NRG4CAST

ENERGY FORECASTING

Project overview

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NRG4Cast - Introduction

- Duration 3 years: 1.12.2012 – 1.12. 2015

- 8 partners:
  1. Institut Jozef Stefan (JSI), Slovenia
  2. Forschungsinstitut fuer Rationalisierung, (FIR) Germany
  3. Consorzio per il sistema Informativo, (CSI PIEMONTE), Italy
  4. IREN Rinnovabili SRL, (IREN) Italy
  5. Envigence, Okoljska Inteligenca, d.o.o., (ENV), Slovenia
  6. National Technical University of Athens, (NTUA), Greece
  7. Kentro Ananeosimon Pigon ke Exikonomisis Energeias - Centre for Renewable Energy Sources and saving Kape (CRES), Greece
  8. SingularLogic Sanonymi Etairia Pliroforiakon Sistimaton kai Efarmogon Pliroforikis (SINGULARLOGIC), Greece

NRG4Cast – Summary

NRG4Cast is developing real-time management, analytics and forecasting services for energy distribution networks

- analyse information:
  - network topology and devices,
  - energy demand and consumption,
  - environmental data and energy prices data.
- software module pipeline providing **prediction** and the **decision support system** based on network monitoring, anomaly detection, route cause analysis, trend detection, planning and optimisation.
- Technologies: machine learning, data and text mining, stream mining, link analysis, information extraction, knowledge formalisation and reasoning.

Focus on electric power networks through the development of a generic framework that will be able to **control, manage, analyse** and **predict behaviour** in an extensible manner on other **energy networks** like gas distribution, heat water distribution and alternative energy distribution networks.

Expected results

- generic toolkit with programmable data adapters
- a set of real-time monitoring and prediction services provide to different stakeholders unique service for:
  - energy planning,
  - network failure and
  - energy price prediction

- Challenges:
  - different types of information
  - highly dynamic environment of energy distribution networks
  - those services have to be applicable in any type of energy distribution network

Case studies

The project is focused on local communities:

- Information from different local infrastructures:
  - the streetlight network, local gas distribution network, local heat distribution network and public buildings.
- Evolution of electric cars usage and micro energy productions

- Case studies:
  - Energy Efficiency in municipalities (Miren - Kostanjevica)
    - Living Laboratory; Miren-Kostanjevica will also integrate its urban environment monitoring service
  - NTUA Campus – energy positive buildings
    - Internal and external data sources
  - Energy efficiency in city districts
    - data from the network consisted from traditional and renewable energy sources as the energy provider/distributor
  - Smart Charging - FIR
    - The involvement of an emerging energy model with unpredictable behaviour into traditional energy distribution network.

Street lighting pilot

- **Municipality**: Street lighting in Municipality (Miren-Kostanjevica, Slovenia) with more than 250 streetlights in a cognitive network equiped with multiple sensor/actuator nodes (exact measurements of CO_2 reduction)
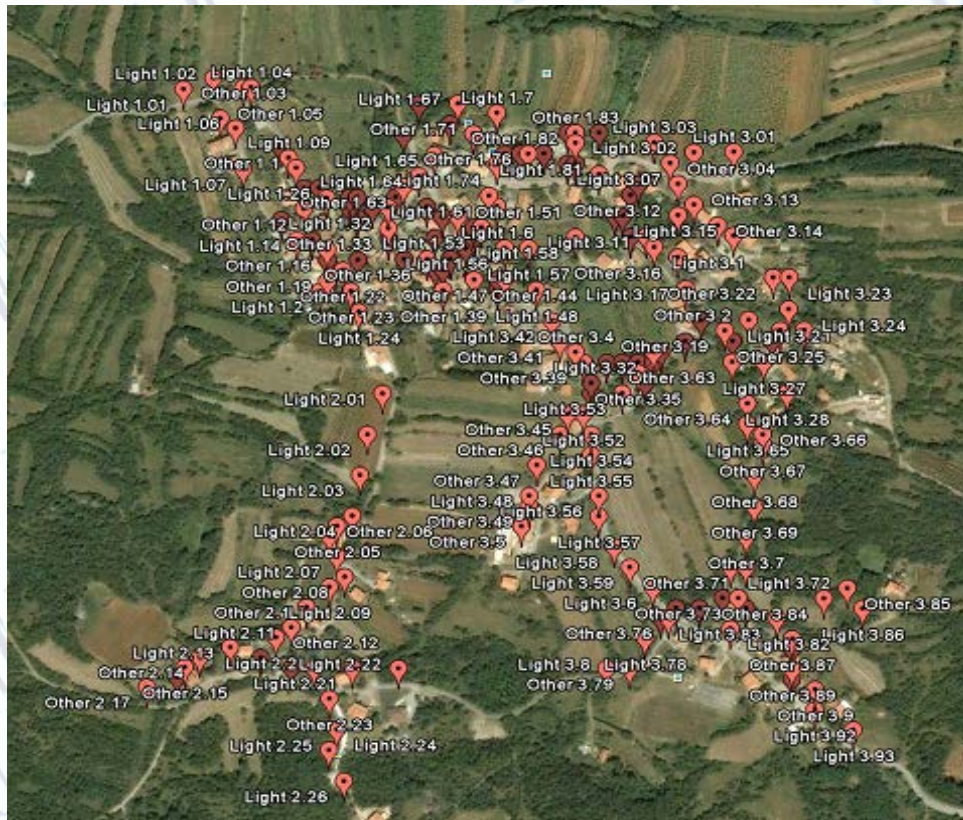
A University Campus Pilot

