



“Green and Smart Mining”

Campaign for Sustainable Mining Development in Thailand

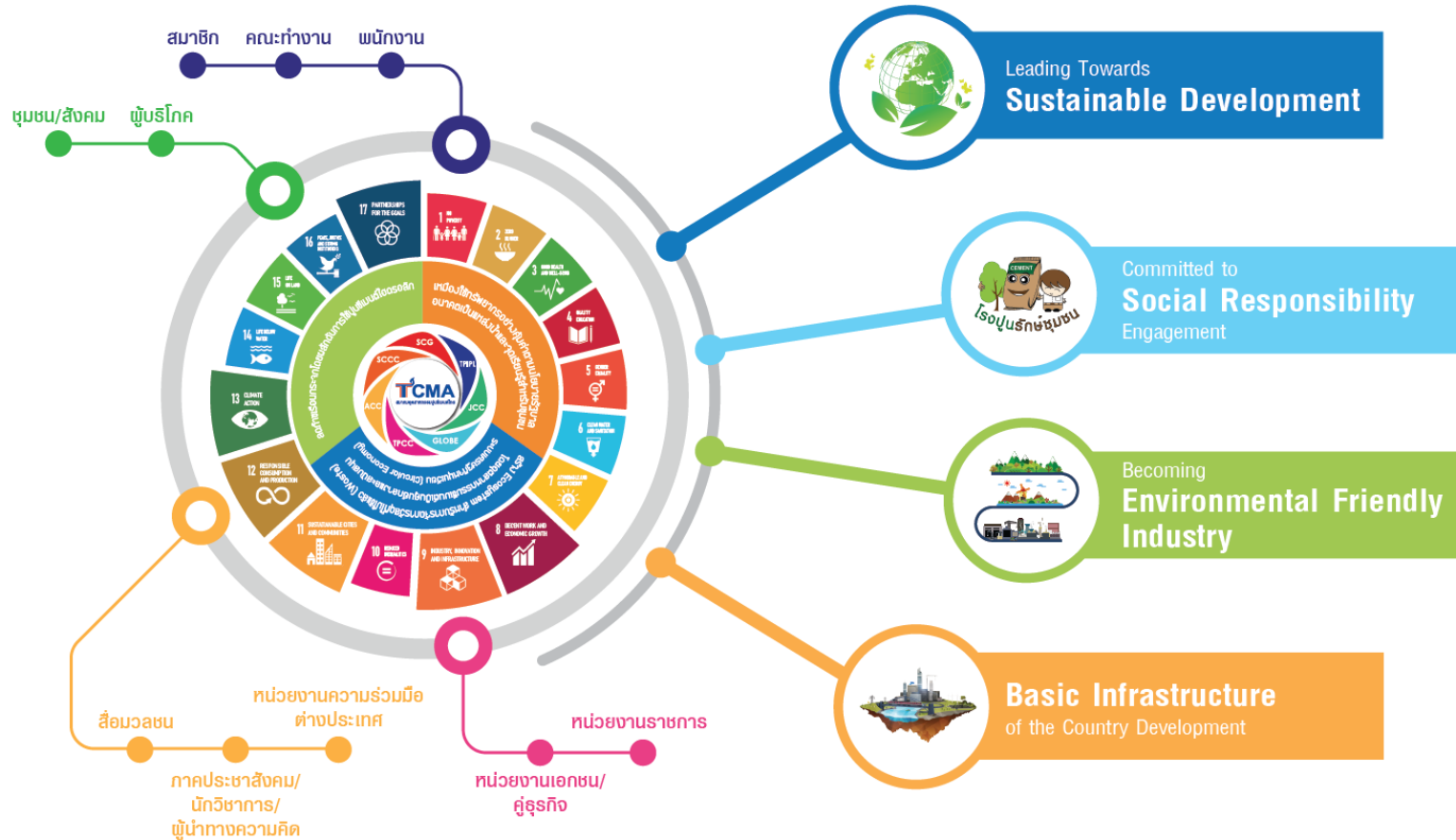
Mr. Sitthipong Khunpirom

Working Group TCMA on Green Mining and Stakeholders Engagement

Thai Cement Manufacturers Association (TCMA)

Quarry Manager, The Siam Cement (Ta Luang) Co., Ltd.

