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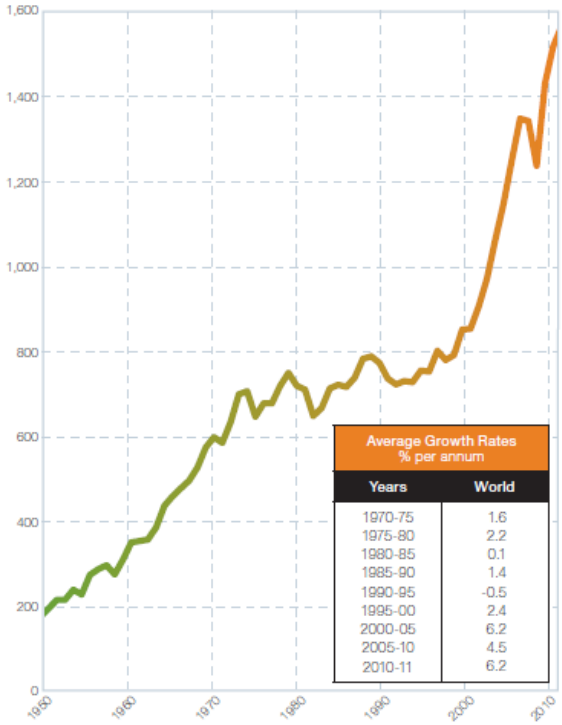
Steel Industry & EnMS

Ladislav HORVATH, 19th November 2012

The iron and steel industry – *where we are*

- Iron & steel industry is the largest consumer of energy among all industrial sectors
- Energy costs represent around 20 to 25 % of the total input of steel producers and it becomes one of the most important topic of steel producers
- Coking coal accounts for more than 65% of primary source of energy



Average Growth Rates % per annum	
Years	World
1970-75	1.6
1975-80	2.2
1980-85	0.1
1985-90	1.4
1990-95	-0.5
1995-00	2.4
2000-05	6.2
2005-10	4.5
2010-11	6.2

Average CO_2 Intensity: **1.8 t CO_2 / t_{CS}**

Average Energy Intensity: **18.2 GJ / t_{CS}**

BF / BOF: 69.5% EAF: 30.5 %

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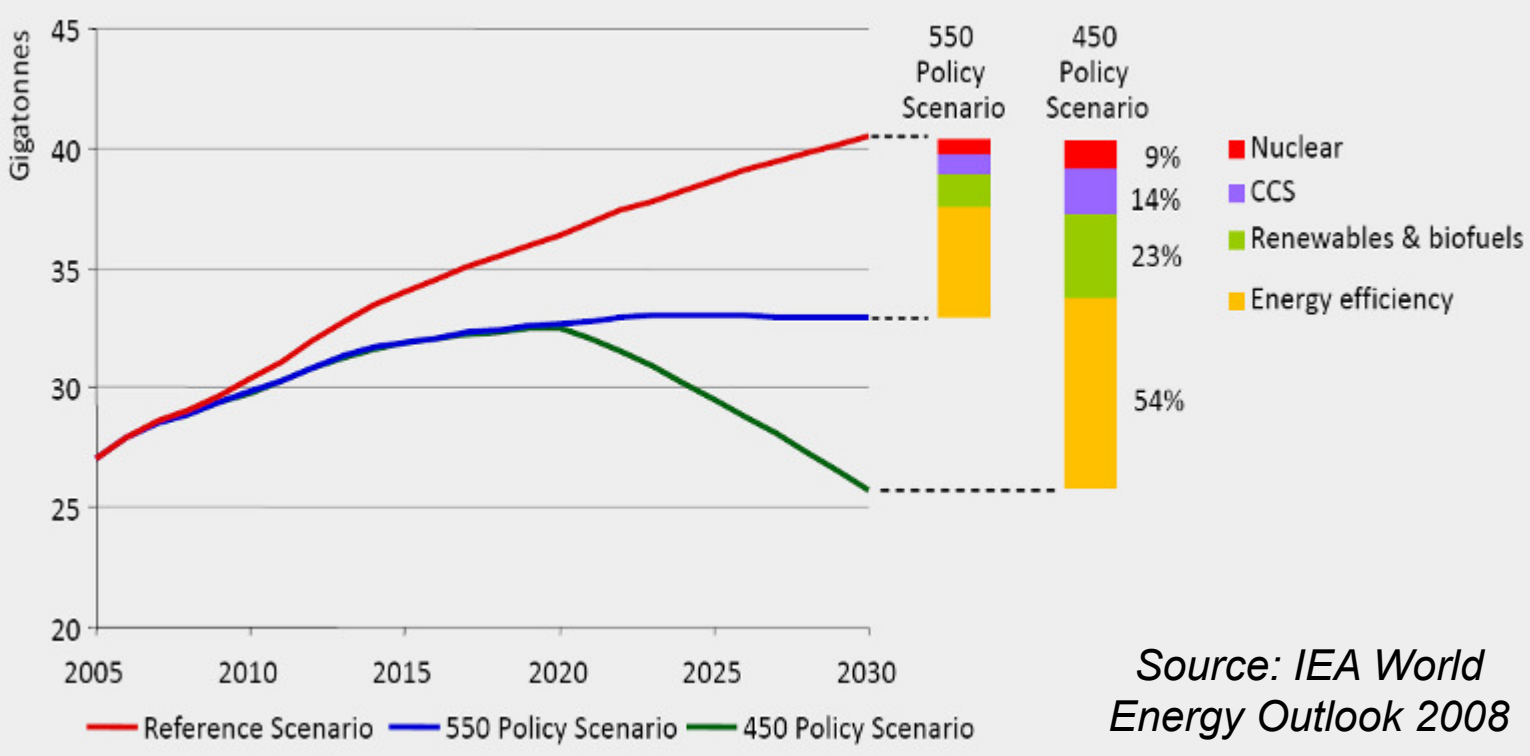
CO_2 emissions in the climate policy scenarios



Source: IEA World Energy Outlook 2008

While technological progress is needed to achieve some emission reductions, efficiency gains and deployment of existing low-carbon energy account for most of the savings.

