

# Advances in the Digitalisation of the Process Industries



## Smart Furnace Analytics

Delivering Operational Excellence and Sustainability through Domain and Data



PETRONAS



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# Rxworld

Case for Change

Situational Assessment

Fired Heater Digital Twin Development

Lesson Learnt

Conclusions and Future Workplan

# Case for Change

## Sustainability Agenda

### Towards Net Zero Carbon Emissions by 2050 (NZCE 2050)

We are acutely aware of stakeholders' expectations about climate actions that support the Paris Agreement. Hence, we have taken bold steps to embrace a lower-carbon energy future.

In 2020, we set in motion our long-term aspiration of achieving Net Zero Carbon Emissions by 2050. We are the first oil and gas company in Southeast Asia to adopt this goal. Our sustainability goals for the longer term that address stakeholder concerns.

In addition, it will not only strengthen the momentum of our climate action but also ensure our operations remain resilient for the long term. It also provides the necessary impetus for us to explore new opportunities in the broader energy space that will create sustainable value for our stakeholders.

To accelerate our move towards NZCE 2050, we have set three short-term targets. Our efforts on the material sustainability and corporate social responsibility will continue to drive value for our stakeholders and society.

#### Our Short-Term Targets

##### Manage Greenhouse Gas (GHG) Emissions

Cap GHG emissions at **49.5 million tonnes** of carbon dioxide equivalent (MtCO<sub>2</sub>e) for our Malaysia operations **by 2024**.

##### Step up on Clean Energy

Increase renewable energy capacity to **3,000 MW** **by 2024**.

##### Increase the Number of Education Beneficiaries

Reach over **24,000 beneficiaries** through education programmes cumulatively **between 2020 to 2024**.

#### Our Long-Term Aspiration

**NET ZERO**  
2050

Our long-term aspiration is defined as *"balancing the remaining Scope 1 and Scope 2 GHG emissions from its assets under operational control with carbon offsets"*.

These carbon offsets can take the form of energy-based offsets or forest-based offsets.

Source: <https://www.petronas.com/integrated-report/files/PETRONAS-IR20-Integrated-Report-2020.pdf>

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# Case for Change



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4:33 PM +08  
Last Updated 2 days ago

World Business Legal Markets Breakingviews Technology Investigations Sports

## Asia Pacific

### Malaysia pledges spending, green goals in 5-year economic plan

2 minute read

By Rozanna Latiff and Liz Lee



#### Summary

- PM Ismail Sabri tables 12th Malaysia Plan
- Expects 4.5%-5.5% average annual GDP until 2025
- Govt to spend over \$95 bln on developments in 2021-2025
- Carbon tax, no more coal power to reach 2050 carbon neutral goal

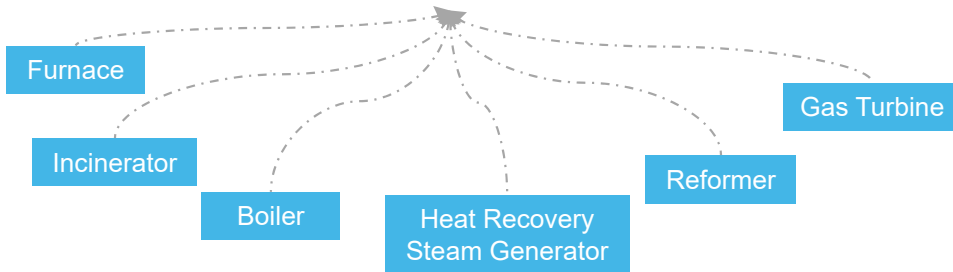
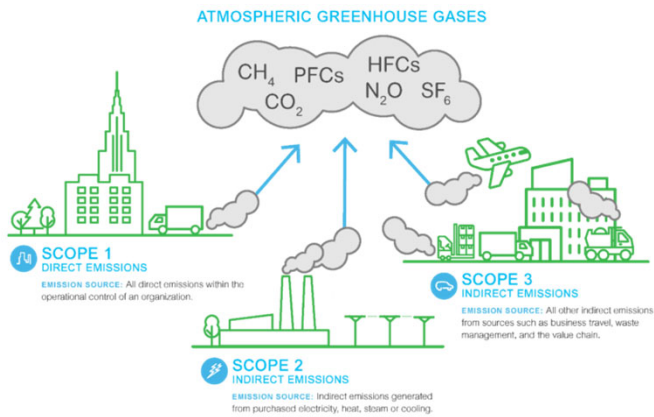
KUALA LUMPUR, Sept 27 (Reuters) - Malaysia's Prime Minister Ismail Sabri Yaakob on Monday tabled a new five-year economic plan, boosting



