

USING DIGITAL TECHNOLOGIES FOR EFFECTIVE ENERGY AND EMISSION MANAGEMENT AND OPTIMIZATION

KBC (A Yokogawa Company)
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WHY FOCUS ON ENERGY?



Energy is the largest controllable operating cost on most sites



Even leading performers see 10-15% energy cost savings and improved margins by up to 20%



Associated emissions reductions align with corporate and/or legislative commitments



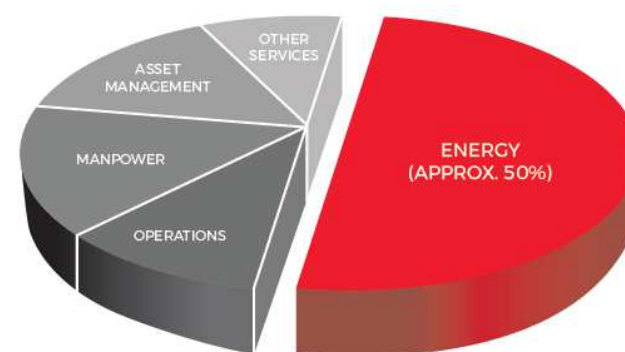
Saving energy is the most reliable way to reduce operating costs in a volatile market - It always saves money and always will



Energy is undergoing a global and local transition with complex decarbonization issues

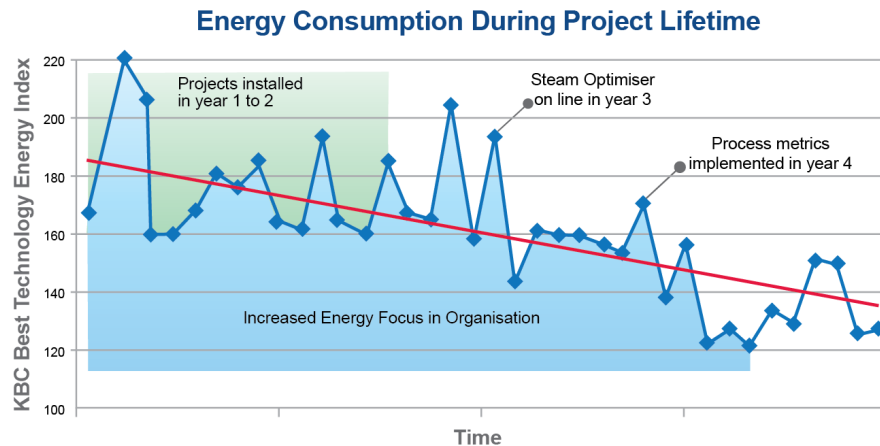


Energy optimization cuts through the uncertainty



KBC ENERGY OPTIMIZATION

Energy Savings Now...



Supported by energy, process and subject matter experts with over 20 years experience using KBC's superior tools and proprietary leading technologies our client saw a 20% reduction in energy index over 4 years, resulting in them becoming a top quartile performer

