# semana de la ingeniería 2022

El poder de la ingeniería en la innovación

6 | 7 | 8 | 9 JUNIO

presencial + streaming

CAI

semana de la ingeniería 2022

El poder de la ingeniería en la innovación

6 | 7 | 8 | 9 JUNIO presencial + streaming CAI

# Climate Tech

## Panel Día 2

KBC

A Yokogawa Company

VISUALMESA® energy management system

Petro-SIM®

*Process, Energy and Emissions Expertise*

## Reducción de Costos Energéticos y Emisiones de Gases de Efecto Invernadero (GEI) Utilizando Digital Twins

**Carlos Ruiz**
**KBC (A Yokogawa Company),**
**Gerente de Producto, Sistema de Gerenciamiento de Energía Visual MESA**
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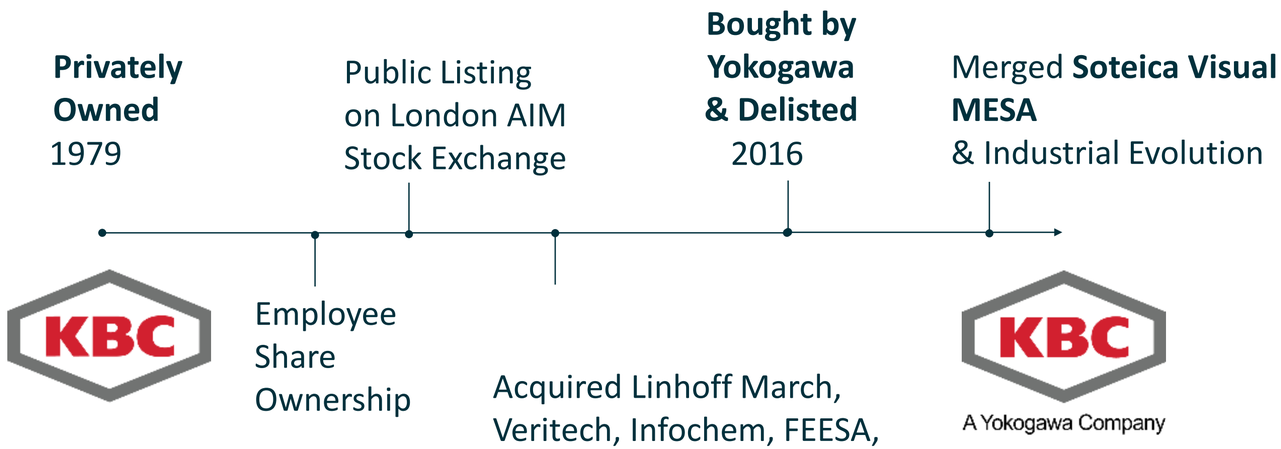
**08 Junio de 2022**

# Agenda

- KBC Company Introduction
- Energy Transition
  - Why is an Energy and GHG Emissions Management System Needed?
  - Energy Transition implies a Transformation
  - $CO_2$ Emissions Reduction Scopes
  - Energy and GHG Emissions Management System Objective
  - What “Digital” and “Twin” Means?
- EMS Real-Time Energy Digital Twins Functionality
- Integrated Software Platform: Petro-SIM and Visual MESA Digital Twins
- EMS Optimal Targets when Dealing with Traditional & Renewables Systems
  - Use Cases
    - Case 1: Interplay between Gas Turbine operation and Solar/Wind generation
    - Case 2: Emissions curtailment with Battery Management
    - Case 3: Hydrogen used to improve Gas Turbine operation
- Conclusions
  - KBC’s real-time, model based, Process and Energy Digital Twins are Fully Prepared for the Energy Transition

# KBC now, an autonomous business unit inside Yokogawa Electric Corporation




YOKOGAWA

107 YEARS OLD

$ 3.7 BILLION REVENUE

18,300 + EMPLOYEES

113 AFFILIATES

60 COUNTRIES

Our website:
kbc.global

**400+**
Profit improvement programs completed

**1,000+**
Energy optimization studies completed

**$20 Billion+**
Benefits delivered

**No. 1**
Downstream process simulation & optimization

**80+**
Reliability studies completed

**350+**
Process units simulated

**10 / 10**
Top OECD oil companies use KBC's DaaS

**No. 1**
P-V-T physical properties package for Chemicals

**1st**
Cloud-based real-time DaaS solution

**8 / 10**
Top OECD oil companies use KBC's DaaS

**25%**
US commercial scale solar PV generation monitored

**No. 1**
Real-time energy optimization technology

# Visual MESA Technologies

A Yokogawa Company

**Visual MESA Software Family**

VISUALMESA® energy management system

Real-time solution for modeling, monitoring, optimization, and scheduling of energy and utilities systems, including steam, water, fuel, GHG emissions, district energy, power and hydrogens systems.

VISUALMESA® production accounting

Production Accounting, Data Reconciliation and Movements & Inventory Management System which assists users with the calculation of their site-wide daily mass balances, on a tank-by-tank and unit-by-unit level.

VISUALMESA® supply chain scheduling

Hybrid continuous and discrete events simulation application to support the management of operations in oil & gas, refining and petrochemical processes.

Visual MESA (formerly Soteica Visual MESA) Software is developed and implemented worldwide from KBC's offices located in Rosario and Santa Fe cities, Argentina

# Why is an Energy and GHG Emissions Management System Needed?

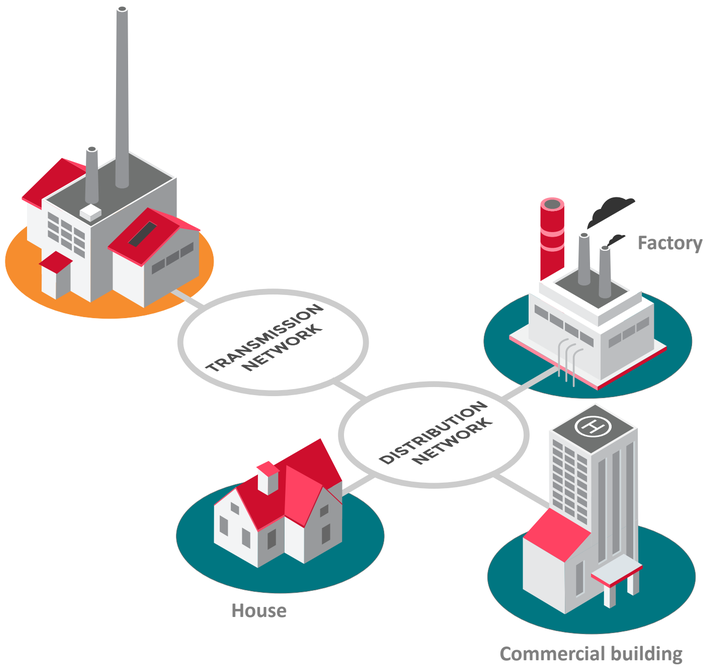
- The energy landscape is drastically changing because of the global concern to **reduce Greenhouse Gas (GHG) emissions**
- Companies are aware of **energy's impact on both, overall energy costs and emissions**
  - For large-scale process plants, energy normally accounts for 50% of operating expenses (that is, excluding the feedstock). Consequently, an **energy reduction of 10% can often improve margins by 5% and, at the same time, reduce GHG emissions**
- Whether a Company use traditional energy, renewable or a mix, **there is a need to find a cost effective way to deal with it**
  - **They imperatively need to make the transition to net zero GHG emissions, *but not go bankrupt* along the way**
- **To increase profits *and* reduce GHG emissions, energy management and optimization is naturally the first place to look**

