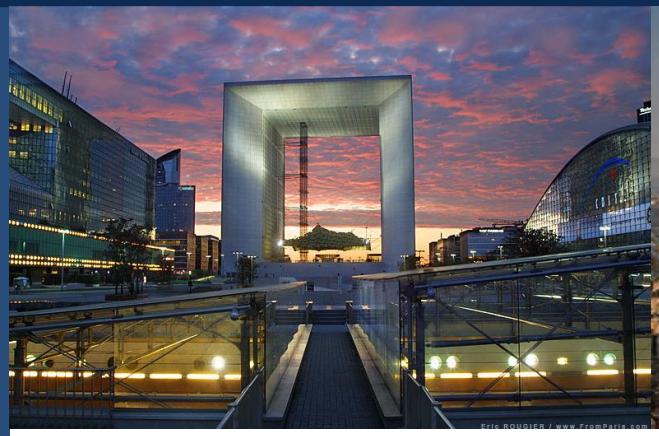
EUROPEAN
TURBINE
NETWORK



ETN AGM & WORKSHOP

2-3 April, Paris La Defense, France

EUROPEAN
TURBINE
NETWORK

FLEXIBLE GENERATION
FLEXGEN

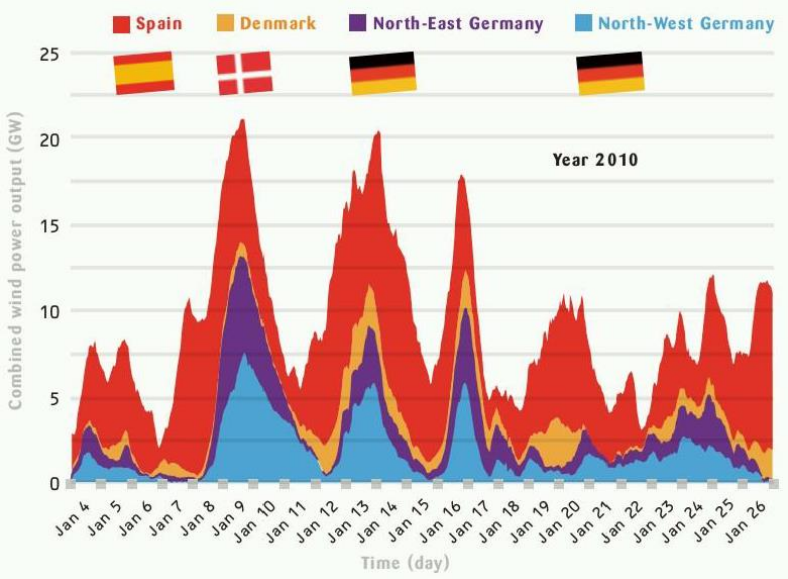
HERWART HÖNEN / PETER BREUHAUS

RWTH Aachen University / IRIS

EUROPEAN TURBINE NETWORK

Background

Power Generation

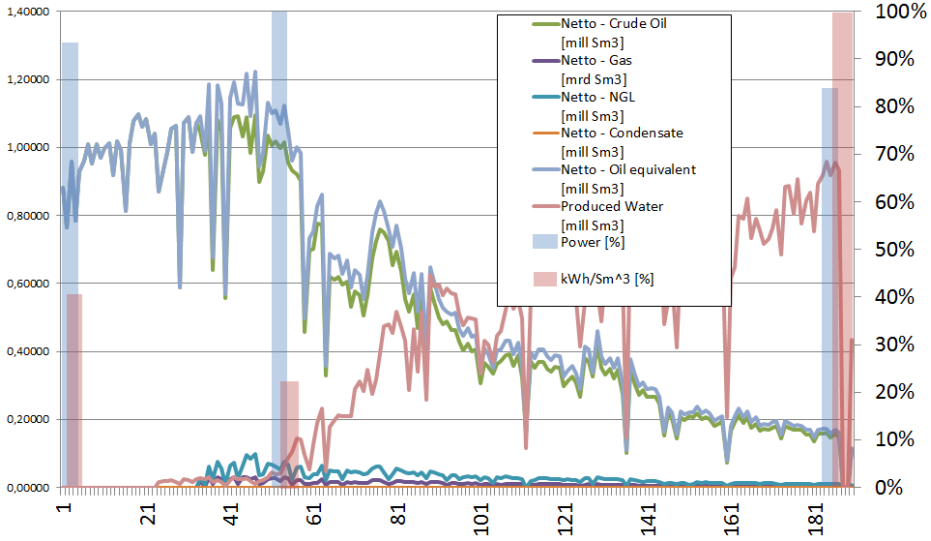


- Fluctuating wind energy
- React by cyclic GT operation

Oil & Gas Application

Island mode (e.g. platform)