December 20, 2022

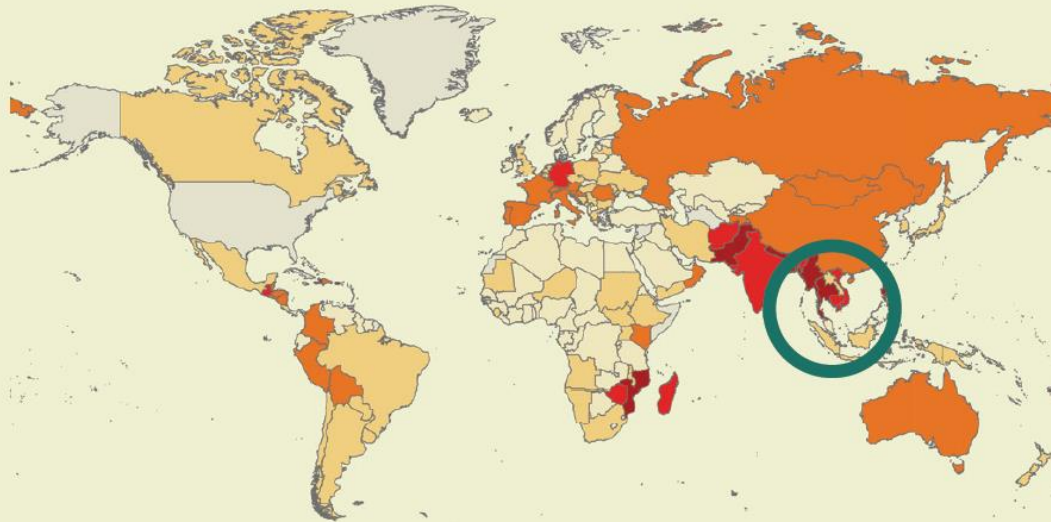




Climate Change and Global Warming

World Map of the Global Climate Risk Index 2021

ประเทศไทย อันดับที่ 9 ของโลกที่ได้รับความเสี่ยงจาก Climate Change ในระยะยาว



Risk Index: ประเมินจากจำนวนผู้เสียชีวิตและความเสียหาย

ที่มา: Germanwatch, January 2021



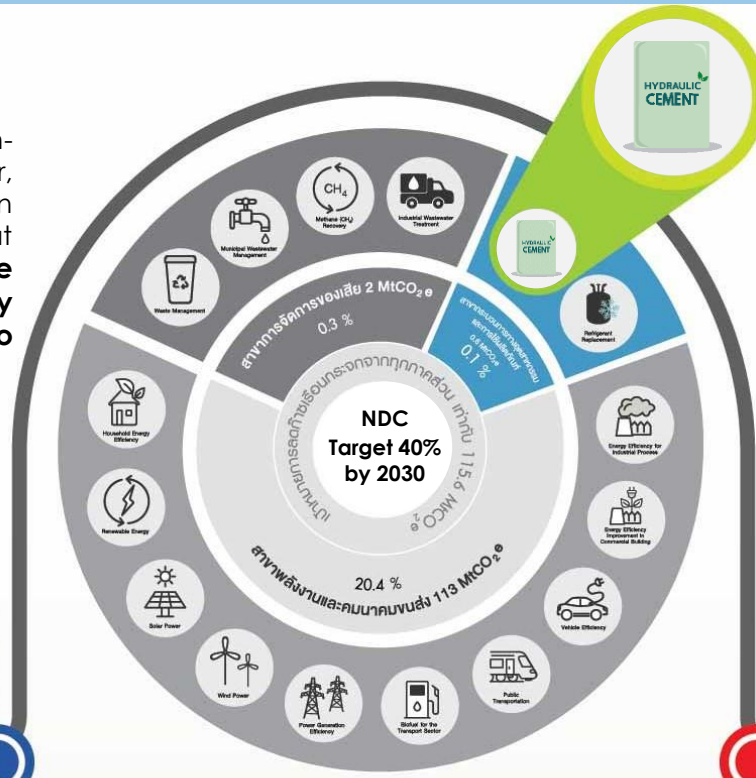
“Effects that scientists had predicted in the past would result from global climate change are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves.”

Source : <https://climate.nasa.gov/effects>

Thailand Net Zero



Prime Minister Prayut Chan-o-cha announced last year, during the COP26 summit in Glasgow, Scotland, that **Thailand aims to meet the goal of carbon neutrality by 2050 and net zero emissions by 2065.**



Reduction-Sector: **Industrial Processes and Product Use (IPPU)**

Measure: **Clinker Substitution** in Cement Industry

NDC
Nationally Determined Contribution
Implementing starts

2016
(2559)



ประเทศไทยยื่นสัตยาบันสาร
เข้าร่วมเป็นภาคีความตกลงปารีส

2021
(2564)



ประเทศไทยประกาศ
ยกระดับลดก๊าซเรือนกระจก

2030
(2573)

Aims to reduce
GHG by 40% with
international support

2050
(2593)

