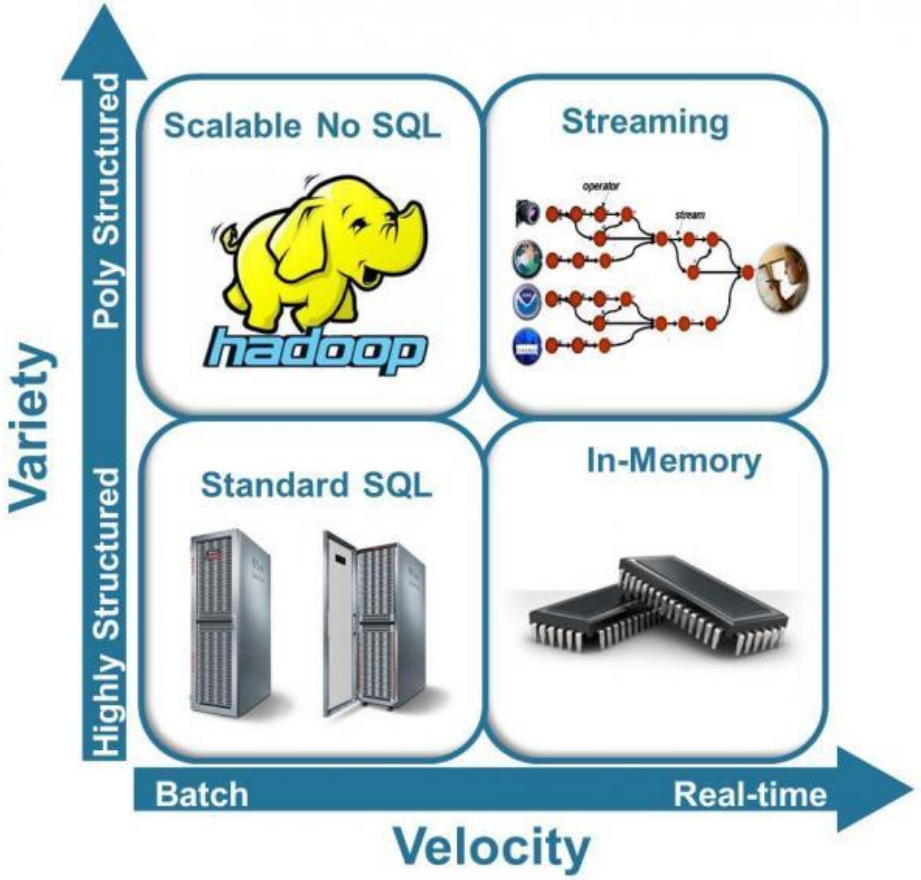
# Big data characteristics

- Volume – the quantity of data
- Variety – categories data belongs to including ‘dark data’
- Velocity – speed of generation and processing