- Steady state operation, planable load changes
- A “lead unit” balances frequency and load changes



EUROPEAN TURBINE NETWORK

Motivation

Increasing share of

- Part load operation
- Cyclic operation
- Starts / Stops

- Part load efficiency / emissions
- Life time consumption

Operational costs ⇔ proceeds

Continuous

- Part load operation
- Share as defined by operator
- Starts / Stops
- Frequency / load stabilisation

- Part load efficiency / emissions
- Life time consumption (very high change rates for Hz balancing)

Operational costs ⇔ proceeds

EUROPEAN TURBINE NETWORK

Objectives

Methodology and software framework for

- cost efficient operation of existing GT installations under highly fluctuating demand and supply patterns
  - technical aspect of energy efficiency as well as the important
  - aspects of technical and economic risks, via techno-economic evaluation

- Layout & design new plants adapted to complex and continuously changing operational conditions
  - minimisation of fuel and resource consumption
  - minimisation of emissions and environmental impact
  - optimization of cash return
  - minimization of operational risk

EUROPEAN TURBINE NETWORK

Boundary Conditions

Taking into account

- Performance behaviour of the single equipment units for different load levels
  - Efficiency
  - Emissions
  - Warm-up operation mode
  - Minimum and maximum loads
- Technologic limitations
  - Maximum load ramp rate of gas turbines, HRSGs, compressors, ……
  - Minimum downtime period
  - Maximum number of start-ups
- Techno-economic aspects
- Industrial experience (Utilities, Oil & Gas companies)

EUROPEAN TURBINE NETWORK

Expeted Outcome

Tool to support (for a given operational scenario) optimised

- operation of existing installations
- design of new plants

Analysis and optimisation of short-term operation of existing installations

Minimisation of operational cost or other relevant objective functions

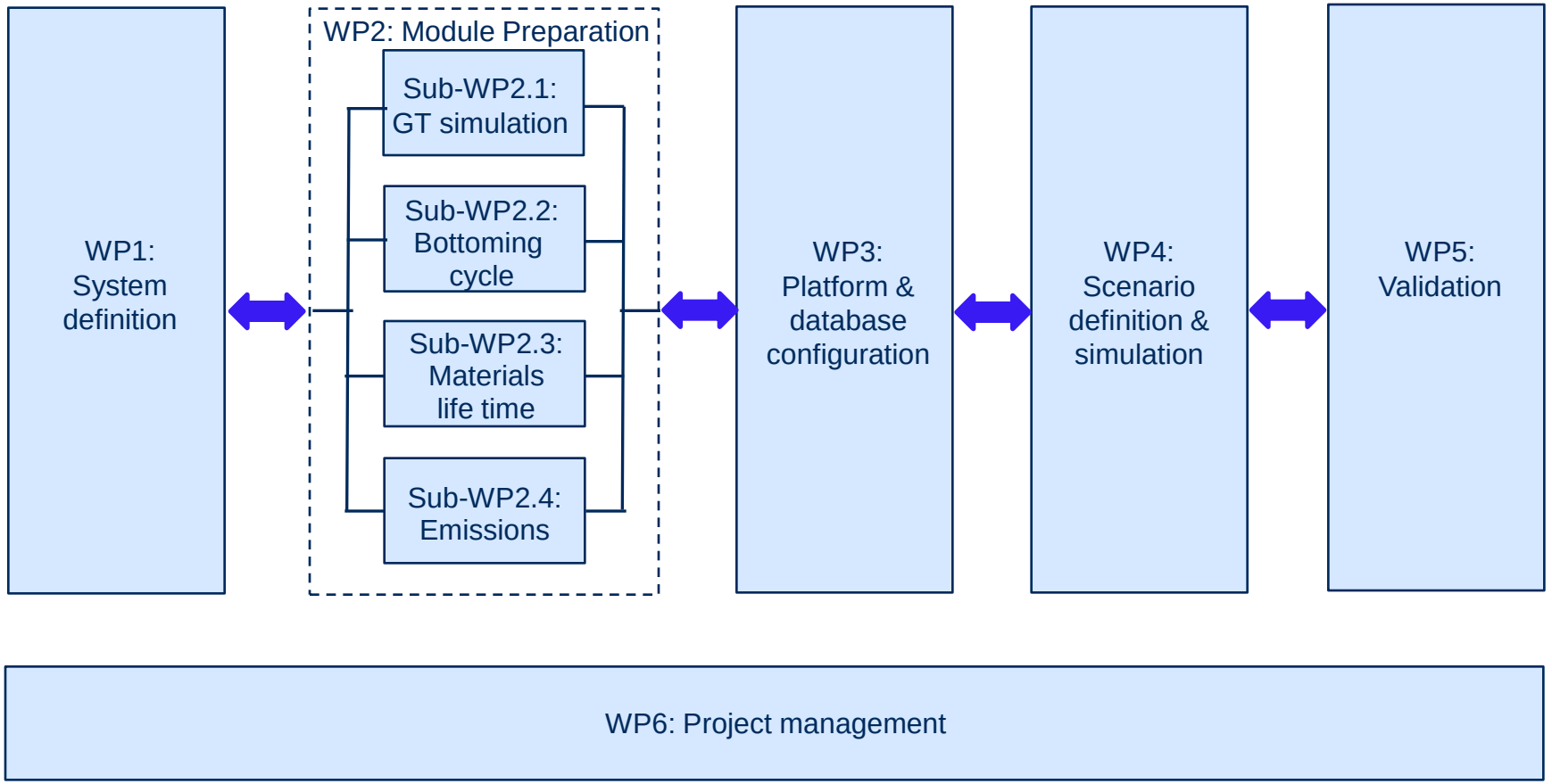
(e.g., minimum energy consumption, minimum CO_2 emissions, …….)

