



# Secure Marine Fuel Integrity

Fuel Marking for Traceability and Supply Chain Assurance

Speaker: Jax Lee, CEO of Nanolumi

nanolumi  
luminicell Reyal

COMPANY BACKGROUND

# Our Story

We are an **advanced luminescent materials** company delivering breakthrough optical platforms for diverse applications through proprietary nano- and molecular technologies. By combining advanced chemistry and optics, we create, detect, and manipulate light to deliver highly integrated solutions in **Product Authentication (Reyal®)** and **Advanced Bioimaging (Luminicell)**.

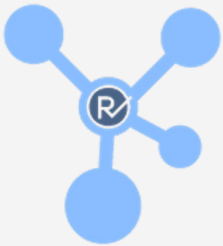


OUR SOLUTION

# Reyal™ Platform

Reyal™ is a complete product authentication & assurance platform. Built for brands and governments who want **unquestionable physical confidence in their products and supply chains.**

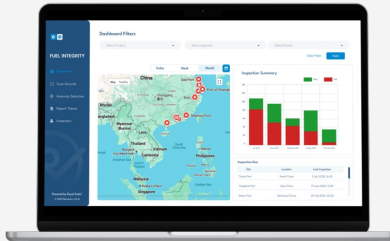
Physical Marking + Digital Verification



Reyal™ Marker



Reyal™ Reader & App

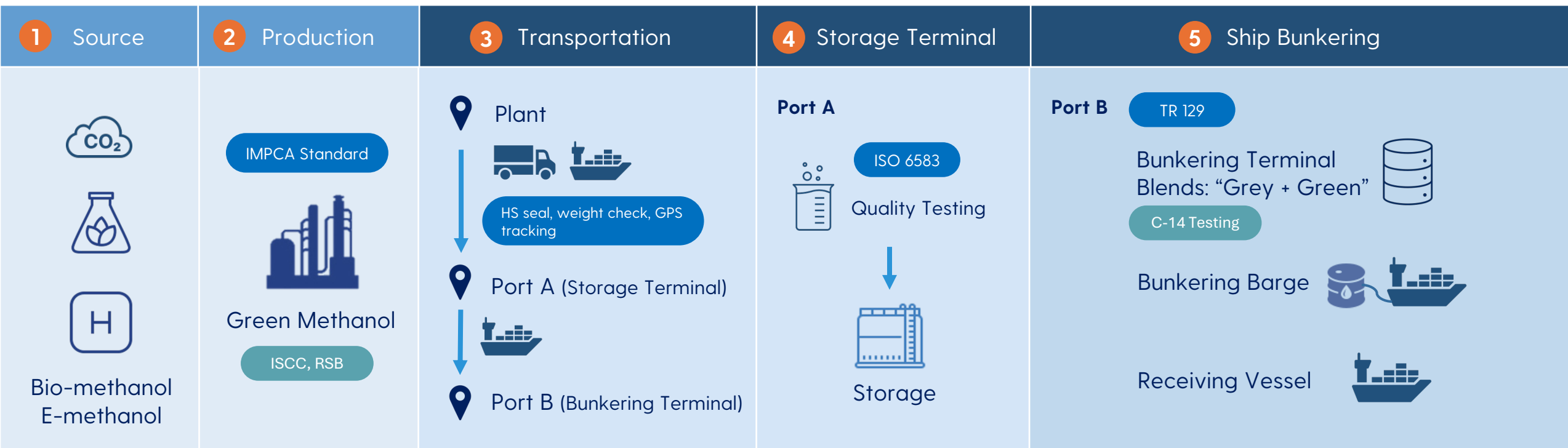


Reyal™ Suite



CURRENT SITUATION

# Green Methanol Supply Chain



Proof of Origin

Proof of Blends

Proof of Data



# Reyal® Use Case | Cargo Integrity / CO2e Tracking



VIDEO

# Reyal™ Marked Methanol



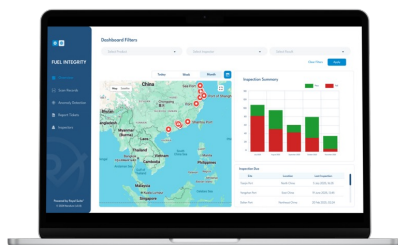
Link: <https://www.youtube.com/watch?v=tQjBiDRzkVk>