Source: <https://www.reuters.com/world/asia-pacific/malaysia-targets-gdp-growth-45-55-per-annum-until-2025-pm-2021-09-27/>

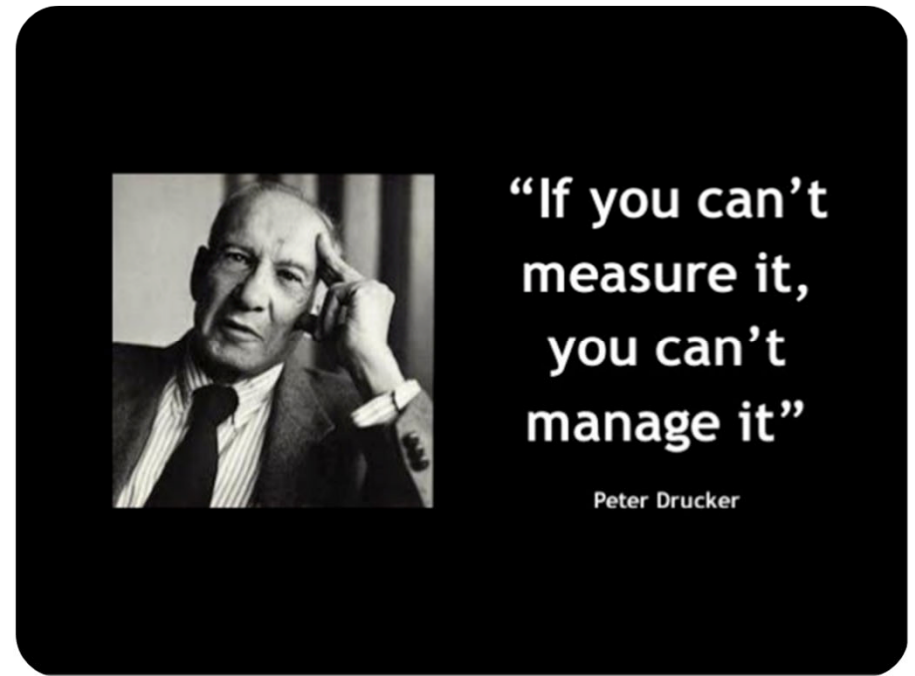
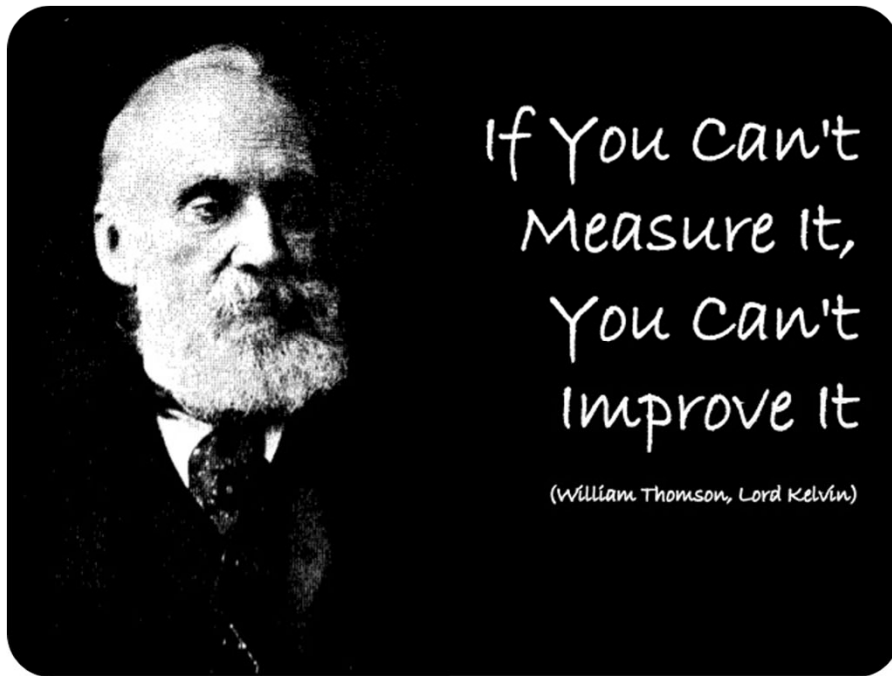
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# Greenhouse Gases Overview