Reduced operating costs

- Lower energy costs
- Lower Emissions
- Reduced costs for applying changes and modifications
- Risk reduction (minimise loss of production) in case of component failure
- Optimised life cycle costs of the plant

EUROPEAN TURBINE NETWORK

Workplan



EUROPEAN TURBINE NETWORK

POWER PLANT FLEXIBILITY IMPROVEMENT: RESEARCH AND IN-FIELD DEMONSTRATION

V. CASAMASSIMA, A. GUAGLIARDI, V. PRANDONI, F. CERNUSCHI

RSE – Ricerca sul Sistema Energetico- Italy

EUROPEAN TURBINE NETWORK

Objective

The main objective is to enable a **more flexible operation** of **existing** fossil (gas and coal) fired power plants, keeping a reasonably **low life consumption rate** of the critical machinery (gas turbines, boilers, steam turbines) in a costs effective manner.

More flexible operation essentially means:

- More frequent and faster plant start up
- Steeper load gradients
- Minimum output decrease

always keeping high plant and personnel safety, acceptable O&M costs, high efficiency, stack emissions within allowable limits

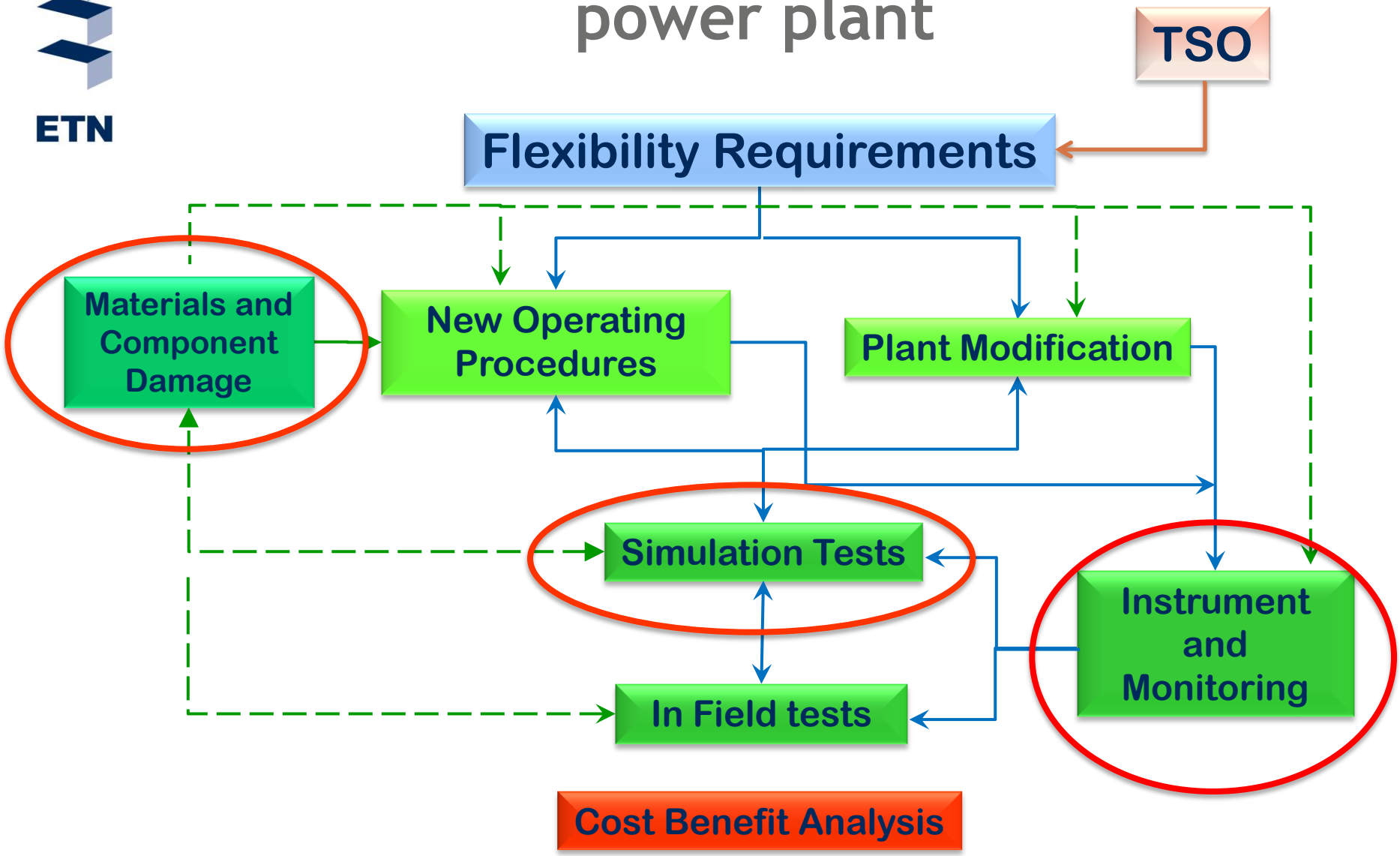
EUROPEAN TURBINE NETWORK

Objective

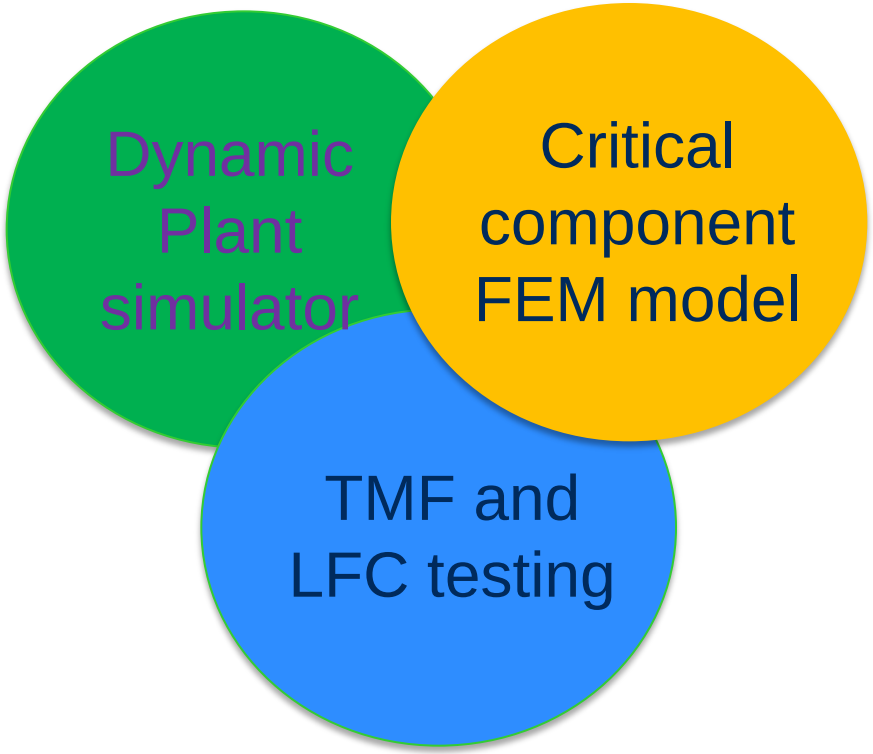
This can be achieved through:

- new operating procedures (start-up, shut-down, load ramps, etc.);
- Component (e.g. new combustion systems, HRSG stack diverter, warming systems, additional steam turbine bypass and steam desuperheaters) and control system modifications;
- advanced diagnostics and monitoring systems development;
- systematic modeling and simulation of power plants functional and mechanical behavior, in order to assess impacts of flexible operation on plant life consumption and emissions.