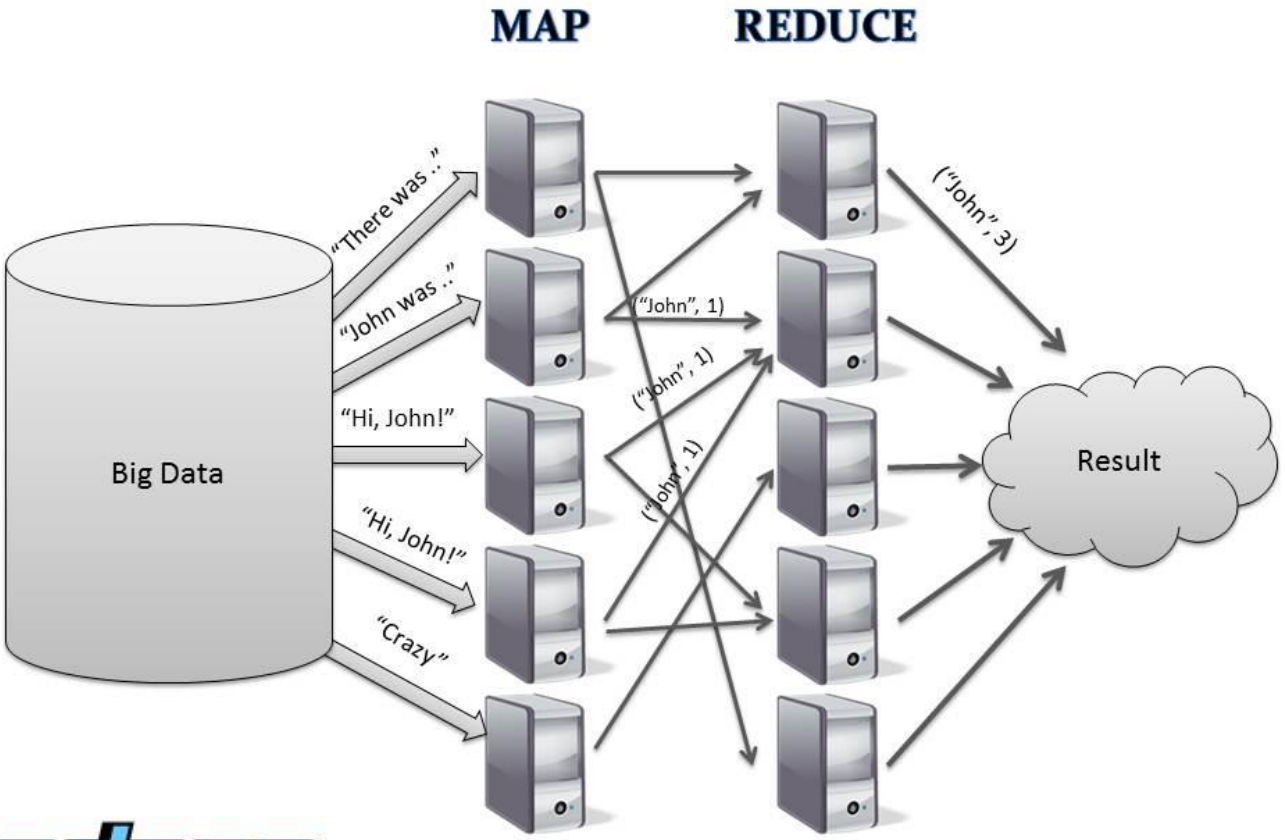

- Veracity – quality and accuracy of data

# Big data technologies




Source: Forrester Webinar: Big Data: Gold Rush or Illusion?, Sept 19, 2013

# Hadoop Map Reduce parallel computation




http://dme.rwth-aachen.de/de/research/projects/mapreduce

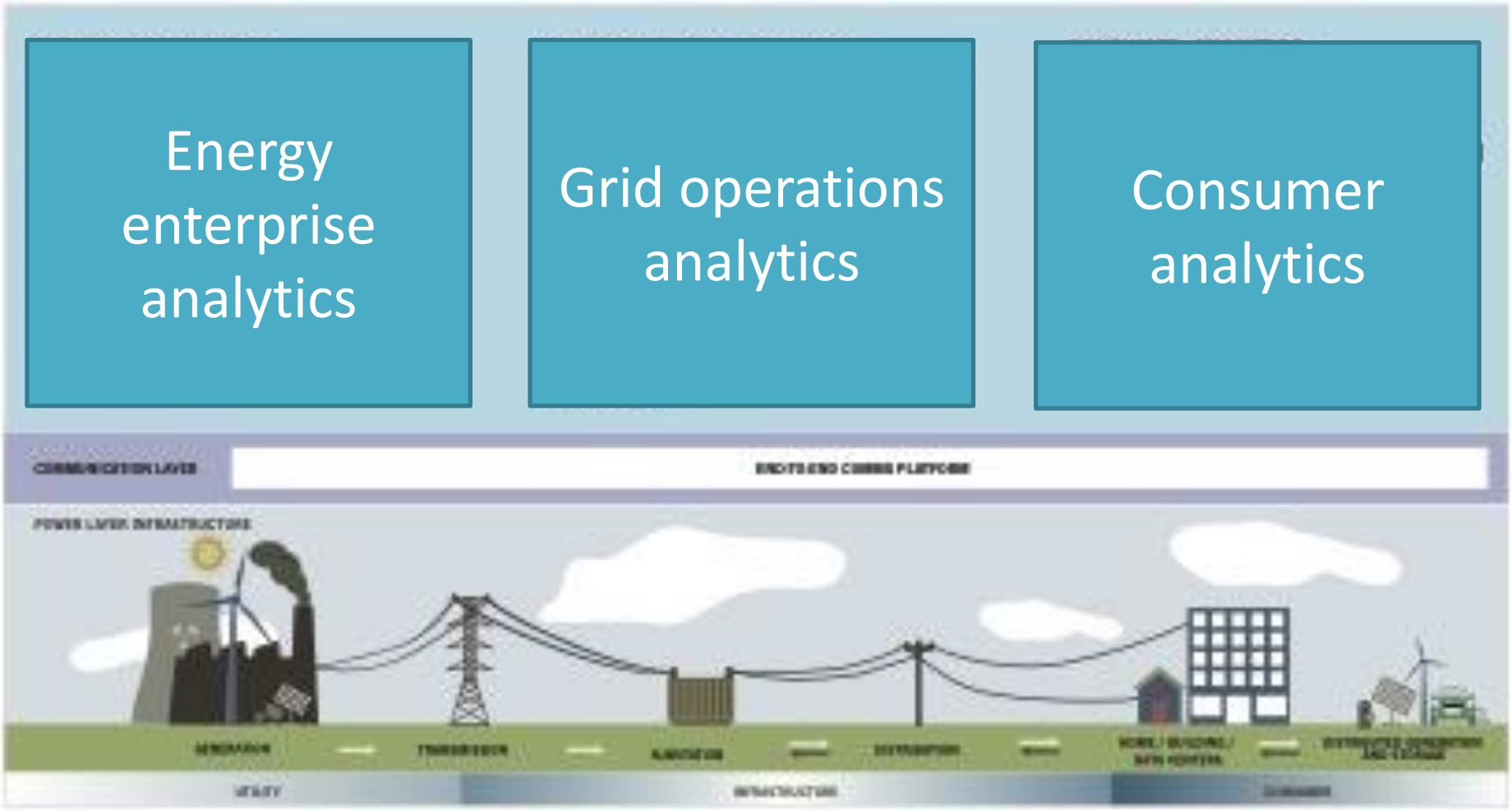
# SMART GRID DATA REQUIREMENTS

# Primary domain for data analytics

Energy enterprise analytics

Grid operations analytics

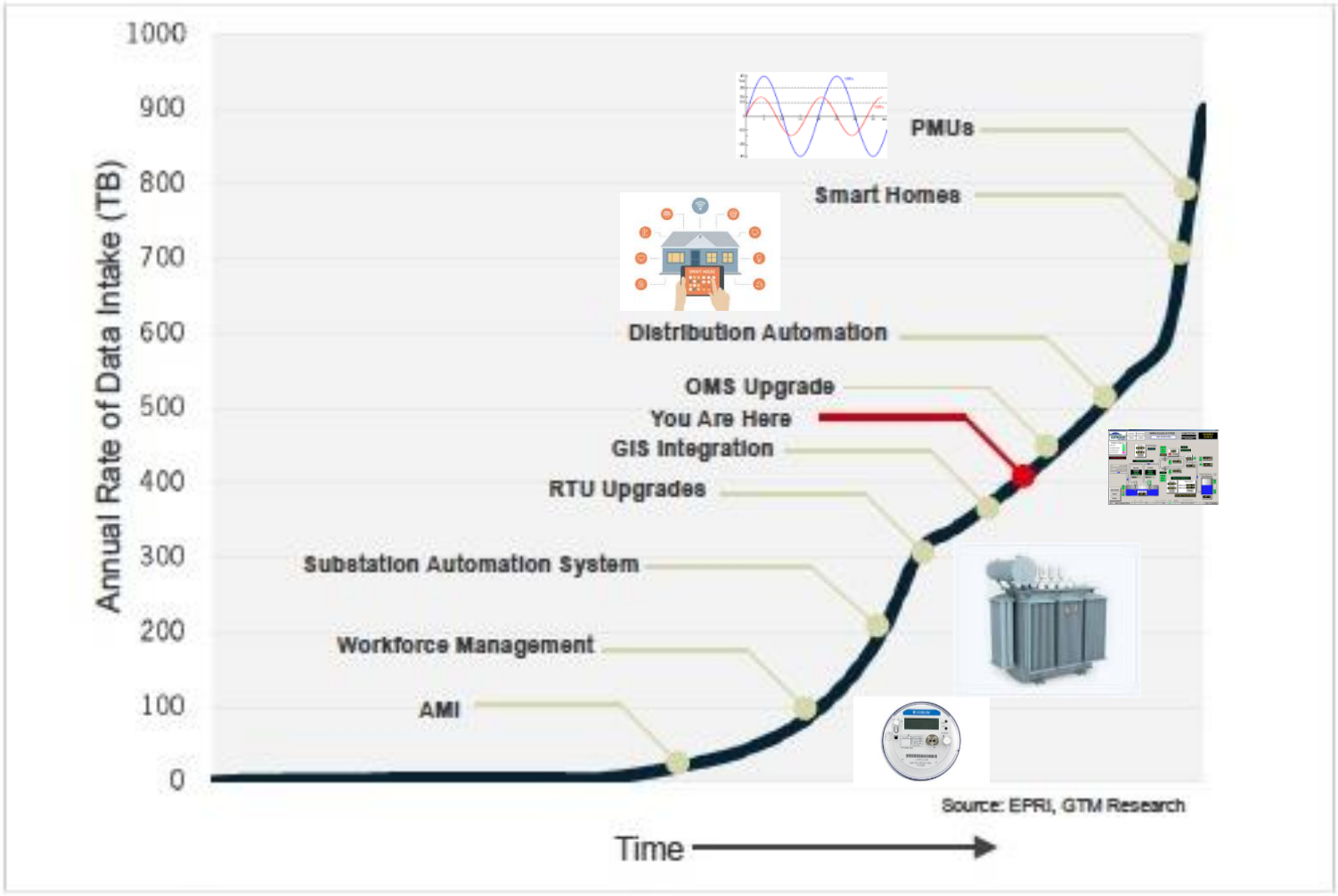
Consumer analytics



SOURCE: GTM RESEARCH

http://www.sas.com/news/analysts/Soft_Grid_2013_2020_Big_Data_Utility_Analytics_Smart_Grid.pdf

