Applications and optimizations of energy and Heat Transfer recovery on refinery plant

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Outline

- **IPLOM: WHO IS IT ?**
- **IPLOM: WHERE IS IT ?**
- **IPLOM: HOW IT WORKS ?**
- **WHY ENERGY EFFICIENCY ?**
- **HOW ENERGY EFFICIENCY ?**
- **IPLOM ENERGY EFFICIENCY CASE**

IPLOM: WHO IS IT ?

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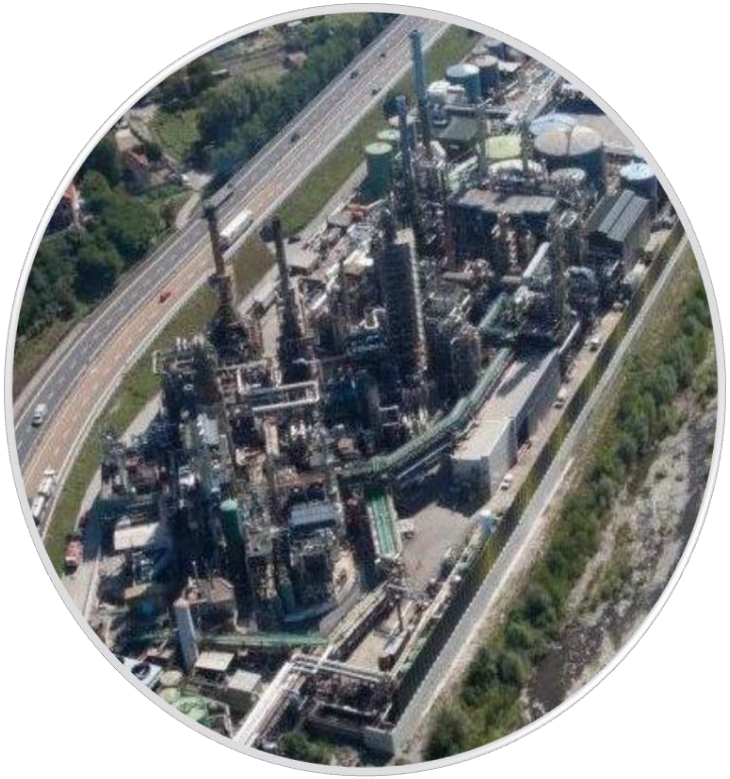
Italian Oil Refinery



From the beginning …

Founded by Italian businessman
Dr. Giovan Battista Profumo
in 1931 close to Turin city
Moved to Busalla (Genoa)
during the II World War
The refinery has grown up during
the years to satisfy the demand of oil products in Italy .

IPLOM: WHO IS IT ?

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Italian Oil Refinery

Private company.
Profumo family,
the founder,
is the reference
shareholder.

During the last
20 years
the production
has grown up
in quality
and quantity

Till today ...

IPLOM: WHO IS IT ?

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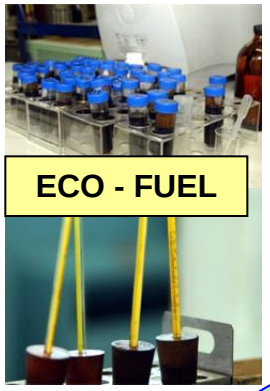
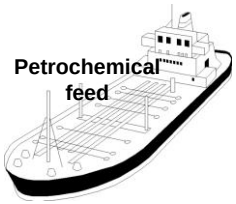
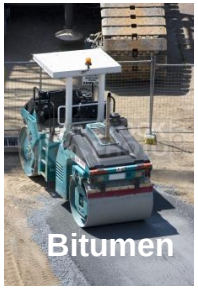
IPLOM
Main Products



Marine Fuel





Heating Oil

CO2

IPLOM: WHO IS IT ?

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IPLOM Certifications

IPLOM: WHERE IS IT ?

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In the North of Italy

Very close to Genoa

At the borders
of Po's Valley

In a strategic commercial area

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IPLOM: WHERE IS IT ?

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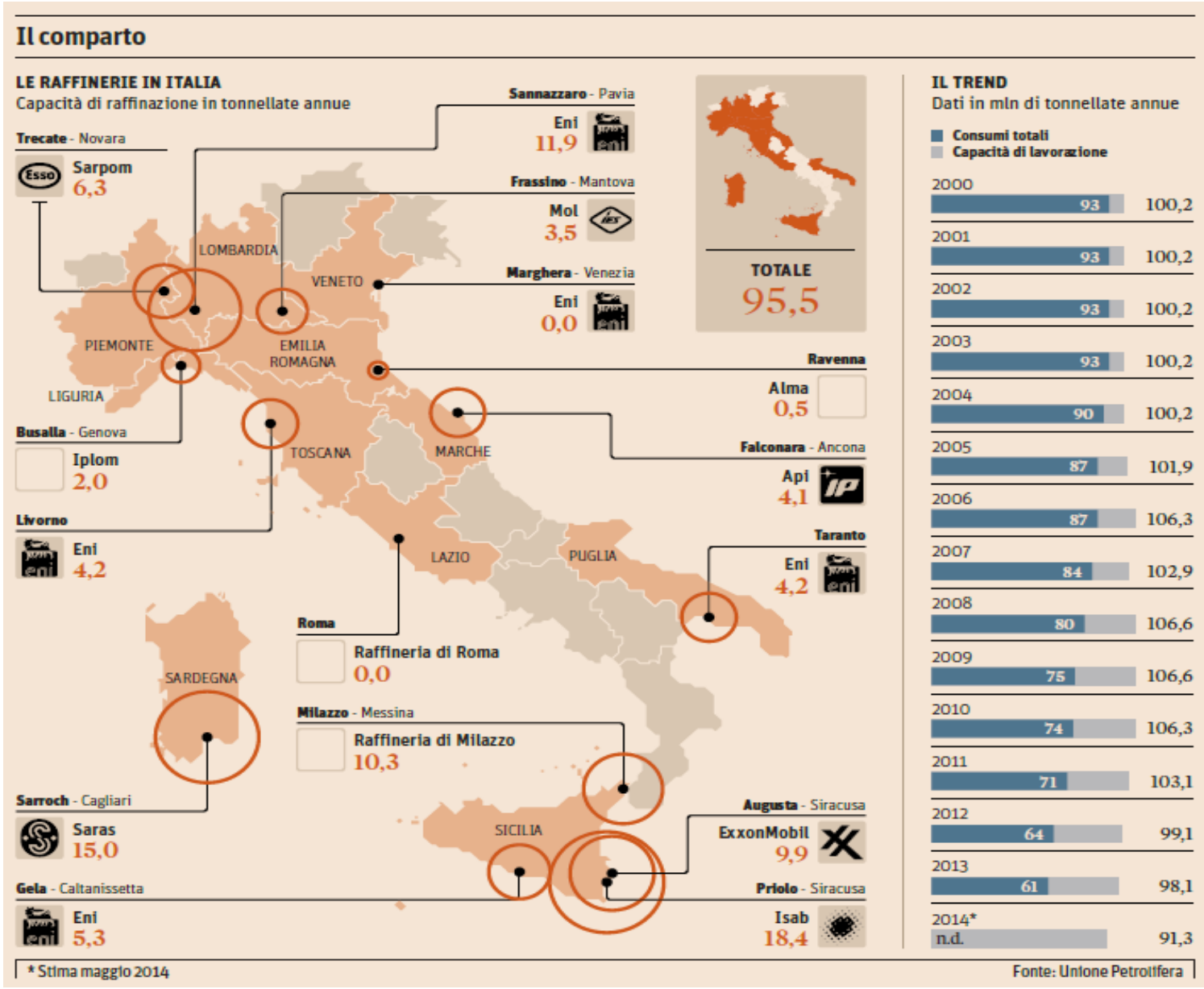

IPLOM: HOW IT WORKS ?

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STORAGE TANKS
BUSALLA

STORAGE TANKS
GENOVA MULTEDO

CRUDE
MIX

STORAGE TANKS
GENOVA FEGINO

IPLOM: HOW IT WORKS ?

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PROCESS

VIRGIN NAFTA

DIESEL

MHC BOTTOM

VACUUM RESIDUE

BITUMEN

METHANE

FG

FUEL OIL

IPLOM: HOW IT WORKS ?

IPLOM

BLENDING

DIESEL

FUEL OIL

FEGINO
STORAGE TANK

IPLOM: HOW IT WORKS ?

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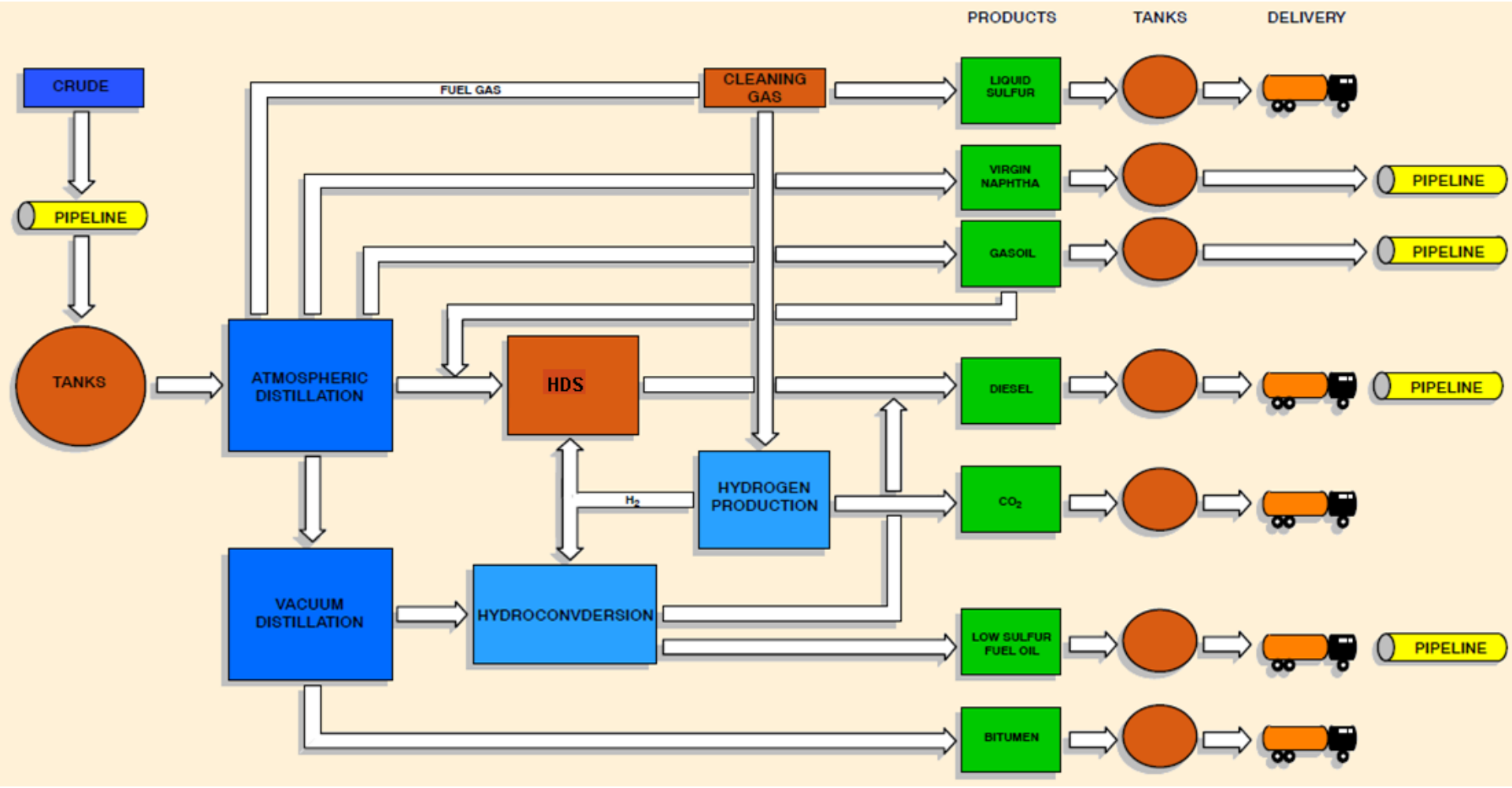
REFINERY PRODUCTION: BLOCK DIAGRAM



WHY ENERGY EFFICIENCY ?

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EUROPEAN UNION 2020 TARGETS: 20-20-20

- 20% increase in energy efficiency
- 20% reduction of greenhouse gas emissions (lower than 1990)
- 20% of energy from renewables

ITALIAN HYSTORICAL PROBLEMS :

- VERY LIMITED PRODUCTION OF CRUDE OIL AND NATURAL GAS
- HIGH PRICES OF ENERGY
- NO NUCLEAR PRODUCTION

WHY ENERGY EFFICIENCY ?