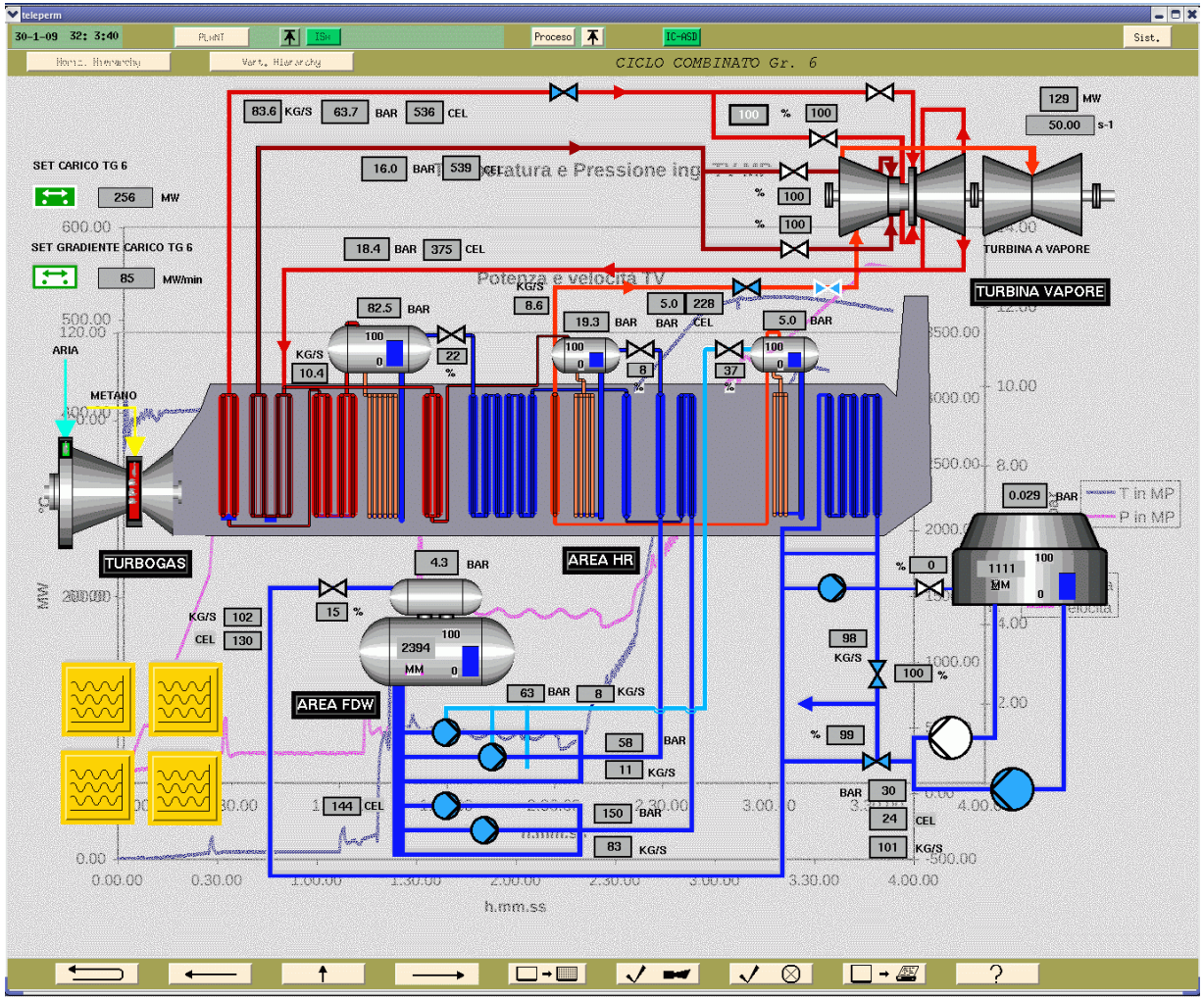
Highly flexible and efficient fossil power plant