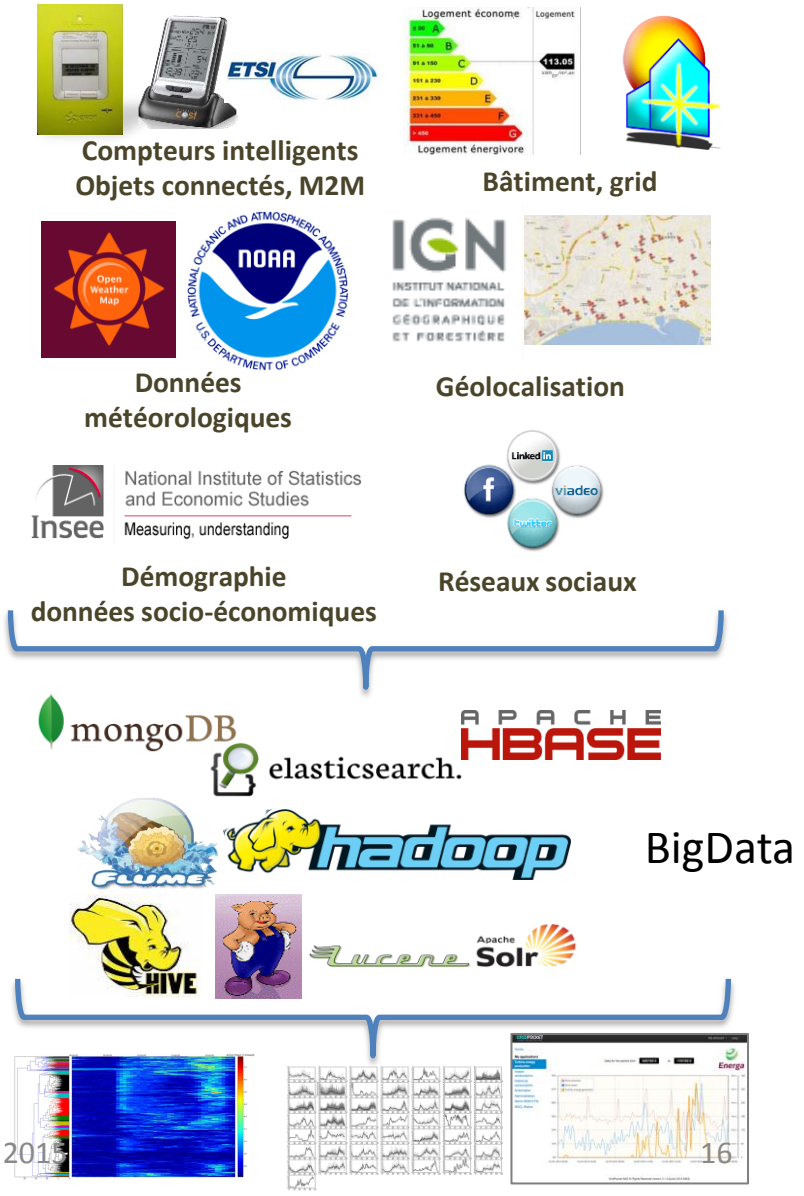
# Data generation at energy utilities



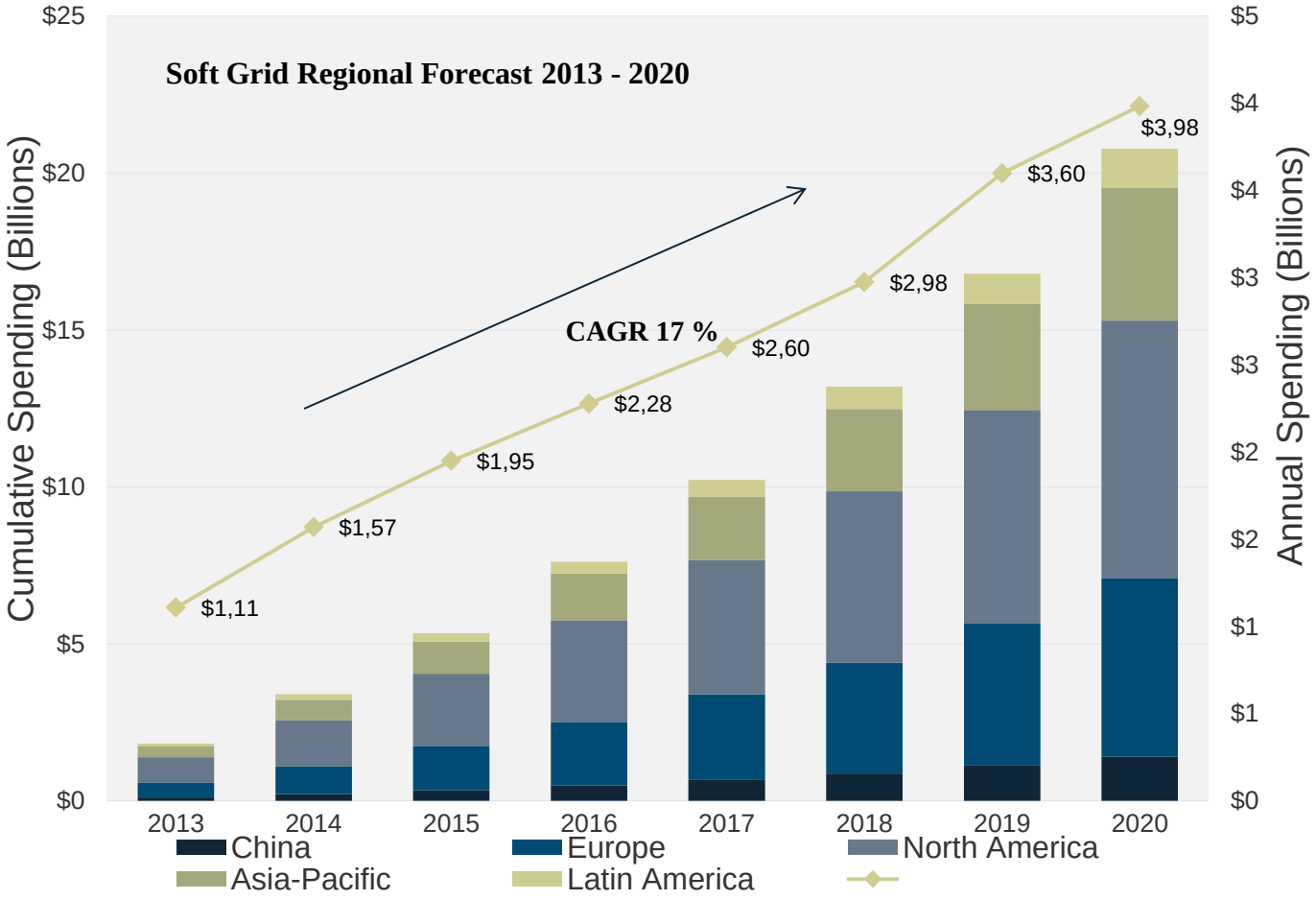

SOURCE: GTM RESEARCH

# Grid and Enterprise Analytics

- System health monitoring
  - Transformers health monitoring – combine AMI, grid sensors, weather, temperature, asset management to determine risks of failure
- Outage Management Systems (OMS)
  - Do not wait for customer to call and report problem, fix unreported outage problems
- Distributed production, plug-in EV
  - disruptive influences on the edges of the grid
  - put pressure on the distribution systems
- Synchrophasor deployment
  - Help detect and correct massive blackout problems
- Strategic assets management
  - location-specific data, satellite imaging, system-wide modeling, day-to-day field operation notes, SCADA system data and long-term asset planning
- Enterprise analytics
  - Financial models to plan for costs and benefits of future deployments



# Global Utility Data Analytics Spending




***GTM Analyst Note***

*"GTM Research forecasts cumulative global spending on smart-grid-related analytics to top $20 billion between the years 2013-2020, with an annual spend of $3.98 billion globally in the year 2020. We estimate, the achieved return on this investment will exceed $120 billion globally over the same period"*

*Source:* greentechmedia: GTM RESEARCH