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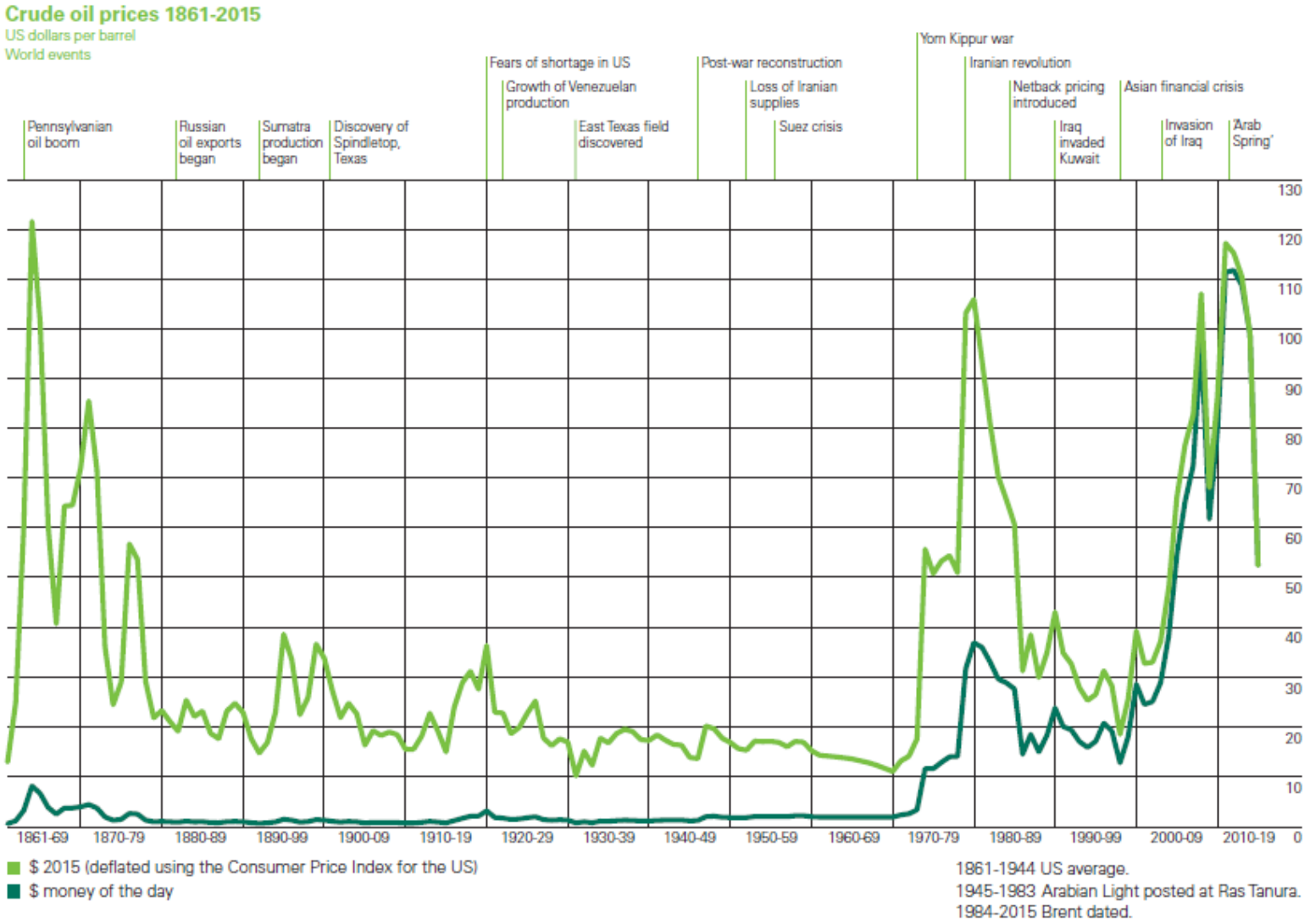
A country that uses less energy to achieve the same or better results reduces its costs and pollution, creating a stronger, more competitive economy.

Cost- effective energy efficiency remains a massively underutilized resource …
before to use any energy sources or to discover other types of energy

We MUST guarantee a future for the next generations …

WHY ENERGY EFFICIENCY ?



Source: BP Statistical Review

WHY ENERGY EFFICIENCY ?

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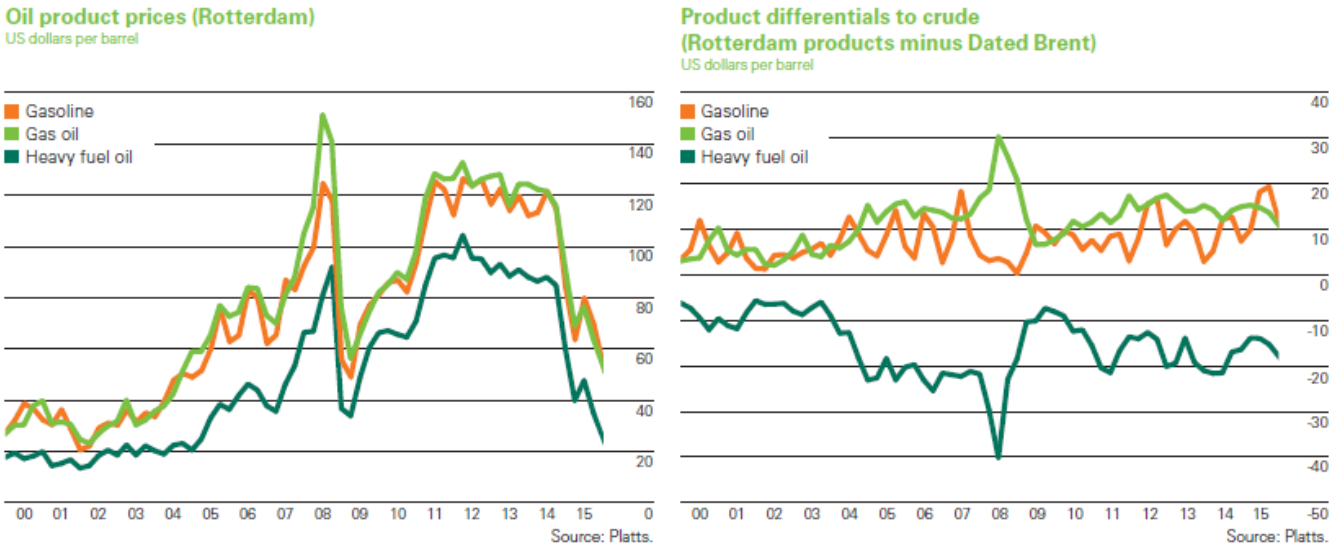

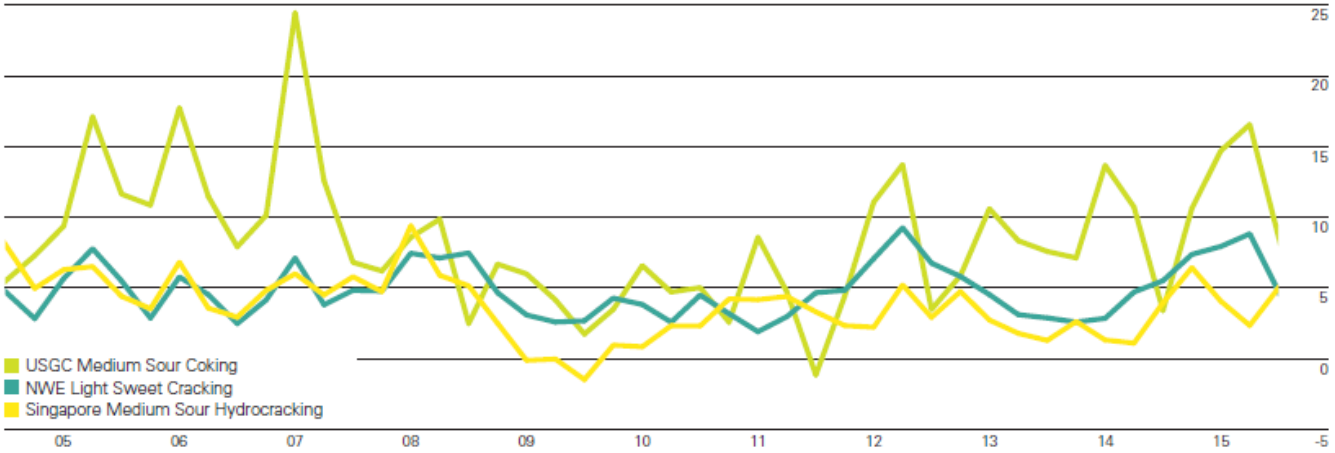

Note: The refining margins presented are benchmark margins for three major global refining centres: US Gulf Coast (USGC), North West Europe (NWE – Rotterdam) and Singapore. In each case they are based on a single crude oil appropriate for that region and have optimized product yields based on a generic refinery configuration (cracking, hydrocracking or coking), again appropriate for that region. The margins are on a semi-variable basis, i.e. the margin after all variable costs and fixed energy costs.

Source: BP Statistical Review

WHY ENERGY EFFICIENCY ?

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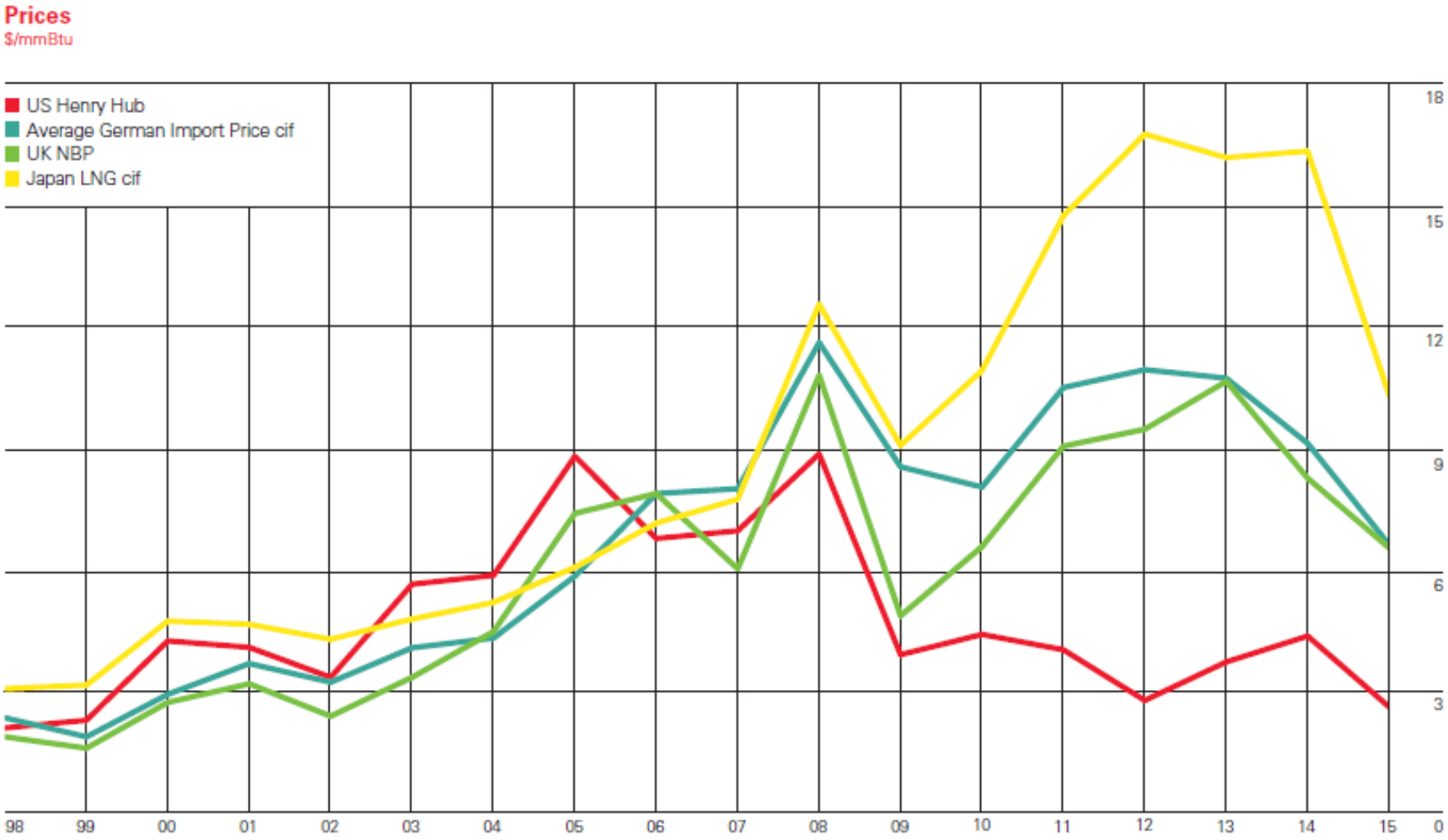

Source: BP Statistical Review

WHY ENERGY EFFICIENCY ?