CARBON NEUTRALITY



Reduction of GHG emissions
in various sectors:

- Energy
- Industrial Processes and Product Use (IPPU)
- Agriculture
- Waste
- Land Use, Land Use Change, and Forestry

2065
(2608)

NET-ZERO GHG Emission

CEMENT INDUSTRY OUTLOOK in THAILAND

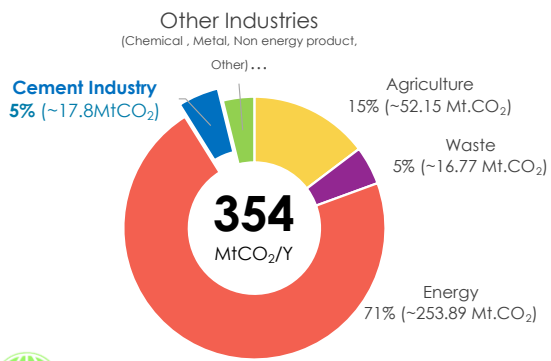
50.3 MT Clinker Production **60.1 MT** Cement Production

12 Cement Plants **32** Cement Kilns

7 Cement Manufacturers

Construction investment to GDP **7.7%**

- Total GHG emissions by sector -



Climate Change Management and Coordination
 กองประสานการจัดการเปลี่ยนแปลงสภาพภูมิอากาศ
 Office of Natural Resources and Environmental Policy and Planning (ONEP)
 Ministry of Natural Resources and Environment

COLLABORATION in actions



2020
 Target : Reduce CO₂
300,000 t-CO₂ by 2022
 (Achieved target in **2021 : 334,557 t-CO₂**)



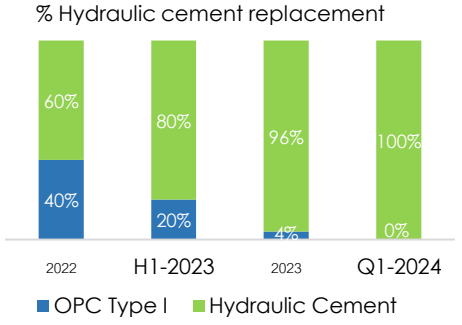
Collaboration between 5 Ministries and 21 alliances.

2022 Challenge Reduce CO₂
1,000,000 ton CO₂ by 2023

TCMA together with 6 Ministries, 30 alliances (government agencies, professional sector, industrial sector, and academic sector) announced **'MISSION 2023'** on greenhouse gas mitigation.