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Energy Use in the Steel Industry Goals:

- Provide opportunities to decrease the energy intensity / ton of crude steel
- Provide best or good practices to utilize energy sources more effectively
- Provide best or good practices to recover energy (heat, gas) where practical
- Enabling companies to develop plans for plant energy intensity reduction
- Practice benchmarking allows prioritization of investments to improve energy efficiency with the biggest impact

Energy project coverage members steel production

1,413.6 mmt of crude steel was total world steel production in 2010

Energy use project members produced 373,3 mmt of crude steel in 2010

346 mmt of steel represent approximately **26.4%** of the total world steel production in 2010

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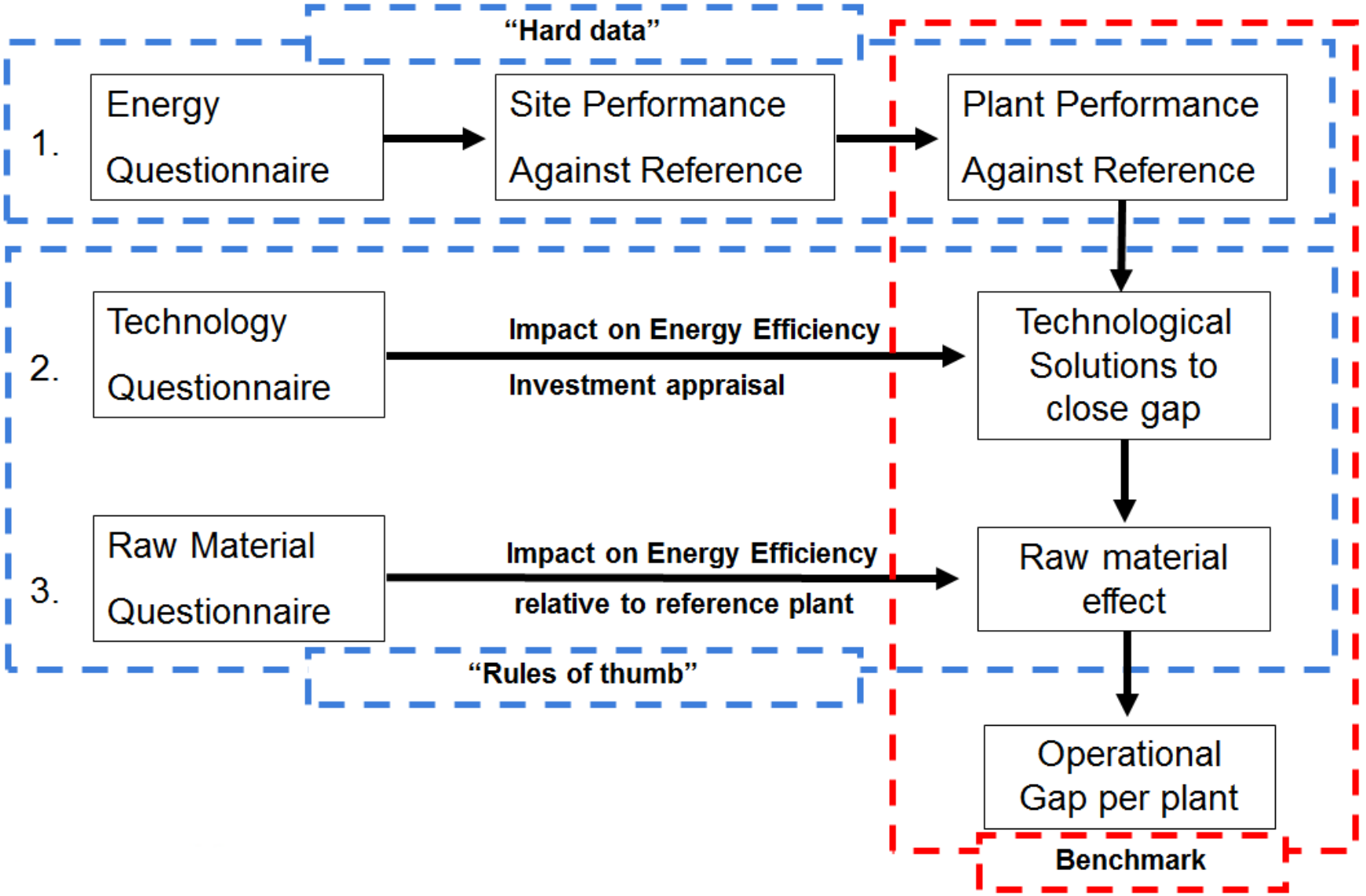
Energy Measurement Methodology



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List of techniques and technologies

- On the base of IISI report from 1998

  - 100 Energy Efficiency Techniques & Technologies were identified

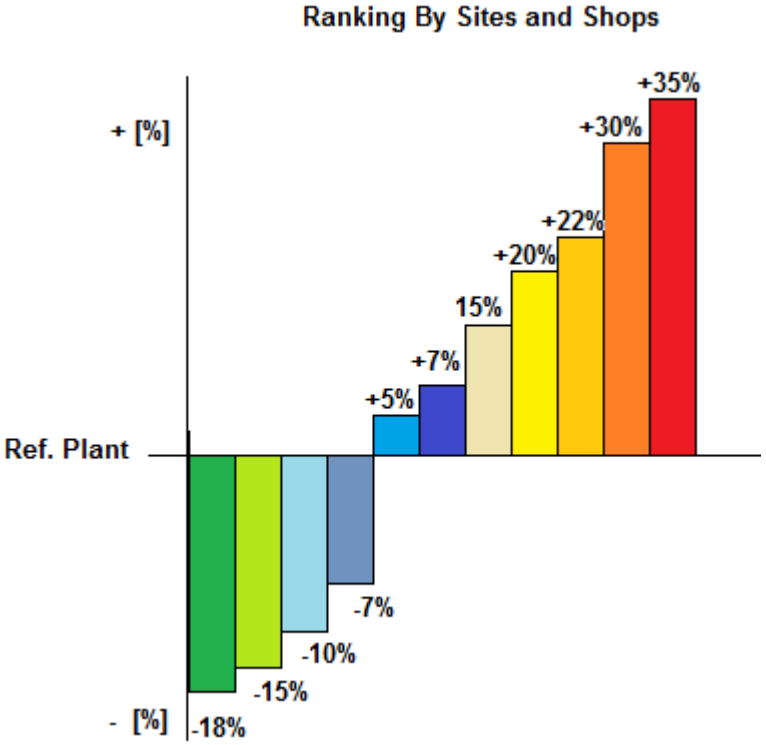
- On the base of other previous reports

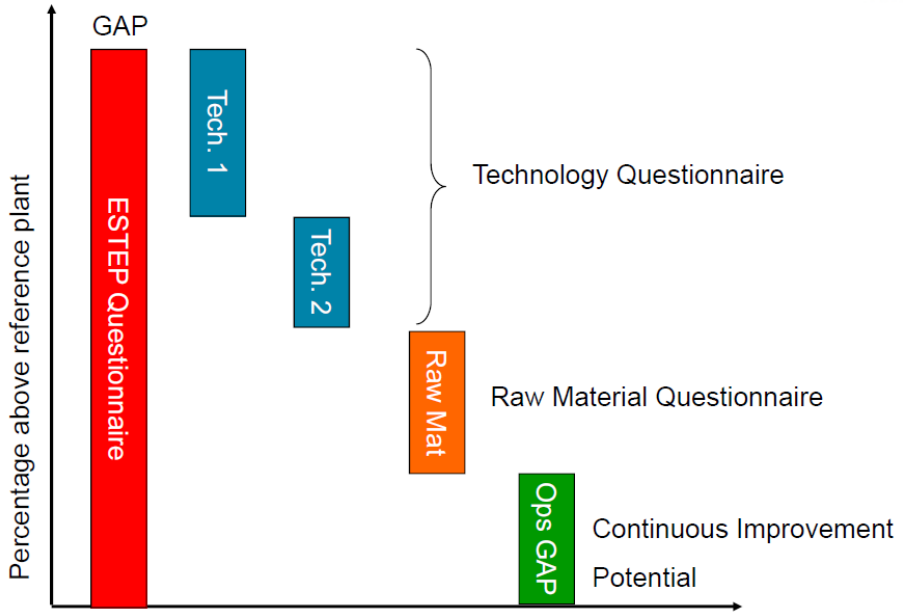
  - 82 Energy Efficiency Techniques and & Technologies were identified

Basic questions in the list:

- Are these techniques and technologies used in your plant?
- The main drivers / reasons for implementation.
- Years of experience with these technologies.
- Did the technologies deliver the expected performance or improvement?
- Do you have development plans to implement energy reducing technologies?

