@green
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- **Malaysia steps up:** Malaysia is championing the ASEAN Power Grid, cross-border renewable trade, and multilateral electricity exchange that align closely with its own NETR ambitions. **p08-09**

- **Landmark outcomes emerge:** Despite no final consensus, COP30 marked a turning point in global climate politics. More than 80 nations supported explicit language for a fossil-fuel phase-out, prompting Brazil to launch two major global roadmaps independently **p10-11**

- **Data, Depth and Decarbonisation:** PETROS is deploying advanced tools - from SQUID-TEM sensing to AI-enhanced subsurface modelling - to cut exploration uncertainty, reduce drilling activity and shrink its carbon footprint. **p12**

# Malaysia's GREEN PIVOT

**Malaysia accelerates its net-zero ambitions with bold climate investments and regional leadership. From KWAP's RM2 billion Dana Iklim+ fund to ASEAN's push for circular economy cooperation at ACEF 2025, IGEM highlights how finance, innovation and policy alignment are reshaping the nation's green transition and strengthening Southeast Asia's sustainability agenda. P14-15**

@green says ...

# A summit that fell short

COP30 arrived with the weight of enormous expectations. Set against a backdrop of escalating climate emergencies, widening inequality, and fracturing geopolitical trust, many hoped Belem would mark a decisive turning point for global climate action.

Instead, despite some symbolic advances, the summit fell short of delivering the concrete, transformational outcomes the world urgently needs, which is essential to foster a sense of accountability among policymakers and advocates.

At its core, COP30 suffered from a familiar paralysis: countries' inability to bridge entrenched divides over the phase-out of fossil fuels, climate finance, and adaptation support. Brazil's bold move to initiate a global debate on transitioning to a fossil-free economy briefly injected a sense of ambition.

But the lack of consensus — with more than 80 countries supporting explicit phase-out language and just as many resisting it — highlighted the deep and worrying fragmentation that must be addressed to build trust and unity in climate action.

Finance, often described as the "make-or-break" issue of climate diplomacy, also failed to meet expectations. Developing nations had hoped COP30 would deliver clarity on scaled-up financing for adaptation, loss and damage, and just transitions.

Instead, the summit produced incremental adjustments rather than the robust, predictable financing architecture required to rebuild trust. For countries already grappling with intensifying floods, droughts and heatwaves, the outcome felt disconnected from lived realities.

Another disappointment was the gap between rhetoric and implementation. While COP30 endorsed decisions to strengthen multilateralism and accelerate implementation of the Paris Agreement, there was little indication that countries were prepared to align their national policies with the level of ambition science demands.

Without enforceable mechanisms or timelines, the pledges risk becoming yet another catalogue of hopes rather than a roadmap for action.

The most significant shortcoming, however, was moral: COP30 did not respond with the urgency demanded by a planet already at the brink, risking a sense of moral disappointment and the need for renewed moral resolve among stakeholders.

In the end, COP30 will be remembered not for what it achieved, but for what it failed to deliver - a decisive, unified leap toward a safer climate future. The burden now falls on COP31 and national governments to close the widening gap between ambition and action.


14-15


08-09



16-17

05

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# A cleaner path in chemistry

- **Water, ethanol, supercritical $CO_2$, ionic liquids and deep eutectic solvents are reducing toxic waste, improving efficiency, and lowering environmental impact.**
- **These solvents extract bioactive compounds more safely, improve drug formulation, protect heat-sensitive nutrients, and leave no harmful residues behind.**
- **Issues like viscosity, cost, and scale-up persist - but global demand for safer, healthier, and ethically aligned products is driving rapid adoption.**

IN our everyday lives, solvents play a silent but crucial role. They are behind the extraction of the antioxidants in your turmeric drink, the purity of your medicines, and the flavour of your favourite herbal tea.

For decades, industrial solvents have been effective yet harmful to the environment and, at times, to human health. But now, a cleaner and safer solution is taking centre stage. These are green solvents.