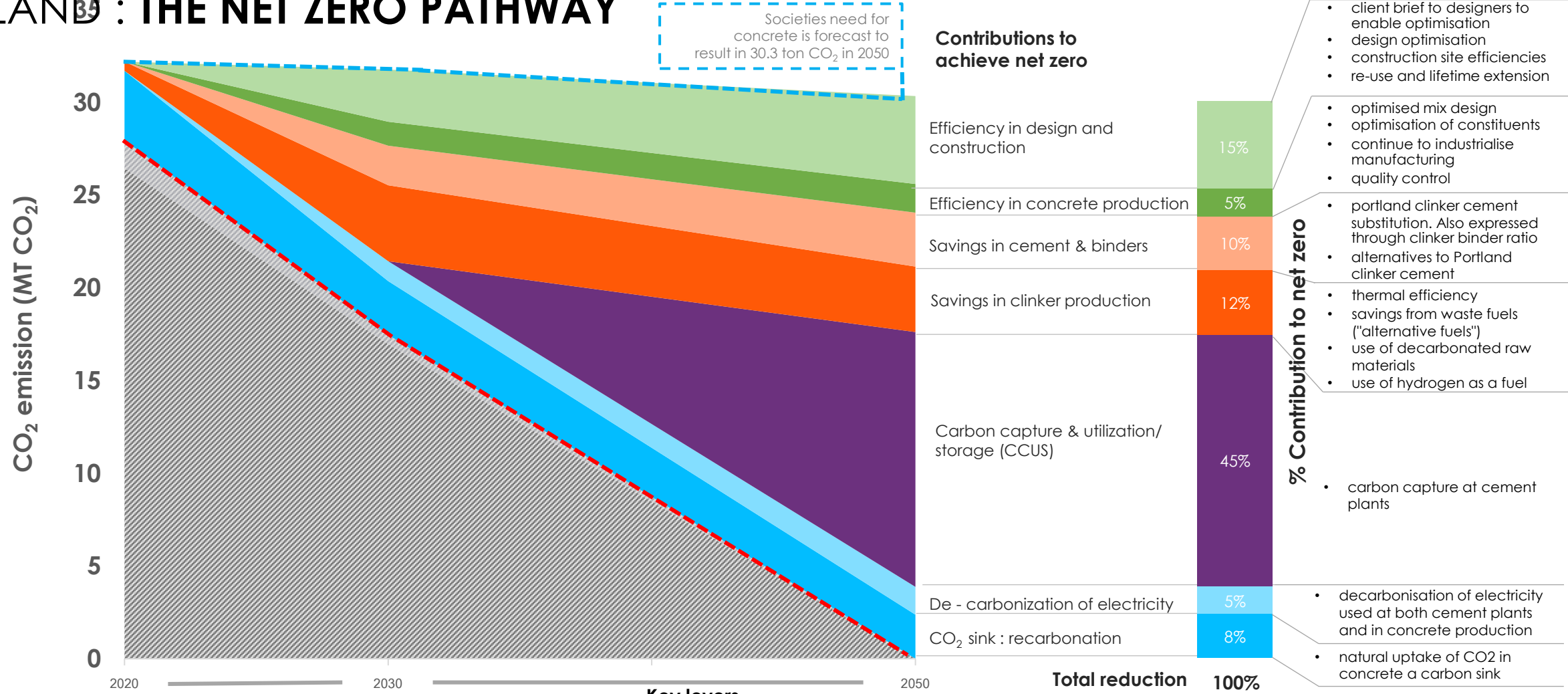
100% Hydraulic Cement



Accelerate using of **hydraulic cement**, which is **low carbon product** through **procurement process for government construction.**

THAILAND : THE NET ZERO PATHWAY

Societies need for concrete is forecast to result in 30.3 ton CO₂ in 2050



--- Net zero pathway
 // CO₂ emissions from electricity
 // Direct net CO₂ emissions

- Key levers**
- Binders
 - Design & Construction
 - AF (RDF & Biomass)
 - CCUS
 - Design & Construction
 - Binders (Hydraulic cement, Calcined clay)
 - AF (RDF & Biomass)

- Contributions to achieve net zero**
- client brief to designers to enable optimisation
 - design optimisation
 - construction site efficiencies
 - re-use and lifetime extension
 - optimised mix design
 - optimisation of constituents
 - continue to industrialise manufacturing
 - quality control
 - portland clinker cement substitution. Also expressed through clinker binder ratio
 - alternatives to Portland clinker cement
 - thermal efficiency
 - savings from waste fuels ("alternative fuels")
 - use of decarbonated raw materials
 - use of hydrogen as a fuel
 - carbon capture at cement plants
 - decarbonisation of electricity used at both cement plants and in concrete production
 - natural uptake of CO₂ in concrete a carbon sink



คุณชนะ ภูมิ
นายกสมาคมอุตสาหกรรมปูนซีเมนต์ไทย (TCMA)
เข้าร่วมงาน COP27 ที่เมืองชาร์ม เอล เซikh ประเทศอียิปต์

Thailand Industry and Government jointly launched Thai Net Zero Roadmap

At COP27 Thailand became the first country in Asia to launch a net zero roadmap and the first GCCA Net Zero Accelerator Country to complete.

The formal partnership between the Thai government and industry was hosted in the Thailand Country Pavilion, which also saw significant Thai media presence and coverage.

near zero carbon cement and concrete by 2030 providing a strong demand signal for our sector.

Cement Breakthrough and Buildings Breakthrough

The Canadian Ambassador for Climate (below left at the Thailand Roadmap launch) announced a wider commitment to launch a 'Cement Breakthrough' at the next COP.



Thomas Guillot was delighted to join Chana Poomee, TCMA President and Vice President of SCG (centre left) and Varawut Silpa-archa, Thailand Minister of Natural Resources and Environment (right).



Cement and Concrete join the First Movers Coalition

"Concrete is essential to the world", said John Kerry, the US Special Presidential Envoy for Climate announcing the launch of the Cement/Concrete stream of the First Movers Coalition.

A UN backed 'Cement Breakthrough' will be a great opportunity for our sector to deliver on national policy requirements across the world, necessary for our net zero mission. We are already engaged with the Canadian government alongside our affiliate Canada Cement Association, who have recently partnered with their government to launch a Net Zero Roadmap for Canada. The Cement Breakthrough is a global initiative and details will emerge over the next year.