- **Neighbourhood**: A University Campus (Athens, Greece) with 62 buildings with high demand in electricity, heating and cooling, with serious considerations of monitoring energy consumption both from environmental but also economical point of view.
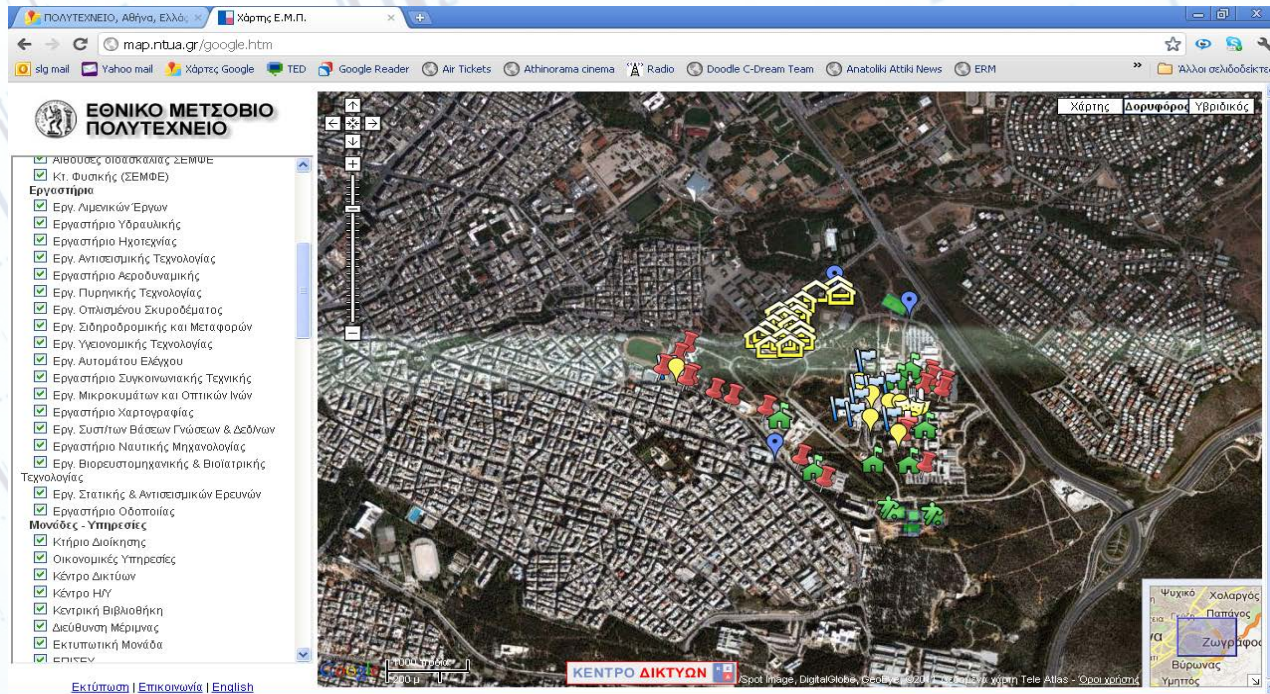
City district

