Decarbonization

JGC Group provides a large variety of Decarbonization Programs which are the proprietary GHG^(*)s assessment solution and optimized operation service based on our successful experiences in countless EPC & O&M fields. (*)GHG : Greenhouse Gas



HiGHGuard[™](GHG Quantification Service)



DDR ^(*) Membrane (CO2 Removal) High Performance Separation Technology

(*)DDR : Deca-Dodecasil 3R, A type of zeolite with a specific crystal structure



Life Cycle Assessment/Management (CO2 Footprint)



Energy Utilization and Optimization of Heat Recovery System



Optimization of Site-Wide Energy Usage

Energy Optimization-Pinch

Service Menu	OE Service menu
Decarbonization Program	1
HiGHGuard™ (GHG Qua	antification Service)
Life Cycle Assessment (CO2 Footprint)	/ Management
CO2 Removal Solutions	5
Energy Optimization	
Fired Heater Improvem	nent

Return to



Optimization of Power-Steam Supply System



GHG Quantification Service



Do you have any of these issues?

Difficulty in quantifying GHG (including CH₄)
 Need to quantify emissions in actual operation
 Identifying baseline for decarbonization project



GHG Quantification

- Quantify GHG (CO₂, CH₄, N₂O) by actual measurement and engineering calculation.
- Conduct actual measurement with drone, satellite, handheld sensor, IR camera
- Provide optimized MRV(*) methodology
- Reporting the GHG emission to the authorities.



(*) Measurement, Reporting and Verification

GHG Quantification Service 🍻 HighGuard

Workflow & Results



Steps

- Identify measuring points and calculation points from design documents.
- Conduct engineering calculations / Actual measurements
- Report to client or government agency with preset format

JGC is

- able to select the most appropriate MRV methodology from those proposed by international organizations and standards/guidelines
- familiar with a variety of plants and can provide the best combination of drones, satellites, and handheld sensors

Our Strengths

- Professional HSE, Process, Mechanical Engineer Teams
- Dispatched technical experts to participate in various international discussions on GHG Measurement, Reporting and Verification (MRV).
- Experience in EPC and O&M of many types of facilities in many locations around the world.
- Collaboration between oversea group companies and local companies.

Our Background

- JGC has been commissioned by Japan Oil, Gas and Metals National Corporation (JOGMEC) to develop their guidelines.
- The Institute of Energy Economics, Japan (IEEJ) has contracted JGC as a technical adviser for GHG MRV

Case Study : Quantification of Methane Emission in Ammonia Plant 🍻 HiGHGuard

(*) PAU: PT Panca Amara Utama

Project in Actual Plant

- JOGMEC/JGC completed direct measurement to quantify Methane emission in PAU(*) Ammonia Plant. (Dec-2022)
- Satellite / Drone / Handheld Sensor / Camera were used in the project
- CO2 calculation was conducted using operating data.



INTEGNANCE VE

Case Study : Quantification of Methane Emission in Ammonia Plant 🌮 HiGHGuard

Utilizing Digital Twin Technology for Further Achievement

- JGC group company Brownreverse Corporation has signed a contact with PAU to begin a joint study. (Sep-2024)
- This joint study digitally replicates the ammonia production plant at PAU to investigate maintenance strategies and operating optimizations that reduce GHG emissions.
- The measured GHG emissions data from each facility will then be mapped onto the 3D viewer "INTEGNANCE VR" to visualize the emissions.



Conceptual drawing of GHG emissions visualization on INTEGNANCE VR



INTEGNANCE VR 🗜 See Details

Memorandum of Understanding ceremony held in Indonesia



https://www.jgc.com/en/business/epc/operation-maintanance/service/

Life Cycle Assessment/Management (CO2 Footprint)

What is the Life Cycle Assessment (LCA)?

- LCA is a method of assessing the environmental impact of your product or service throughout its life cycle (or at a specific stage) : Resource extraction, raw materials, product production, distribution, consumption, disposal, recycling
- LCA can objectively and quantitatively evaluate whether a product is "good" or "friendly" for the environment, human body, and society

Advanced Application of LCA (LCM) to



Concept of LCA

Scope 3 Extraction Scope 3 Scope 3 Scope 3 Picture (Scope 3) Picture

High Client Concern on Environmental Impact, Optimized Plant Life Cycle (Engineering, Procurement, Construction, Commissioning, Startup, Maintenance, Manning, Turnaround, Demolition) , GHG Protocol (Scope 1/2/3)

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Life Cycle Assessment/Management (CO2 Footprint)

PETJ

eq/kg

[kg-CO₂

Emission

GHG



Outcomes

- Numerical Results^(*): Detailed CO2 emissions data for each process stage
- **Higher CO2 Reductions:** The new recycling process is expected to achieve significantly higher CO2 reductions compared to the conventional process
- **Visualization of Hot Spots:** Identification and visualization of high CO2 emission hot spots

Achievements

- Conference Participation:
 - Attended the International Conference (EcoBalance 2022/24, LCM 2023)
 - Attended the 8th S-LCA Conference 2022 Leave No One Behind –

CO2 Footprint Calculation:

- Calculated CO2 footprint (Scope 1/2/3) for CDP Report 2021, 2022, and 2023
- JGC Holdings received a Score B





(*)The scope of evaluation, methods, and assumptions that greatly affect the results, it depends on the implementers and companies

Life Cycle Assessment/Management (CO2 Footprint)



<u>Outcomes</u>

- Numerical Approach for Plant Life Cycle: A comprehensive assessment is applied to focus on for GHG Protocol scopes (1/2/3)
- **Real-Time Monitoring:** With a data-centric (DX) approach, both environmental impact and operational data can be monitored in real time, allowing for the identification of hotspots
- **Visualization of CO2 Emission Hot Spots:** High CO2 emission hot spots are visualized throughout the plant life cycle
- **CAPEX/OPEX and CO2 Emissions Relationship:** Understanding the relationship between CAPEX, OPEX and CO2 emissions