# Energy Transition Implies a Transformation (1)

## From…

Predominantly centralized

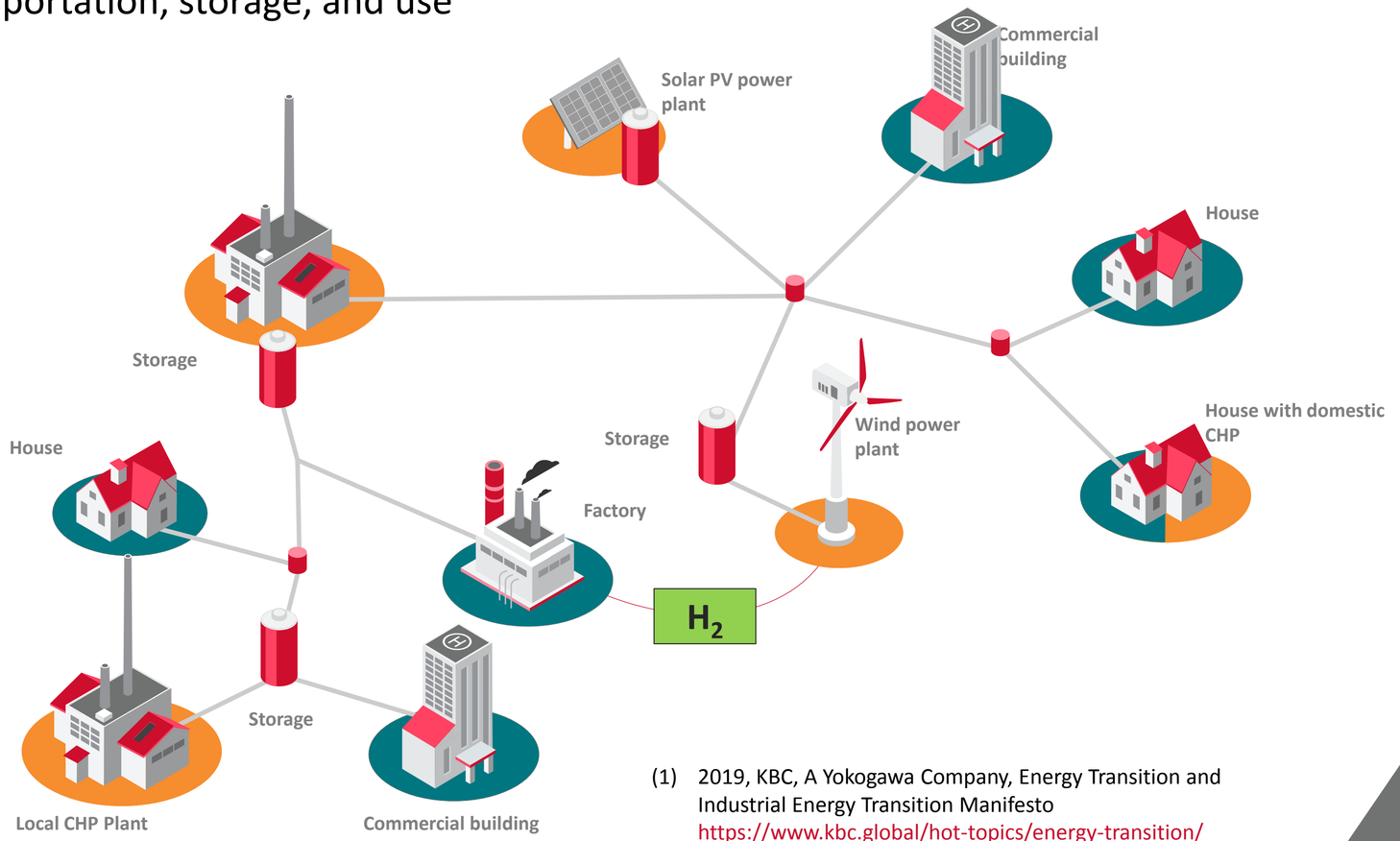
Hydrocarbon sourced energy generation




## To…

Decentralized

Lower $CO_2$ emission energy generation, transportation, storage, and use

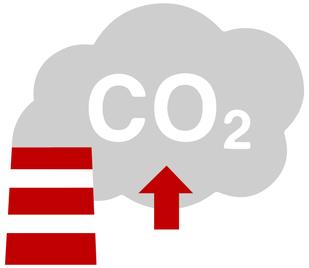


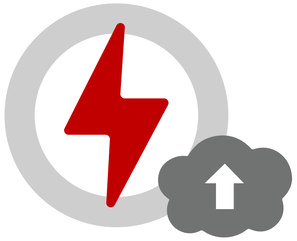

(1) 2019, KBC, A Yokogawa Company, Energy Transition and Industrial Energy Transition Manifesto
https://www.kbc.global/hot-topics/energy-transition/
https://www.kbc.global/insights/whitepapers/industrial-energy-transition-manifesto/

# $CO_2$ Emission Reduction (1)

Decarbonization initiatives can be grouped into three different scopes:

* Typical EMS addressed scopes



**Scope 1:**

**Direct Emissions**

➡ An energy consumption problem

**Scope 2:**

**Emissions from energy imports**

➡ A supplier problem

**Scope 3:**

**Emissions from the products sold**

➡ A business problem

(1) 2019, KBC, A Yokogawa Company, Energy Transition and Industrial Energy Transition Manifesto
https://www.kbc.global/hot-topics/energy-transition/
https://www.kbc.global/insights/whitepapers/industrial-energy-transition-manifesto/

