

ISO 50001 Energy Management System – Case Study

2022

Saudi Arabia

Saudi Arabia

YANSAB

35% energy saving achievement for SABIC strategy and 2MMBTU saving equal 2.2 M \$ for SEEC.



Case Study Snapshot

Industry	YANSAB
Product/Service	Petrochemical plant
Location	YANBU
Energy performance improvement percentage (2010-2021)	35% improvement over 2010 years
Total energy cost savings (2010-2021)	USD 23,264,482 /year
Cost to implement Energy Management System (EnMS)	USD 48,500 /cycle
Total energy savings (2010-2021)	19,653,206 GJ /year
Total CO₂-e emission reduction (2010-2021)	1,123,040 Ton/year

Organization Profile / Business Case

Yanbu National Petrochemical Company (YANSAB) is a Saudi Joint Stock Company commenced its Commercial operations on 1 March 2010. The objectives of YANSAB are to engage in manufacturing of petrochemical products (Ethylene, Ethylene Glycol, High Density Polyethylene, Low Linear Density Polyethylene, Polypropylene, Butene1, MTBE and BTX) with 4 million ton production rate in accordance with its Articles of Association, and other applicable regulations in the Kingdom

YANSAB Established an Energy Management System (EnMS) that complies with the requirements of the International Standard ISO-50001-2011 and ISO-50001-2018. EnMS shall support the systematic approach to continual improvement of Energy performance and energy cost index to meet YANSAB long term Energy and Sustainability Strategy as well as meeting regional regulatory requirement of energy efficiency improvement.

Energy Management improvement is focused on the Energy Intensity (EI) for YANSAB plants and efficiency, energy consumption and the operational optimization for the manufacturing plants, physical assets, utilities and buildings.

EnMS shall enable YANSAB to achieve SABIC 2025 strategic objective of a 25% Energy Intensity reduction from the 2010 base line, and to achieve their best possible energy quartile performance as per Saudi Energy Efficiency Program (SEEP) Strategy.

ISO 50001 Energy Management System – Case Study

2022

Saudi Arabia

“Energy Continual Improvement is one of YANSAB major goals.”

—Hattan Ghandorah, E&S manger

Business Benefits

ISO-50001 enhanced the management workflow to assure energy continual improvement is one of YANSAB policies, goals, and strategies. Certified EnMS cost of implementation including the estimated staff time = $16500+32000 = 48,500$ US\$

- In 2019 YANSAB achieved 1st cycle SEEC program by reducing the plant energy consumption and maintained the plants Energy Intensity (EI) as per global benchmark and get a credit of 2 MMBTU saving that equal to 2.2 M \$.
- In 2021, YANSAB energy nonprofit project has been accepted and certified by UN. The project was successful and resulted in achieving a saving of 126 GWhr and 35,827 CO2 emission.
- Up to date, YANSAB has achieved an Improvement of 35% on its Energy Intensity and a reduction of 23% of GHG intensity (CO2 emission) from its 2010 base line. Please refer to table 1.

Plan

In 2010, SABIC started the Sustainability program to achieve a reduction of 25% of its Energy Consumption, intensity, GHG intensity “CO2 emission”, water consumption intensity, and 50% of material effectiveness intensity in 2025.

In 2011, Saudi Energy Efficiency Center program (SEEC) officially requested YANSAB to improve plant energy performance by maintaining the plant Energy Intensity on 2nd quartile as per global benchmark in 2019 for the 1st Cycle. 2nd Cycle (2020-2025) with revised the global benchmark target. (Fig 2)

Energy & Sustainability (E&S) management system become one of YANSAB value drivers and strategy to obtain the financial commitment and resources to achieve YANSAB goals:

- SEEC target (regulation requirement)
- SABIC sustainability target (SABIC business Strategy)
- YANSAB energy continual improvement

YANSAB executive management demonstrated their commitment by initiating new department “Energy & Sustainability (E&S) department, and involved in development management system focusing on issuance of policy, business objective, supervision of activities include documentation, training, and the publicity of system to stakeholders. In addition, approval of the main documents and the policy and participated in management review meetings. Furthermore, arrangement of required sources such as subject matter experts and financial requirement.