- Fuel gas is the dominant **energy source** for major fired equipment
  - furnace
  - heater
  - boiler
  - Heat Recovery Steam Generator (HRSG)
  - Reformer
- There is opportunity to improve equipment efficiency which will result in **reduction of fuel gas consumption** and subsequently **reduction of GHG emissions**

Source: <https://www.3blmedia.com/news/why-providing-alternatives-sf6-and-other-greenhouse-gases-important-carbon-reduction>



HOW DO WE DO IT?

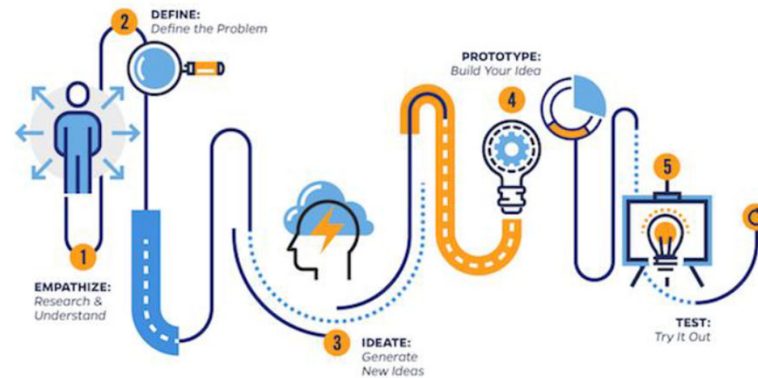
Source: Image from Google

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# Situational Assessment



## Empathize

- Conduct interview from plant people such as process specialist, energy specialist, operation and maintenance
- This step is to further understand what are the issues that they are currently facing

## Define

- From the interview findings, define the most urgent and intense pain points from the plant operation
- This step is to curate the problem statement "How Might We..."

## Ideate

- Brainstorming session among the specialist to identify what are the possible solutions to the pain points identified from previous step

## Prototype

- This is the step which the Use Case is developed to address the most urgent and intense pain points that operation people are facing

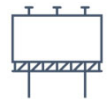
## Test

- The prototype is shared with users for their feedback for improvement
- This is a crucial part to check if the prototype has met the necessary requirement

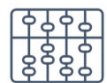
Source: <https://www.interaction-design.org/literature/topics/design-thinking>

# Insights from Situational Assessment Conducted

## Pain Points



Furnace performance and efficiency calculation resides on premise and only visible at plant level. This also applies to overall energy index and energy consumption data



Non-standardized furnace efficiency calculation method which brings challenges to benchmarking and assessment process



Manual work process in determining the furnace performance and efficiency, which only being done at the end of the month. This causes late corrective actions to be taken if required



Lack of prescriptive guides leading to inconsistent furnace troubleshooting (especially on combustion issues).



## Desired State



Groupwide furnace performance overview



Standardized and simplified work process in calculating furnace performance and efficiency