- **Old city buildings**: energy consumption in historical city (Torino, Italy) for improving energy efficiency and predicting the energy consumption in historical buildings.
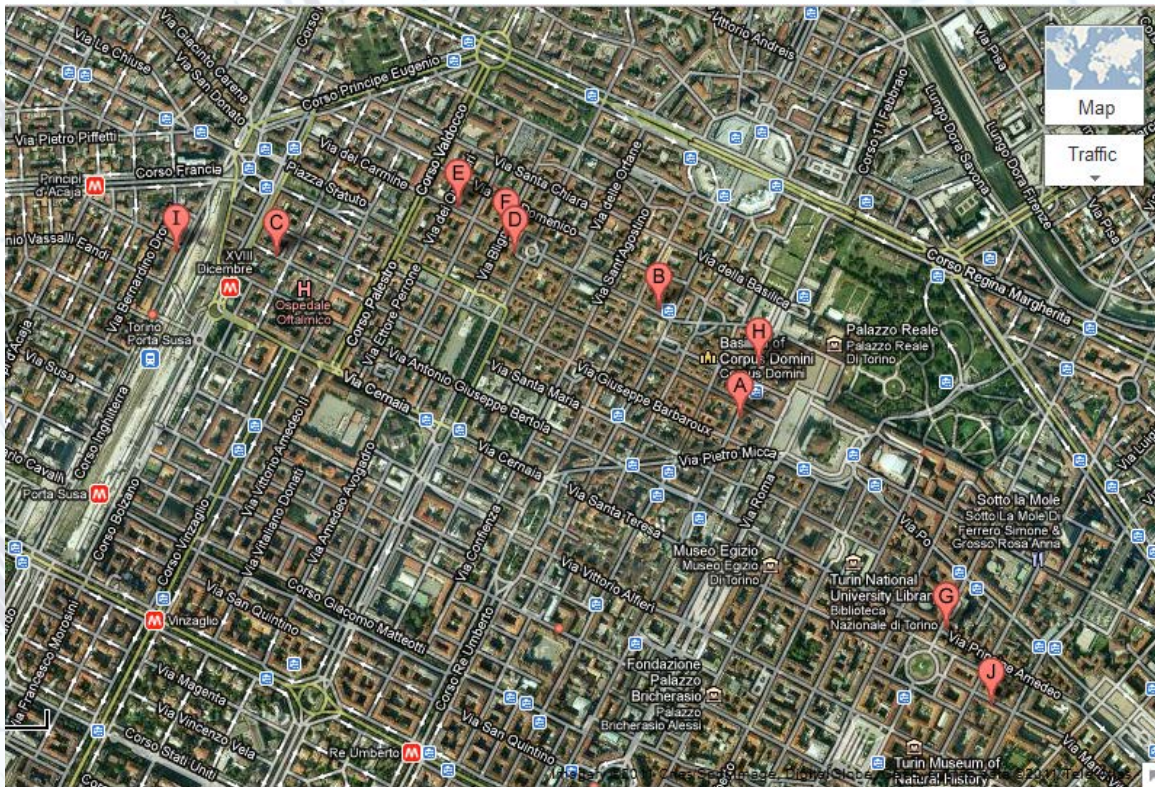
Electrical cars Pilot

- **Electric vehicles:** A smart charging method for electrical vehicles and solutions for forecasting energy demand from electrical vehicles into the urban/ neighborhood area (Aachen, Germany).