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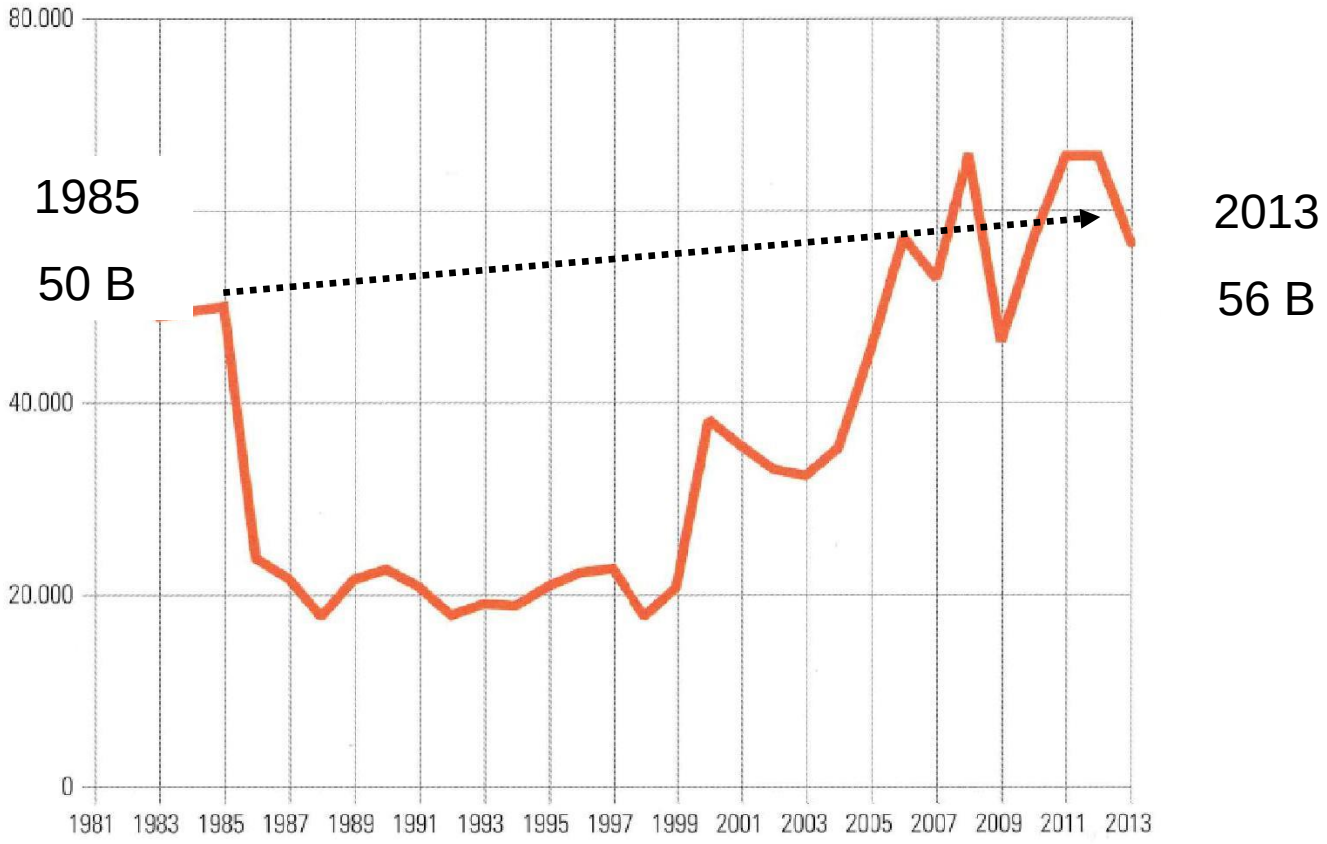
ITALIAN ENERGY BILL IN 2013 PRICES [Millions of Euro]

Italian energy bill	
divided	
GDP	
1985	4.7%
2013	3.6%



SOURCE: UP

WHY ENERGY EFFICIENCY ?

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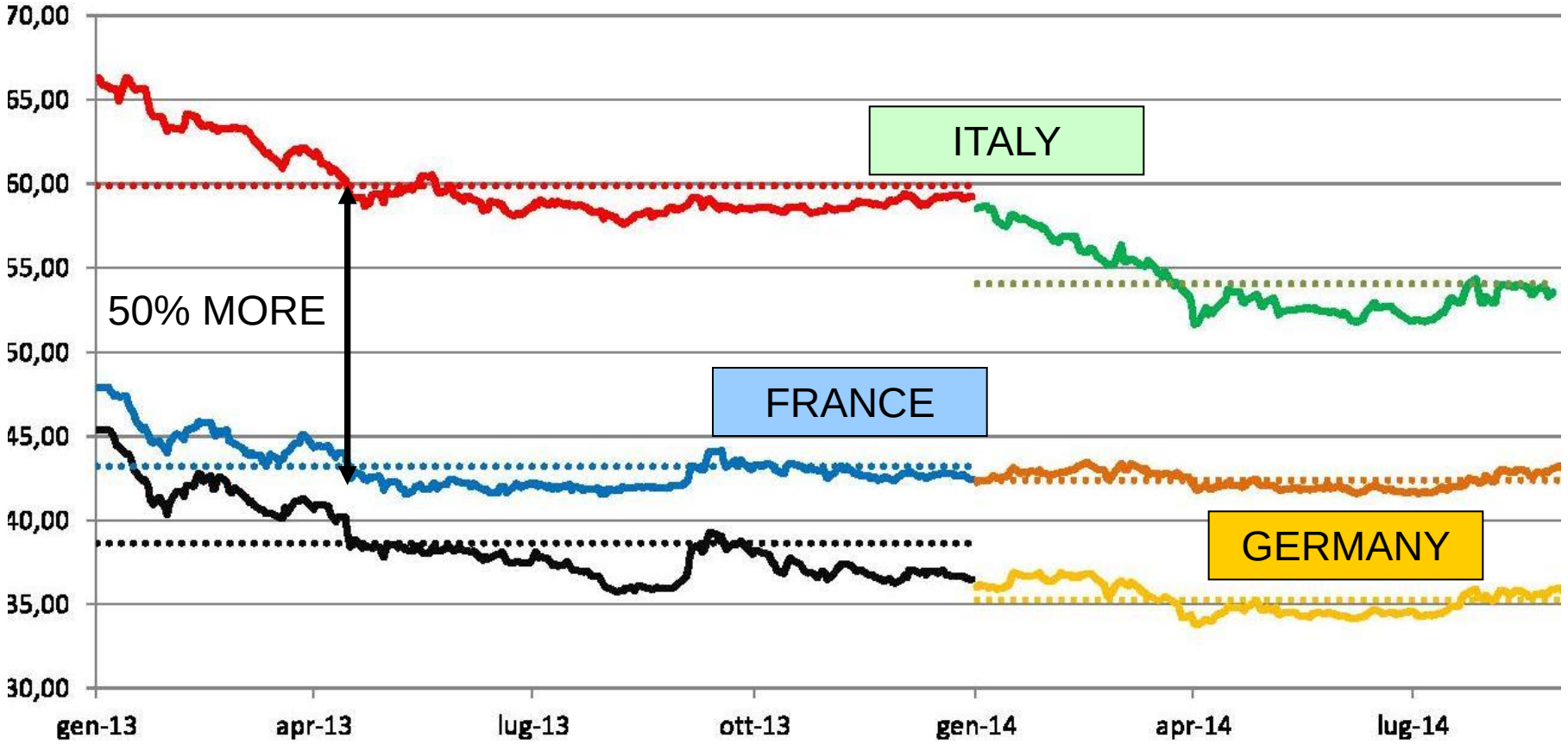
ELECTRIC POWER PRICE



ITALIAN END USER PRICE:

ABOUT 2.5 TIMES THIS ENERGY PRICE FOR:

TAXES AND INCENTIVES TO RENEWABLE

WHY ENERGY EFFICIENCY ?

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2014 International Energy Efficiency Scorecard

Witness the great Italian commitment towards energy efficiency

SOURCE: ACEE

WHY ENERGY EFFICIENCY ?

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Table 3. Total final energy consumption per capit

	Tonne of oil equivalent per person
India	0.6
Brazil	1.4
Mexico	1.6
China	2.0
Italy	2.6
Spain	2.7
UK	3.0
EU	3.3
Japan	3.5
France	3.8
Germany	3.8
Russia	5.1
South Korea	5.3
Australia	5.9
USA	6.8
Canada	7.2

Sources: IEA 2014 (energy consumption data); World Bank 2013 (GDP and population data).

Table 4. Total final energy consumption per dollar of GDP

	Tonne of oil equivalent per billion dollars
Japan	75.8
UK	77.8
Italy	78.7
Australia	87.2
Germany	89.7
Spain	94.2
France	96.3
EU	99.6
Brazil	119.9
USA	131.3
Canada	138.7
Mexico	162.9
South Korea	232.8
China	331.6
Russia	362.8
India	406.9

WHY ENERGY EFFICIENCY ?

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	GDP (trillion current $)	Total final consumption (ktoe) (1,000 tonnes of oil equivalent)	Building consumption (ktoe)	Industrial consumption (ktoe)	Transport consumption (ktoe)	Population
Australia	1.53	77,847	17,420	23,120	28,617	22,683,600
Brazil	2.25	217,889	34,114	82,808	69,987	198,656,019
Canada	1.82	203,975	59,246	56,476	59,487	34,880,491
China	8.23	1,634,706	59,246	783,253		000
EU	16.69	1,143,539	416,453	269,073		794
France	2.61	152,203	57,894	28,523		89
Germany	3.43	221,023	86,100	54,953	53,050	81,889,839
India	1.84	492,513	196,041	168,068	55,491	1,236,686,732
Italy	2.01	126,749	47,064	28,888	38,508	60,917,978
Japan	5.96	314,473	112,382	84,731	76,947	127,561,489
Mexico	1.18	116,070	21,755	29,186	51,847	120,847,477
Russia	2.01	458,571	153,395	128,113	96,485	143,533,000
South Korea	1.13	161,041	40,302	47,200	29,424	50,004,000
Spain	1.32	88,596	25,741	20,489	32,050	46217961
UK	2.47	126,301	49,869	25,968	41,264	63,227,526
USA	16.24	1,503,707	468,996	287,006	583,443	313,914,040

INDUSTRY

22.8%

Sources: IEA 2014 (energy consumption data); World Bank 2013 (GDP and population data).

WHY ENERGY EFFICIENCY ?

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CHP systems generate useful thermal energy and electricity or mechanical power in a single, integrated system.

The use of CHP systems is much more efficient than the separate generation of thermal energy and electricity because heat that is normally wasted in conventional power generation is recovered to meet thermal demands.

Electricity generated by CHP	
Italy	**24.1%**
EU	14.4%
China	14.0%
Russia	14.0%
Germany	13.3%
South Korea	11.6%
Spain	6.6%
UK	6.5%
USA	6.3%
India	5.0%
Mexico	4.6%
France	4.4%
Japan	3.0%
Australia	2.5%
Canada	1.8%
Brazil	< 1%

SOURCE

WEC2013, CEN(2011 China)

IEA(2010), IEA 2088 Brazil SENER 2013 Mexico

WHY ENERGY EFFICIENCY ?

INDUSTRY

Great efforts

in the last

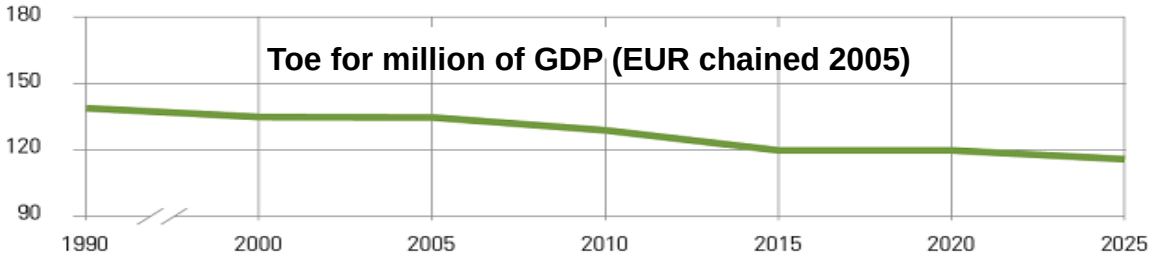
25 year

14%

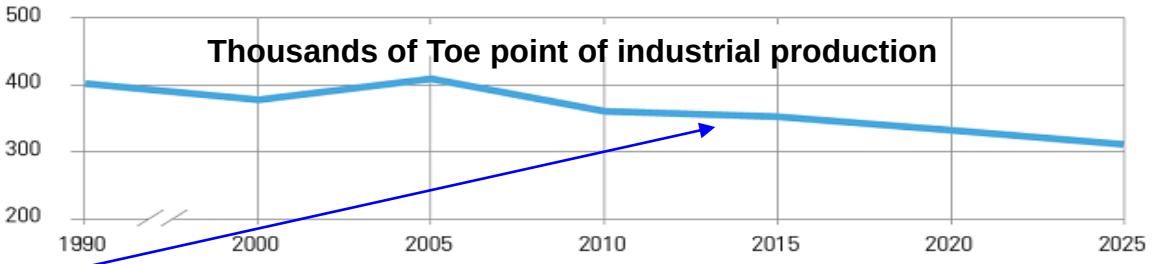
reduction

in energy intensity

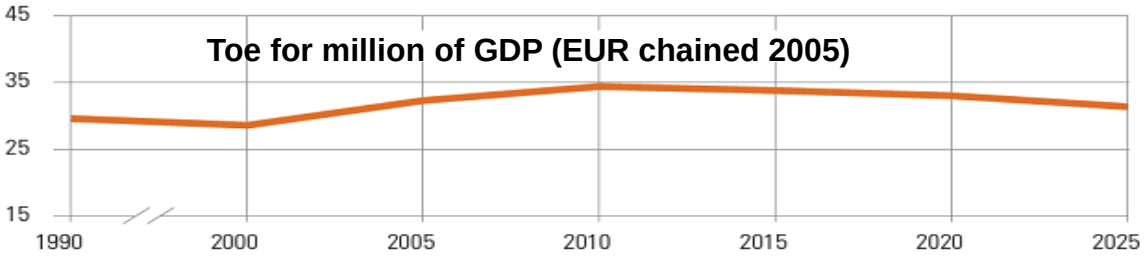
ITALIAN ECONOMIC SYSTEM



INDUSTRY



DOMESTIC SECTOR



HOW ENERGY EFFICIENCY ?