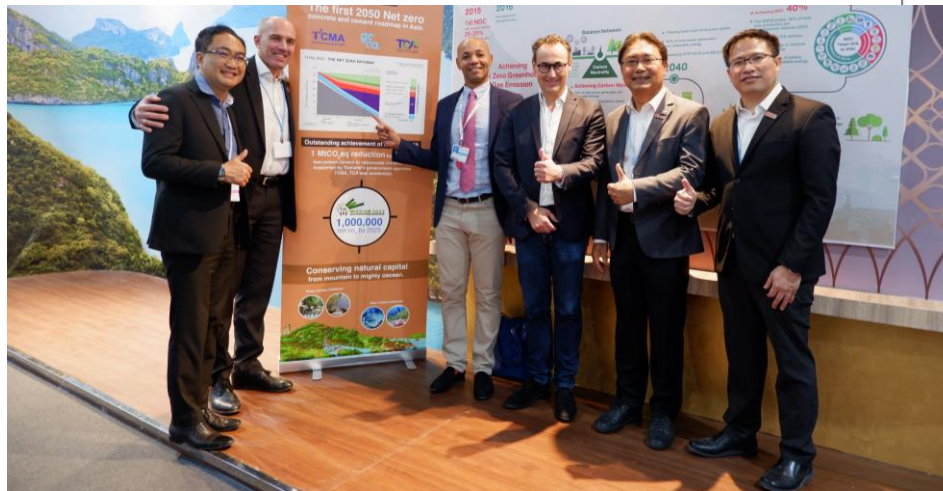
First Movers pledged to purchase at least 10%

A 'Buildings Breakthrough' was also signalled at COP focusing on the performance of buildings and the role of construction. It is another significant initiative for us to ensure we input our industry's key role in the circular economy.

Further activity

In addition to these key highlights, our sector was strongly represented at COP, with the GCCA, member companies and affiliates speaking at a plethora of events.

Our major presence by industry member companies included: Four CEOs, two Country



TCMA's Members and Plants Location



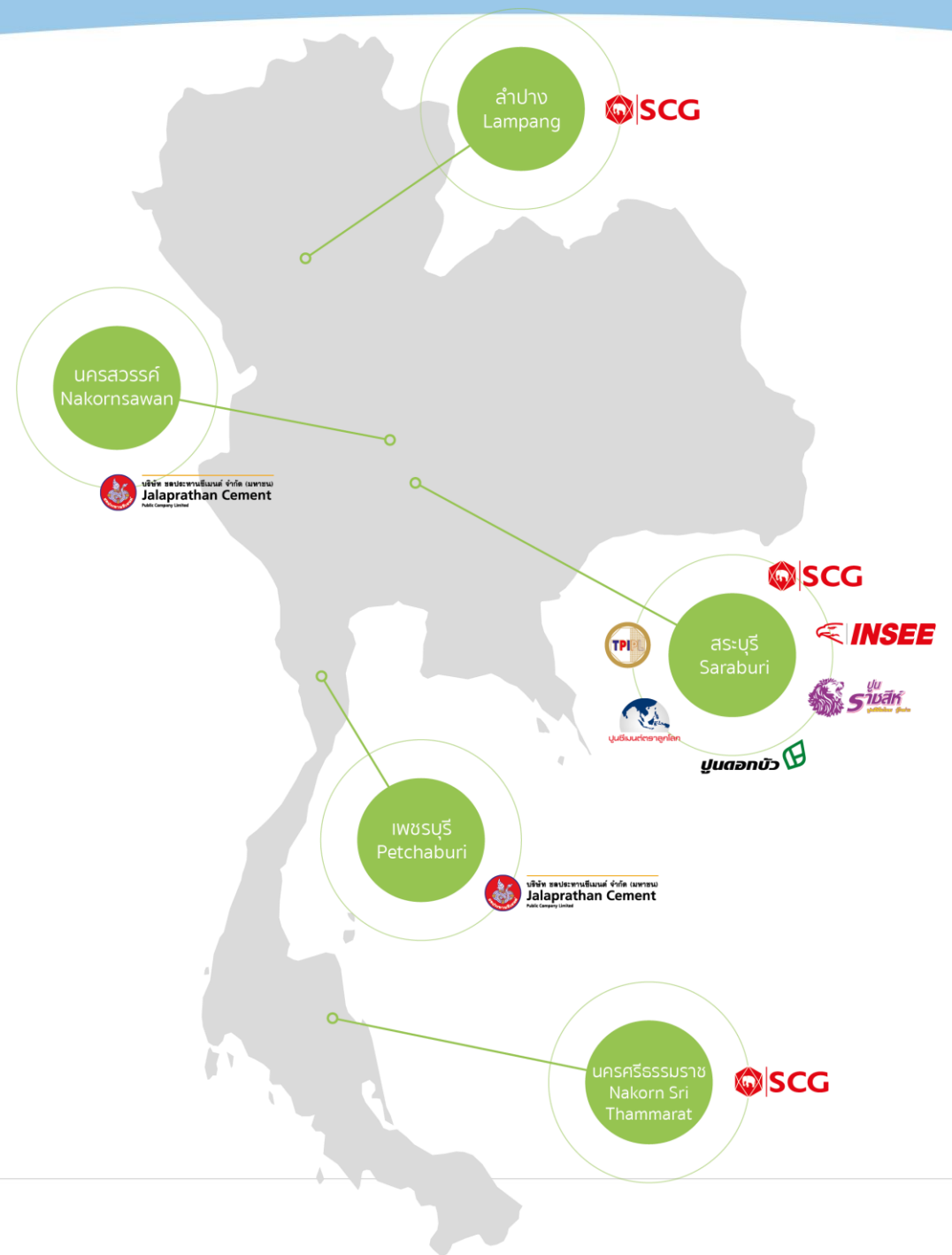
บริษัท ชลประทานซีเมนต์ จำกัด (มหาชน)
Jalaprathan Cement
Public Company Limited