In 2016, YANSAB sustainability team has developed and documented an Energy Management System (EnMS). EnMS covers and defines YANSAB energy boundary limit, energy natural sources fig-1 (Fuel “sales gas” from Aramco and power from MARAFEQ), and energy user (Utility, olefin, Ethylene glycol, Butene-1, Benzen, high-density polyethylene, low-density polyethylene, polypropylene) plants. The EnMS also covers and defines energy significant equipment like boilers, furnaces, motors, turbines, Extruders and etc. It also covers energy consumption quantity for each plant, building and equipment. The EnMS defines energy goals and intensity target calculation for the site/ plants, energy indicators for each equipment, energy streams, and key energy variables based on best history and the design data.

YANSAB EnMS team defined the base line based on following criteria:

ISO 50001 Energy Management System – Case Study

2022

Saudi Arabia

- 1- YANSAB over all Energy intensity ($EI = \frac{\text{total energy consumption GJ}}{\text{Total production rate ton}}$) in 2010 to be reduced 25% in 2025 to achieve SABIC sustainability target. Please refer to table 1
- 2- YANSAB individual plant EI for (Olefin, Ethylene glycol, Butene-1, Benzen, High Density Poly Ethylene, Low Density Polyethylene, Polypropylene) with this equation ($\text{Plant EI} = \frac{\text{Plant net energy consumption MMBTU}}{\text{Plant production rate ton}}$) in 2011 to achieve 2ndQuartile benchmark as per SEEC target. Please refer to table 2.

YANSAB EnMS team started working in three parallel workflow to achieve the above target.

- 1- First workflow is to initiate project pipelines workflow that includes specific system and tools like Energy Assessment tool to generate/ prioritize the ideas/projects and YANSAB Forecast tool to estimate the energy saving from each idea/project. Table Please refer to Table 5.
- 2- Second workflow is to develop and build real time E&S monitors that includes all energy resources, significant equipment, assets, and buildings on all Distributed Control System (DCS), PI vision system, and YOKOGAWA Exquantum program at YANSAB plants. Full team from process, operation, maintenance, financial, environment, and business planning departments for each plant are assigned to monitor and analyze the Energy and Sustainability (E&S) performance in daily, weekly, and monthly basis as per defined roles and responsibilities in EnMs procedure. If there is any gaps or deviation from the target due to plant reliability, YANSAB E&S team will justify the incident to create the efficient road map to recover the losses and maintain the E&S performance. Please refer to table 3 and fig 3.
- 3- Third work flow ,YANSAB management is reviewing E&S KPIs, project update, and goals in monthly basis to assure the plant energy performance on high efficient. Please refer to fig 4.

In 2017, with support from Total Quality Management (TQM) department team, YANSAB made contract with BSI company to Certify the EnMS procedure based on ISO 50001-2011.

In 2018 after reviewing and maintaining all ISO 50001-2011 requirement, YANSAB had been successfully certified.

In 2021, YANSAB has transitioned the EnMS to meet the requirements of ISO 50001-2018 after adding the energy performance target under business risk management and is successfully certified.

Annual energy audit and annual energy management review are planned with BSI to assure the EnMS procedure is working well.