Energy4Cast goals

- The aim of NRG4Cast project is to develop advanced solutions for predicting behavior of large energy networks for the three fundamental scenarios:
  - Predicting energy demand on several granularity levels (region, country, energy distribution operator, city, business, household),
  - Predicting energy network failures on an international, national and local network topologies,
  - Detecting short term trends in energy prices and long term trends in national energy policies.
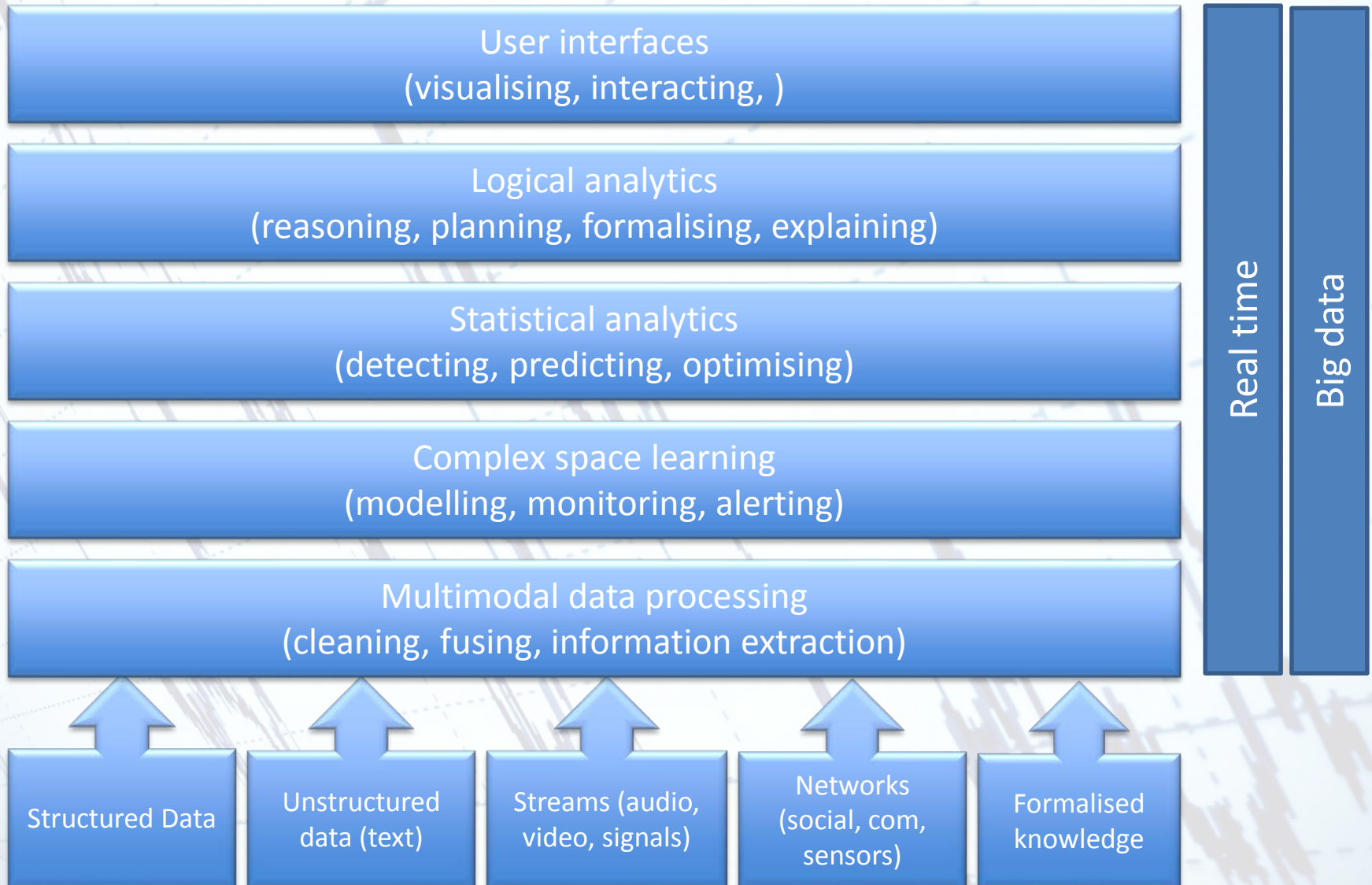
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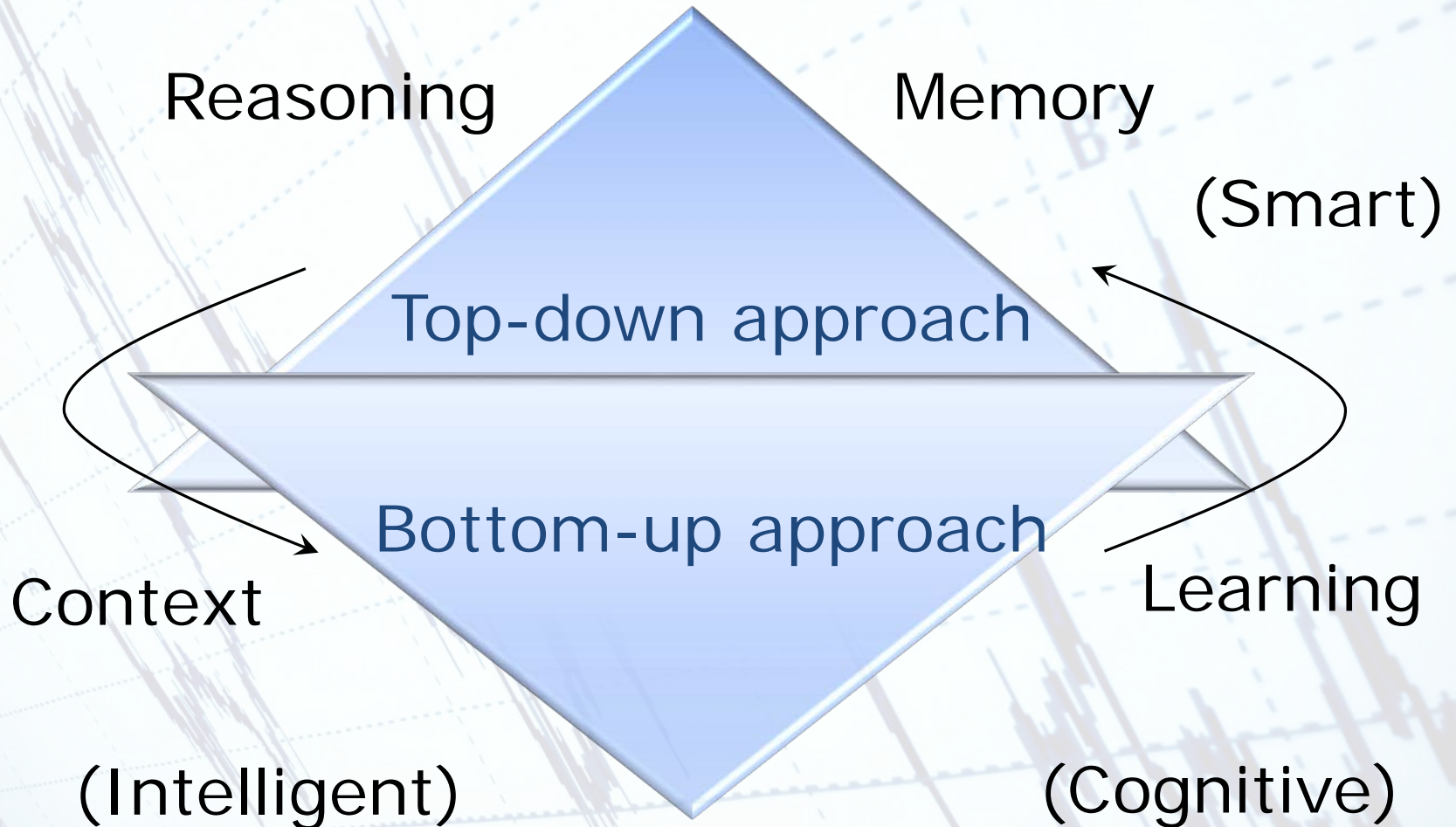
How do we do that?