ปูน
ราชสีห์
ปูนซีเมนต์ไทย จำกัด



ปูนซีเมนต์ตราลูกโลก



CONVENTIONAL MINING INDUSTRY'S PAIN POINT



SURVEY

Inefficient manpower management



PLAN & DEVELOP

Unable to utilize data from log sheet



DRILL & BLAST

Unable to make real-time decision



LOADING

High diesel & maintenance cost



HAULING

Difficulty in recruiting workers



CRUSHING

Require operator for individual machine



REFORESTATION

Unable to trace back historical data

● Idle Shovel

● Manual Blast-hole Positioning

● Manually Excavate by Quality Group

● Queuing Truck

● Idle Excavator

● Manual & Separated Control Room

● Lagging Machine Condition

● High-risk Job

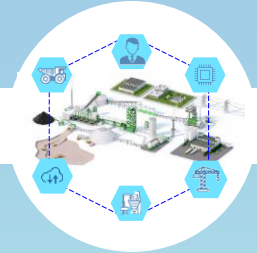
● Operation Monitoring by Human Patrol

TRANSFORMATION TO GREEN & SMART MINING

MINE OPERATIONAL MANAGEMENT



WORKFORCE MANAGEMENT



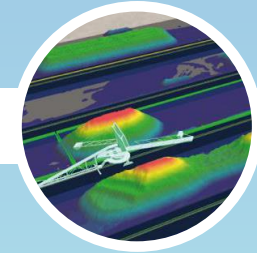
QUALITY ASSURANCE MANAGEMENT



MACHINE & PROCESS PATROL MANAGEMENT



EQUIPMENT MANAGEMENT



STOCK & INVENTORY MANAGEMENT



SAFETY AND ENVIRONMENT MANAGEMENT

DATA ANALYTICS

REAL-TIME SITE MONITORING

OPERATION DASHBOARD

DECISION INTELLIGENCE

PRODUCTION OPTIMIZATION AND SCHEDULING

RESOURCES OPTIMIZATION

ML FORECASTING AND SIMULATION

WORKFLOW PLATFORM



M1: iSURVEY & MAPPING

M2: iMINE PLAN & DEVELOP

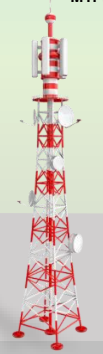
M3: iDRILL & BLAST

M4: iFLEET MANAGEMENT

M5: EV UNMANNED TRUCK/
REMOTE EXCAVATOR

M6: SMART CRUSHER/
AGGREGATE PLANT

M7: iREFORESTATION & ENVIRONMENTAL
MANAGEMENT

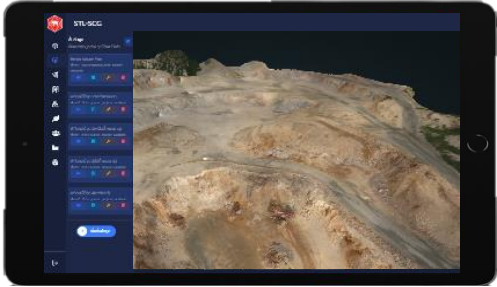


5G

- Topography Survey
- BIMly Mine Plan & Scheduling
- Online Inspection & Operational Data
- Blast-hole Navigation
- Drone for Blasting
- Drone for Reforestation
- Block Modeling
- AI CCTV
- Handheld XRF Online Analysis
- Blast Image Analysis
- Online Inspection & Operation Data
- Tele-Remote Excavator
- Automatic Centralized Crusher
- Image Analysis (CIRA Core)
- Environment Monitoring
- Dynamic Dispatching
- Unmanned EV Dump Truck
- Cross-belt Analyzer
- Renewable Energy