# Reyal™ Suite

**Reyal™ RIF Reader**  
Collects data from samples

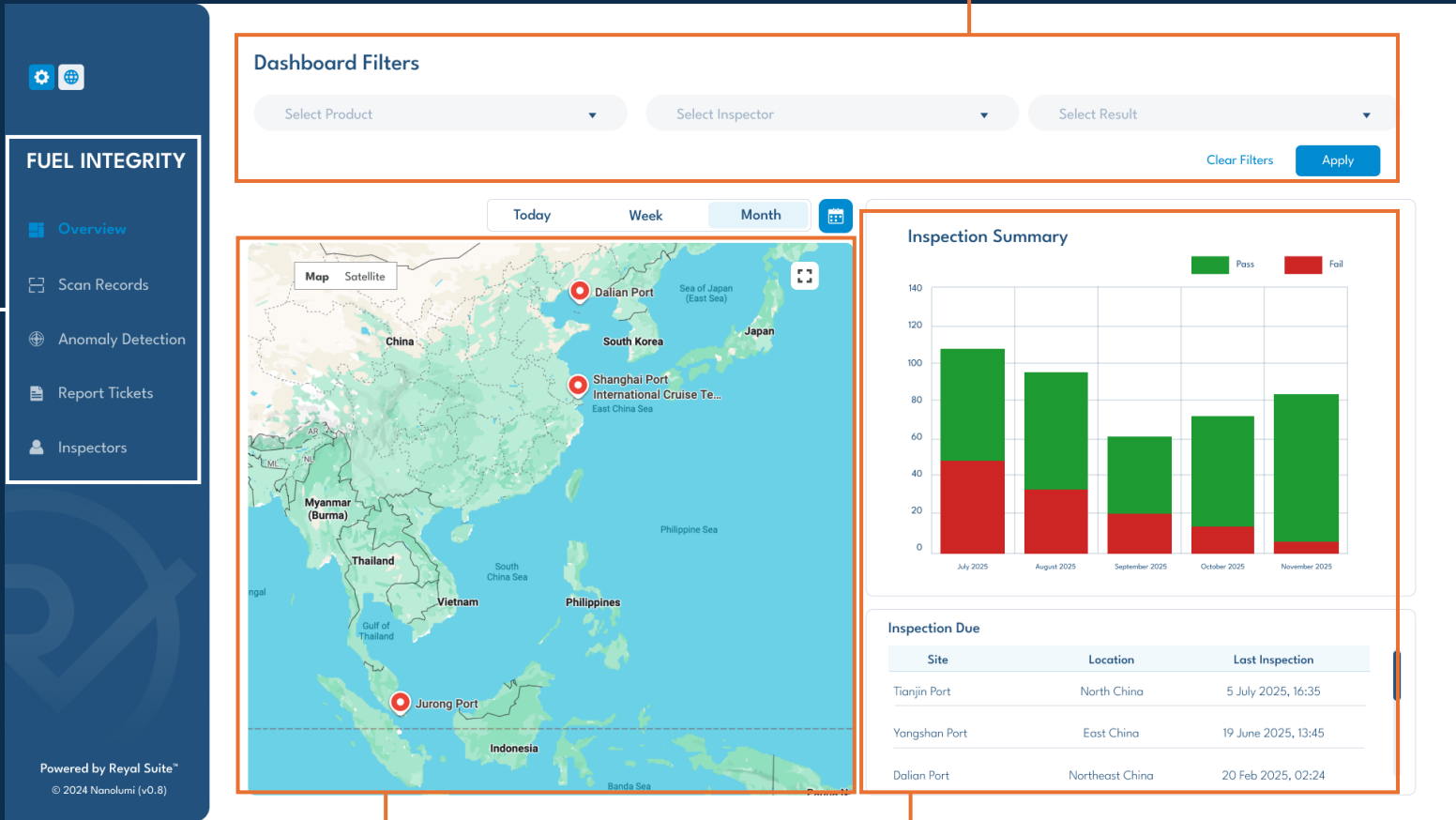


**Reyal™ Suite (Dashboard)**  
The data is uploaded to a secure cloud database for centralized management



Generate **actionable data analytics** and **make informed decisions** to ensure supply chain integrity

## Interactive Interfaces (Customizable)



Filter Product Category

Map Visualization Results

Check Inspection Results

# Certified and Versatile





		Characterisation Fuel Compatibility	POC Testing Use-case specific	Certification No-harm, Fuel Quality Tests
Traditional Fuels	Diesel Land, Marine			✓ EN 590 EI 1535
	Gasoline			✓ EN 228 EI 1535
2 <sup>nd</sup> and 3 <sup>rd</sup> Generation Biofuels	Methanol Marine application	✓	✓	IMPCA (Ongoing) ISO 6583:2024 (Ongoing)
	Ethanol Marine application			Ongoing
	FAME (Marine) UCOME, ..., etc.			Ongoing
	HVO (Land) Renewable Diesel			✓ EN 19540
	SAF (Aviation) Aviation Fuel			✓ ASTM D7566