- Analyse

- Model

- Understand

- Simulate

- Optimise

- Predict

- Plan
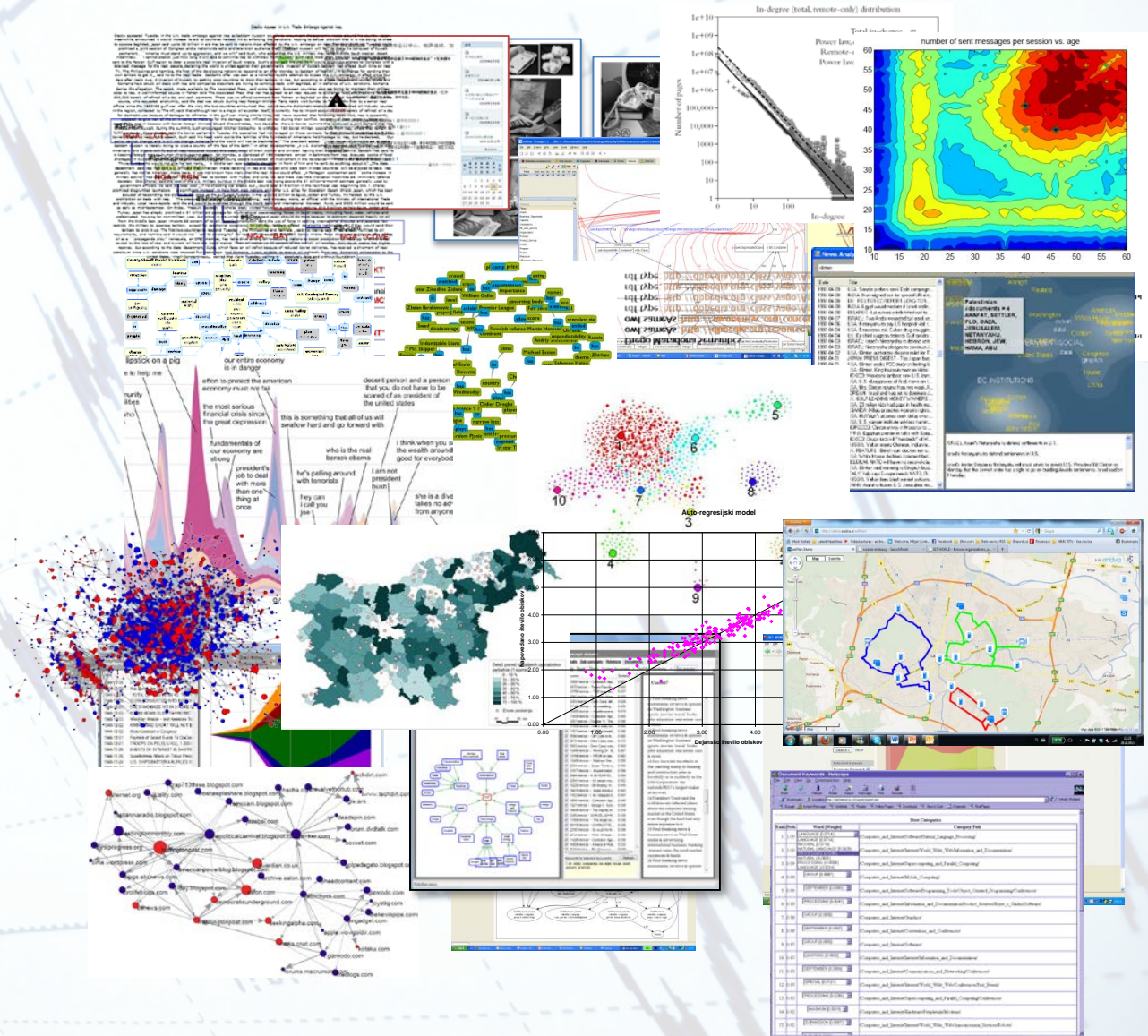
How do we do that?

User interfaces
(visualising, interacting,)

Logical analytics
(reasoning, planning, formalising, explaining)

Statistical analytics
(detecting, predicting, optimising)

Complex space learning
(modelling, monitoring, alerting)

Multimodal data processing
(cleaning, fusing, information extraction)

Real time

Big data

Structured Data

Unstructured data (text)

Streams (audio, video, signals)

Networks (social, com, sensors)

Formalised knowledge

NRG4Cast project

| Intelligent sensors

Existing infrastructure information

Energy bidders

Weather forecast, temperature,... | Data conversion and data adapters

Data cleaning and data fusion

Distribution | Modelling

Information extraction

Semantic Enrichment

Metadata generation | Compelx events detection

Route cause analysis

Knowledge formalisation | Complex events description

Multicriteria optimisation

Situational awareness |

Predicting energy demand

| Network topology | | | **Realtime** | Real-time **decission** | Warnings and reaction |

Predicting energy network failures

| Energy prices | cleaning | modeling | complex events **detection** | Trend detection, **Optimisation and Planning** | Context, plan generation |

Predicting energy prices

| | **Traditional networks** | **New energy network models** | **Integrated networks** | **Reasoning, diagnosis** | **API, Toolkit** |