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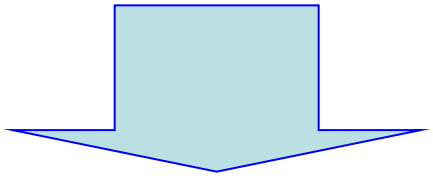
ETS DIRECTIVE 2009/29/EC phase III

GRADUAL REDUCTION OF FREE CO2 ALLOWANCES:
NONE FOR ELECTRIC POWER PRODUCTION
2010: 20% LOWER THAN 2013 FREE ALLOWANCES



THE COMPANIES:

WILL HAVE TO BUY ADDITIONAL CO2 TONNES IN A MARKET

A STRONG INCENTIVE TOWARDS ENERGY EFFICIENCY

TO CUT CO2 EMISSIONS

HOW ENERGY EFFICIENCY ?

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FQD DIRECTIVE 98/70/EC – 2009/30/EC Article 7A

REDUCTION OF 10%

OF CARBON FOOTPRINT

IN THE LIFE CYCLE OF FUELS

THE APPLICATION OF THIS ARTICLE IS STILL UNDER DISCUSSION

UNPREDICTABLE AT THE MOMENT WITHOUT IMPLEMENTING DECREE

BUT

ANYWAY A PUSH TOWARD A MORE EFFICIENT

GLOBAL TRANSPORTATION SYSTEM

HOW ENERGY EFFICIENCY ?

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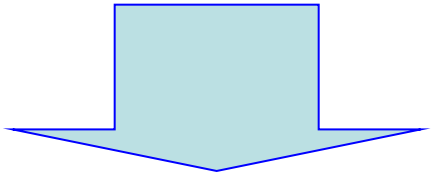
EED ENERGY EFFICIENCY DIRECTIVE 27/12/EC

20% PRIMARY ENERGY SAVINGS IN THE YEAR 2020

SAVINGS OF 1.5% FOR ALL ENERGY SELLERS TO END USER

ENERGY AUDIT REQUIRED



CERTIFICATION ISO 50001

ENERGY MANAGER QUALIFIED

NEW PROJECTS OF ENERGY SAVING

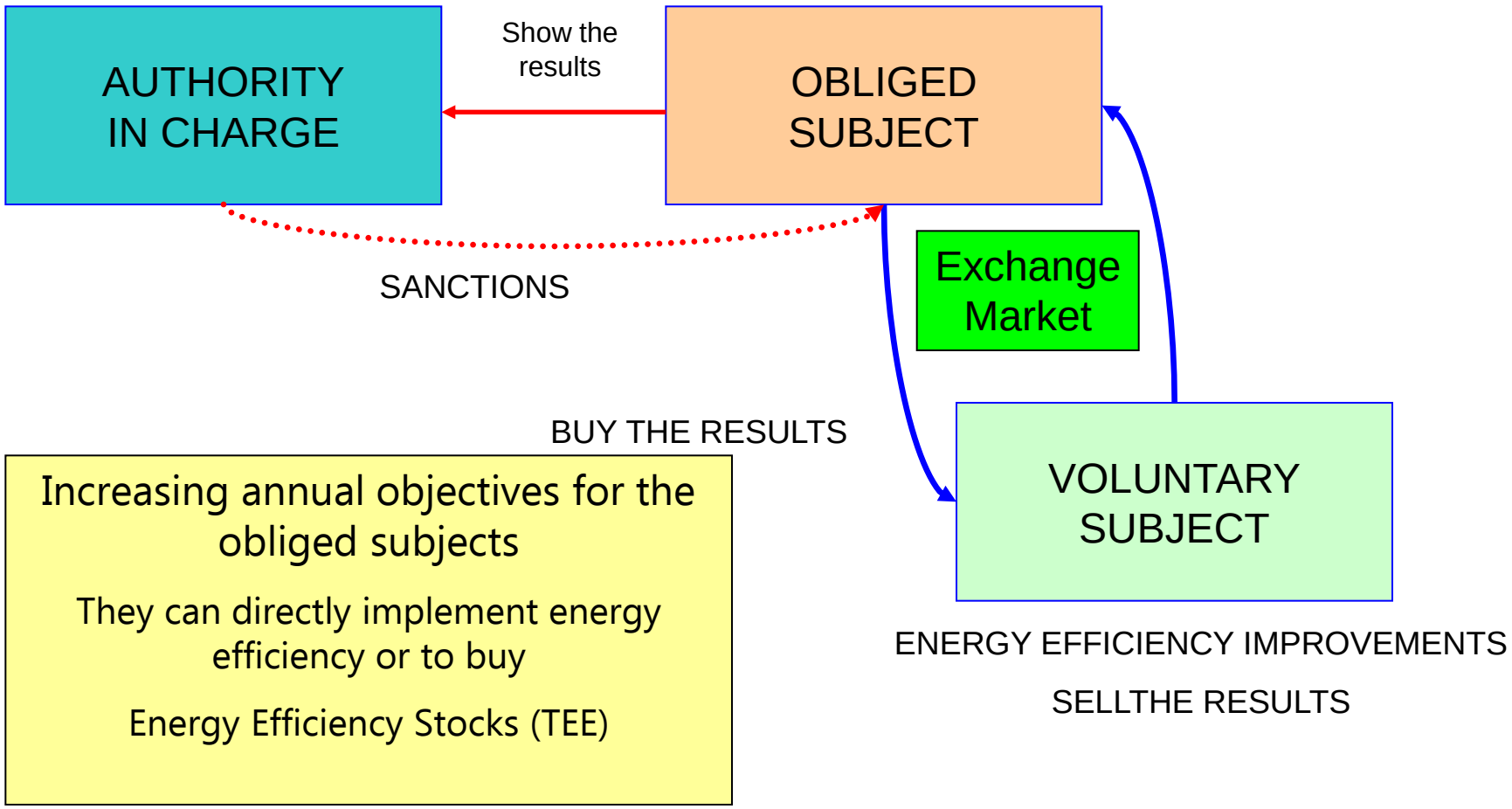
IN ITALY “WHITE CERIFICATES”

HOW ENERGY EFFICIENCY ?

IPLOM

"WHITE CERTIFICATES": AN ITALIAN EXPERIENCE

A MECHANISM "BASELINE AND TRADE"



Increasing annual objectives for the obliged subjects

They can directly implement energy efficiency or to buy

Energy Efficiency Stocks (TEE)

IPLOM

"WHITE CERTIFICATES": AN ITALIAN EXPERIENCE

BENEFITS

✓ GOOD RATIO COST / BENEFIT TO PROMOTE THE ACHIEVEMENT OF THE OBJECTIVES IN ENERGY EFFICIENCY

✓ ALL TECHNOLOGIES CAN BE INCLUDED

✓ MORE CONVENIENT TECHNOLOGIES ARE MORE REWARDED

✓ ALL SUBJECTS ARE INVOLVED, INCLUDED INDUSTRIAL ONES

DIFFICULTIES

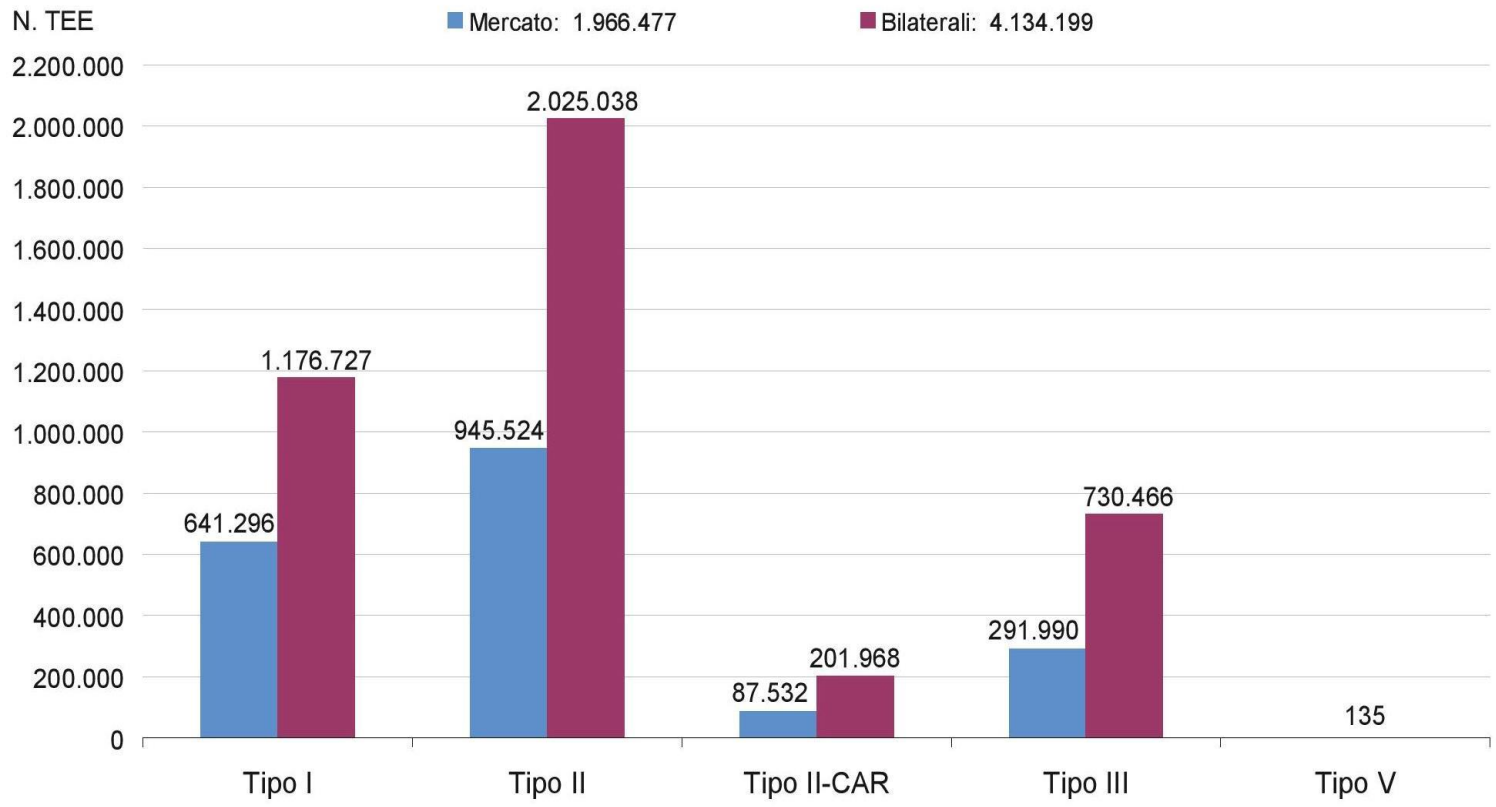
• CASH FLOW UNCERTAINTY FOR THE INVESTORS BECAUSE THE PRICE OF "WHITE CERTIFICATES" (TEE) IS VARIABLE (MARKET LINKED)