# BIG FOOT RESEARCH PROJECT

# BigFoot objectives

- Analytics-as-a-Service
  - Self-tuned deployments in private (and public) clouds
  - Hardware and data consolidation through virtualization
  - Performance enhancements to mitigate bottlenecks
  - Multi-site add-ons for geo-replication
- Resource allocation mechanisms
  - New scheduling components to deal with heterogeneous work-loads
  - New work-sharing optimizations for both batch and interactive engines
- In-situ querying of RAW data
  - Distributed query mechanism to operate on heterogeneous RAW data
  - On-the-fly indexing for modern storage devices
- High-level languages
  - Scalable Machine Learning library
  - Time Series Library


# BigFoot project consortium

- Eurecom (France) *Project leader*
- Ecole Polytechnique Fedérale de Lausanne
- TU Berlin / Deutsche Telecom Lab (T-Lab) (Germany)
- Symantec (Ireland)
- GridPocket (France)

- Projet Proposal to EU FP7 Call

EURECOM
Sophia Antipolis

EPFL
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Technische Universität Berlin

Symantec.

GRIDPOCKET
PERSONAL SMARTGRID SOLUTIONS

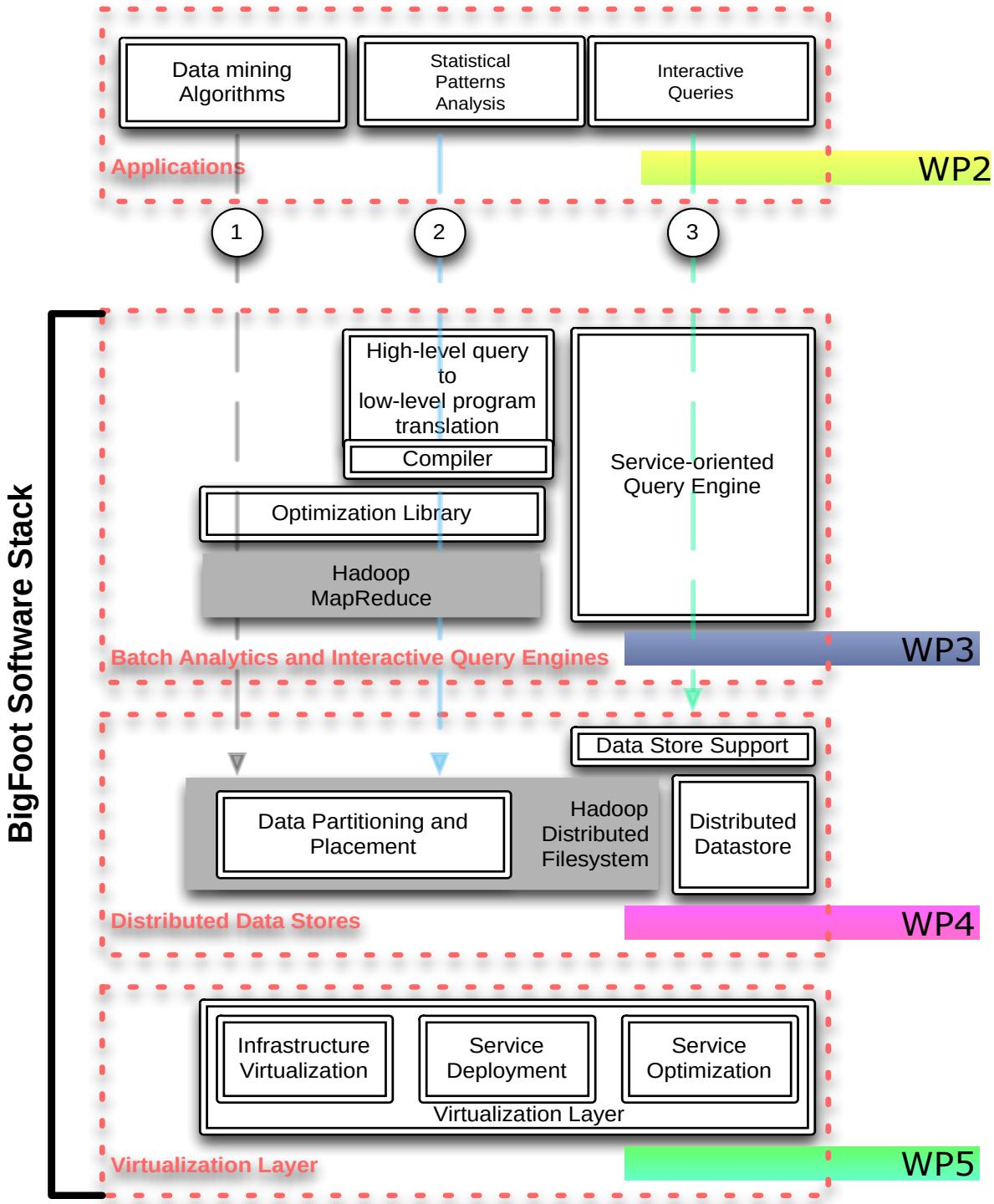
SEVENTH FRAMEWORK PROGRAMME

# Previous experience

EURECOM
Sophia Antipolis

- 100 nodes
  - single ARM v5, 1.2GHz, 512MB RAM, 64GB Flash
- Power efficient
  - 5 watts per node
- Regular network
  - GB Ethernet