# Energy and GHG Emissions Management System Objective

- An Energy and GHG Emissions Management System **objective** is to ***simultaneously* reduce cost and emissions**
  - Starting **right now**, within the current context, of mostly centralized and hydrocarbon sourced energy generation
  - Continue doing it **during the energy transition**, while making process improvements, incorporating renewable energy vectors, energy storage devices and decentralizing assets
  - And finally **sustaining** the decentralized, lower $CO_2$ emission energy generation, transportation, storage, and use, towards **the net zero GHG emissions optimal operation, under a mostly renewables-based energy system**

# What “Digital” and “Twin” Means?

- Digitalization: The scalable application of the digital technologies, and alignment of the organizational capabilities that an energy or chemical process operation should have and master with digital information at the core in order to **achieve excellence** (1)

- Digital Twin (DT) concept has been around since 2002 when Michael Grieves, at the University of Michigan, first used the terminology. It is based on the idea that a **digital informational construct** about a physical system could be created as an entity on its own (2)

  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 (2)

  The basic concept of the DT model has remained stable from its inception in 2002, while the digital/computing capabilities and power continually and sustainably grew since then.

References:

(1) *Digitalization Manifesto, KBC, 2018* https://www.kbc.global/insights/whitepapers/digitalization-manifesto/

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

# Real-Time Energy Digital Twins Functionality

TRADING SYSTEM

EMISSIONS REGULATIONS

FORECASTS

CUSTOMERS DEMAND

EXTERNAL UTILITIES CONTRACTS

MARKET PRICES

WEATHER

VISUALMESA® energy management system

Petro-SIM®

OPTIMAL MULTI PERIOD SCHEDULE

REAL TIME OPTIMIZATION

CLOSED-LOOP (to control system)

OPEN-LOOP (advisory mode)

SIMULATION

MEASUREMENTS AND DATA

OPTIMUM SET POINTS OR APC TARGETS

KPIS, STREAMS AND EMISSIONS CALCULATIONS

ERP

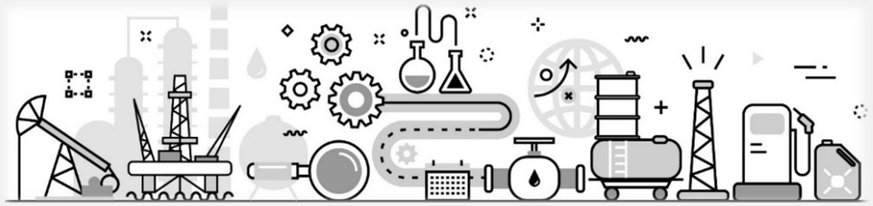
CONTROL SYSTEM / REAL TIME DATABASE

HISTORIAN

ENERGY AND UTILITIES SYSTEM

Hydrogen Fuel Renewables Steam Water Electricity

(DEGREES OF FREEDOM IN GENERATION AND DISTRIBUTION)



PROCESS (UTILITIES CONSUMERS AND GENERATORS)