Energy Measurement Methodology – Results analyses





- ***Ranking prepared for shop levels:*** Sinter plant, Coke plant, Pellet plant, Smelting red., DRI, Blast Furnace, BOF, EAF, HRM.

- ***Ranking prepared for site level:*** Site (incl. Power plant, ASU and Flares), Iron ore based steel prod, Scrap based steel prod., Hot metal prod.

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EnMS in Steel Plants

Energy Management System (Technical Solution to Optimize Energy Use)

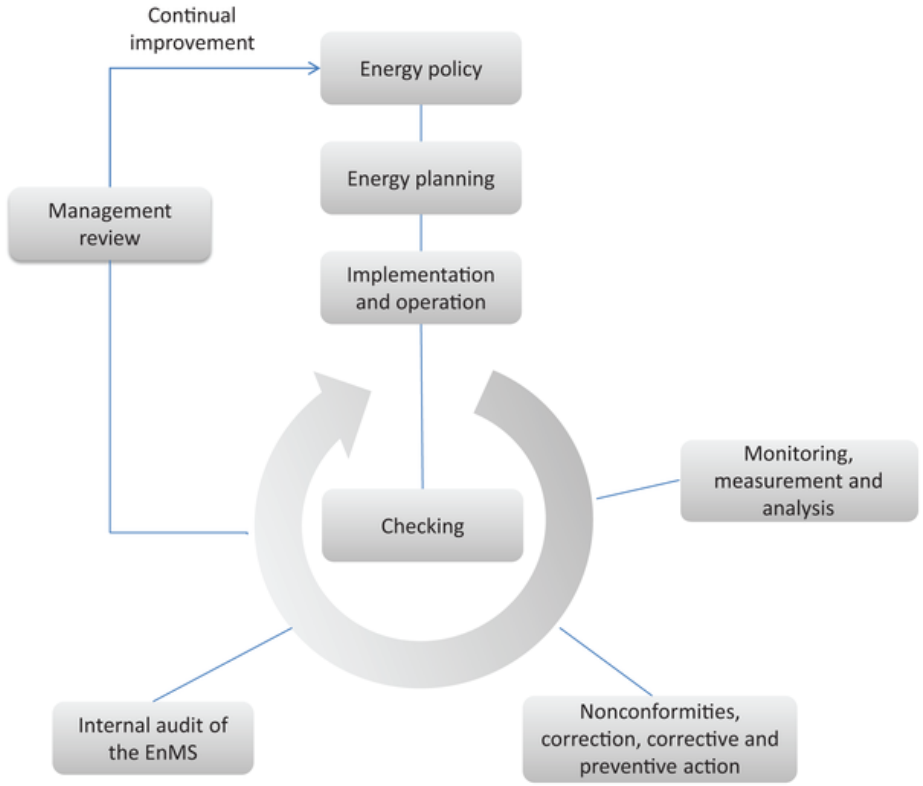
Definition: EnMS atomization (computer based) of data collection that either assists the energy operators in the decision-making or even actively controls the entire energy distribution system.

Energy Management System (Management Process to Optimize Energy Use)

Definition: EnMS (Real time management) provide information on actual and planned energy indicators of production, consumption, distribution and transformation in respect to metallurgical production as close as possible to the current reality (hourly and / or every 15 minutes or in user-defined interval) and in consolidated way (monthly).

This energy management system is an implemented standard like the ISO 50001 standard.

ISO 50001 - Energy Management System



Based on the concept of:

- **Plan**
- **Do**
- **Check**
- **Act**

Scope of ISO 50001: specifies requirements applicable to energy supply and energy uses and consumption, including *measurement,* documentation and reporting, *design and procurement practices for energy using equipment, systems, processes, and personnel.*

Source: www.iso.com

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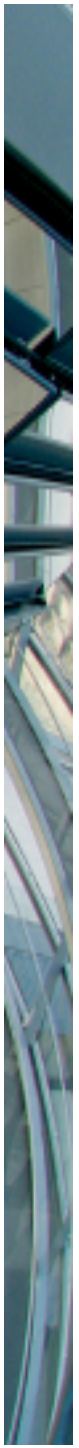
Energy management system

- Helps plant operators in the iron and steel industry to monitor and optimize their energy flows
- Helps management to analyze / compare plans vs. results
- Detects avoidable energy losses *(gases, electricity, steam, carbon, etc.)*
- Generates consumption forecasts and minimize peak loads *(analyze usage, real consumption, losses, etc.)*

Reporting Frequency (Incl. Max., Min., Average Value)

- Annual results
- Monthly results
- Daily results
- Reporting per shift
- Real time EI / ED evaluation *(per 15 min., per hour, per product, etc.)*



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Energy Management System - Goals

- Optimize purchase and consumption of all fuel types and energy inputs
- Propose an efficient system for comprehensive management of all major energy flows within the metallurgy plant
- Optimize the use of metallurgical gases in resources where are generated, resp. in other appropriate facilities
- Effective use of media pressure energy, sensible and physical heat of metallurgical gases and fumes
- Reduce energy intensity per tonne of product / products.
- Reduce CO_2 and other emissions
- Operate an effective system for the comprehensive management of energy flows

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EnMS in Iron and Steel Plants

Energy Management System (Technical Solution to Optimize Energy Use)

- Improve energy efficiency of steel processes
- Coordinate boiler, alternator and steam header pressure control
- Designed to optimize indigenous fuel usage and minimize bleed
- Maximize energy recovery from captured process gases (COG, BFG, BOFG) within the power plant
- Avoid waste of energy / Decrease emission intensity

Energy Management System (Management Process to Optimize Energy Use)

- Improve energy efficiency of steel production
- Daily review of generating capacity and utilization
- Reported as a KPI and viewed at higher management levels
- Energy saving