... And in the Future

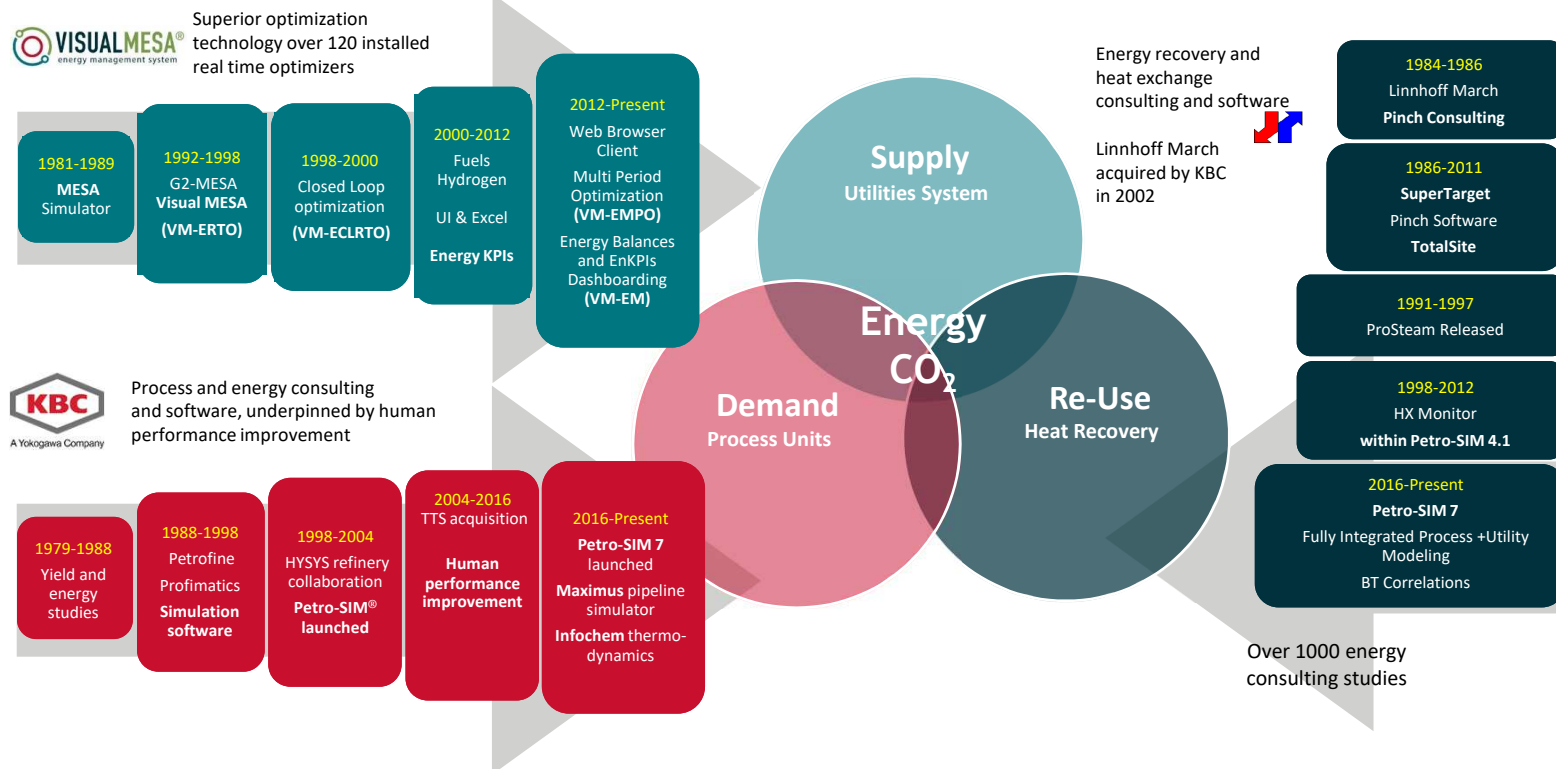
Future-proof method to reduce operating costs and emissions regardless of carbon price

Critical first step towards decarbonization in the energy transition

Reduces future expenditure for strategies such as electrification or carbon capture

THE A-Z OF ENERGY MANAGEMENT

KBC UNITES THE WORLD LEADERS IN ENERGY SUPPLY, DEMAND AND RE-USE TO PROVIDE A COMPLETE SOLUTION



KBC GHG REDUCTION DIGITAL PATHWAY

Emissions Management

Emissions Accounting & Reporting

- +**Auditability** for Official Reporting
- +**Reliability** based on reconciled balance
- +Net Zero target setting and tracking

Emissions Reduction

Monitoring and Optimization

- Improve Operational Efficiency
- Visibility, granularity and speed to action
- Current and day ahead

Automated Implementation

Closed loop
AI/ML

WE ACHIEVE THE DIGITAL PATHWAY WITH OUR DIGITAL TWIN TECHNOLOGIES

Digital Twin concept is based on the idea that a digital informational construct about a physical system could be created as an entity on its own ⁽¹⁾