HBASE HIVE hadoop


BigFoot Software Stack
Data mining Algorithms
Statistical Patterns Analysis
Interactive Queries
Applications
WP2
1
2
3
High-level query to low-level program translation
Compiler
Optimization Library
Hadoop MapReduce
Service-oriented Query Engine
Batch Analytics and Interactive Query Engines
WP3
Data Store Support
Data Partitioning and Placement
Hadoop Distributed Filesystem
Distributed Datastore
Distributed Data Stores
WP4
Infrastructure Virtualization
Service Deployment
Service Optimization
Virtualization Layer
Virtualization Layer
WP5

# Data analytics target groups

**Generic users**

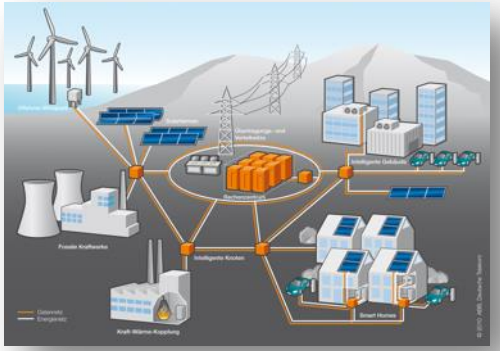
- Academic Researchers
- Engineers & Data Scientists
- Big Data Companies

**Cyber-security users**

- Security software companies
- CERT teams
- Security researchers

**Smart Grid users**

- Electric consumers
- Utility companies
- Energy data scientists



# Bigfoot usage work flow

1. Compose your VM with BigFoot components or use pre-composed VM

Pre-composed VMs

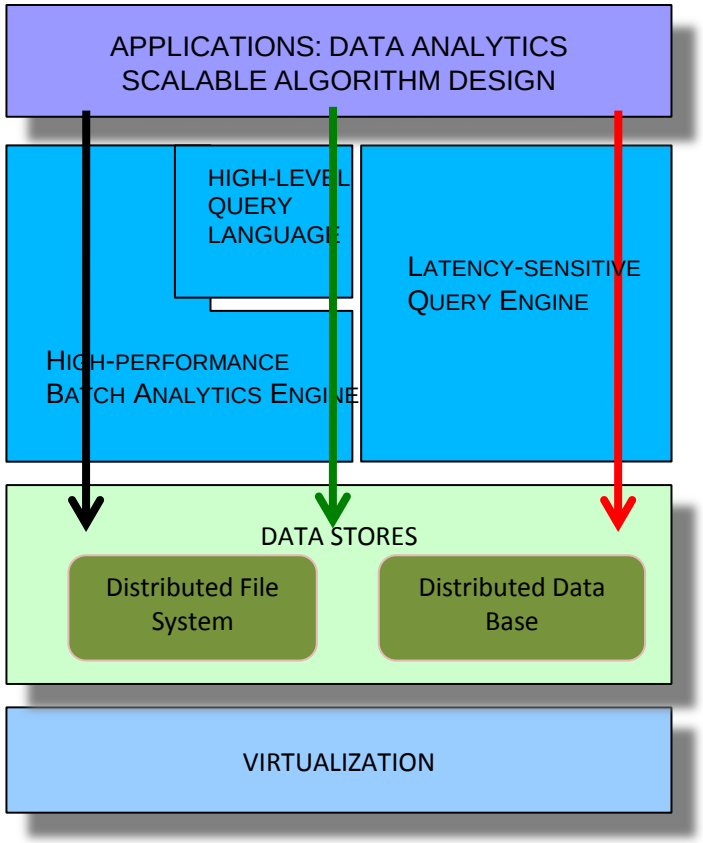
2. Deploy your cluster with fast deployment tools

3. Run your analytics Or use existing apps

Pre-composed Applications

# How is BigFoot optimised

- Optimization :
  - Currently virtualization servers are applications agnostic, (eg. If several VM share same I/O there is no benefit)
  - Network virtualization (topology configuration)
- Optimization storage layer
  - Physical optimization (layout, typically data is sorted in time, optimize the way data is written)
  - Optimization for processing performance
- Low latency and batch processing –BigFoot file system

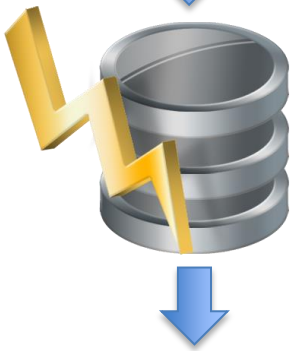


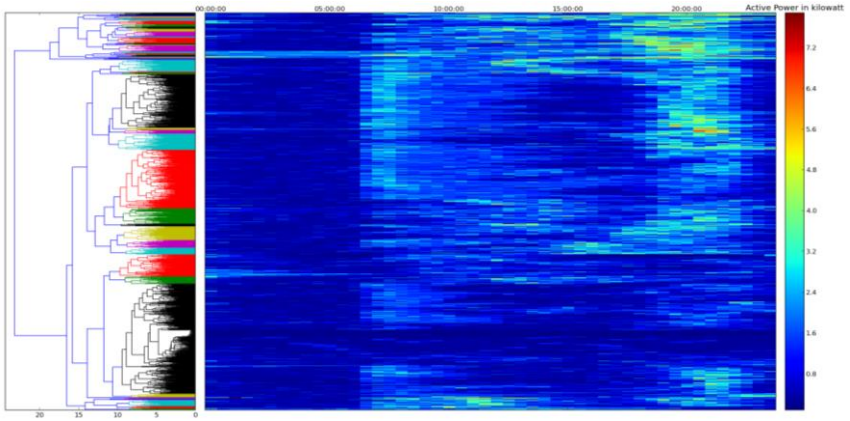
# Exploitation strategies

- Symantec
  - Innovative software products
  - Symantec.cloud (Spam BU)
  - Deepsight, Security Response and MSS (Managed Security Services)
- GridPocket
  - Platform for energy utilities
  - Behavioral energy efficiency
  - Time Series Lab product
- Academic partners
  - Academia / industry relations
  - Teaching and trainings
  - Platforms as key enablers for future research

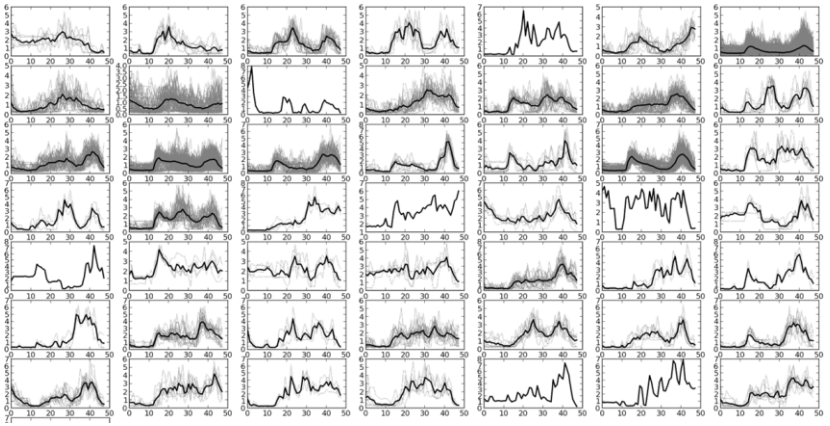
# Example application in Time Series Lab