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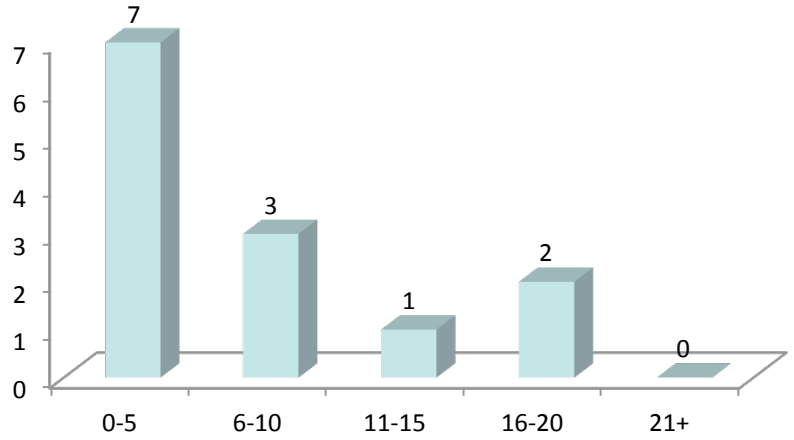
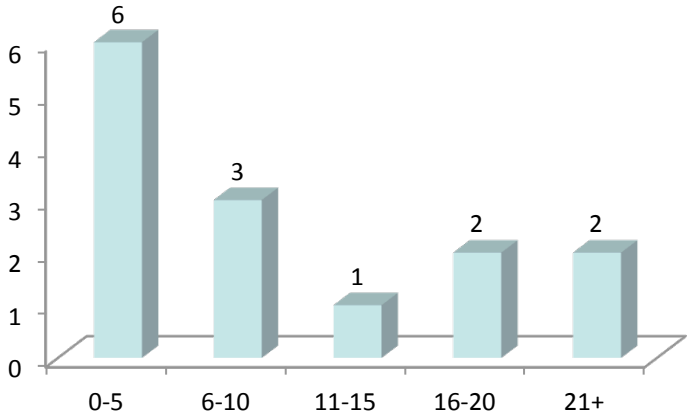
EnMS in Steel Plants – *Energy use project members*

Energy Management System (Technical Solution to Optimize Energy Use)



14 Steel companies utilize EnMS - TS*

Energy Management System (Management Process to Optimize Energy Use)



13 Steel companies utilize EnMS - MP*

* - within energy use project

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Basic characteristic of the EnMS

- Automatic deployment design of energy production sources, taking into account of economy
- Define the requirements for external power supplies, commercial dispatching binding
- Option for manual modification of resources
- Variant preparation of plans, versions comparison
- Support for different time horizons - year, month, day,
- Detailed planning with time step 1-hour (or 15 minutes),
- Close connection on a balanced system – comparison of the plan and the actual real data,
- Creating of operating modes database, automatic learning
- Integration with control systems - transfer of the final plan of deployment of resources and the use of appliances, decision support for operational management

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EnMS – Answers to questions

- Why it happened?
- What will be the cost of production if we will operate in different way?
- Did we reach the planned EI?
- How long does a device work without downtimes?
- Can we determine the time and length of downtime and its reason?

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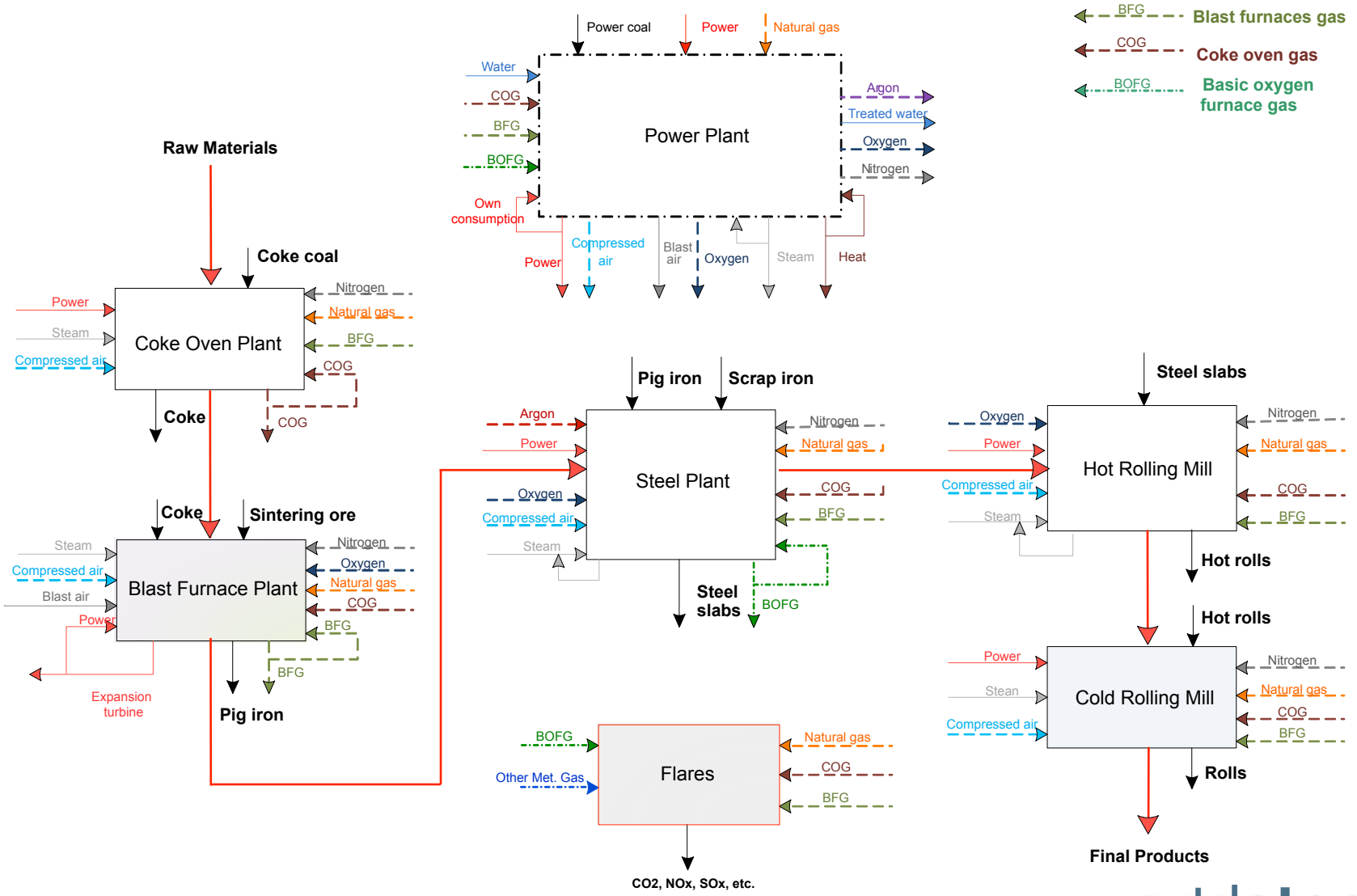
Energy Inputs & Outputs