- ◆ This digital information would be a “twin” of the information that was embedded within the physical system itself and be linked with that physical system through the entire lifecycle of the system

KBC/Yokogawa digital twins:

- Petro-SIM[®] (Process Digital Twin)
- Visual MESA[®] Energy Management System (Energy Digital Twin)



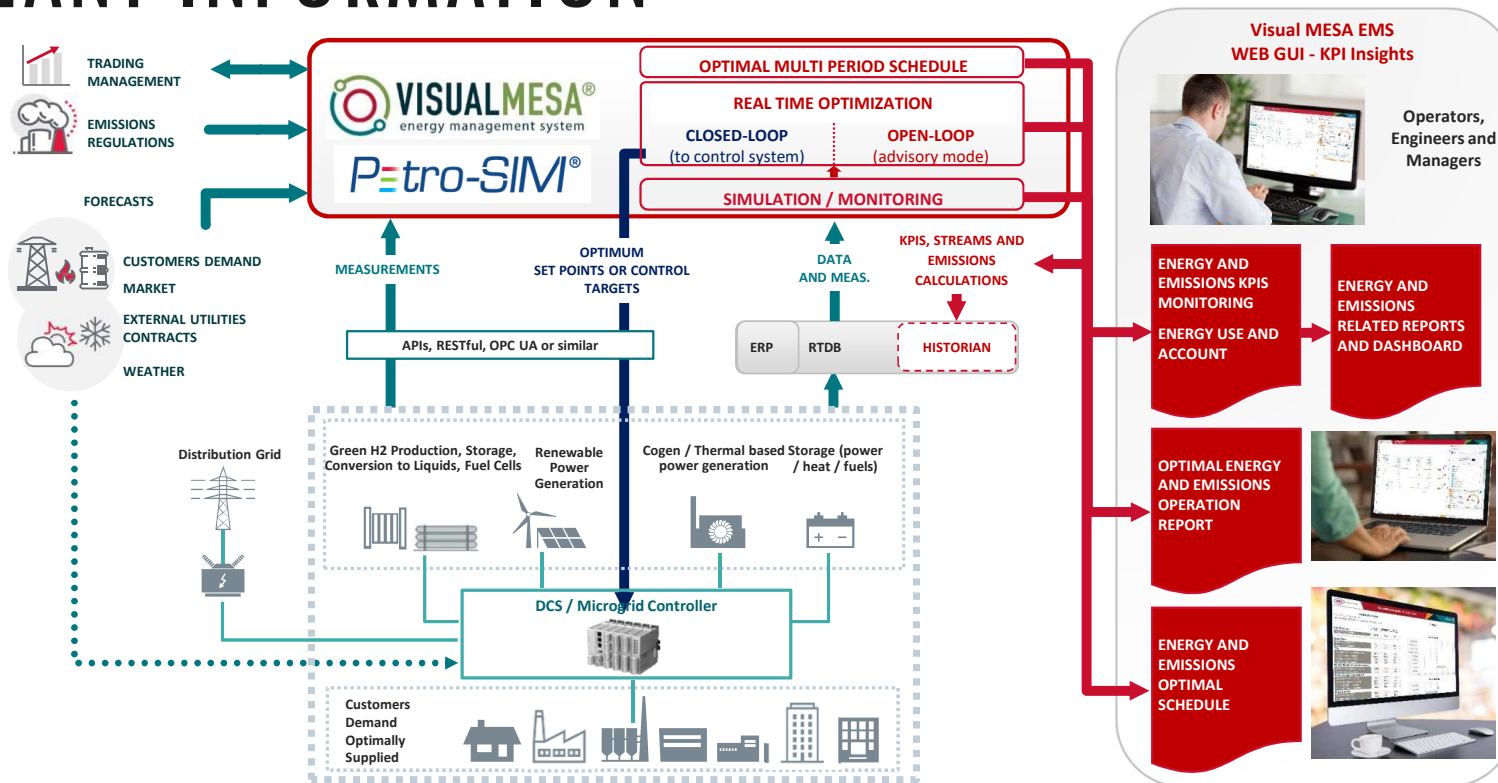
References:

(1) *Origins of the Digital Twin Concept*, 2016, M. Grieves and J. Vickers, https://www.researchgate.net/publication/307509727_Origins_of_the_Digital_Twin_Concept

INTEGRATED SOFTWARE PLATFORM: VISUAL MESA AND PETRO-SIM DIGITAL TWINS



INTEGRATING DIGITAL MANAGEMENT WITH YOUR PLANT INFORMATION



VISUAL MESA ENERGY MANAGEMENT SYSTEM

It is a computer program based on first principles

It is designed to model, optimize and monitor energy systems

- Fuels, power, steam, water, condensates and hydrogen
- Emissions
- External utilities contracts

It runs with live plant data

It can be operated in Open Loop or in Closed Loop

- Optimum set points are sent to DCS in closed loop mode

It is also used to optimize scheduling of energy system operation

It is considered an Energy Digital Twin



ARE YOU MANAGING ENERGY KPI'S EFFECTIVELY?

Most high level metrics (KPI) are straightforward to define

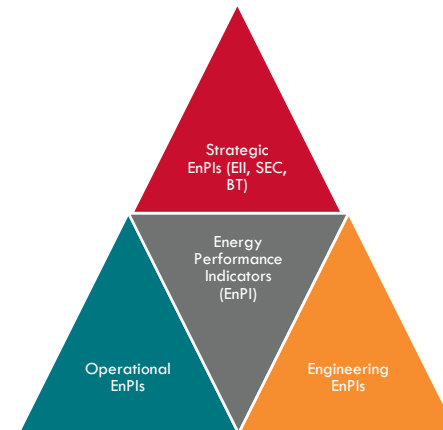
- Example: Specific consumption, efficiency

Energy Influencing Variables (EIV) are challenging to correlate to KPI

- Need process simulation (Petro-SIM) in some cases
- Need Deep Process/Energy Knowledge

Lost opportunity calculation \$/h – Key driver to include in any monitoring system

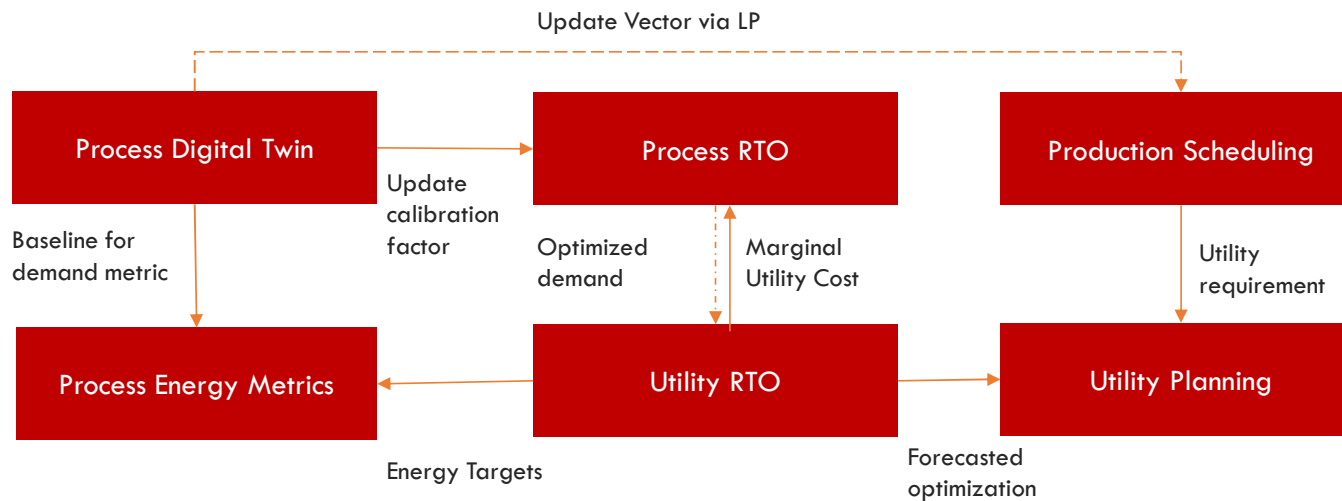
Petro-SIM Process Model derived target setting for optimum energy use while meeting quality requirements