VM-ERTO
VM-ECLRTO

Visual MESA
E&E MS Suite

VM-MPO

VM-EM

Visual MESA EMS
Web GUI - KPI Insights

Operators, Engineers and Managers

ENERGY AND EMISSIONS KPIS MONITORING

ENERGY USE AND ACCOUNT

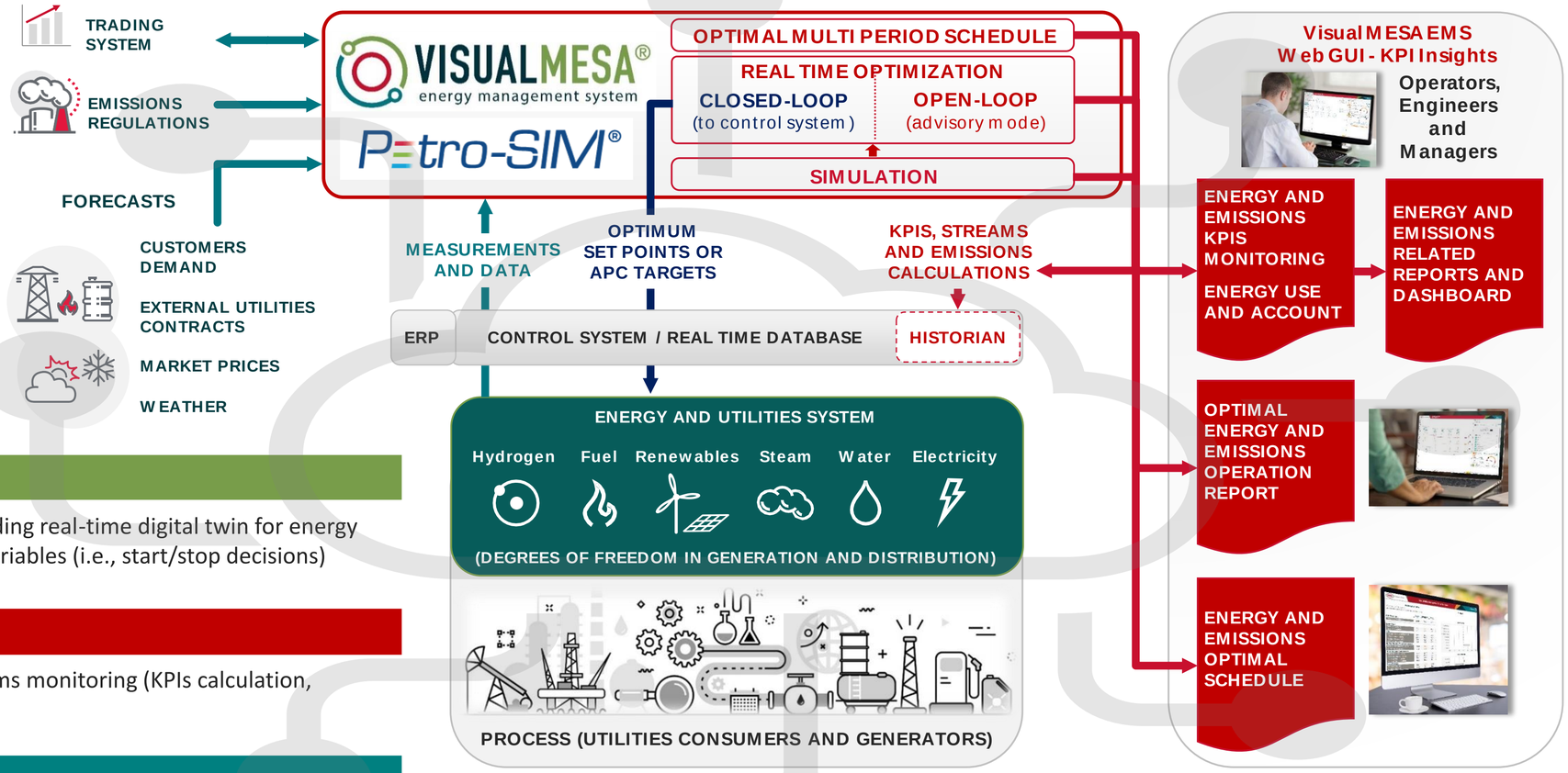
ENERGY AND EMISSIONS RELATED REPORTS AND DASHBOARD

OPTIMAL ENERGY AND EMISSIONS OPERATION REPORT

ENERGY AND EMISSIONS OPTIMAL SCHEDULE

# Real-Time Energy Digital Twins Functionality

On-Premise
or
Cloud Deployment




## VM-ERTO / ECLRTO

Visual MESA Energy Real Time Optimizer (open or closed loop) is the leading real-time digital twin for energy systems optimization and GHGs emission reduction, including discrete variables (i.e., start/stop decisions)

## VM-EM

Visual MESA Energy Monitor is specifically designed for the energy systems monitoring (KPIs calculation, emissions, energy balances, historization, alarming, etc.)

## VM-MPO

Visual MESA Multi-Period Optimizer is the energy management tool for the optimal scheduling of energy assets, including storage inventories and forecasts (weather, demand, power and fuel prices, etc.)

**Real-time Digital Twin apps seamlessly integrated under the same modeling and web access platform**
**More than 30 years of experience and more than 120 site-wide installations**