The three pillars of the RSE approach

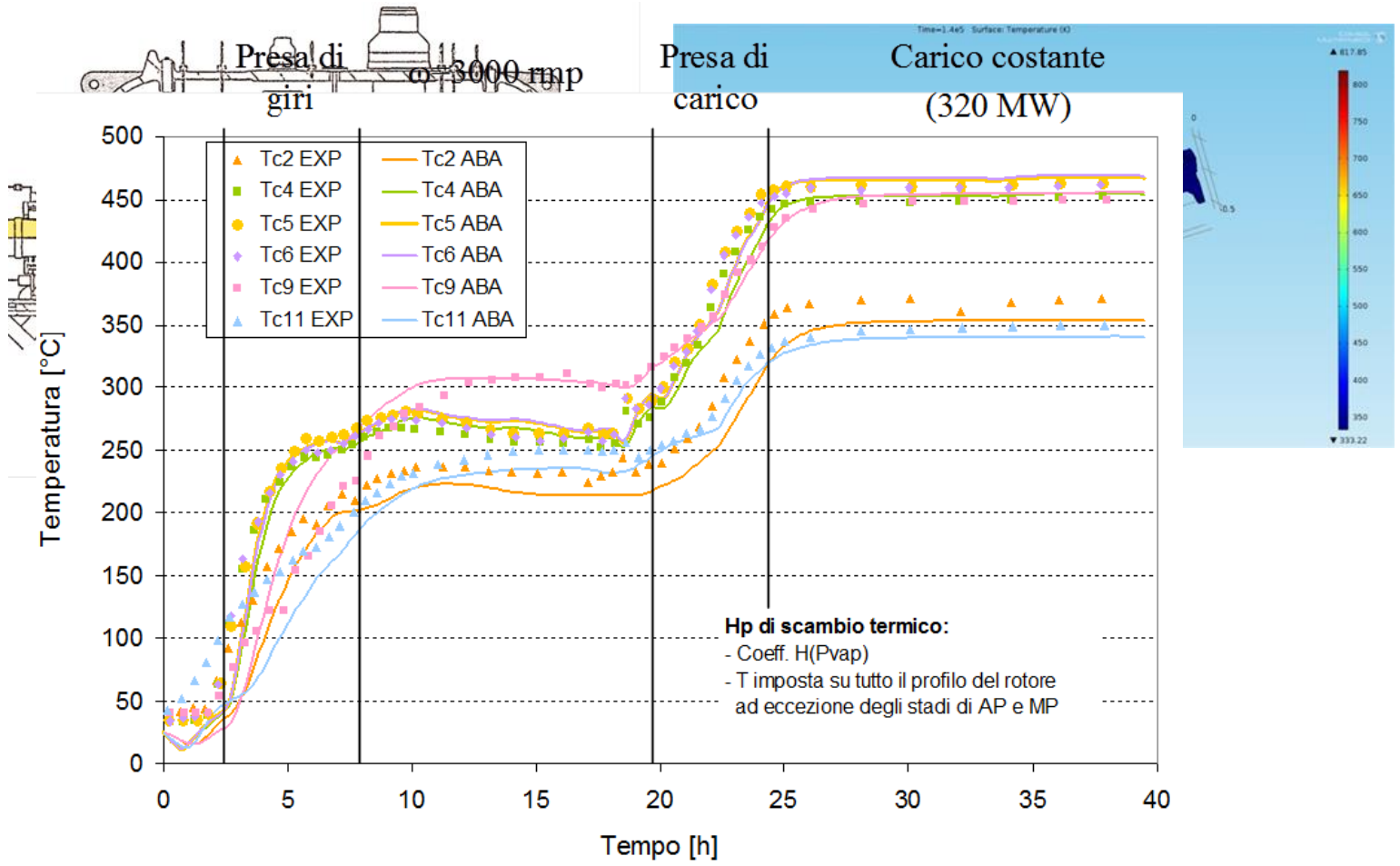


Plant simulator



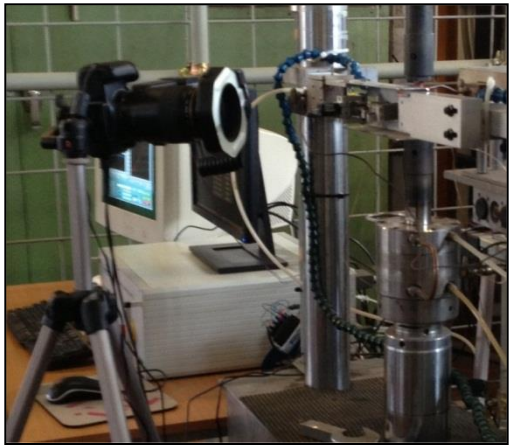
Main page of HMI Engineering Dynamic Simulator of a CC

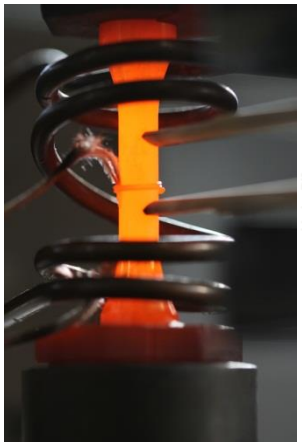
FEM model of steam turbine

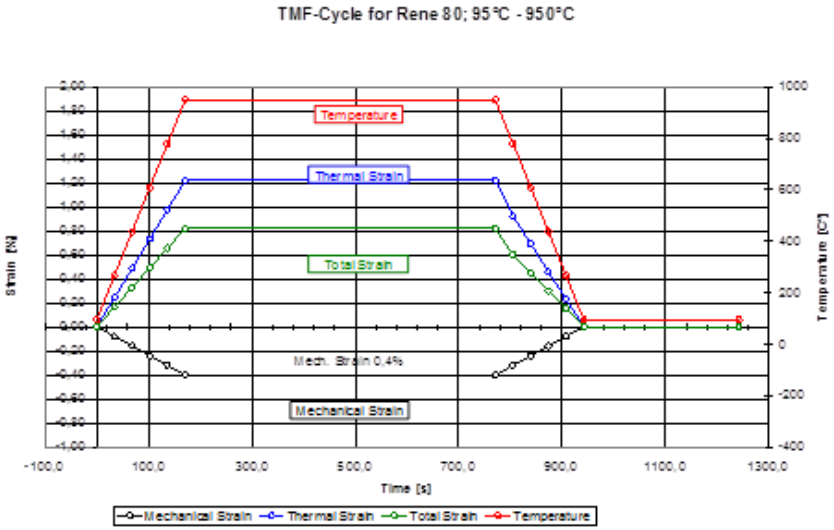


LCF and TMF testing of Materials

Service like TMF cycles to assess the material performances in real operating conditions