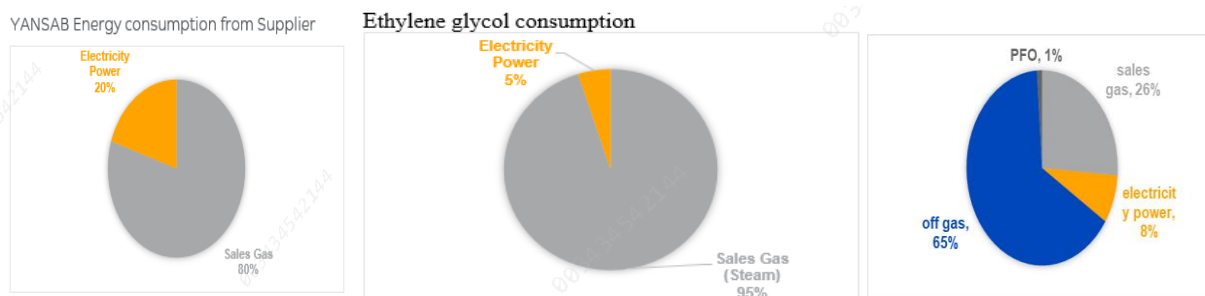


Fig-1

ISO 50001 Energy Management System – Case Study

2022

Saudi Arabia

Plant	Base line EI 2010 GJ/Ton	EI Target 2025 %	YANSAB performance 2020	Business impact cost
YANSAB	14.83	25% 11.13 GJ/ton	35% 9.65 GJ/ton 19.65 MGJ/year	23,264,482 /year

Table 1

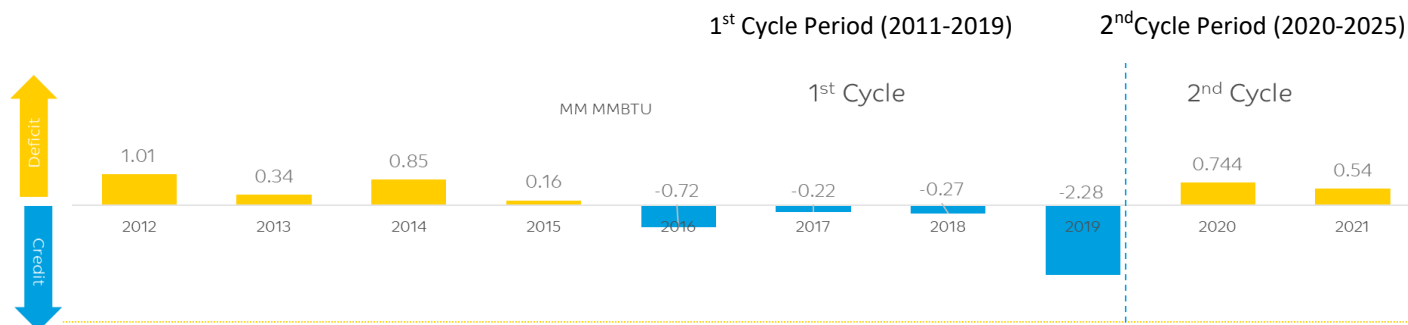


Fig 2

Plant	Energy Consumption 2011 (KBDOE)	Base line EI 2011 MMBTU/Ton	EI Target 2019 MMBTU/Ton	Improvement required (%)	YANSAB SAVING MMBTU	Business impact cost
Olefin	10.36	13.97	19.2	0	0	
EOEG	5.8	18.75	17.45	6.93%	2,207,765	
PP	2.75	3.06	2.54		509,458	
HDPE	0.87	5.3	5.16	2.67%	0	
LLDPE	0.57	2.8	3.72	0%	396,746	
YANSAB Overall	18.17			2.3%	2,748,907 1.298 KBDOE	2.25 M \$

Table 2

“Continual Energy Management review to meet ISO 50001 requirement is very helpful to have high efficient energy management procedure”

— Ahmed A-Shaikh, Staff Energy and Sustainability Engineer

Do, Check, and Act

EnMS for continual improvement and achieve YANSAB Energy & Sustainability (E&S) goals & strategy is integrated in YANSAB policy. It is also communicated to all YANSAB employees with high commitment from YANSAB Executive management. Process engineering Sr. Manager is assigned to lead (E&S) department that functioned to implement EnMS. New E&S manager with two full time E&S engineers are appointed in E&S department. New E&S team implemented EnMS as per role and responsibility that defined on EnMS procedure.