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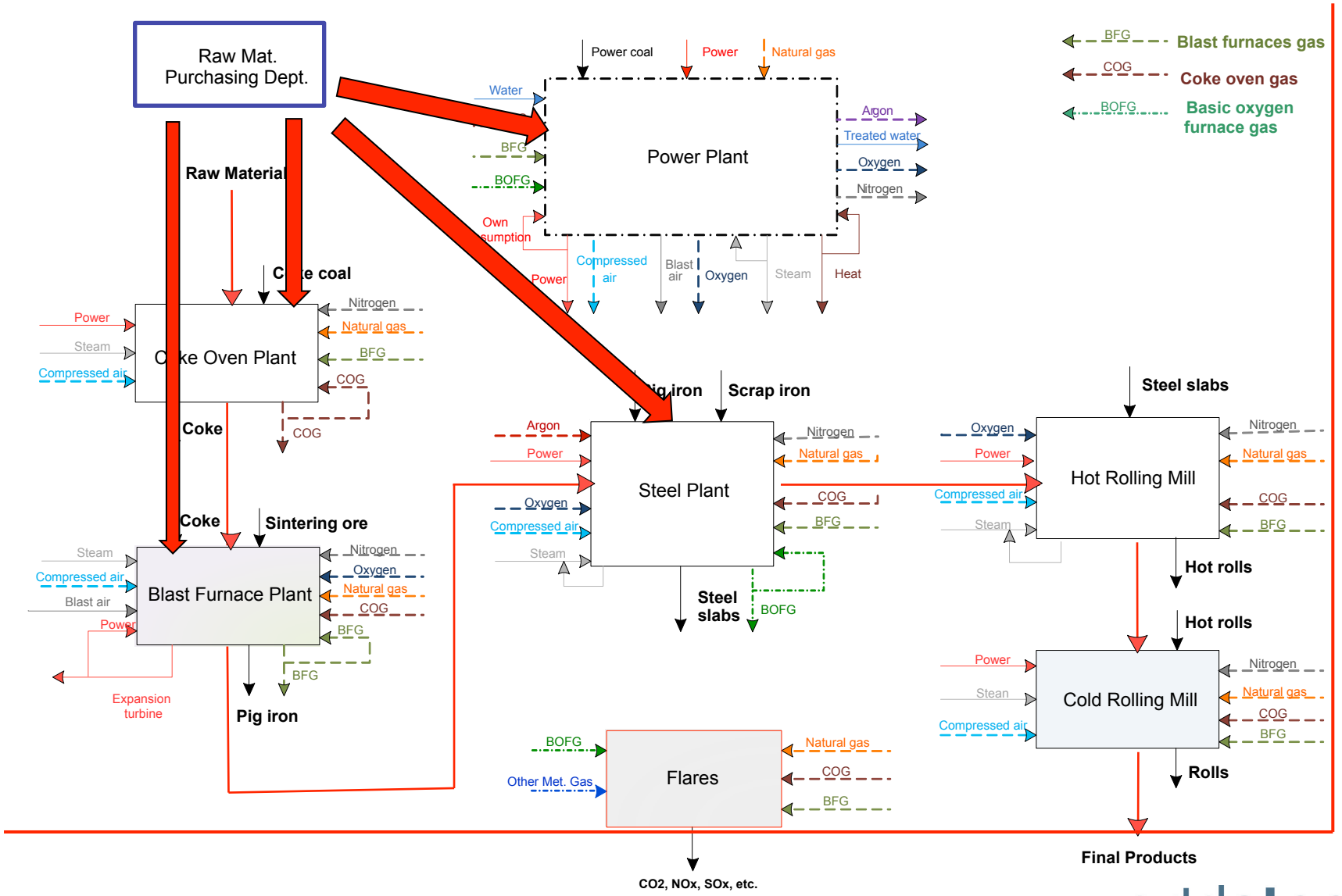
Energy Inputs & Outputs



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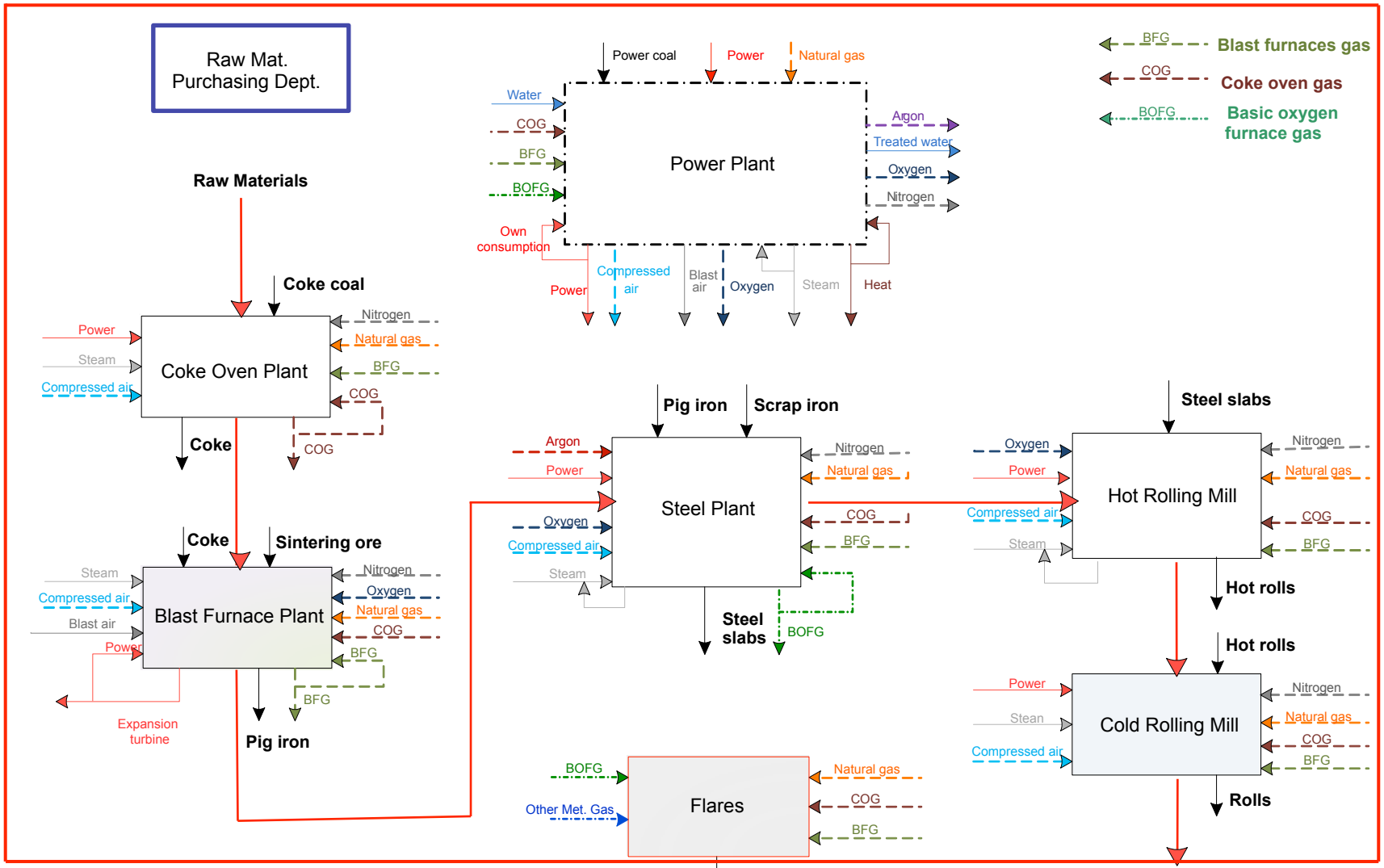
Energy Inputs & Outputs