# Integrated Software Platform: Petro-SIM and Visual MESA Digital Twins

Petro-SIM®

VISUALMESA® energy management system

## PAST

Process design and optimization

Massive historization of Key Performance Indicators (KPIs) and GHG emissions

Energy balances & GHG emissions reports for any time frame

**MONITORING & REPORTING**

## PRESENT

Real Time Actions for Cost and GHG emissions minimization

Open or Closed Loop

Cloud/Web access

KPIs/GHG emissions alarms and notifications

**MONITORING & OPTIMIZATION**

## FUTURE

Process improvements roadmap

Multi Period Optimization for automatic energy and emissions schedule

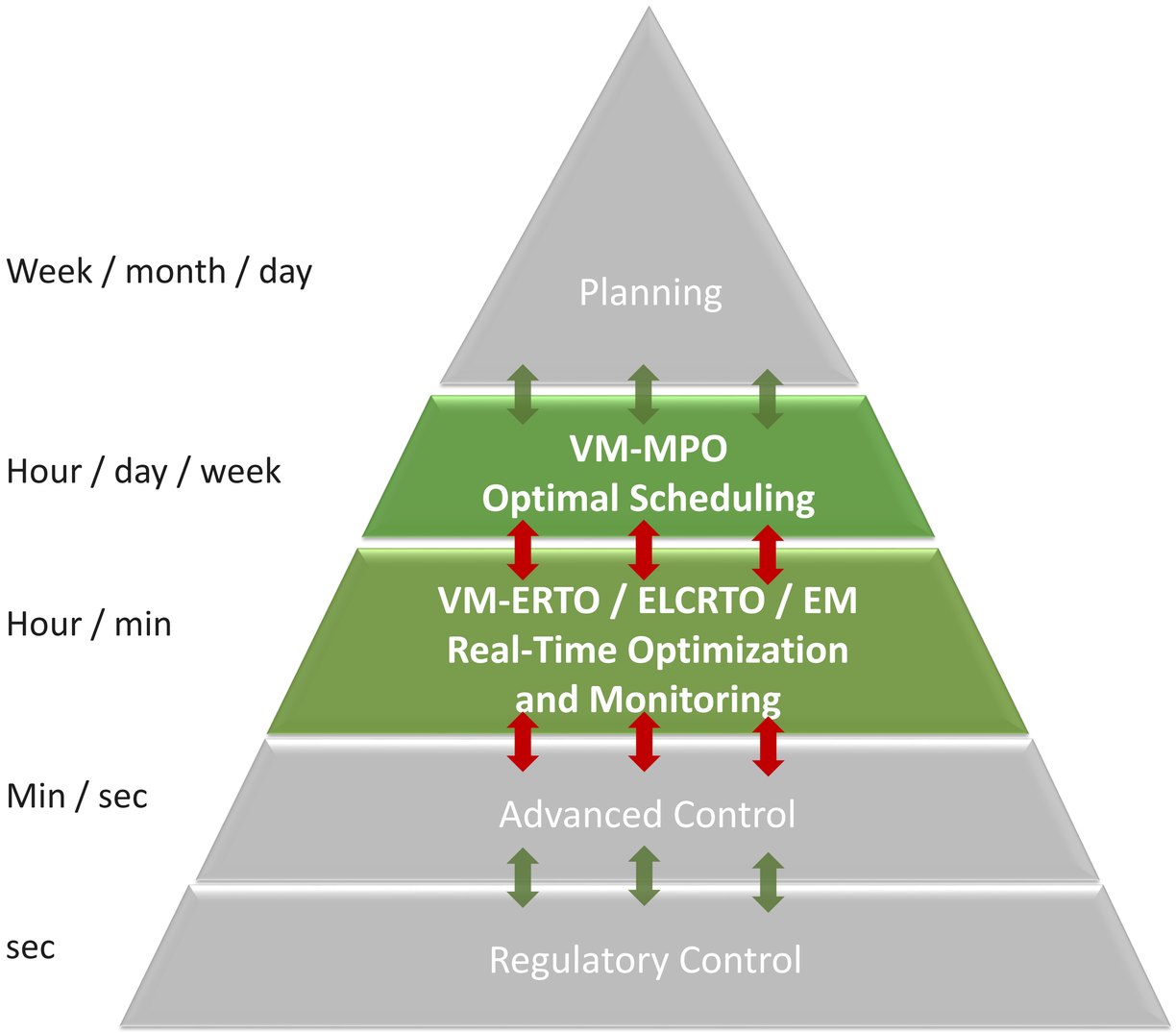
Weather / renewable forecast

Energy cost, storage and GHG emissions management

**SCHEDULING & PLANNING**

*Process, Energy and Emissions Consulting*

# Integrated Software Platform: Petro-SIM and Visual MESA Digital Twins

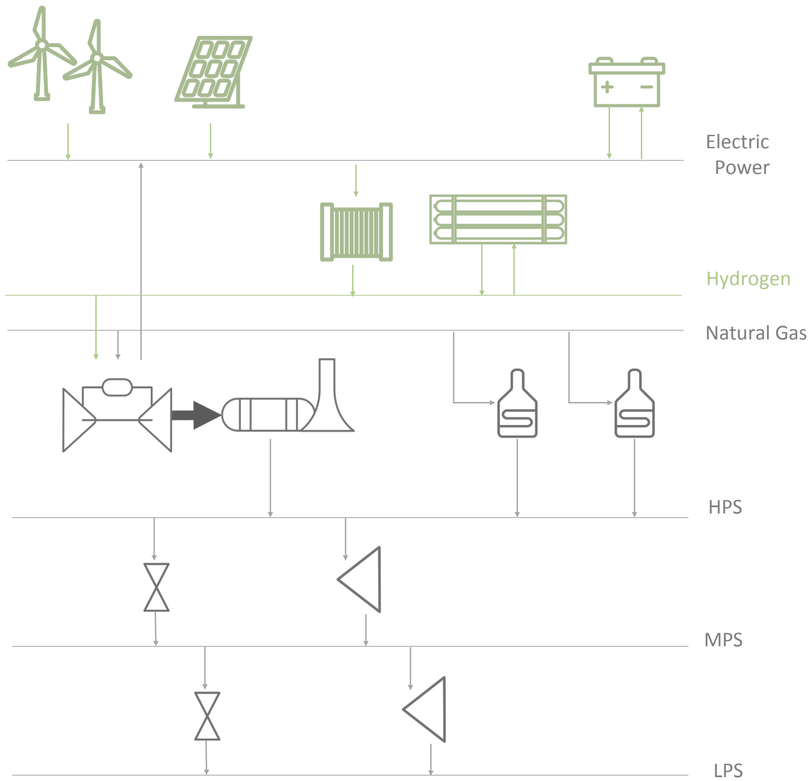



Petro-SIM®

VISUALMESA®
energy management system

An integrated software platform for the decision layers where **all the energy and emissions related, time-dependent variables, are monitored, optimally defined and implemented**, under the same real-time, digital twin based environment

# EMS Optimal Targets when Dealing with Traditional & Renewables Systems



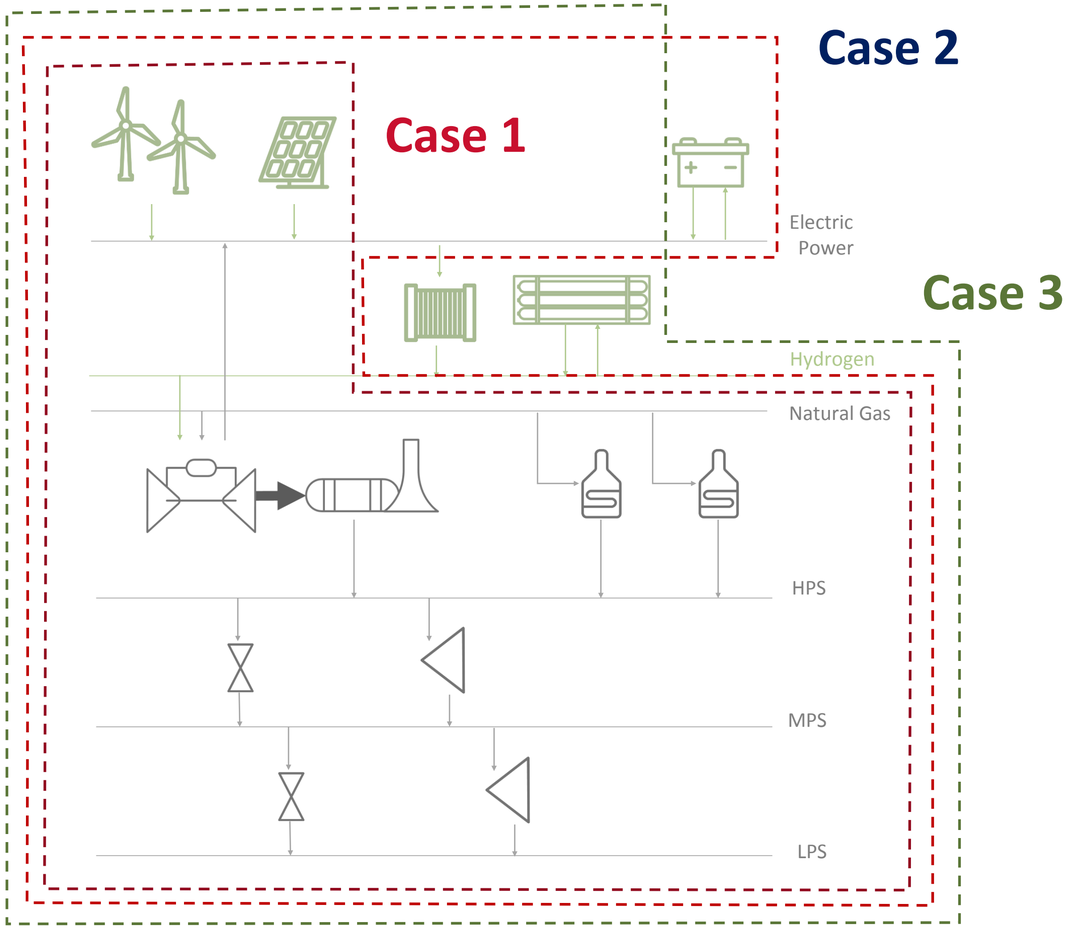

**Utility Systems Within Energy Transition Environment**

- Existing, traditional utility systems, are being upgraded to take advantage of renewable sources, with a corresponding increase in systems complexity.
- Even though several studies have focused on understanding the economical impact of renewables integrated in the Oil and Gas at a design stage[1], how to operate them effectively is still a challenge.
- Aligning optimal short-term scheduling with real time operations is key to maintaining feasibility and profitability.

[1] Liu, Zuming & Limb, Mei & Kraft, Markus & Wang, Xiaonan. (2020). Simultaneous design and operation optimization of renewable combined cooling heating and power systems. AIChE Journal.