# Existing Fuel Marking Solutions

	Isotopes	XRF	GCMS	Dyes
Effectiveness	<p><b>Detection by Physical Isotopes</b></p> <p>Requires isotope elements which are costly to generate and limited in accessibility</p> <p>Costly Isotopes</p>	<p><b>Detection by X-Ray Fluorescence</b></p> <p>Overly sensitive, false positive occurrence even with trace amount in shared transport containers</p> <p>Requires X-ray source Typical markers Halogen containing</p>	<p><b>Detection by Gas Chromatography Mass Spectrometry</b></p> <p>Sensitive to contamination, making accurate quantification extremely difficult</p> <p>Requires additional consumables e.g. inert gas (Helium)</p>	<p><b>Detection By Color</b></p> <p>Noise from feedstock color variability leads to inaccurate results</p> <p>Extremely easy to launder Easy to be fooled</p>
Testing Process	<ul style="list-style-type: none"><li>Non-destructive. Non-invasive.</li><li><b>Expertise</b> needed for sample preparation and operation</li><li>Results in <b>hours</b></li></ul>	<ul style="list-style-type: none"><li>Non-destructive. <b>X-ray irradiation</b></li><li><b>Expertise</b> needed for sample preparation and operation</li><li><b>High maintenance</b> for irradiation safety and source</li><li>Results in <b>&lt;10 mins</b></li></ul>	<ul style="list-style-type: none"><li><b>Destructive. Invasive</b></li><li><b>Expertise</b> needed for sample preparation and operation</li><li><b>High maintenance</b> (for reliable results)</li><li>High operational cost</li><li>Results in <b>~30 mins to hours</b></li></ul>	<ul style="list-style-type: none"><li><b>Destructive. Invasive</b></li><li>No expertise/certification needed</li><li>Low maintenance</li><li>Results in <b>mins</b></li></ul>
Ease of Deployment	<p><b>CENTRAL LAB</b></p> <ul style="list-style-type: none"><li><b>Bulky</b>, limited to central lab only</li><li><b>Specialized equipment</b> is needed</li></ul> 	<p><b>CENTRAL LAB</b></p> <ul style="list-style-type: none"><li><b>Bulky (12 kg)</b></li><li><b>Field detection</b> needs mobile van and specialized equipment</li></ul> 	<p><b>CENTRAL LAB</b></p> <ul style="list-style-type: none"><li><b>Bulky (44 kg)</b></li><li><b>Field detection</b> needs mobile van and specialized equipment</li></ul> 	<p><b>DESIGNATED LAB</b></p> <ul style="list-style-type: none"><li><b>Multiple apparatus</b> with <b>extra preparation steps</b> (e.g., chemical reactions)</li></ul> 

# Multiple Layers of Verification

 Reyal	<sup>14</sup> Carbon Testing	Mass Balance & LCA
<p>Delivers real-time, on-site identification and traceability, ensuring <b>continuous verification</b> across blending and logistics.</p>	<p>Provides scientific validation of the biogenic carbon content for laboratory verification.</p>	<p>Ensures certified feedstock and sustainability compliance in documentation and life cycle analysis and accounting.</p>
		

# Operational Scale and Variability

MARKING BILLIONS OF LITRES ANNUALLY

Reyal™ Marker for dosing into  
import diesel and gasoline



Marking of wagons



Team preparing  
to mark incoming  
trains & wagons



Professional team ready to conduct  
marking operations



Managed extremely rapid rollout, showing up to 40% declaration of products  
Historical month v.s. month gains since launch. **Huge Tax gains for gov**



RENEWABLE DIESEL

## Changi Airport

Reyal® collaborated with Changi Airport Group (CAG) and Neste to enhance sustainable fuel assurance at Singapore Changi Airport. The delivered fuel underwent onsite testing at CAG's fuel station, confirming an accurate **50% renewable diesel blend**.





AT A GLANCE

# Summary

01

## End-to-end Assurance Platform

Cloud-based tools to connect physical products with a digital identity for green fuel & brand protection

02

## Forensic Level Authentication in the Field

Bringing typical central lab forensic level authentication into the field with rapid, large-scale deployment

03

## Evidence based Carbon Network

Connects stakeholders across critical stages, delivering standardized, auditable data for accurate carbon tracking



# THANK YOU

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Let's Make A Visible Difference Together