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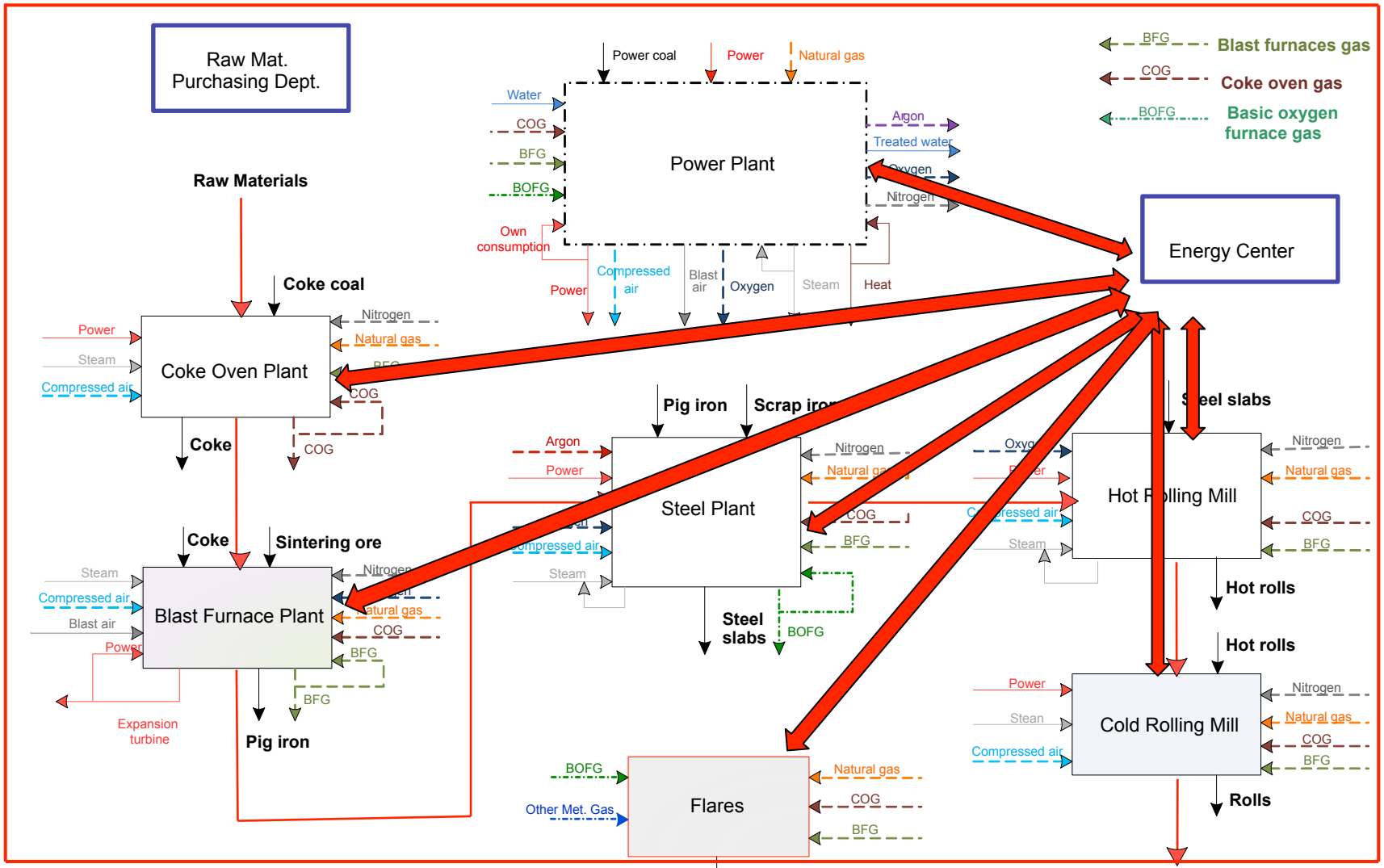
Energy Inputs & Outputs



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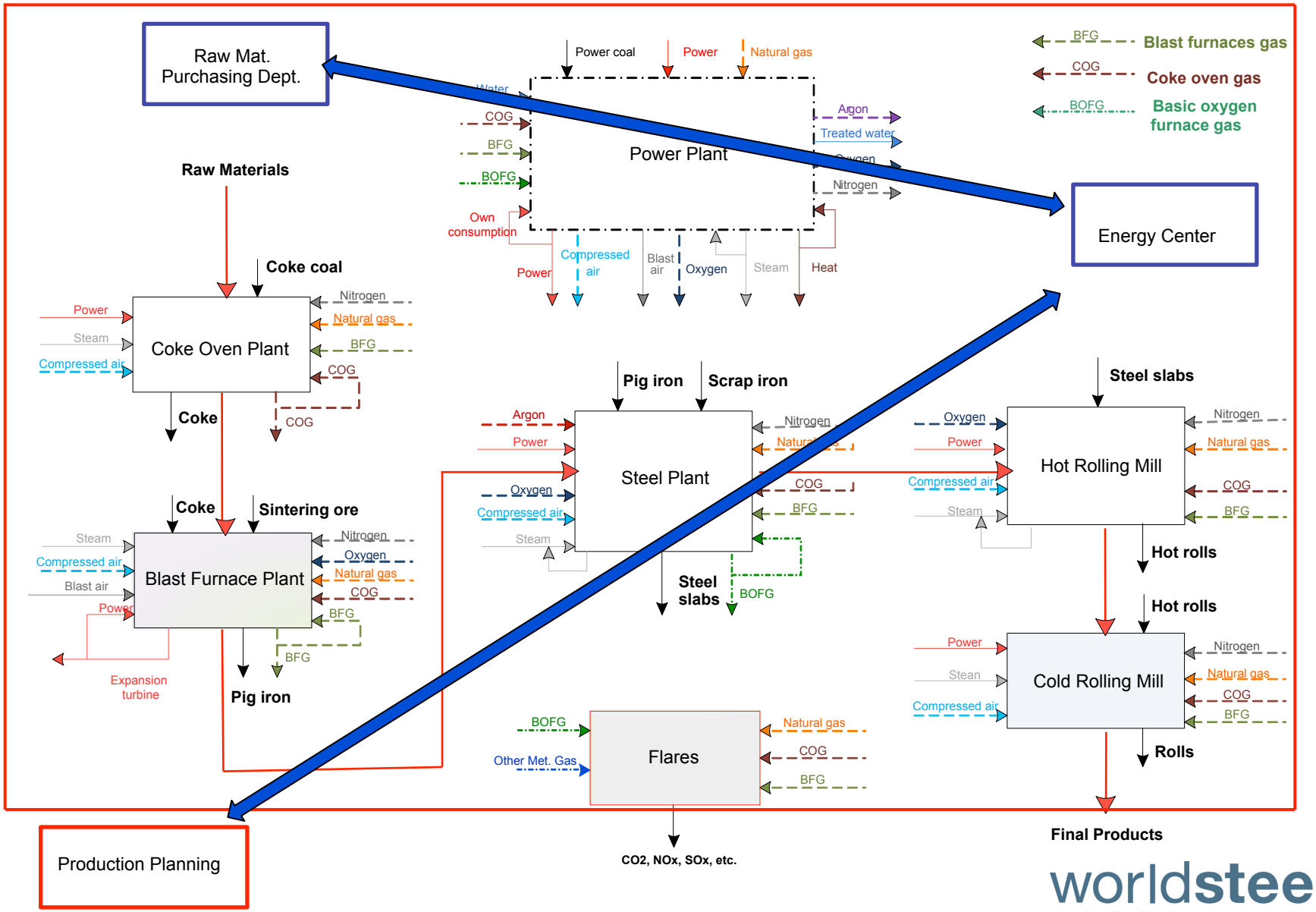
Energy Inputs & Outputs