Our Strength

- **Broad LCA Expertise:** Conducting Life Cycle Assessment (LCA) not only for the manufacturing business but also for the construction industry
- **Process Engineering Perspective:** Utilizing a process engineering perspective to optimize material flow and reduce GHG emissions
- Advanced Visualization: Capability to visualize emissions using the inhouse 3D maintenance viewer INTEGNANCE VR See Details



CO2 Removal Solutions

Challenges for CO2 Capture in Operating Assets

Management of Increased CO₂ in Feed Gas



- ✓ Natural gas/associated gas quality varies over the life of oil/gas fields.
 ✓ Unexpected increases of CO₂ in the feed gas
- requires additional CO_2 capture units/enhancement of the CO_2 capture performance.

Limited Space and Utilities



- Limitation in the available space to accommodate the new unit/expansion of the unit.
- ✓ Limitation in the available utilities to operate the CO₂ removal unit

HiPACT[®] - an Innovative CO₂ Capture Process





DDR Membrane - High Performance Separation Technology



CO2 Removal Solutions – DDR Zeolite Membrane

DDR Zeolite Membrane

Technology

- Technology jointly developed by JGC and NGK
- World's largest zeolite membrane element

Advantages

- Enhanced separation performance
 - = minimal hydrocarbon loss
- Tough under high pressure, high CO_2 concentration
 - = longer membrane life
- Significant lifecycle cost saving (20-30%)



Application

- Natural Gas Processing (CO₂ removal in CO₂ rich gas fields)
- CO₂ recovery from associated gas for CO₂-EOR^(*) projects ^(*) EOR: Enhanced Oil Recovery



Technology Development Status

- Field tested at U.S. oil field (2017, completed)
- Commercial scale field test at U.S. oil field (from 2020)

Details of the technology can be found at: <u>https://www.jgc.com/en/business/tech-innovation/environment/ddr-membrane.html</u>

CO2 Removal Solutions - HiPACT®

HiPACT® - CO2 Capture Process

Technology

• Chemical absorption process, using newly developed absorption solvent (jointly developed with BASF)

Advantages

- Highly stable against thermal degradation
- Enables high pressure CO₂ stripping, leading to significant energy and cost saving (25 to 35% reduction)
- Reducing the number of compression stages, optimizing the space



Reduction of initial investment and reduction of operating costs

by high pressure CO₂ stripping process



Details of the technology can be found at: https://www.jgc.com/en/business/tech-innovation/environment/hipact.html



Energy Optimization

Do you have any of these issues?

- How to reduce energy consumption?
- How to eliminate equipment bottlenecks?
- What kind of equipment should be updated to improve efficiency?

What is our service ?

- **Equipment Effectiveness**: Diagnosis to identify the efficiency of existing facilities to be improved and suggestions for types of equipment to be modified.
- **Pinch Analysis:** Identify heat recovery target and create solutions such as heat recovery networks that balance the trade-off between investment costs and energy savings.
- **Operation Improvement:** Studies on unit operation and utility facilities modifications to improve energy efficiency.
- Advanced Technology: Studies and proposals on the introduction of high-efficiency equipment and new heat recovery technologies.

Our Approach



Optimization: Unit to Plant-Wide Level

What is Pinch Analysis?

Systematic and Visualization Methods to Identify the Target



Energy Optimization

Workflow & Result



- Plant Data collection(Operating Data, Climate Data)
- Analysis and diagnosis
- Modeling for Pinch Analysis, and Targeting
- Prioritization of solutions into tree categories as Phase-I
- As Phase-II, detailed study to materialize the investment solutions proposed in Phase-I



Our Strengths

- The proven and successful experiences in executing similar consultancy services.
- Extensive technical knowledge and know-how for energy and water conservation.
- Qualified professionals.
- Collaboration between oversea EPC-capable group companies and out-sourcing for consultancy services.

Our Experiences

	Industry	Japan	Overseas
50 +	Petroleum Refinery	26	11
	Petrochemical	6	4
Projects	Chemical	5	-
	Steel	1	-
	Total	38	15

- Contributed to over 50 projects in various phases (FS, Pre-FEED, FEED, EPC, Revamps) for Petroleum Refinery, Petrochemical, Chemicals, etc.
- We are certified by a national oil company as an energy consultant.



Fired Heater Improvement



Do you have any of these issues?

- **Poor performance and unreliable operation**
- Reducing maintenance interval due to severe material degradation
- Need for engineering consulting partner for heater modification

Fired Heater Improvement Solution

- Utilized **Computational Fluid Dynamics (CFD)** to simulate Combustion and Heat Transfer
- Assessed as-installed Heater Performance based on operation data and CFD Results
- Identified O&M Issues and their Root Causes
- Proposed and Evaluated Performance and Reliability Improvement Plan
 - Burner Layout Optimization for Replacement
 - Windbox Modification for Uniform Air Flow Distribution to each burner
- Provided the Technical Guidance for the Implementation of the proposed solutions

Examples of combustion and heat transfer analysis of Furnace (CFD)



Fired Heater Improvement





Our Strengths

- Years of experience in serving domestic customers for performance improvement of fired heaters utilizing the advanced CFD simulation
- Extensive experience in Combustion and Heat Transfer modeling and evaluating heater designs
- Collaboration with Material Engineering experts
- Customer-Focused Global Engineering Service Provider

Our Experiences

the advance CFD simulations



Simulation-based engineering service for plant diagnosis and lifetime improvement