• IT IS DIFFICULT TO REWARD STRATEGIC TECHNOLOGIES, IF THEY ARE HIGH COST TECHNOLOGIES

IPLOM

"WHITE CERTIFICATES": AN ITALIAN EXPERIENCE

TEE scambiati dal 1 gennaio 2014 Fonte: GME



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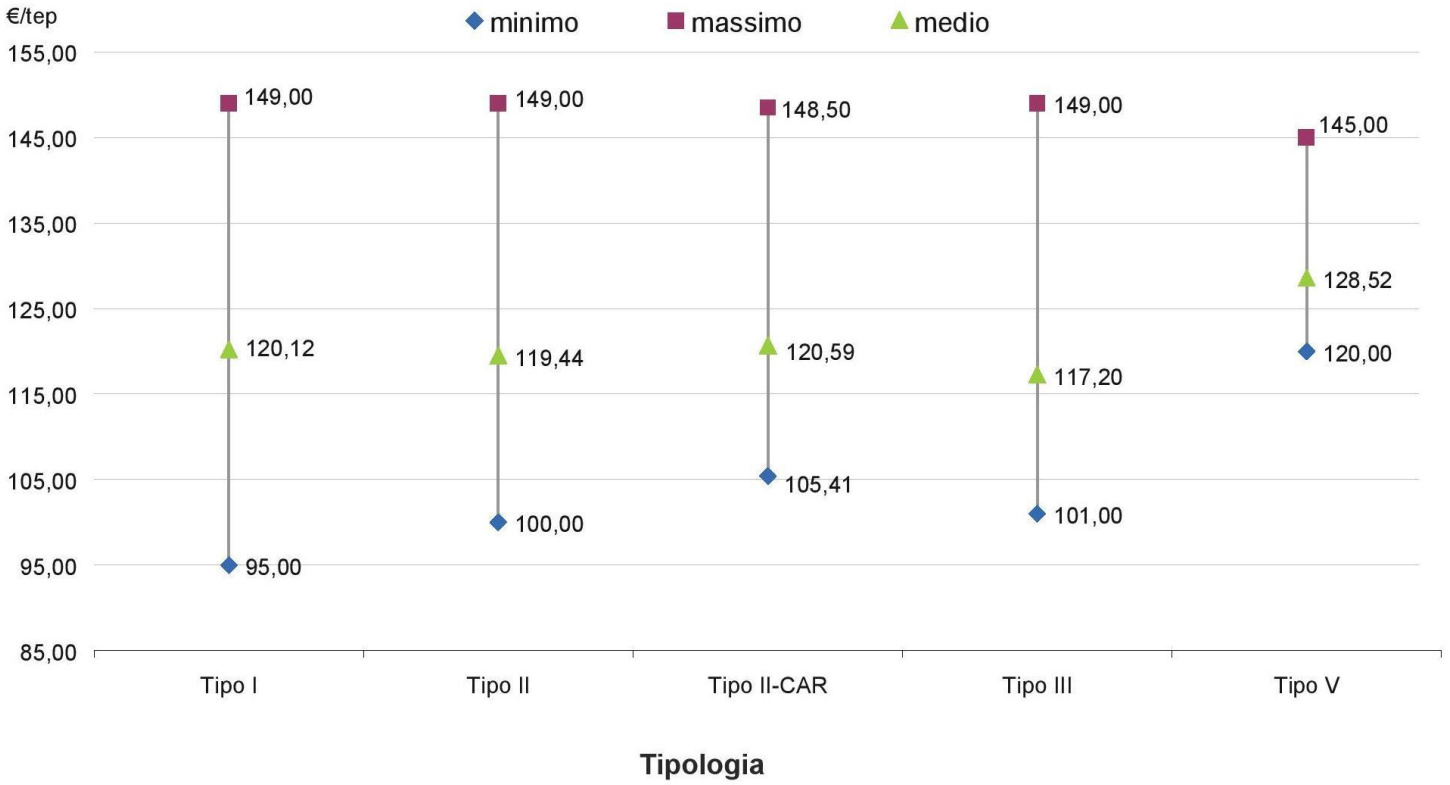
"WHITE CERTIFICATES": AN ITALIAN EXPERIENCE

TEE, prezzi sul mercato GME (sessioni da gennaio 2014) Fonte: GME



THE MECHANISM WORKS WELL

PAY BACK PERIOD ON ENERGY INVESTMENT IS HALVED

IPLOM ENERGY EFFICIENCY CASE

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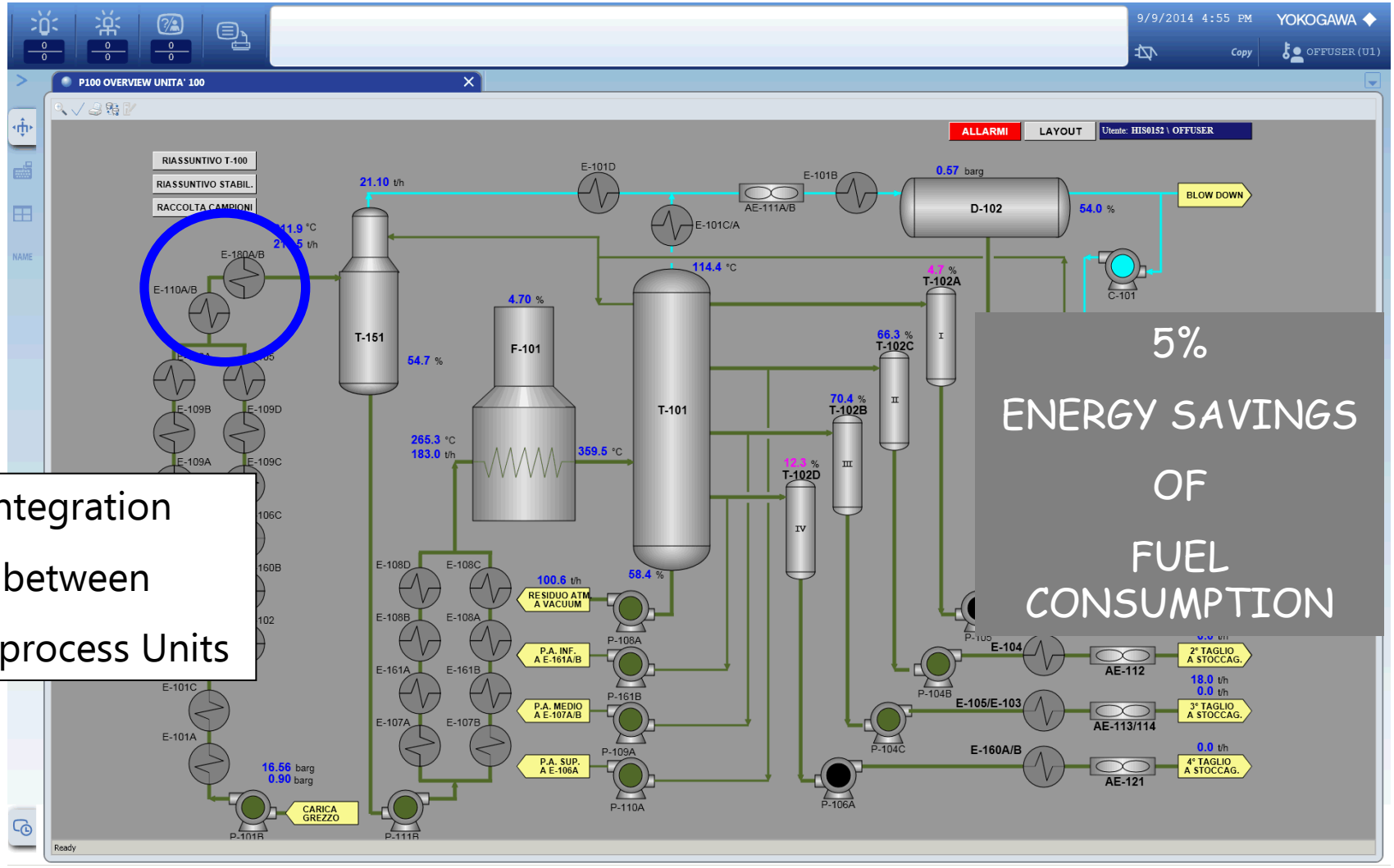
OPTIMIZATION OF HEAT EXCHANGER NETWORK