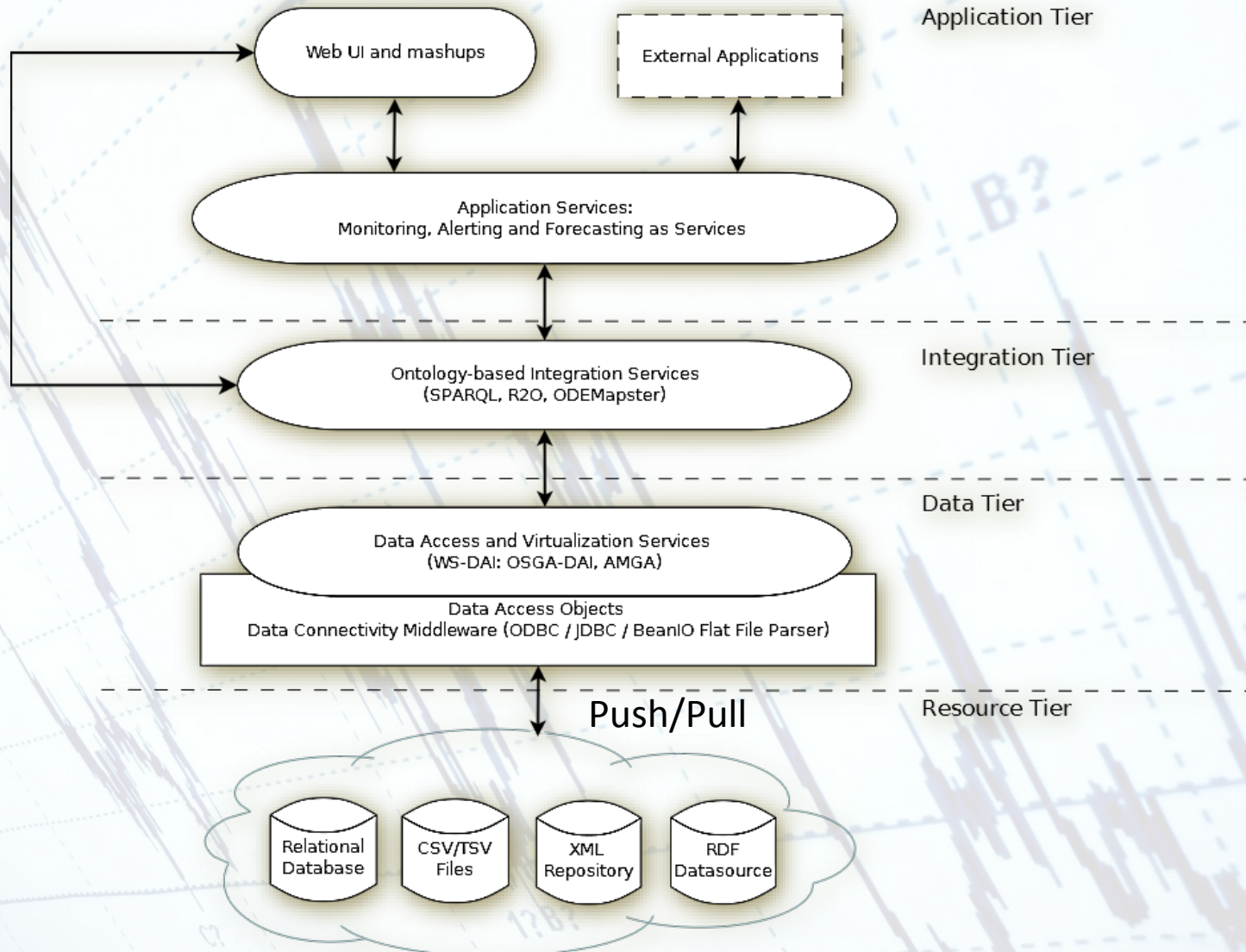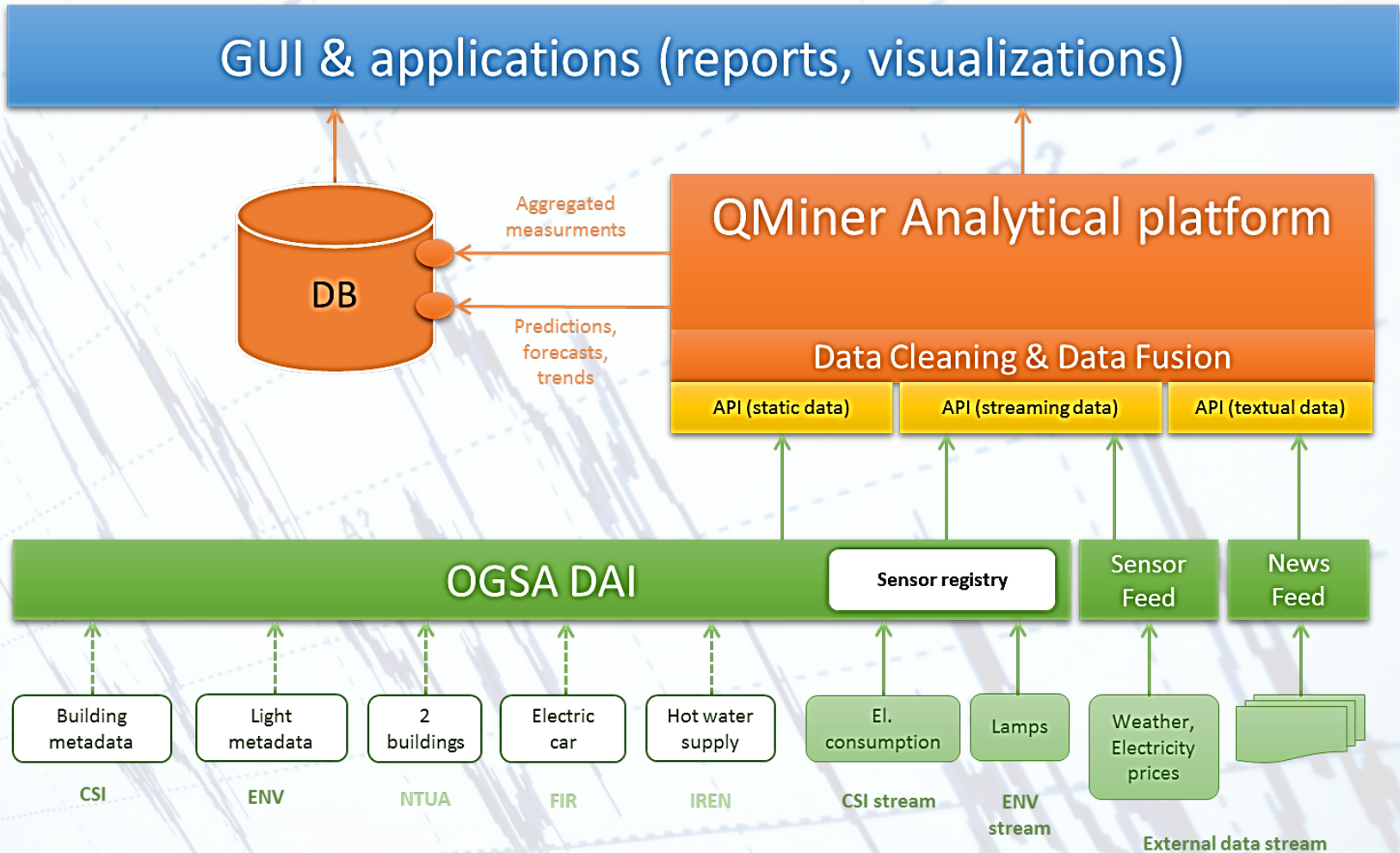| WP1 | WP2 | WP3 | WP4 | WP5 | WP6 |