*KBC has expanded the Visual MESA Energy Management System, digital twins based applications, to fully support the decision-making process of such systems*

# EMS Optimal Targets when Dealing with Traditional & Renewables Systems

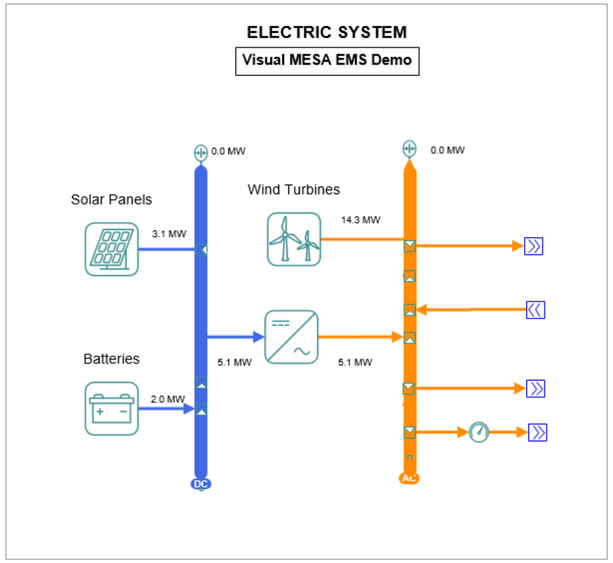


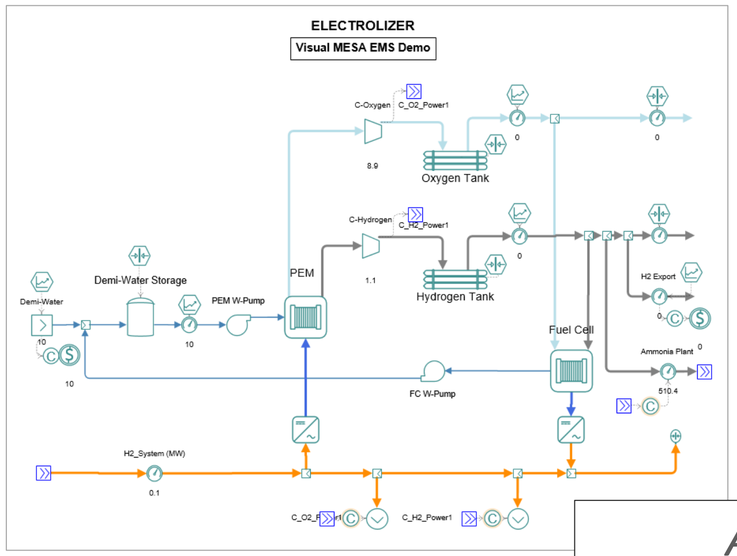

**Use Cases:**

- **Case 1:** Interplay between Gas Turbine operation and Solar/Wind generation
- **Case 2:** Emissions curtailment with Battery Management
- **Case 3:** Hydrogen used to improve Gas Turbine operation

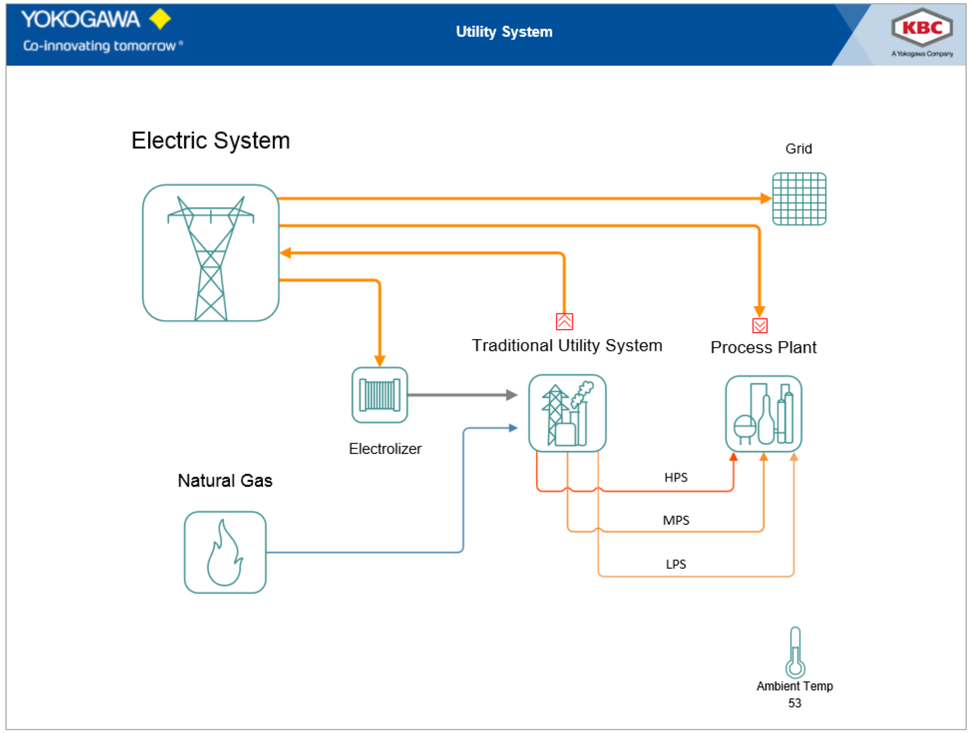
Real-Time Scheduling System for the Optimal Operation of Utility Plants with Renewable Energy Assets, Jun Ruiz (KBC), Spring 22 + 18th GCPS, A Joint AIChE and CCPS Meeting, San Antonio, Texas, April 10-14, 2022.

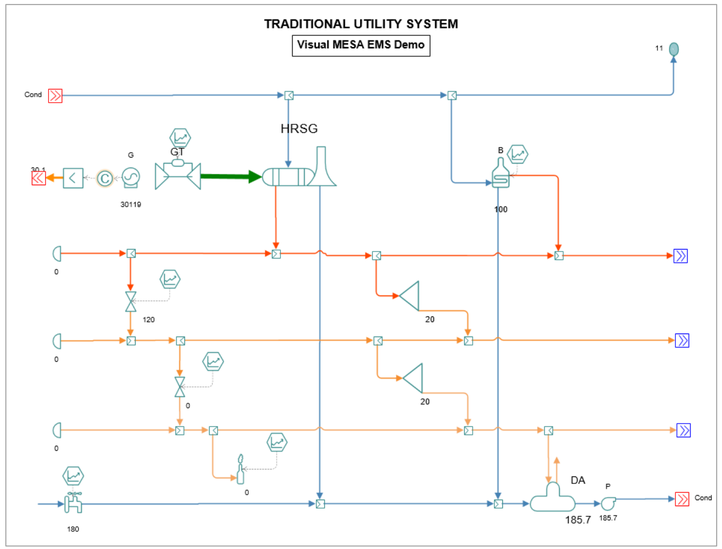
# EMS Optimal Targets when Dealing with Traditional & Renewables Systems