Integration between two process Units

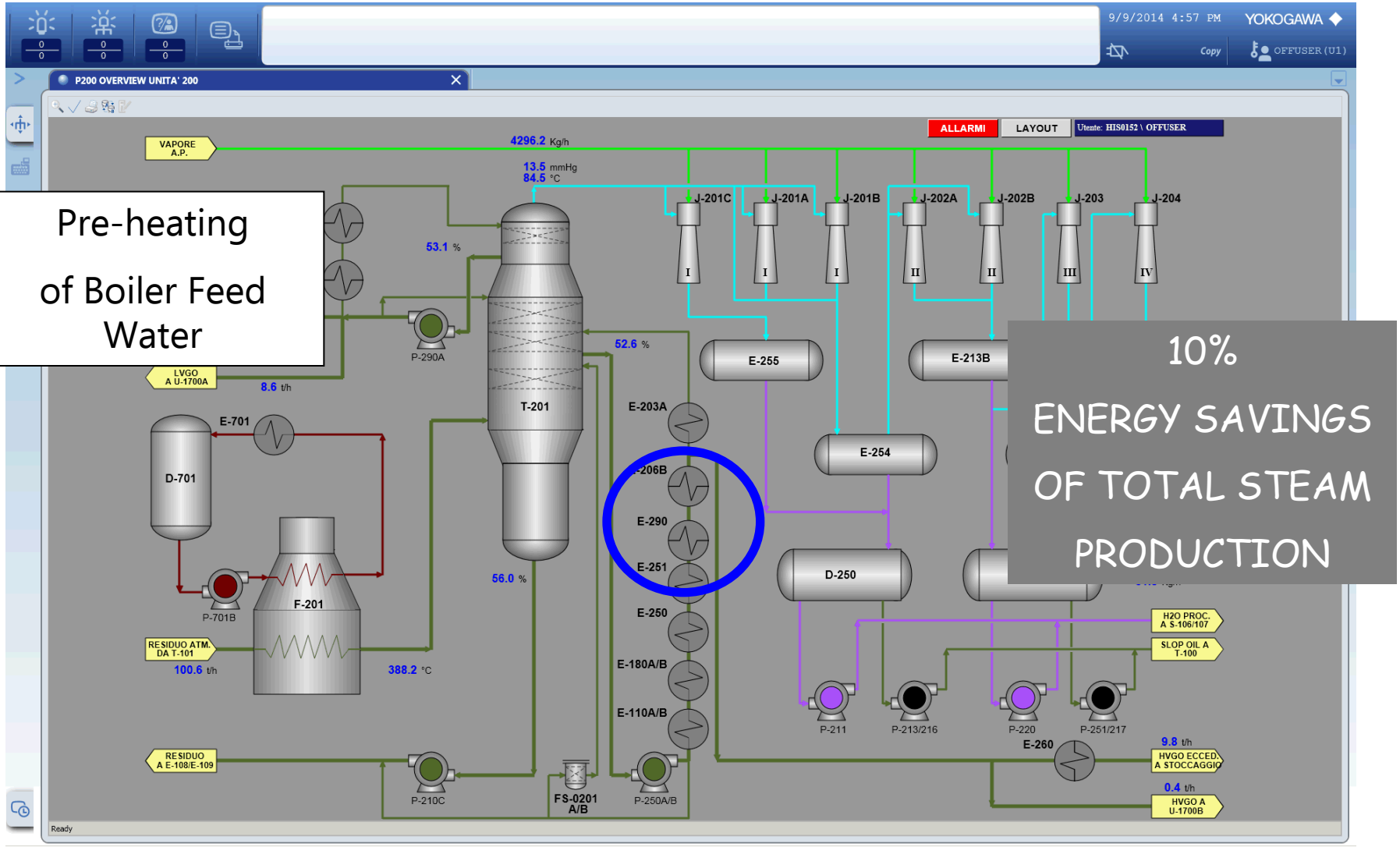
5% ENERGY SAVINGS OF FUEL CONSUMPTION

IPLOM ENERGY EFFICIENCY CASE

OPTIMIZATION OF HEAT EXCHANGER NETWORK

Pre-heating

of Boiler Feed Water



10%

ENERGY SAVINGS OF TOTAL STEAM PRODUCTION

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AIR PRE-HEATER INSTALLATION ON THE PROCESS FURNACES

Pre-heating

of combustion air

10%

ENERGYSAVINGS

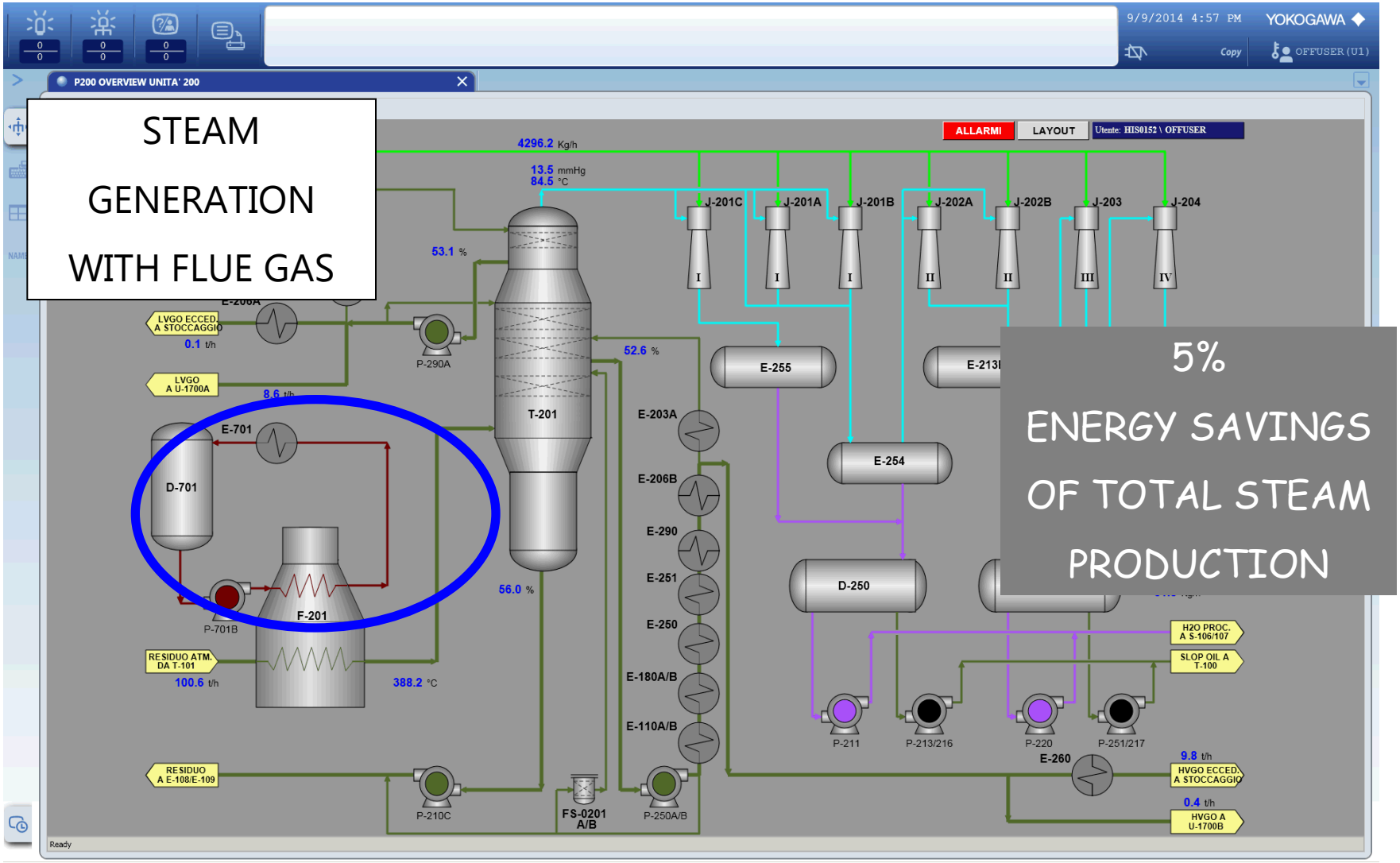
OF

TOTAL FUEL CONSUMPTION

IPLOM ENERGY EFFICIENCY CASE

OPTIMIZATION OF HEAT EXCHANGER NETWORK

STEAM GENERATION WITH FLUE GAS



5%

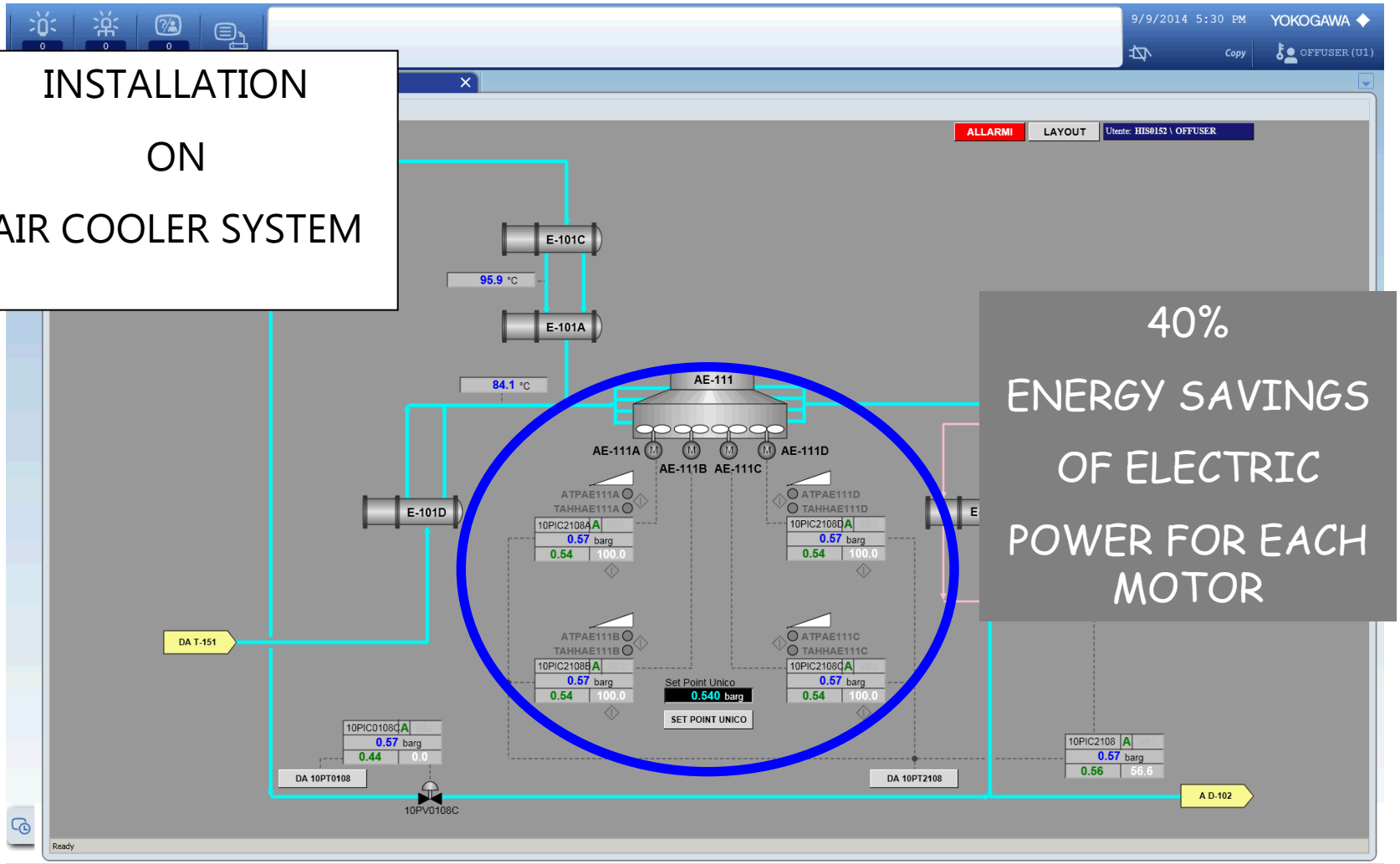
ENERGY SAVINGS OF TOTAL STEAM PRODUCTION

VARIABLE FREQUENCY DRIVER – INSTALLATION ON ELECTRIC MOTOR

INSTALLATION

ON

AIR COOLER SYSTEM



40%

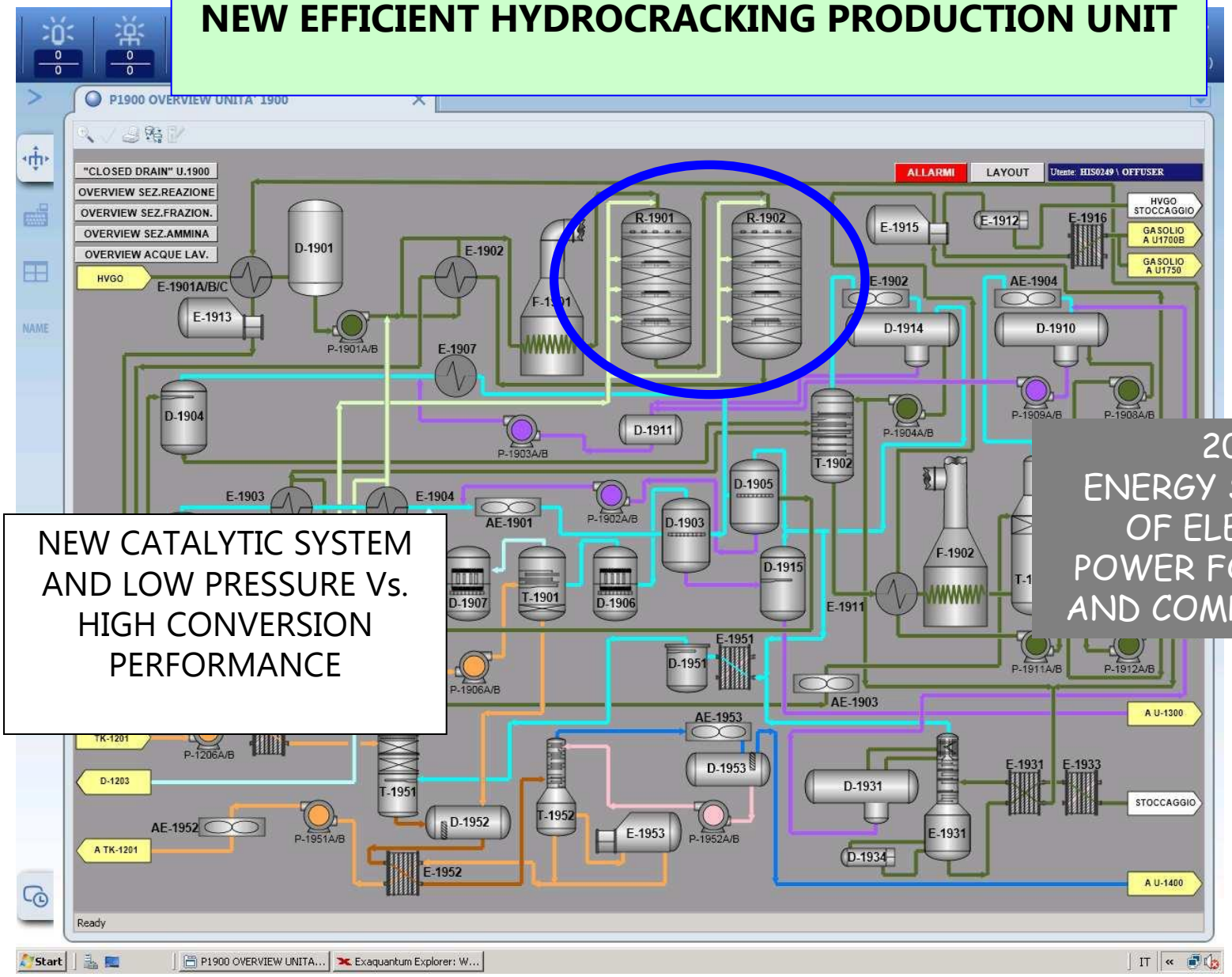
ENERGY SAVINGS

OF ELECTRIC

POWER FOR EACH MOTOR

IPLOM ENERGY EFFICIENCY CASE

NEW EFFICIENT HYDROCRACKING PRODUCTION UNIT



NEW CATALYTIC SYSTEM AND LOW PRESSURE Vs. HIGH CONVERSION PERFORMANCE

20% ENERGY SAVINGS OF ELECTRIC POWER FOR PUMPS AND COMPRESSORS

IPLOM ENERGY EFFICIENCY CASE

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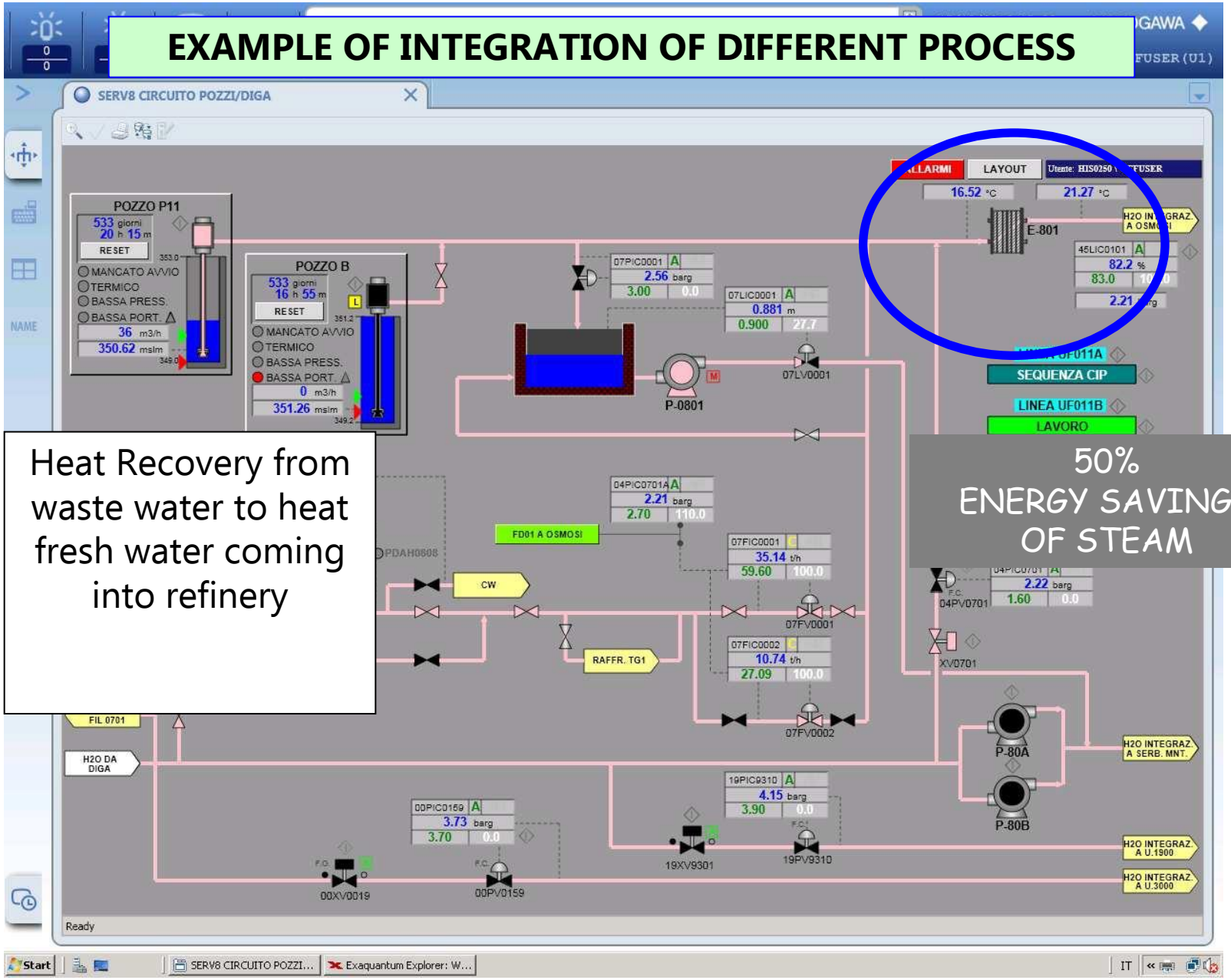
EXAMPLE OF INTEGRATION OF DIFFERENT PROCESS