NRG4CAST Toolkit Architecture

NRG4Cast architecture

Data management: lessons learned

- Data cleansing and fusion:
  - No easy solution for multimodal data
  - Extensive variations in type of data errors
    - each data-source has its own regularities/irregularities

- Data integration:
  - Two data silos:
    - Real time functionalities vs static-structured (summarized) data
  - Consolidated data model for static and dynamic data

  - Ontology usage:
    - No one-big ontology
    - registration of various sensor nodes (metadata) – data fusion
    - Applications of Reasoning (knowledge extractions)

Join as community partner

- NRG4CAST offers the opportunity for organizations to become community partners of the NRG4CAST:
  - Energy providers
  - Energy consumers
  - Industrial associations with members in the field of energy production, trade and distribution
  - Cities/ municipalities
  - Projects/initiations focusing on energy efficiency in urban environments
  - Associations and other interested parties

Join as community partner

- Rights of Community Partners:
  - Access to research, and data provisioning and management results
  - Ability to participate in training, dissemination and community building events
  - Access to open training infrastructure
  - Early access to ongoing NRG4CAST results through participation in NRG4CAST meetings
  - Partner logo listed on NRG4CAST website
- Opportunity to shape the results and topics of the NRG4CAST programs through contribution of requirements and use cases

Thank you!