EUROPEAN TURBINE NETWORK

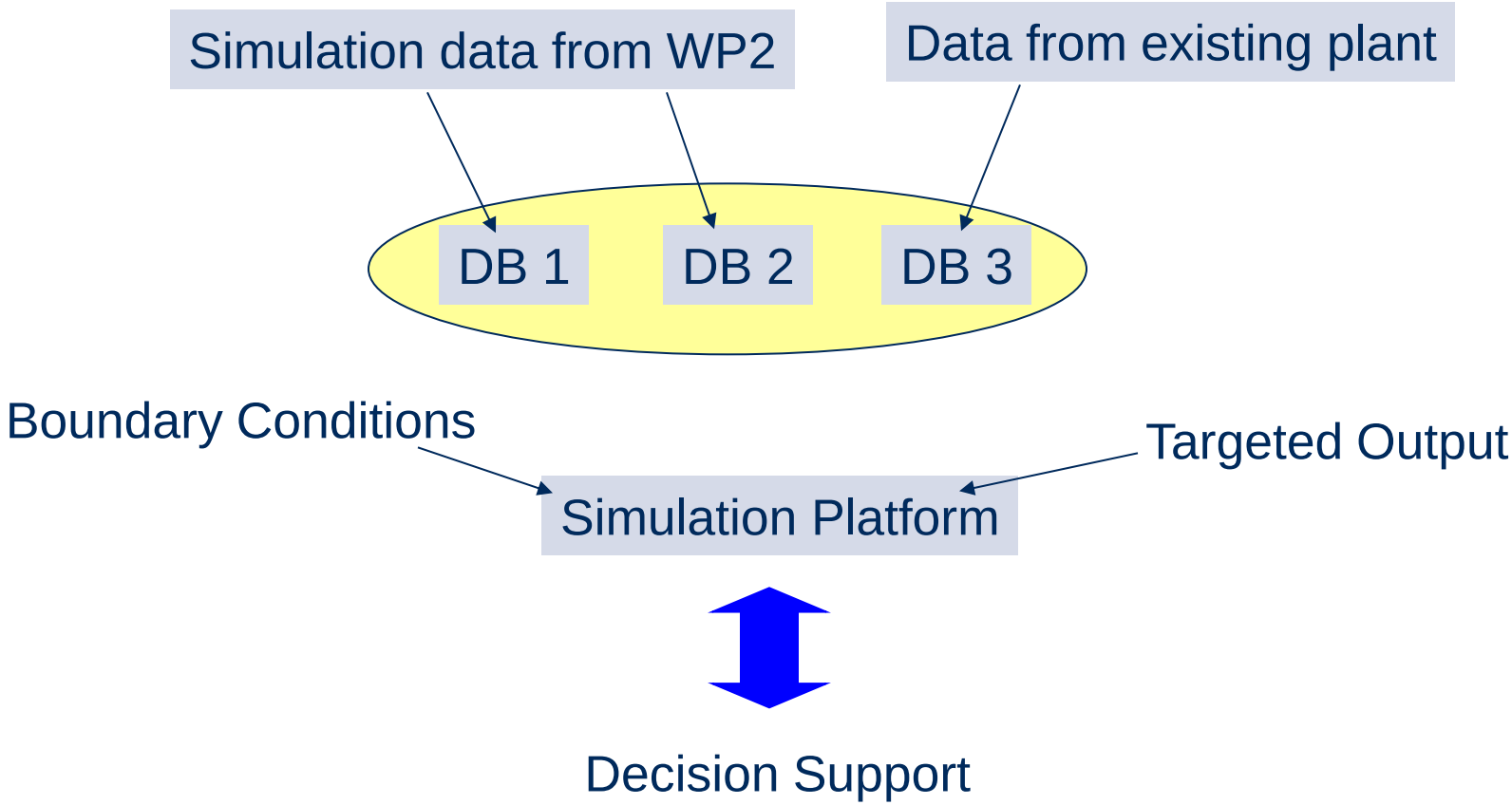
Contact

Ing. Vincenzo Casamassima

RSE SpA – Ricerca sul Sistema Energetico
Via Rubattino, 54
20134 Milano
Italy
Vincenzo.casamassima@rse-web.it

EUROPEAN TURBINE NETWORK

Structure



18

EUROPEAN TURBINE NETWORK

Partners needed

- TSO: flexibility requirements.
- Plant operators: plants data, in field tests.
- Plant manufacturers: component damage evaluation, study of plant modifications and operating procedures, control system improvement, instrumentation and monitoring.
- Research centers: plant and components modeling and simulation, materials testing, cost-benefit analyses, operating procedures studies, monitoring tools development.