Compteurs intelligents



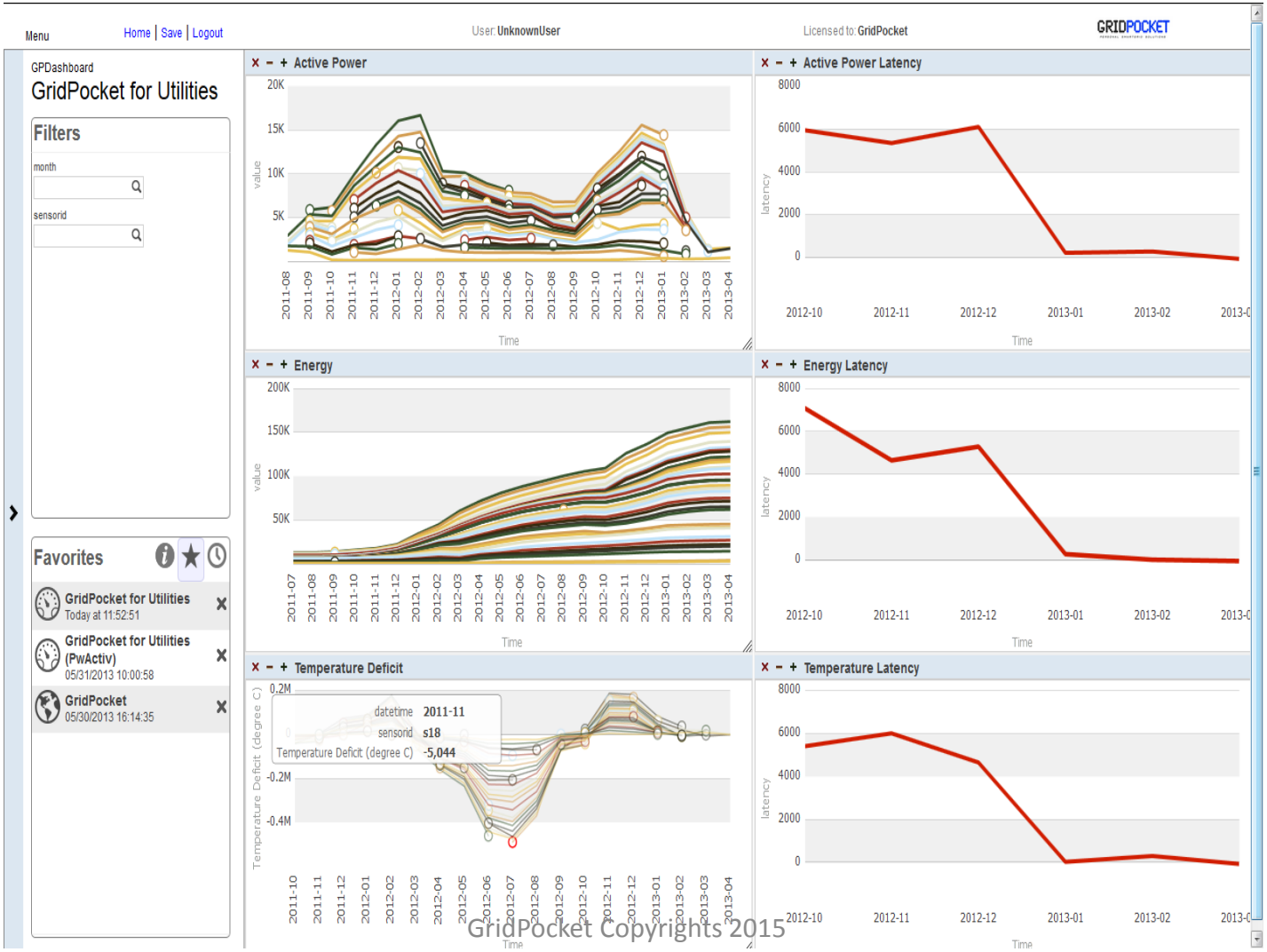



Linear Regression Tree / Random Forest - Prediction, Indicators



K-Nearst Neighbourghs (KNN) - Clustering, Prediction, Corrections

# Big Data analytics



# GridPocket Times Series Lab

- Used as part of **OpenVAS** platform

- TSL launched in January **2014**

- First customer deployment with **GDF Suez** in France

GDF SUEZ


ENERGY UTILITIES, ESCOs,
ENERGY DATA SCIENTISTS

Software-as-a-service white label platform

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## TIME SERIES LAB™

BigData & Smart Grid analytics platform for Energy utilities

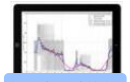
Time Series Lab™ processes terabytes of energy data at a much higher rate than traditional cloud-computing platforms. It enables the storage and analysis of raw data to provide energy consumption insights including statistical and energetic baselining for all types of energy customers. In addition, consumption forecasting and consumption profile optimization algorithms related to demand response and load peak shifting maintain the equilibrium inside the Smart Grid.

Admin interface example

**Smart services for utilities**

energy consumption management and analytics

Client's consumption profile | Baseline energy consumption | Demand response management | Real time Smart Grid monitoring | Smart Grid performance diagnosis




Essential statistical analysis of your historical consumption (resampling, statistical summaries, aggregation, distance measure, variance, autocorrelation, moving average)


Disaggregation of clients energy consumption enables to discover heating, cooling and other specific electric usages


Short-term and long-term load forecast for both utility managers and individual clients

### Turn your energy data into smart opportunities

GridPocket's platform solution for utilities is based on the cutting-edge technology for the collection, storage and analysis of BigData, which are generated by intelligent metering devices. Collecting, managing and analyzing smart metering data to create valuable information for customers is a complex and challenging task for energy utilities. Getting insights from the massive amount of meter data can produce substantial benefits for utilities - increase profit margins, optimize energy supply grid management and accelerate decision making process.

www.gridpocket.com

## BIGDATA PLATFORM

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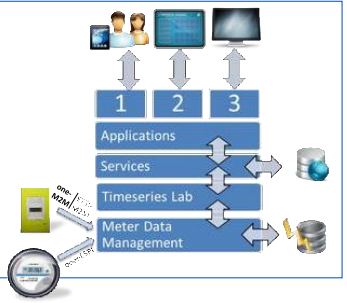
The architecture stack of BigData platform enables the collection of energy data which provides real time information concerning Smart Grid condition.

The scalability of a stack allows to process several parallel ongoing processes that are represented by synthetic information via graphs and dashboards.

The data cleaning for multiple formats, sources and technologies provides rich detail leading to value-added information.