Energy and sustainability campaign was done to announce and introduced the EnMS goals, strategy and commitment to all YANSAB employee. High engagement from YANSAB management to inspire YANSAB Employees to improve the YANSAB energy performance and enhance the energy and sustainability behavior.

ISO 50001 Energy Management System – Case Study

2022

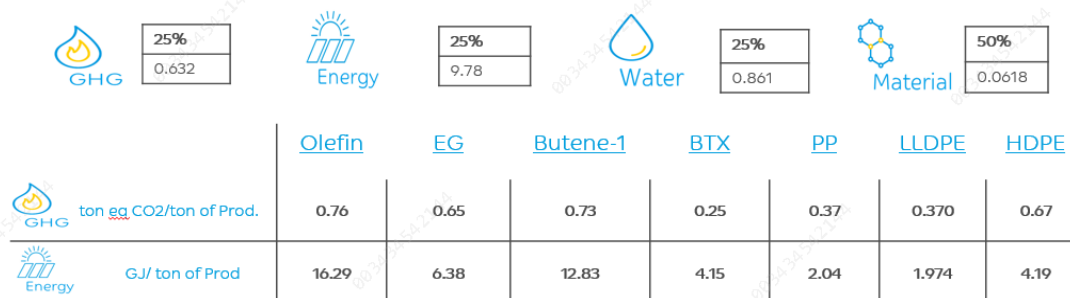
Saudi Arabia

Achieving 1st cycle SEEC target was very challenge because of the deficit was very high for EG plant and HDPE plant. YANSAB management was very attention to have road map including the project required and optimization ideas to achieve 2019 target. YANSAB has achieved the target successfully with gain 2.75 MM MMBTU = 2.25 U\$MM. (Table 2)

YANSAB E&S team is publishing and sharing the E&S targets annually after YANSAB management approval to all YANSAB employees. The road map that needs to achieve the targets is also to be shared with all YANSAB employees.



ENERGY & SUSTAINABILITY TARGET



Referring to EnMS procedure, energy source (sales gas from ARAMCO, internal Fuel from crackers, and power from MARAFEQ) consumption for YANSAB site and individual has been identified fig1. The E&S dashboard (fig 3) had been developed to monitor on real time energy resources, energy significant equipment indicators, energy streams, and key energy variables based on best historical and the design data. Table 3 lists some Energy Significant Equipment with energy indicators for each equipment.

Equipment	No of Asset	Energy consum GJ/day	Tot Energy GJ/day	Energy source	Key Energy driver
1 Boiler	5	11664 /boiler	58320	Sales gas	Steam load, Fuel flow, stack temp, excess air , boiler efficiency
2 C.W Pump	6	322.4 / pump	1934.4	Power	Pump running status, C.W flow
3 S.W Pump	5	395.9 / pump	1979.5	Power	Pump running status, S.W flow
4 BFW Pump	2	344.2 / pump	688.4	Sales gas (Steam)	Pump running status, BFW flow
5 BFW Pump	2	371.5 / pump	743	Power	Pump running status, BFW flow
6 Air Compressor	2	168.9 / comp	337.8	Sales gas (Steam)	Compressor running status, Air flow, Air Dew Point
7 Furnace cracker	8	10551/furnace	84408	Off gas	TLE outlet temp, stack temp, excess air
8 K-1301 (80/54)	1	5422.8	5423	Off Gas (steam)	Compressor control system mode (CCS)
9 E-2523	1	2385	2385	Sales Gas (Steam))	Steam flow
10 Extruder MX-4801	2	1150 483	1633	Sales gas Steam	Steam flow

Table 3 (Some YANSAB Energy significant Equipment)

ISO 50001 Energy Management System – Case Study

2022

Saudi Arabia

Based on plant history data the energy relevant variable effected on energy consumption as per follow:

- 1- Plant reliability. For example Un-plan Shutdown, plant off spec, plant’s energy significant equipment trip will effect badly on energy consumption and performance. Like olefin CGC equipment.
- 2- Plant load “low plant production rate” due to Feed curtailment from supplier, product quality, and marketing issue.
- 3- High outside temperature on summer session. High outside temperature lead to increase running of cooling water and seawater pumps to maintain the coiling water temperature in the plant heat exchangers. Increase the Fin fans on cooling water towers to reduce the seawater temperature.