Leadership <i>Plant manager</i>	Management <i>Unit manager</i>	Technical <i>Process/Control/Mechanical engineer</i>			Operation <i>Operator</i>				
Energy Cost	Specific Energy Cons. per Prod	Net Steam/Water Import Enthalpy	Total Power Import	Fuel Consumption	MP steam Import Rate	LP Steam Import Rate	Condensate Export Rate	Power Import	Incinerator Fuel Rate
Energy Efficiency					Steam Specific Enthalpy	Condensate Specific Enthalpy	Fuel LHV	MMA Product Rate	
	TBA Unit Equipment Performance	MTBE Reactor Heat Input	MTBE Recycle Ratio		Fresh MTBE Feed Rate	MTBE Recycle Rate	Steam Rate to Reactor Heater		
		Each Column Reboiler Duty	Each Column Reflux Ratio		Each Column Reboiler Steam Rate	Each Column Reflux Rate	Each Column Distillate Rate	Each Column Press	Each Column Temp
	Oxidation Unit Equipment Performance	1 st Reactor Recycle Ratio	2 nd Reactor Recycle Ratio	Washing Tower Water to MeOH Ratio	Fresh ¹ Isobutylene Rate to 1 st Reactor	Isobutylene Recycle Rate To 1 st Reactor	MAL Recycle Rate to 2 nd Reactor	Washing Tower BTM Water Rate	MeOH Rate from Washing Tower CVHD
		Each Column Reboiler Duty	Each Column Reflux Ratio		Each Column Reboiler Steam Rate	Each Column Reflux Rate	Each Column Distillate Rate	Each Column Press	Each Column Temp
		Air Compressor Power to Air Supply Ratio	Air Compressor Vent Ratio	Air Compressor Compression Ratio	Air Compressor Motor Power	Air Compressor Fresh Air Rate	Air Rate to 1 st Reactor	Air Rate to 2 nd Reactor	Air Compressor Press
		Incinerator Fuel to Purge Gas Ratio	Incinerator Air to Purge Gas Ratio		Incinerator Fuel Gas Rate	Purge Gas Rate from MAL Absorber	Incinerator Combustion Air Rate	Incinerator Temp	
	Isomerization Unit Equipment Performance	MAA Extractor Heat Input	MAA Extractor Solvent Feed Ratio		MAA Extractor Steam Rate	MAA Extractor Feed Rate	MAA Extractor Solvent Feed Rate	MAA Extractor Solvent Feed Temp	MAA Extractor Press / Temp
		MMA Extractor Heat Input	MMA Extractor Water Feed Ratio		MMA Extractor Steam Rate	MMA Extractor Feed Rate	MMA Extractor Water Feed Rate	MMA Extractor Water Feed Temp	MMA Extractor Press / Temp
		Each Column Reboiler Duty	Each Column Reflux Ratio		Each Column Reboiler Steam Rate	Each Column Reflux Rate	Each Column Distillate Rate	Each Column Press	Each Column Temp

OPTIMIZING THE SITE AS A WHOLE

Supply Side Optimization need to work hand in hand with Demand Side Energy Management to provide full benefit of Cost and Emission Reduction for the complex



CONCLUSION

A digital twin based energy management system is required to manage the complex process/energy interactions in a hydrocarbon processing plant

Energy Management needs to take care of both the energy supply and energy demand optimization, and bridge the gap between the Environmental team and Energy Improvement team.

The KBC solution enables you to:

- Uncover deeper savings faster
- Achieve “true” site wide operational energy efficiency across demand/supply
- Bring engineering analysis to consistent operators’ action
- Improve engineers’ productivity
- Create a platform for Industry 4.0 technologies to thrive

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