M1: iMINE SURVEY & MAPPING

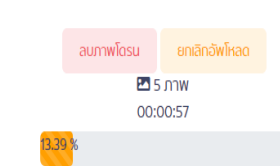
3D Topography



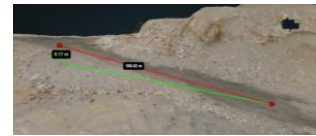
Survey Scheduling



Cloud Mapping



Measurement

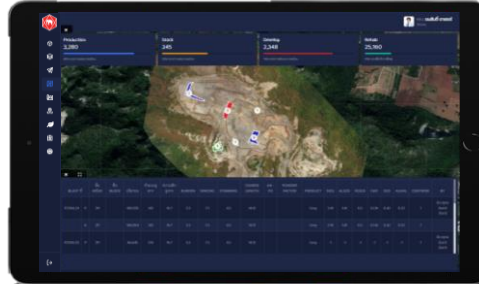


Calculation



M2: iMINE PLAN & DEVELOP

BIMly Mine Plan



Mine Design



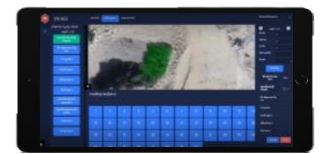
Job Scheduling



Job Assignment

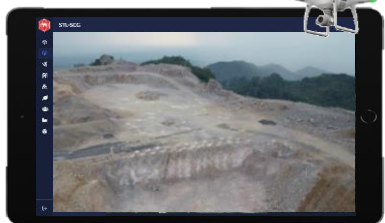


On-site Logging



M3: iMINE DRILL & BLAST

Drone for Blasting



Design and Analysis



High Precision Drill & Blast

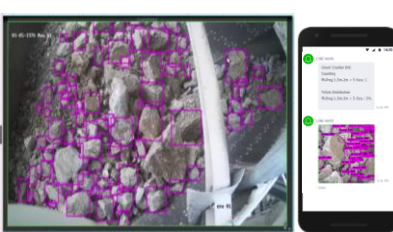


Result Measurement

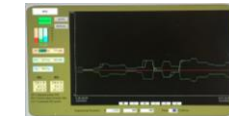


M6: SMART CRUSHER

Material In-Feed Detection



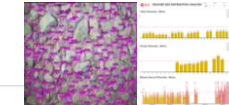
Auto-Feed Crusher



Auto-Gap Adjustment

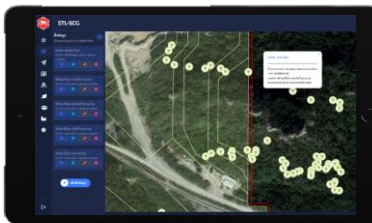


Online Size Monitoring



M7: iMINE REHABILITATION

Drone for Rehabilitation



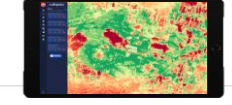
SMART Tree Nursery



Reforestation Technology



Monitor and Evaluation



M4: iFLEET MANAGEMENT SYSTEM

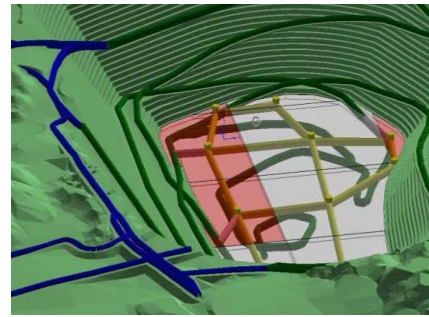
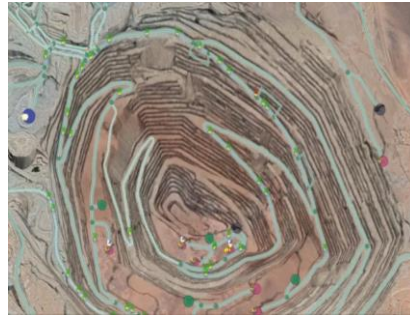


Resources Allocation

Determining a number of trucks required to haul mine material based on short-range planning goals using a linear or nonlinear programming model.

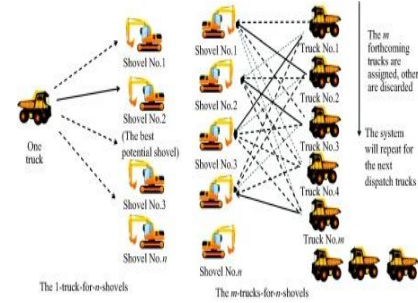
Route Optimization

Minimizing travel time for transporting material from a loading face to a dumping area or travelling from a dumping area to a loading face.