YANSAB E&S team is monitoring, analyzing, and prioritizing the actions required to maintain the energy and sustainability (GHG, energy, water consumption, material waste) intensity performance in daily basis.

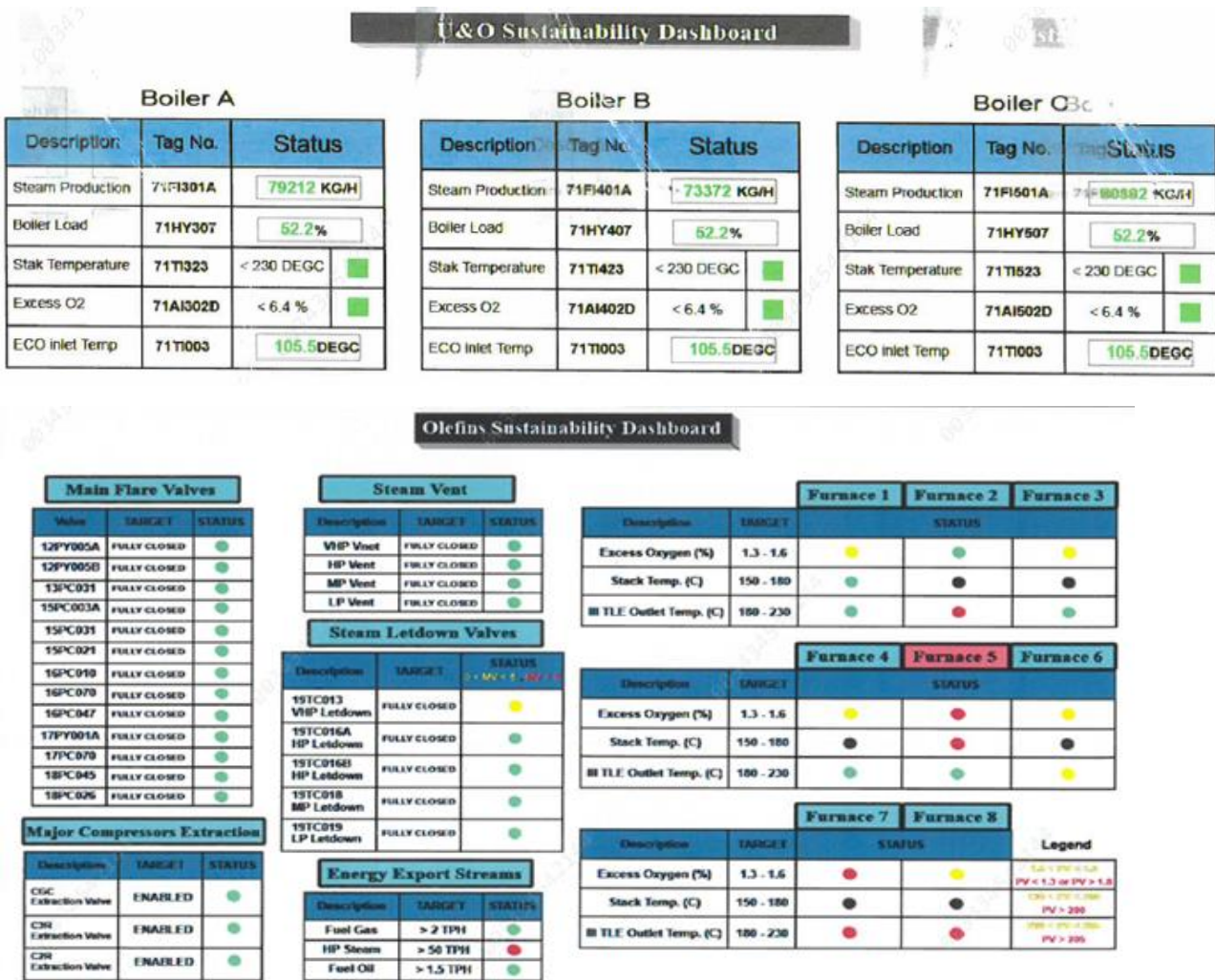


Fig 3

In case of any irregularity, gap or deviations from targets identified through the DCS/ PI energy dashboard (Fig 2) due to plant reliability, operation focal point engineer will report in the process gap report (PGR) including the root cause (if known), justification, correction with target date, energy value impact. YANSAB E&S team (operation, process, E&S, and concerned department engineers) will review the incident and agree for efficient road map to bridge the gap losses and maintain the E&S performance. Table 4

ISO 50001 Energy Management System – Case Study

2022

Saudi Arabia

An example for the handling of such deviations, a medium pressure steam vent was reported 5-8 t/hr was venting due to valve passing. Operation Focal Point and Maintenance Engineer took the corrective action in (PGR) to normalized plant energy performance on target date. Process Engineer calculated the energy losses. E&S team generated the road map to recover the energy losses by saving some quantity of MPS in the process.

	Operation action in (PGR)	Energy saving GJ	Energy coast saving (1 MMBTU = 1.25\$)
1	Reduce the excess air to 2% in all utility boilers	63,700 GJ/year 3504 ton CO2 emission	75,404 \$ /year
2	Increase steam turbine extraction in steam turbine generator	129,300 GJ	153,058 \$
3	Close HP to MP L/D station valve in olefin header by increase gas compressor turbine extraction in EG	128,000 GJ	151,520 \$

Table 4

YANSAB E&S team conducts an annual energy assessment for each plant to generate improvement ideas/projects. The project list is prioritized in the project forecast tools with estimate the energy saving.