## VM-MPO Modeling Environment



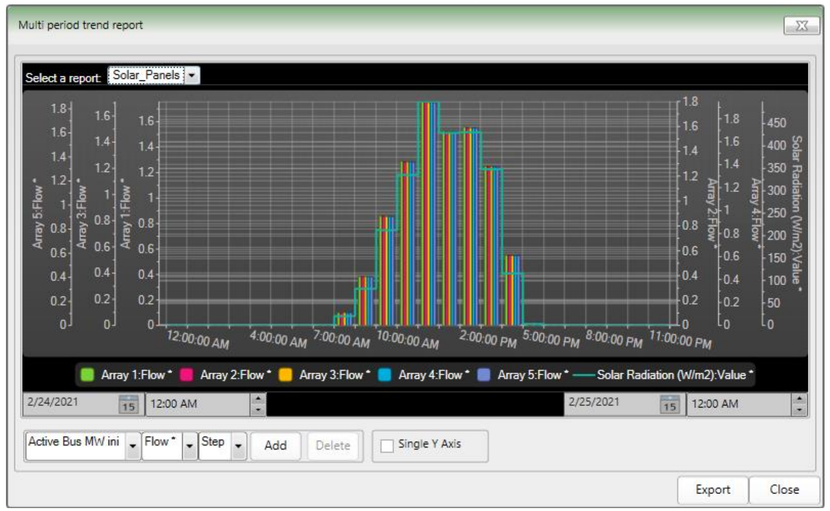

**An existing traditional utility system (e.g., steam and power production with fueled boilers, GT and HRSG) was expanded with renewable assets**

*All use cases were solved using the VM-MPO app*

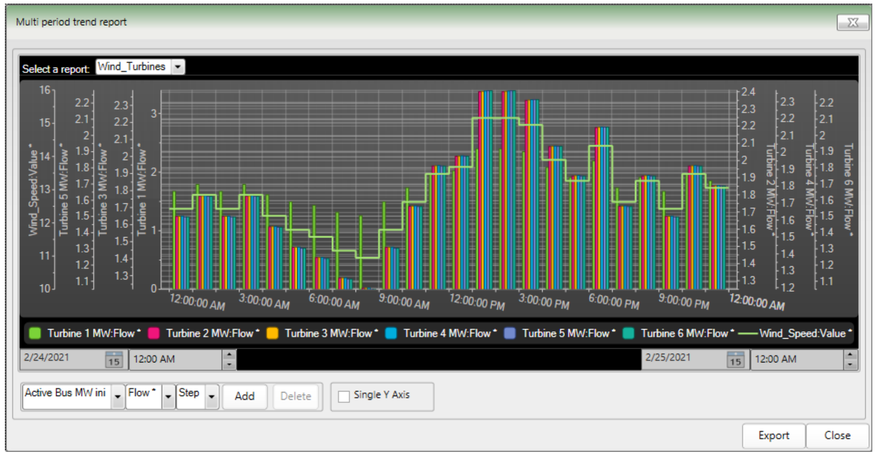
# EMS Optimal Targets when Dealing with Traditional & Renewables Systems

A Yokogawa Company

## Case 1 Interplay between Gas Turbine operation and Solar/Wind generation




Solar PV and Wind Turbines Power Generation




- The presence of renewable sources, such as solar and wind, with its corresponding uncertainty and variability, impacts the proper allocation of traditional utility assets (e.g., Gas Turbine).

- Since the operation of solar and wind power sources is virtually free, gas turbines will work to compensate for the lack of sufficient power production.

- Due to minimum down time restrictions and other multi-period constraints, a scheduling system is necessary to find the proper allocation of assets.

# EMS Optimal Targets when Dealing with Traditional & Renewables Systems

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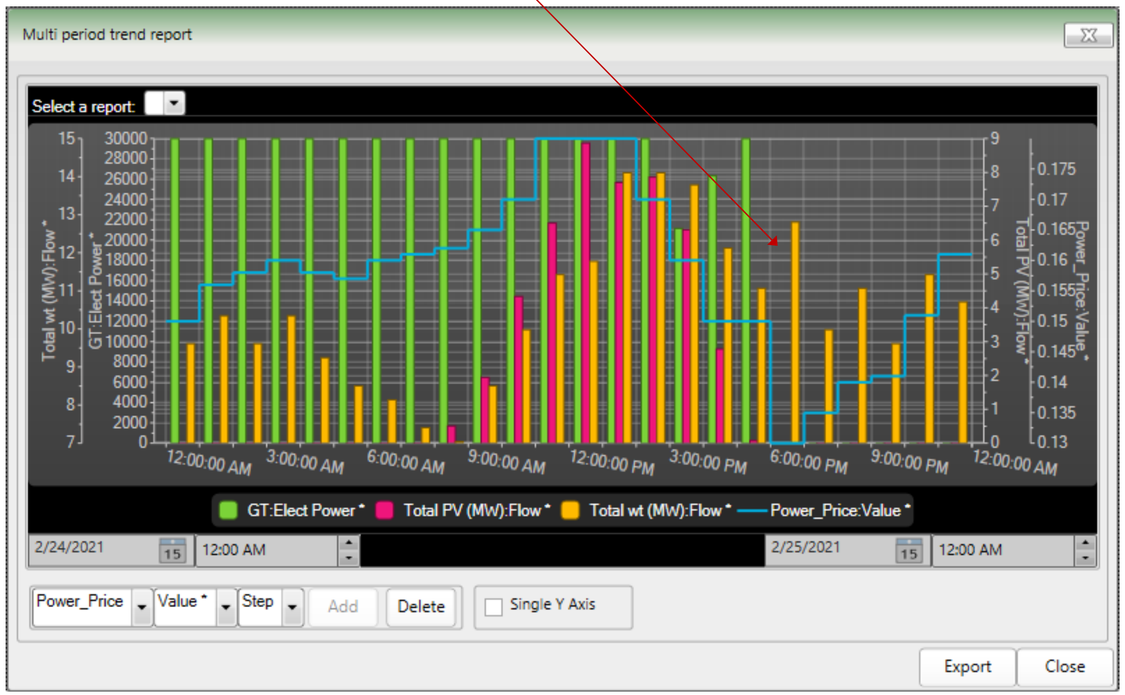
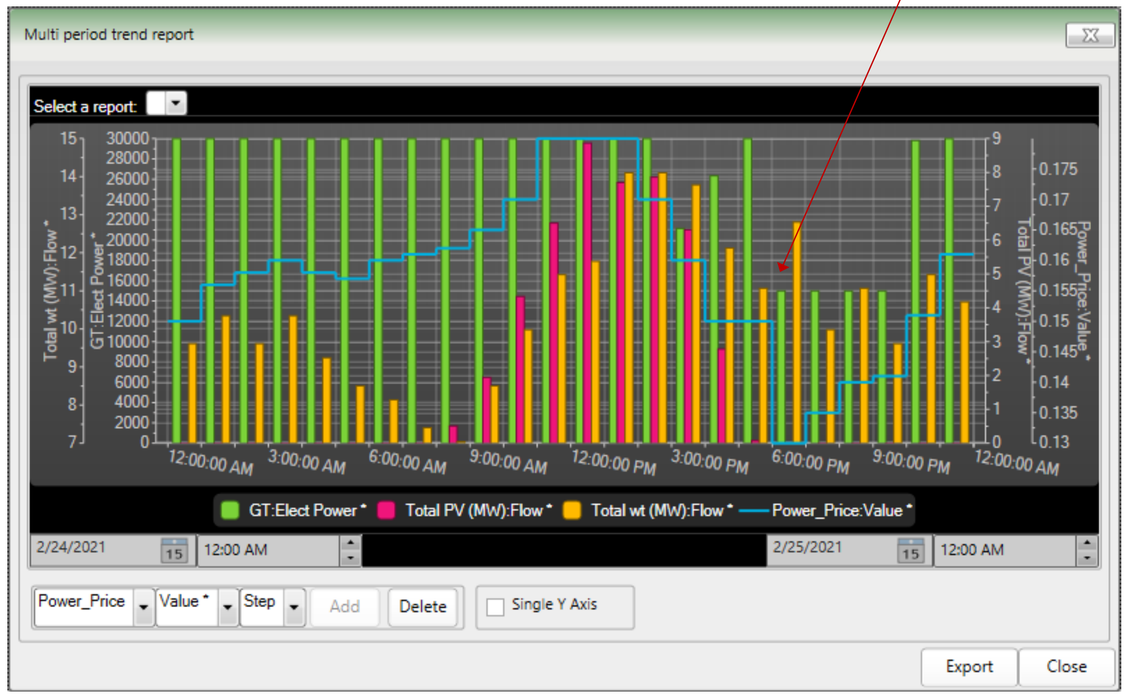
## Case 1 Interplay between Gas Turbine operation and Solar/Wind generation