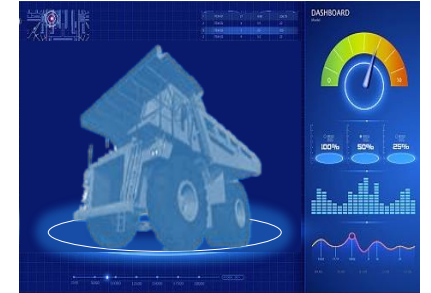
Dynamic Dispatching

Dynamically allocate trucks based on the optimal solutions using heuristics or mathematical model throughout the operating shift.



Machine Condition Monitoring

Monitoring individual machine condition in real-time; allow for further predictive maintenance.



M5: UNMANNED EV TRUCK

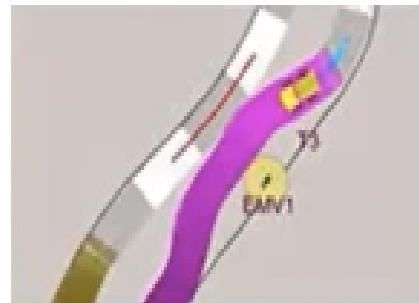
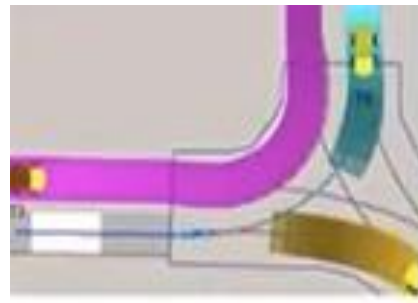


Auto Interaction

- Auto Interaction allows safe interaction between unmanned trucks.
- Unmanned trucks will navigate intersections, dump and load locations.

Manual Interaction

- Manual Interaction allows for safe interaction between Manned Vehicle and unmanned truck.
- Travel, Passing, and Park.



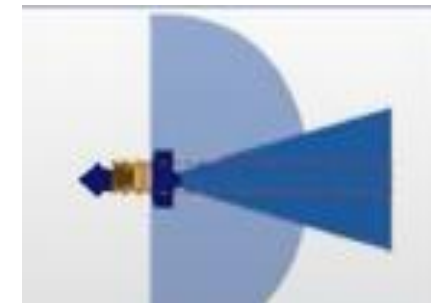
Collision Detection System

- Collision Detection System detects when an unmanned truck permission lines a manned vehicle safety envelope and signal a warning.



Obstacle Detection System

- When the Obstacle Detection System detects an obstacle (front or rear), the unmanned truck will come to a stop.



Dispatching & Unmanned System Architecture

DISPATCHING & UNMANNED TRUCK PLATFORM



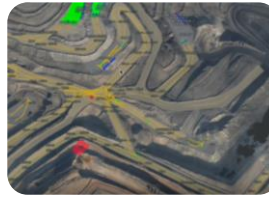
Modernized Command Center



Digital Twin Mapping



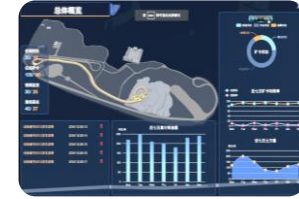
Intelligent Scheduling



Operational Simulation



Equipment Monitoring And Safety Management



Performance Analysis Dashboard



Tele-Remote Platform



Data Streaming

SERVER & DATABASE



NETWORK & COMMUNICATION SYSTEM



5G Dedicated Private Network



Satellite Navigation/RTK/SLAM Location



Data Streaming

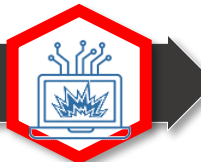
MINING MODULE



iMine Survey & Mapping



iMine Plan & Develop



iMine Drill & Blast



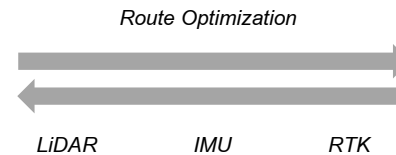
PHYSICAL ASSET



Loading at Loader



Loaded Truck



Empty Truck



Dump at Crusher

GREEN & SMART MINING



Green & Smart Mining Benefits



- Job **efficiency** increase from truck utilization and driver shift change



- **Cost saving**



Energy cost



Maintenance cost



Labor cost



- **Significant improvement in workplace safety**



Reduce risk from
loss / injuries



Reduce risk from skill
shortage



- Less **CO₂** emission



- **Productivity** increase

**THANK
YOU**



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