	YANSAB Project	Energy saving GJ	Energy coast saving 1 MMBTU = 1.25\$)
1	Olefin 80/54	200,000 GJ	236,750 \$/year
2	EG DPN	350,000 GJ	414,312 \$/year
3	Install new economizer in utility boilers	72833 GJ/year 3800 ton CO2 emission /year	86,216 \$/year
4	Install a New Cycle Water Exchanger (PACKINOX)	116,156 GJ	137,500 \$/year

Table 5

YANSAB EnMS tools

	YANSAB EnMS tools	Objective	type	sources
1	E&S Dashboard	Monitors all Energy Significant Equipment, Energy indicators, and KEV	DCS, PI System	All data read on real time from Tags.
2	Sustainability footprint inventory	Data base to record all data of E&S streams, users, consumption, chemical composition to estimate (EI) for YANSAB site and each plant and	Excel sheet	All data recorded monthly from Tags.
3	KPI forecast tools	Database to list all projects/ideas to estimate the benefit energy saving, energy cost, project tracking, project priority.	Excel sheet	All data recorded monthly
4	Energy & sustainability assessment tools	Database to estimate all YANSAB energy project benefit and energy cost either positive or negative impact.	Excel sheet	All data recorded monthly
5	KPI monitors performance tools	Data base to estimate the site/plant performance	Excel sheet	All data recorded monthly
6	Process gap report	It is for recording the deviation in energy for each plant that is obtained	Excel sheet	All data recorded daily

ISO 50001 Energy Management System – Case Study

2022

Saudi Arabia

from the E&S dashboard or plant site visit

YANSAB executive Management is involving on EnMS implementation, review and continual improvement. They also conduct a monthly review of the E&S KPIs, project update, and goals to assure the plant energy performance on high efficient (fig-4)