Gas Turbine Shut Down




Gas Turbine Allocation considering break-even price. Minimum down time requirement satisfied after shut-down.

Gas Turbine Operating at Minimum Capacity




Gas Turbine Allocation considering break-even price and minimum down time requirement. Optimal allocation does not recommend shutting down the Gas Turbine.

*Definition of the proper multi-period constraints is key to maximize benefits*

# EMS Optimal Targets when Dealing with Traditional & Renewables Systems

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## Case 2 Emissions curtailment with Battery Management


**GT Allocation without battery usage**

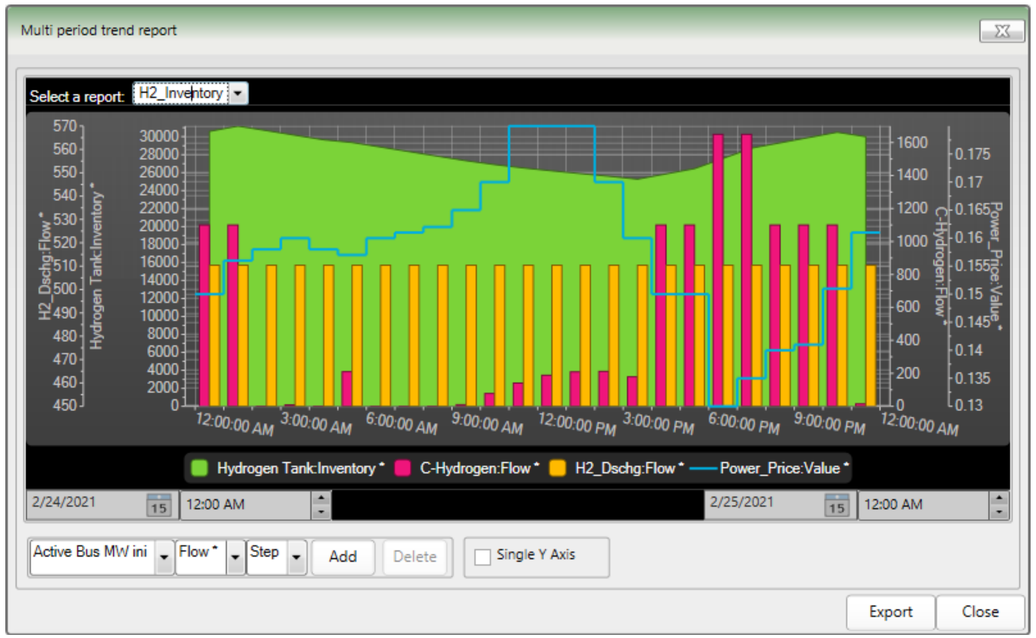

**GT Allocation with battery usage**

- Typically, batteries are used to shave electricity cost peaks and make the grid more robust.
- When batteries work along traditional assets (e.g., gas turbines) they impact, not only electricity costs but also GHG emissions.
- With a proper battery management, gas turbines could be operated in a way that reduce GHG emissions.

*A decrease in GHG emissions is obtained by the proper allocation of battery usage*

# EMS Optimal Targets when Dealing with Traditional & Renewables Systems

## Case 3 Hydrogen used to improve Gas Turbine operation




**Green hydrogen storage management with constant gas turbine consumption**

- With the advances in cheaper electrolyzer technologies, green hydrogen is becoming an appealing medium in which to store green energy.
- In turn, several gas turbine manufacturers are more and more interested in considering hydrogen as part of the fuel mix that is fed to turbines.
- How to best allocate the hydrogen use considering environmental and market conditions is a challenge.

*5% decrease in power costs compared to unmanaged hydrogen production*

# Real-Time, Model Based Digital Twins for Energy and GHG Emissions Management

A Yokogawa Company

Petro-SIM®

VISUALMESA® energy management system

| PAST | PRESENT | FUTURE |
|---|---|---|
| MONITORING & REPORTING | MONITORING & OPTIMIZATION | SCHEDULING & PLANNING |

KBC's real-time, model based,
Process and Energy Digital Twins applications
provide all the key and fundamental tools
for supporting business decisions
to optimally manage
renewable, conventional and combined energy systems,
including storage and emissions

## Ready for the energy transition!

A Yokogawa Company

# ¡Muchas Gracias!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