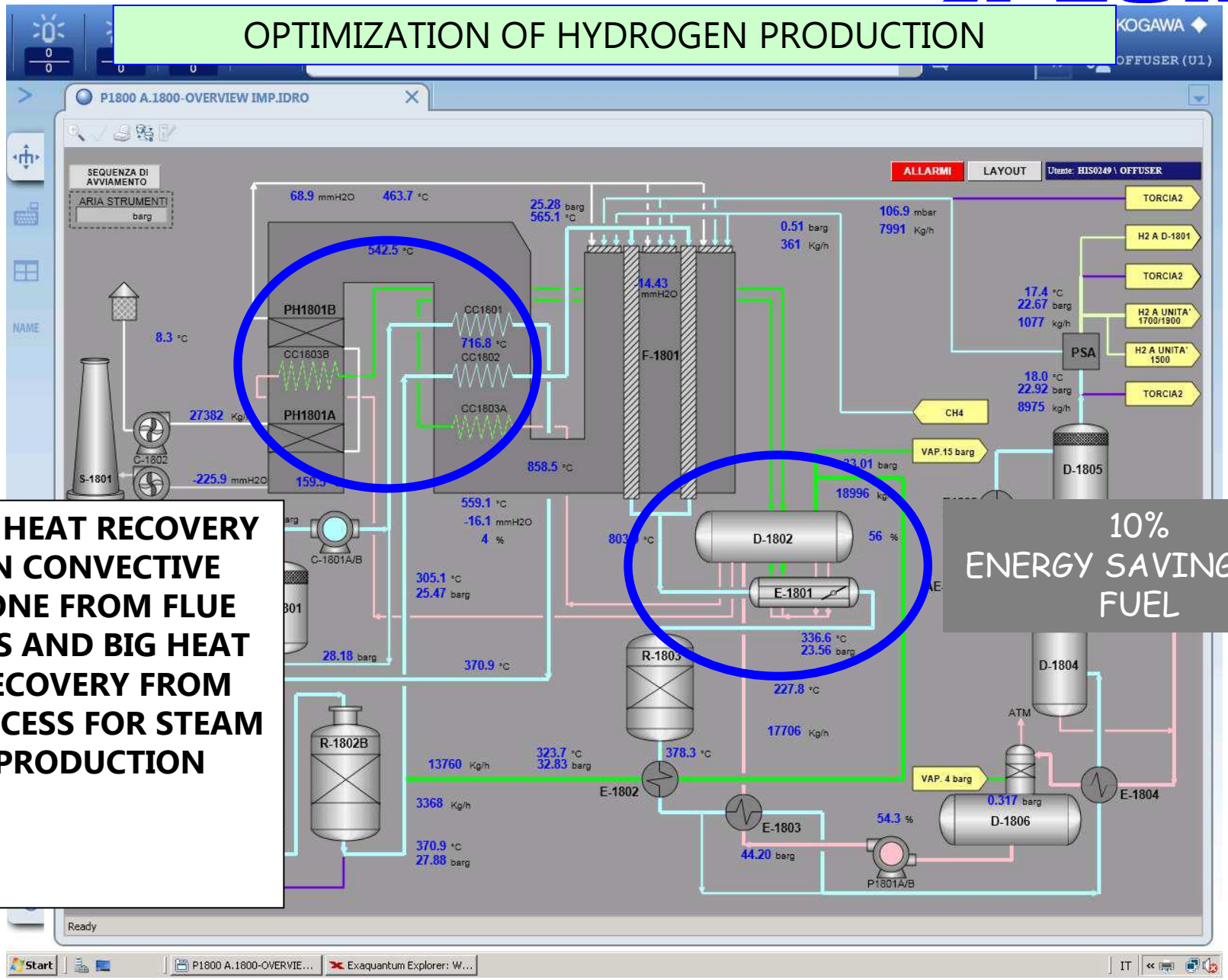


Heat Recovery from waste water to heat fresh water coming into refinery

50%
ENERGY SAVINGS
OF STEAM

IPLOM ENERGY EFFICIENCY CASE

OPTIMIZATION OF HYDROGEN PRODUCTION

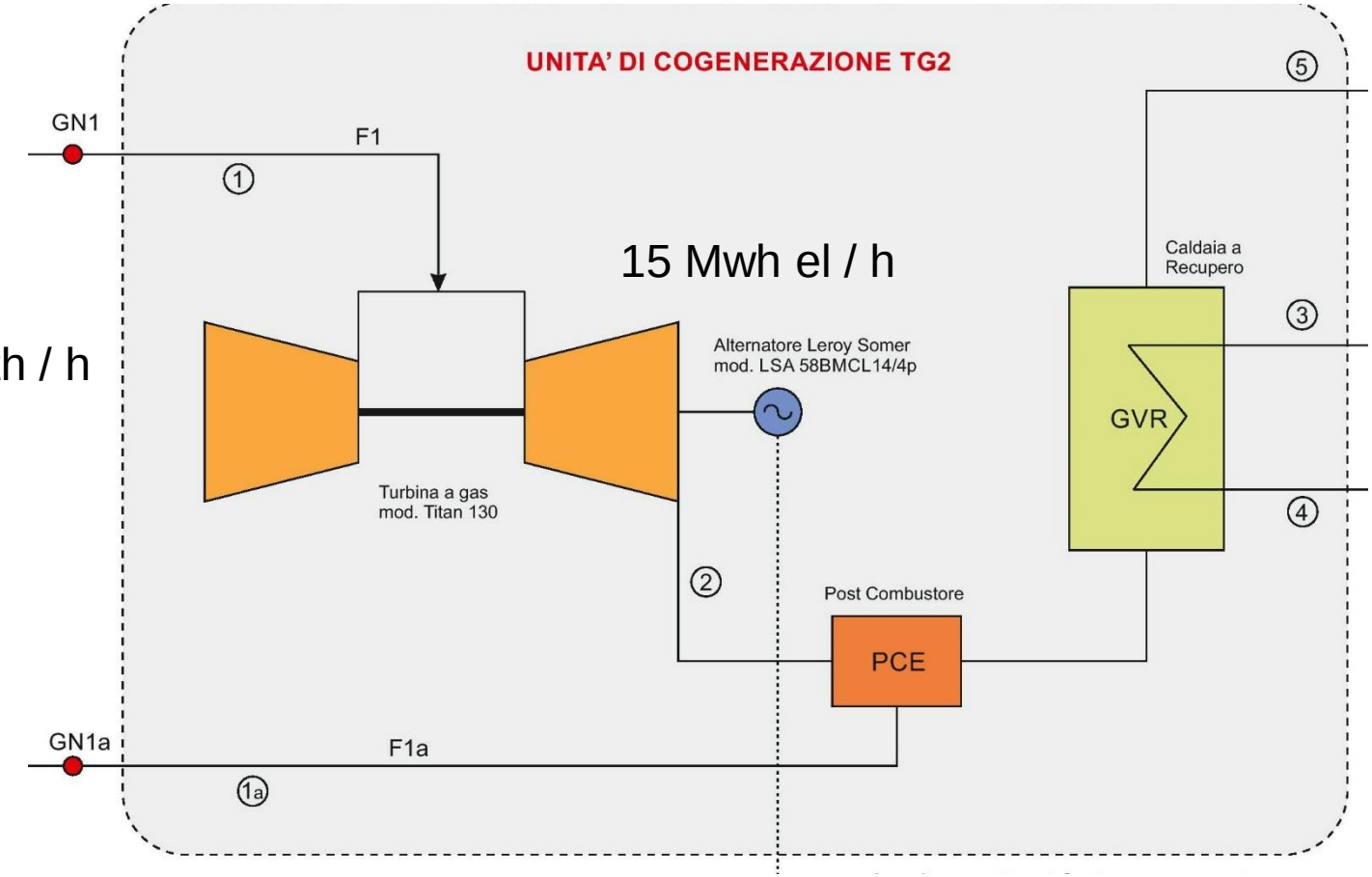


BIG HEAT RECOVERY IN CONVECTIVE ZONE FROM FLUE GAS AND BIG HEAT RECOVERY FROM PROCESS FOR STEAM PRODUCTION

10% ENERGY SAVINGS IN FUEL

IPLOM ENERGY EFFICIENCY CASE

COMBINED HEAT AND POWER GENERATION



IPLOM ENERGY EFFICIENCY CASE

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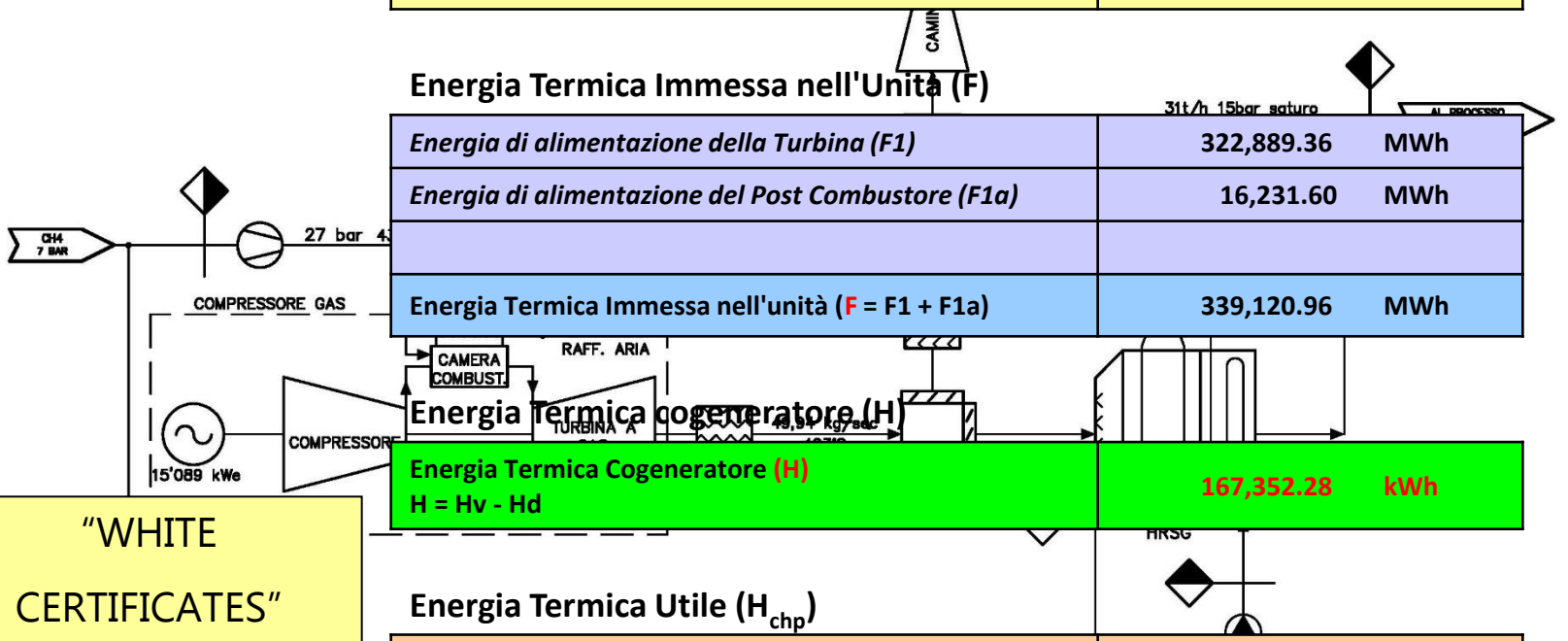
COMBINED HEAT AND POWER GENERATION

Energia Elettrica Prodotta (E)