Automated work process with minimal intervention required from plant engineers



Actionable insights and guidelines



## Simplification and automation of work process



Plant Data



1<sup>st</sup> Principle Model



GHG Calculation

## Management of data in centralized database



Hybrid Data

## Application of Data Science knowledge



Machine Learning/  
Predictive Model

## End Results



Hybrid Predictive Model



Performance Monitoring

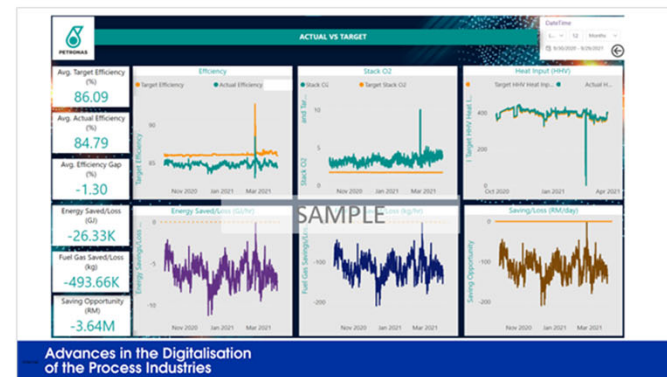
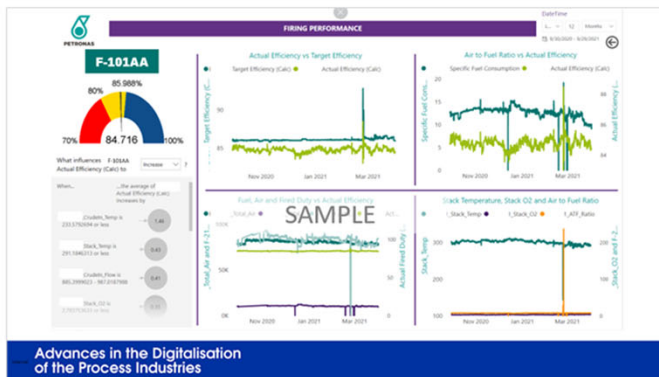
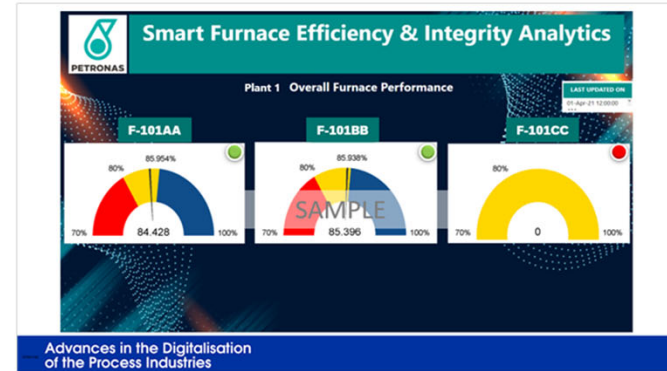
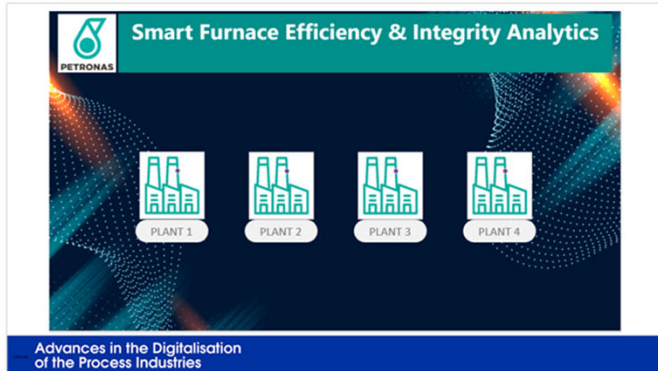


Prescriptive Guides

**GHG**  
QUANTIFICATION

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# Furnace Performance Dashboard

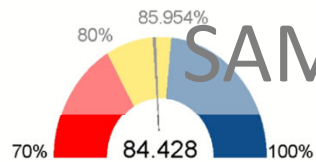


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# Predictive Analytics Feature



- WHAT IF ANALYSIS



SAMPLE

LATEST DATA

01-Apr-21 12:00:00 AM

Air_Temp	34.3
AirCellA_Flow	37,774.6
AirCellB_Flow	41,194.1
SHSteamIn_Pressure	3.2
SHSteamIn_Temp	362.6
Stack_O2	3.8
Stack_Temp	292.8
Total_Fuel	9,511.6



- This feature lists all influential variables (IV) that affects furnace efficiency
- User will be able to change the levers such as fuel gas flowrate, air flowrate, stack O2 to determine the furnace efficiency
- This will assist operation on recommended operating envelope for the furnace

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# Lesson Learnt



Understanding the target audience requirement before embarking any digital twin initiative



Proper problem statement definition



Collaboration between engineering (domain) experts with data science specialist



Competitive and cost effective

# Conclusions and Future Workplans

- A real-time dashboard allows monitoring of critical parameters such as furnace performance data, fuel gas consumption, fuel gas costs as well as greenhouse gas emissions.
- This will provide guidance to the plant operators on how to optimize current operations in near real time.
- Optimized furnace operations will result in fuel savings and less emissions from furnace stacks, in line with the company's sustainability development aspiration to reduce greenhouse gas emissions towards achieving Net Zero Carbon Emissions (NZCE) by 2050
- Future enhancement to integrate with predictive and prescriptive analytics software

Thank you for your passion!



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