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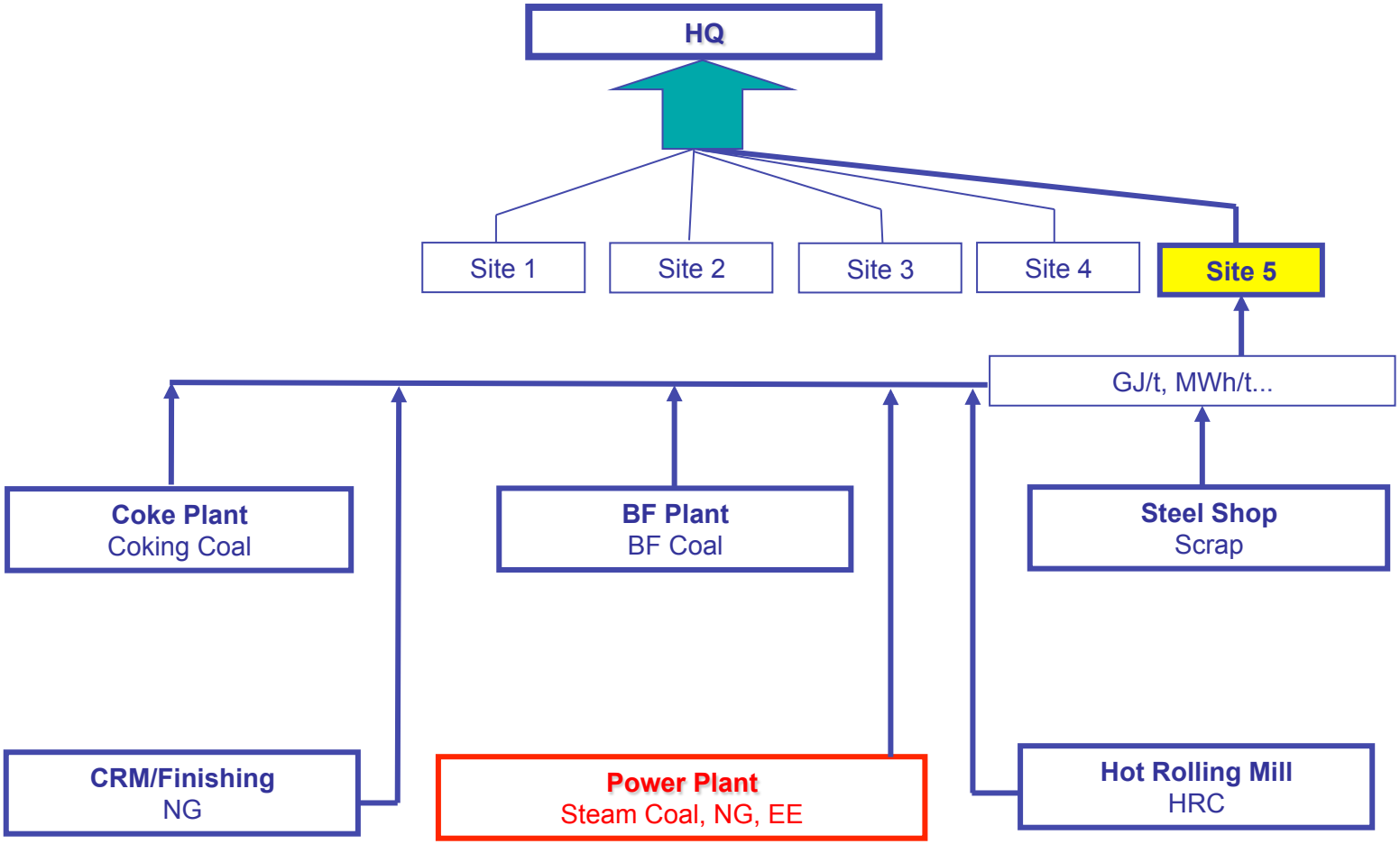
Basic EnMS Architecture – example from member company



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Key Performance Indexes (KPI)

- Total EI control for selected product by selected Key Performance Index (KPI)
- On-line control of energy efficiency of primary energy cariers transformation and utilization by plant
- Metallurgical processes EI & OPEX control
- CO_2 reduction targets evaluation
- Primary energy cariers & CO_2 trade control
- Internal EI benchmarking / on-line energy audit

USD / t_{CS}	USD / GJ $_{(Steam)}$	GJ / t_{HM}
MWh / t_{CS}	GJ / MWh	t_{CO2} / t_{CS}

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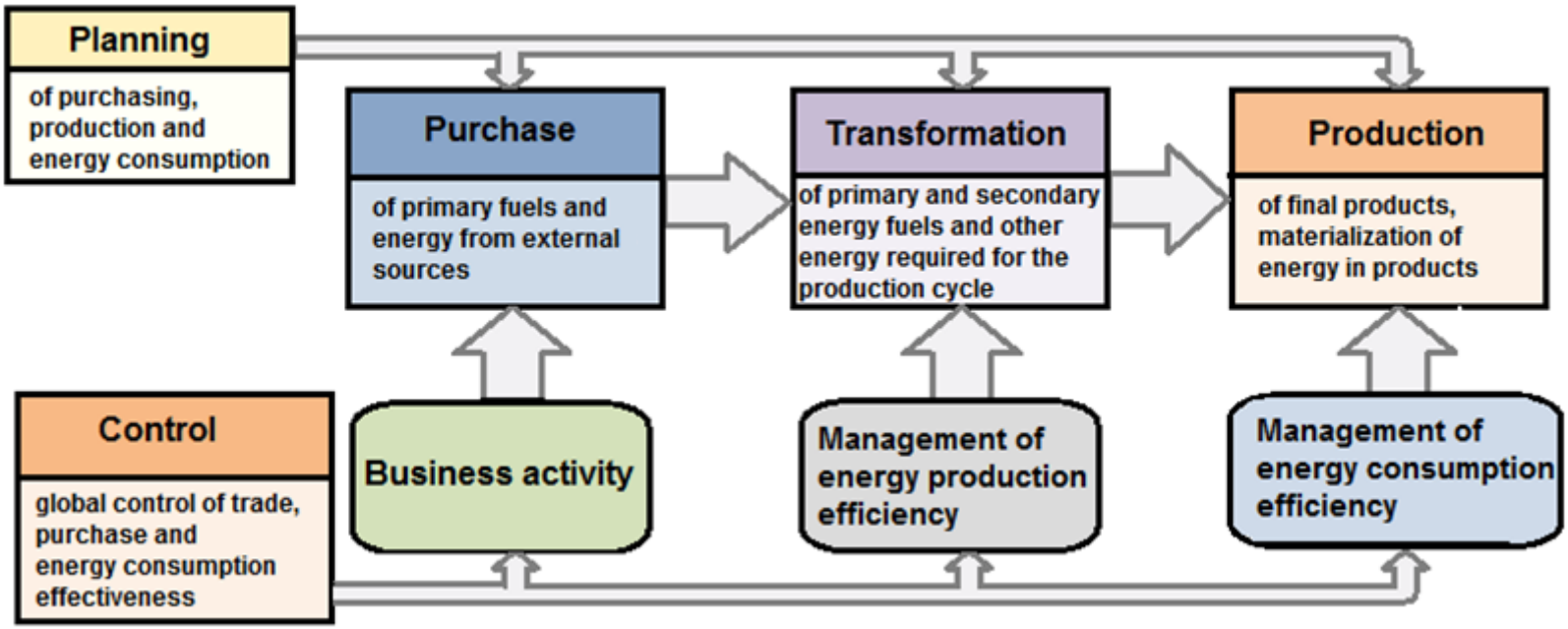
Conection between planning, operation & purchasing
(example from member company)