Energia Elettrica Prodotta (E)	108,860.87	Mwh

Energia Termica Immessa nell'Unità (F)

Energia di alimentazione della Turbina (F1)	322,889.36	MWh
Energia di alimentazione del Post Combustore (F1a)	16,231.60	MWh
Energia Termica Immessa nell'unità (F = F1 + F1a)	339,120.96	MWh



Energia Termica cogeneratore (H)

Energia Termica Cogeneratore (H) H = Hv - Hd	167,352.28	kWh

"WHITE CERTIFICATES"
11594 TEE
SELLING
ON THE MARKET

Energia Termica Utile (H_{chp})

H	167,352.28	MWh
$H_{non\ chp,H}$	11,141.17	MWh
$H_{chp} = (H - H_{non\ chp,H})$	156,211.11	MWh

Rendimento Globale ($\eta_{globale}$)

Rendimento Globale ($\eta_{globale}$) $\eta_{globale} = (E + H_{chp})/(F - F_{non\ chp,H})$	0.8209

IPLOM ENERGY EFFICIENCY CASE

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EFENIS PROJECT

EFENIS

ENERGY EFFICIENCY

DEMONSTRATION IN

MANUFACTURING INDUSTRY

ACADEMIC PARTNERS

University of Manchester

University of Genoa

University of Maribor

University of Tessaloniki

Universityof Pannonia

University of Paderbon

VTT

IPLOM: leader of

Workpackage 8 Demonstration

PUTTING INTO PRACTICE TOTAL SITE ENERGY MANAGEMENT FOR CHP AND DISTRICT HEATING

INDUSTRIAL PARTNERS

MOL

BAYER

IPLOM

VESTAS

IPLOM ENERGY EFFICIENCY CASE

IPLOM

EFENIS

EFENIS PROJECT

PINCH AND TOTAL SITE ANALYSIS

HAS ELABORATED FOR ALL IPLOM UNITS

USING EFENIS-SITE SOFTWARE AND MASS/ENERGY RECONCILIATION ALGORITHM

AN ANALYSIS OF THE EXISTING, TARGET AN

MODIFIED DESIGNS

UNDER VARYING OPERATIONAL CONDITIONS

AND SCENARIOS FOR EACH UNIT

(1) Data collection for different load cases for each unit

(2) Data storage systems

(3) Model calculations

(4) Static Pinch Analysis of the existing units

(5) Perform a static Total Site analysis

(6) Calculation of the overall carbon footprint for the total site target

(7) Engineering of the identified modifications

(8) Estimate od return of investment

IPLOM ENERGY EFFICIENCY CASE

EFENIS PROJECT

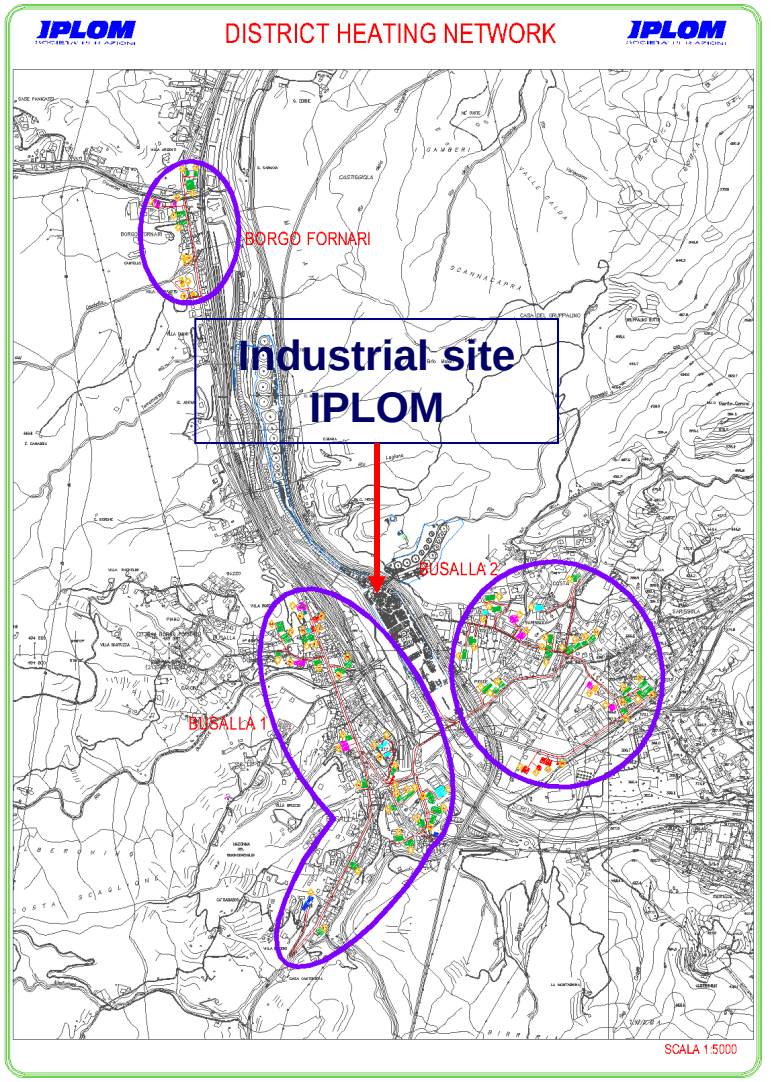
ELABORATION

OF THE DESIGN

DISTRICT HEATING NETWORK

WITH WASTE HEAT

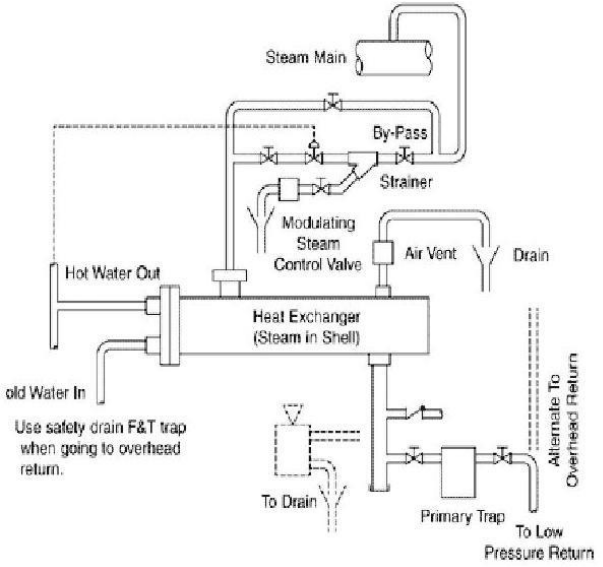
OF REFINERY



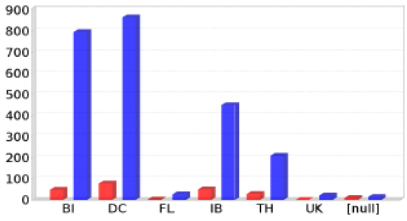
STEAM TRAPS

RECONCILIED STEAM BALANCE, IDENTIFICATION OF "WASTE" STEAM THROUGH CONTINUOS MONITORIG. MAINTENANCE AND SUBSTITUTION OF "BAD" STEAM TRAPS

TARGET EFFICIENCY OVER 90%

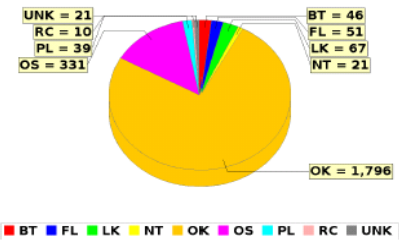


RIEPILOGO TIPI SCARICATORI



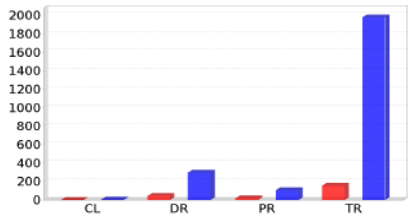
Tipo generico		Conteggio popolazione	% sul totale	Conteggio n. guasti	Guasti in servizio
BI	Bimetallico	795	33,4%	47	6,4%
DC	Termodinamico	866	36,4%	78	10,8%
FL	Galleggiante	27	1,1%	1	7,7%
IB	Secchiello rovesciato	449	18,8%	49	12,8%
TH	Termostatico	210	8,8%	28	17,5%
UK	Sconosciuto	21	0,9%	0	0,0%
Altro		14	0,6%	10	76,9%
Totali:		2.382	100%	213	10,4%

RIEPILOGO CONDIZIONI



Condizione		Conteggio popolazione	% sul totale
BT	Perdita continua	46	1,9%
FL	Allagato	51	2,1%
LK	Perdita leggera	67	2,8%
NT	Non sottoposto a test	21	0,9%
OK	OK	1.796	75,4%
OS	Non in servizio	331	13,9%
PL	Intasato	39	1,6%
RC	ciclo rapido	10	0,4%
UNK	Sconosciuto	21	0,9%
Totali:		2.382	100%

RIEPILOGO APPLICAZIONI

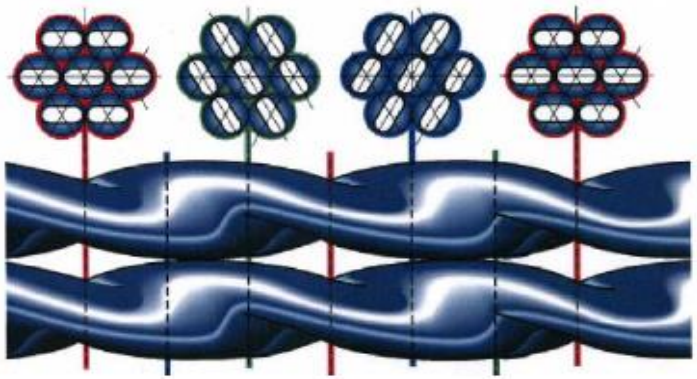


Applicazione		Conteggio popolazione	% sul totale	Conteggio n. guasti	Guasti in servizio
CL	Serpentina	4	0,2%	1	25,0%
DR	Pozzetto raccolta condensa	295	12,4%	42	16,4%
PR	Processo	104	4,4%	16	22,5%
TR	Tracciamento	1.979	83,1%	154	9,0%
Totali:		2.382	100%	213	10,4%

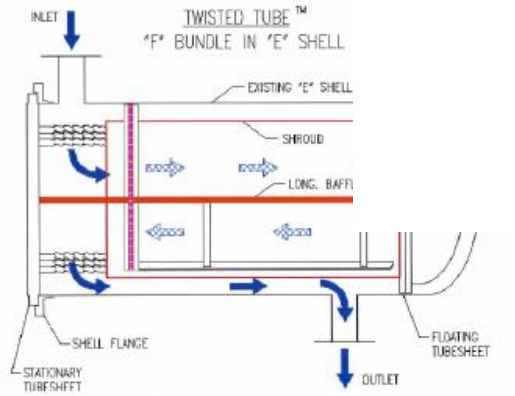
"TWISTED TUBE" APPLICATION TO HEAT EXCHANGER

ADVANCED HEAT RECOVERY IN HYDROTREATING UNITS

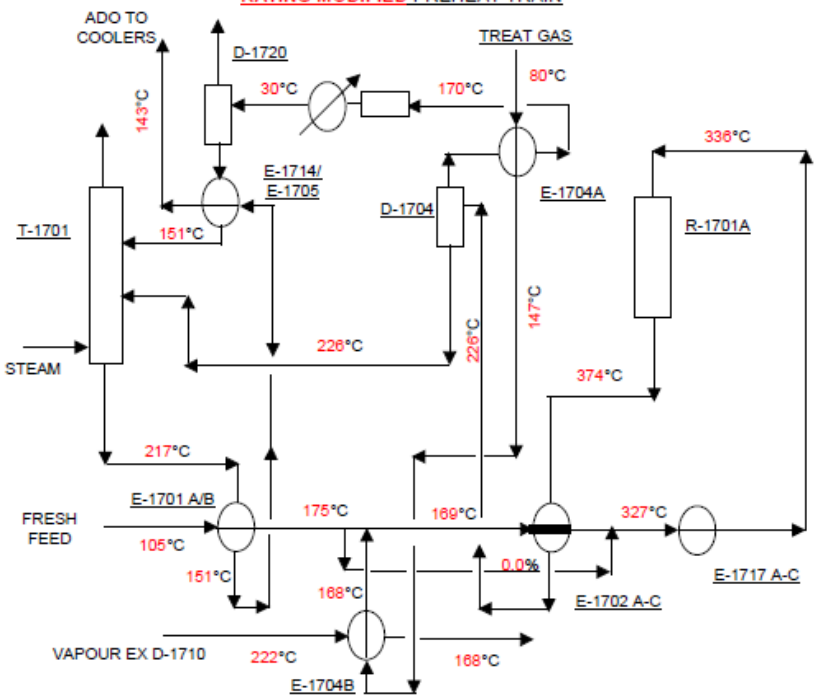
TUBES ARRANGEMENT



TEMA TYPE CONVERTED



PROJECT CASE STUDY – SOR OPERATION - ZERO BYPASS RATING E-1702 A-C
RATING MODIFIED PREHEAT TRAIN



Thank you

IPLOM