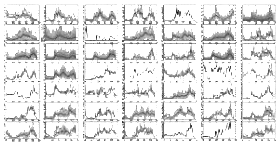
It improves the management of their metering infrastructure, help them to understand their customer's habits while providing advanced energy services and increasing customer loyalty.




### Solution

- Scalable Smart Grid data analytics
- Complex graph – based data integration
- Data exploitation
- Data mining, graph mining
- Dashboards
- Deliver reports or workflows + maintenance
- Maintenance
- Adapting products to different use cases

### Clustering of cost curves example



### Technology support & consulting

- Hardware and Architecture specification
- Platform profiling and tuning
- Virtualization
- Code developement and optimization
- Large-scale energy data collection and storage in NoSQL, Mongo DB, HDFS, Hive, Pig, Oozie, HBase and more

### References

As a European BigFoot project contributor, we have deployed our technology of Time Series Lab™ for data collection, storage and treatment of big volume of energy data.

### Open energy data platform use case

Platform performs an energy data collection and storage from the variety of tertiary buildings (enterprises, universities, sme). The time series of energy data variables are then sent to the database and proposed to third person via user interface.

Open energy data platform proposes open API to developers. The access is protected by an authorization request HTTP and a data validation system.

mongoDB | Spark | mahout | one M2M

### CONTACT INFORMATION

Become our partner
www.gridpocket.com

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EMAIL US
contact@gridpocket.com

GRIDPOCKET
300 Route des Crêtes
06560 Sophia-Antipolis
France

# EXMPLES REAL PROJECTS

# GridPocket plateforme technologique

**Smart Meters**

0110100101

**Intelligent buildings**

0110100101

**Other data sources**

0110100101

GRIDPOCKET

PERSONAL SMARTGRID SOLUTIONS

Behavioral consumer engagement

M2M apps

Energy search engine (Big Data)

Semantic M2M (ETSI)

$$$

**End Users**

- Gratification
- New services
- Energy savings

$$$

**Utilities**

- Increased customer profit
- CO2 reduction
- Customer retention

$$$

**Manufacturers**

- Embedded software
- Time to market

# EcoTroks energy rewarding

Energy data

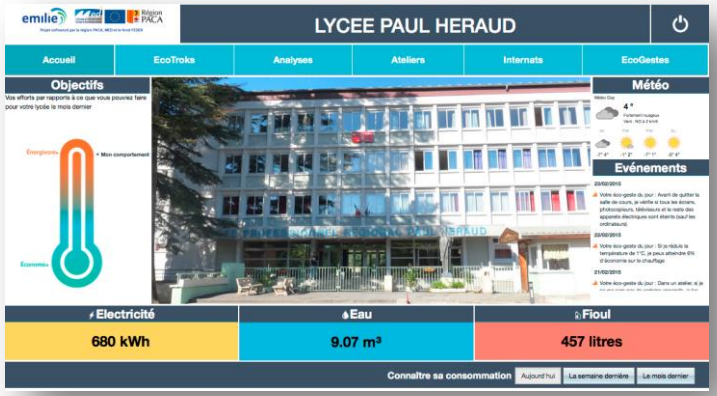

Efficiency indicator

EcoTroks

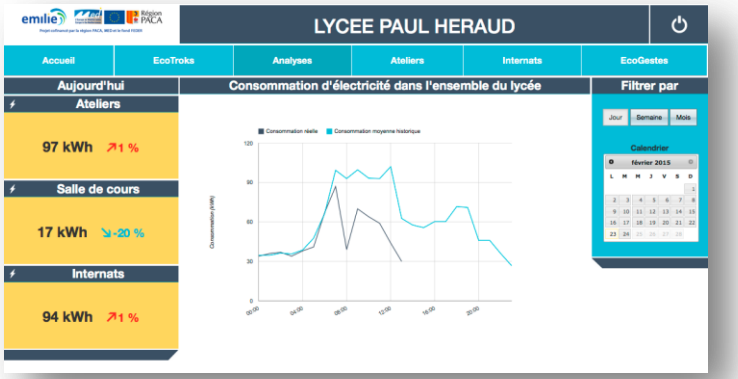
Behavioral stimulation :

- Reduce consumption
  - Off-peak usage
  - Peak shaving

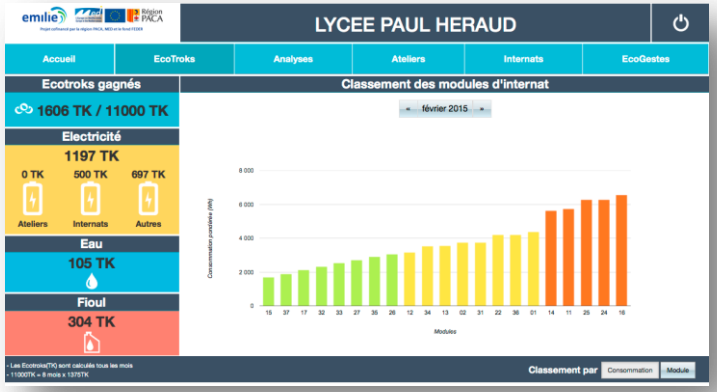
# EcoTroks Pro – buildings efficiency



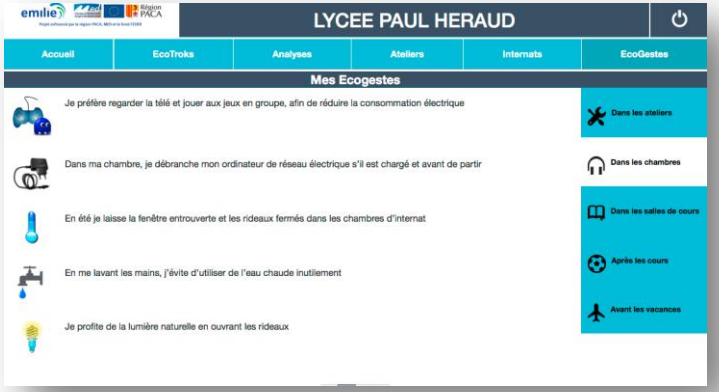

Ecran tactile d'information




Analyses en temps réel



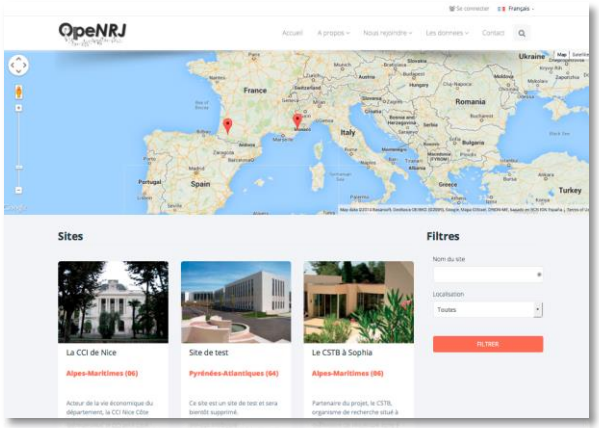

Comparaisons et défis



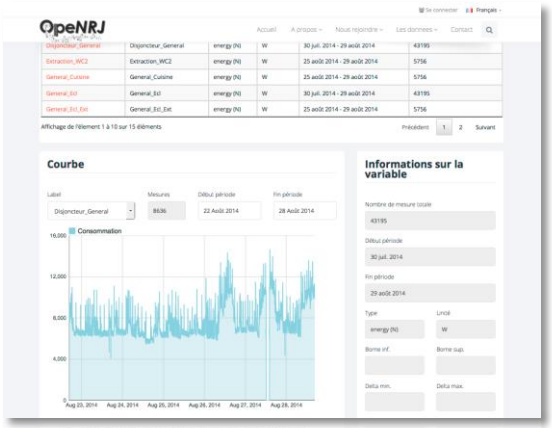

Conseils énergétiques

# OpenNRJ – public open energy data service


Plateforme publique
de collecte et diffusion
de données énergétiques
ouverte à tous et gratuite.