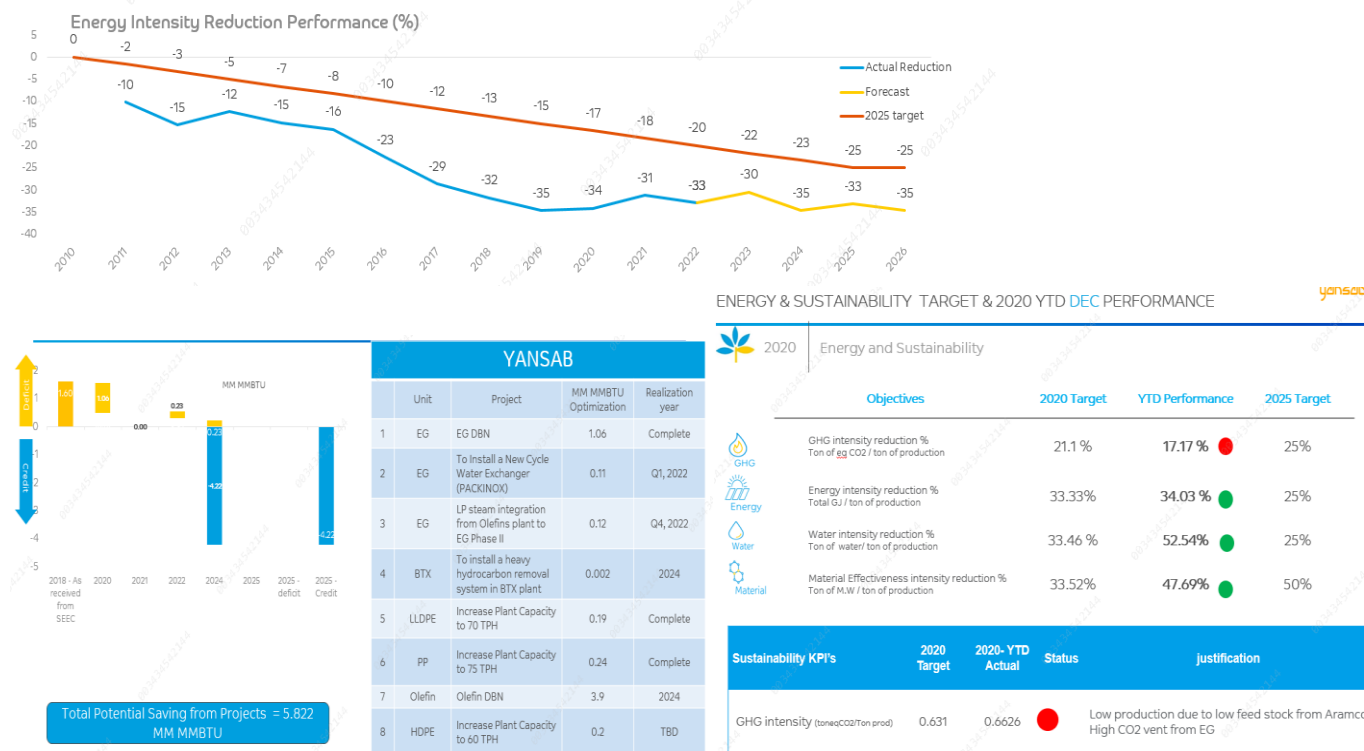


Fig-4

Competency

A competence Energy team at YANSAB should complete the following:

- 1- SABIC energy certificate program. YANSAB has up to date 15 Energy Expert Engineers Certified.
- 2- Certified Energy manger owned by SEEC.
- 3- Energy and Sustainability awareness

Transparency

YANSAB has announced to public, YANSAB board, Capital Market Authority (CMA), and SABIC to have an EnMS complied with ISO-5001-2011 in 2017 and - ISO-5001-2018 in 2021.

EnMS Policy has been integrated with YANSAB policy and communicated to all stakeholders. EnMS experience can also be shared as needed with other SABIC Affiliates, Regulatory Authorities and Partners.

What We Can Do Differently

YANSAB EnMS need to have an installation of energy software for close loop monitoring with high efficient recommendation.

Best practice to be shared with similar petrochemical plant.