EUROPEAN
TURBINE
NETWORK

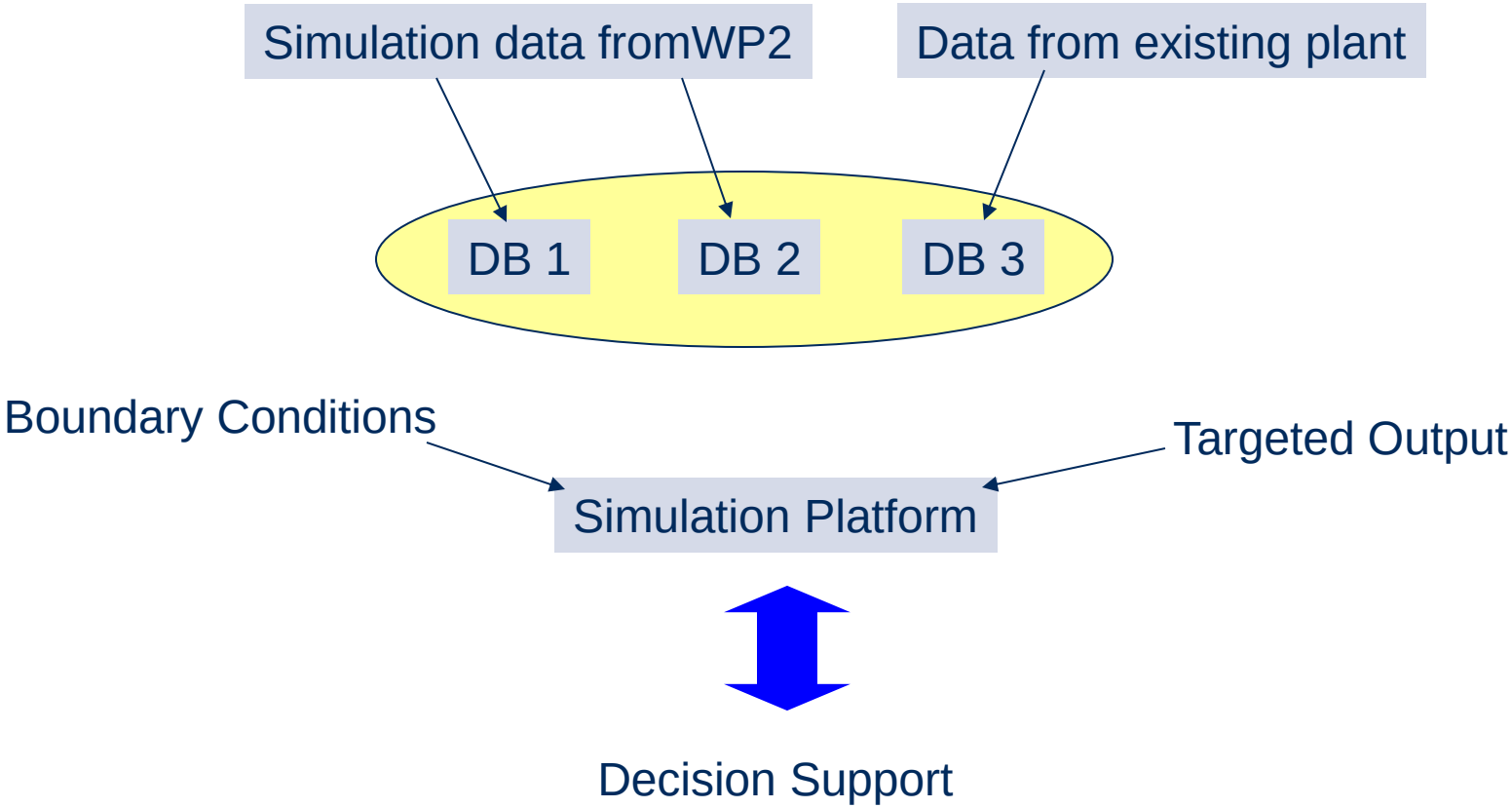
Contact

Sign up for free subscription on the ETN website

Chaussée de Charleroi 146-148/20, 1060 Brussels, Belgium

Tel: +32 (0)2 646 15 77 info@etn-gasturbine.eu

www.etn-gasturbine.eu


Simulation data fromWP2
Data from existing plant
DB 1
DB 2
DB 3
Boundary Conditions
Targeted Output
Simulation Platform
Decision Support