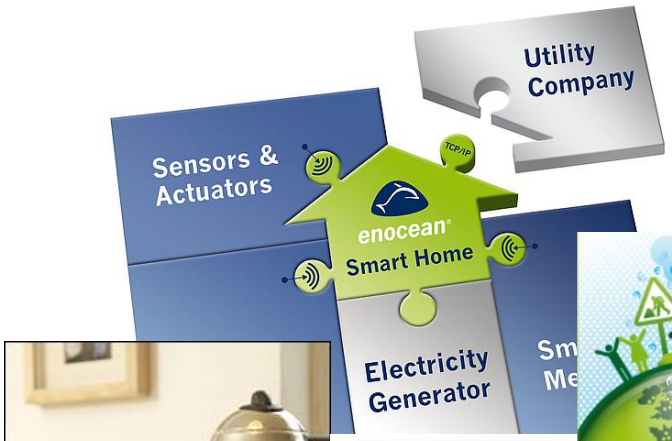

Plusieurs sites actives
(mairies, médiathèque,
université, labos, bureaux).
Possibilité d'ouverture de
nouveaux sites.



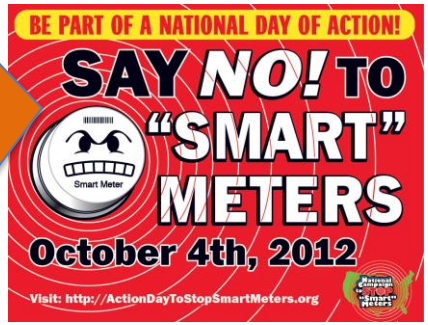

Visualisation, téléchargement,
API. Données de consommation,
production, éléc, gaz, eau.
Metadata de bâtiments.

# DATA PRIVACY

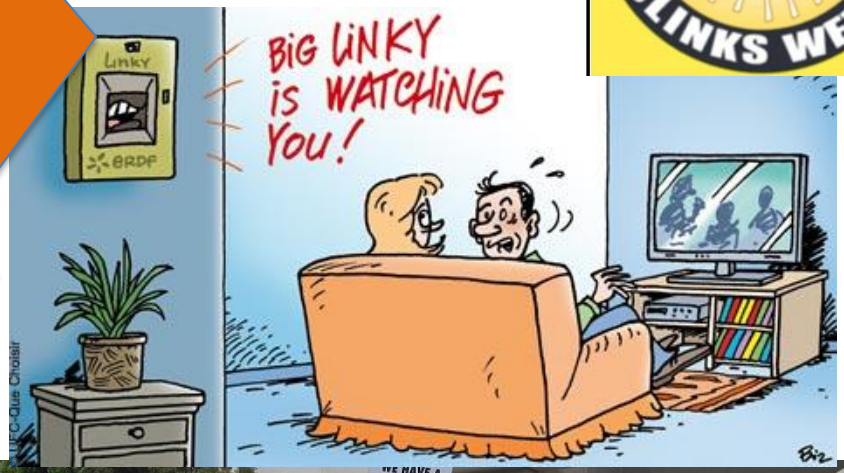
# Smart Grid Privacy Issues





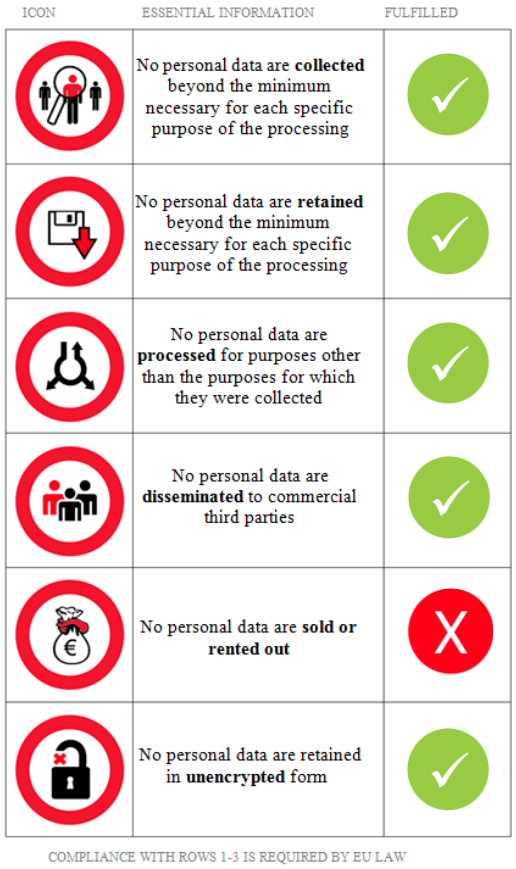







# Data privacy

- Currently EU Data Protection Directive 95/45/EC
  - 28 different interpretations
  - Not sufficient with globalization and cloud technologies
- France CNIL (Commission Nationale de l'informatique et des libertés)
  - Recommandation 15 novembre 2012
  - Minimise data collection, consumer opt-in for services
- EU General Data Protection Regulation - ongoing
  - **Privacy by Design** and by Default (article 23)
  - Consent (article 7)
  - Data breaches and transparency (article 31, 32)
  - **Right to erasure** (right to be forgotten)
  - Data portability
  - Sanctions up to **100 million EUR** or 5% annual worldwide turnover
- Expected adoption in 2015, enforcement from 2017



| ICON | ESSENTIAL INFORMATION | FULFILLED |
|---|---|---|
| | No personal data are **collected** beyond the minimum necessary for each specific purpose of the processing | ✓ |
| | No personal data are **retained** beyond the minimum necessary for each specific purpose of the processing | ✓ |
| | No personal data are **processed** for purposes other than the purposes for which they were collected | ✓ |
| | No personal data are **disseminated** to commercial third parties | ✓ |
| | No personal data are **sold or rented out** | X |
| | No personal data are retained in **unencrypted** form | ✓ |

COMPLIANCE WITH ROWS 1-3 IS REQUIRED BY EU LAW

EU General Data Protection Regulation


# *Thank you!*

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