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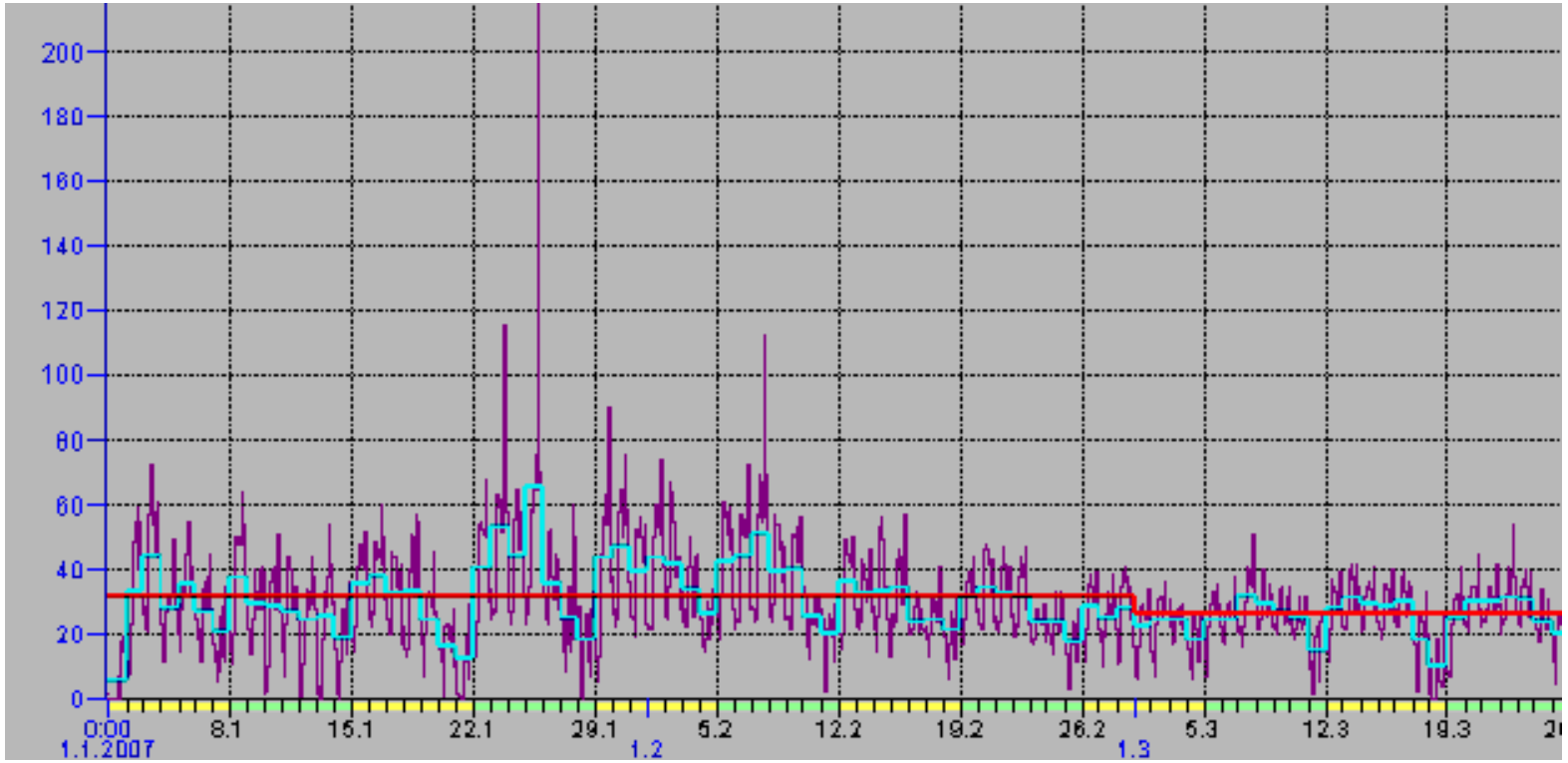
Information in different time period - example



- Monthly information value
- Daily information value
- Hours information value – only this value can answer “Why?”

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Data collection, visualization and operative balance

- Energy data collection (production, distribution and consumption)
  - *Electricity, steam, natural gas, water, fuels, emissions, etc.*
- Visualization in real time – graphs, schemes, tables
- Data archives / shifts with aggregation to the level of 15 min. and 1 hour
- Hierarchical division of data by operational and technological entity
- Basic balances of production, consumption, losses for each energy carriers
- Possibilities to monitor quality of energy cariers *(temperature, pressure, heating value, etc.)*
- Evaluate the difference of consumption from the plan

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EnMS Installation at Steel Plant – First Steps

- Establish what to measure (Electricity, fuels, water, etc.)
- Establish ratio between measured and calculated data
- Establish main function of EnMS: energy balance, alarms, real time management, planning, daily energy consumption etc.
- Industrial gases allocation on the base of equivalent coal, it means: GJ of BF Gas equal to GJ of coal equivalent
- Development of predictor model with possibilities to analyze emission production
- Plan vs. Actual data comparison
- Management control and reporting
- Definition of alarms
- Energy efficiency calculation and possibilities to compare EI with fictive conditions / steel plant operation. EnMS helps to make a decision about future investments / projects

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EnMS: cost, payback, energy saving

- Energy saving *(direct)*: Most iron and steel enterprises that have implemented EnMS achieved average ***annual energy intensity of*** 0.6 – 4 %, which means according to the average Energy Intensity of steel plants (18.2 GJ / t_{CS}), steel producers saving is in the range of 0.12 – 0.7 GJ / t_{CS}.
- Energy saving *(in-direct)*: Steel producers energy saving (on the base of EnMS results and decisions) can reach 5 – 10% energy saving / t_{CS}
- Time payback: the typical EnMS time payback of energy use project members is from 1 to 3 years (depends on the level of EnMS, process route, previous measurement)
- Cost: depends on EnMS version, plant configuration, region, etc.

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Energy Management System – Project Members Benefits

- Active managing of energy use and costs, reducing exposure to rising energy costs
- Reduce emissions without negative effect on operations
- Continual improvement of energy intensity (energy use/product)
- Energy intensity plan generation on the base of material production plan and schedule repairs and equipment downtime
- Document savings for internal and external use (e.g. emission credits)
- Utilize company personnel and resources wisely
- Safely store data with possibilities to analyze them

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