Green solvents are emerging as a game-changer in both the pharmaceutical and food industries. They offer a way to produce, extract, and process substances with less harm to our health and to the environment.

These solvents are biodegradable, often non-toxic, and derived from renewable resources. More importantly, they are already making a real difference in laboratories and factories around the world.

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## WHAT MAKES A SOLVENT 'GREEN'?

Not all solvents are created equal. Traditional solvents like chloroform, acetone, or hexane are effective but volatile and often hazardous. Green solvents, by contrast, are designed to minimise toxicity and waste. Many are made from renewable raw materials. Water, ethanol, ionic liquids (ILs), supercritical carbon dioxide (CO2), and deep eutectic solvents (DESs) are among the most studied and promising options. Each of these has unique properties.

Supercritical fluids, for example, exist in a state where they behave like both gas and liquid. This allows them to extract compounds efficiently without using high temperatures that could damage sensitive nutrients or medicinal properties. Supercritical $CO_2$ has proven particularly effective in extracting antioxidants from turmeric (Le Tan et al., 2025). This allows cleaner herbal supplements and food ingredients to be produced without chemical residues.

Deep eutectic solvents (DESs) are another family of green solvents. DESs are created by mixing components that form a stable, low-melting liquid. They are affordable and biodegradable, and they perform very well in extracting valuable compounds from natural products. For instance, DESs have been successfully used to extract curcumin from turmeric and polyphenols (Sahu et al., 2025). This preserves the health benefits of these compounds without the use of hazardous chemicals.

## Healing without harm

The pharmaceutical industry has long depended on organic solvents, many of which are toxic and non-renewable. Green solvents are now providing safer and more sustainable alternatives.

In drug development, green solvents are being used in the synthesis of active pharmaceutical ingredients, formulation processes, and drug delivery systems. For example, water and ethanol are increasingly used as reaction media. ILs and DESs help stabilise and solubilise poorly water-soluble drug molecules(Mohd Noor et al., 2024). This improves how well medicines are absorbed and how effective they are.

One success story comes from the production of Melitracen hydrochloride, an antidepressant. When researchers switched to greener solvents like 2-MeTHF and IPA, they achieved an impressive 99.75 per cent yield and 99.85 per cent purity: while producing far less waste (Narukulla & Kaki, 2025).

This shows how green chemistry can boost efficiency, cut costs, and protect the environment at the same time. Green solvents are also advancing cancer research. In some studies, anticancer compounds have been synthesised using DESs, helping to develop potentially less toxic treatments.

## GREENER CHEMISTRY

Green solvents are playing a similar role in the food industry, especially in processing and quality assurance. Food extraction processes often rely on solvents, and when unsafe or non-biodegradable ones are used, they can leave behind residues in the final product. Green solvents help eliminate this risk.

For instance, DESs have been used to extract antioxidants from ingredients like ginger and turmeric. These solvents allow processors to preserve the sensitive bioactive compounds while using less energy. For example, supercritical $CO_2$ can extract curcuminoids from turmeric at lower temperatures (Kongpol et al., 2022). This preserves the antioxidant properties better than traditional heat-based methods.

Natural solvents such as limonene, which is extracted from citrus peels, and ethyl lactate, derived from fermented corn, are also gaining popularity. These substances are non-toxic and leave no harmful residues. This makes them ideal for use in food production.

In addition to processing, green solvents are used in food safety testing. Modern analytical methods are now applied to detect chemical contaminants, pesticide residues, and heavy metals in food products. This ensures that the food is not only nutritious but also safe for consumers.

## THE ENVIRONMENTAL EDGE

Green solvents offer a safer, less toxic alternative that produces minimal hazardous waste and lowers the risk of environmental contamination. They also help reduce carbon emissions. For instance, ethanol used in catalytic hydrogenation can cut emissions by 40%. Supercritical $CO_2$ replaces volatile organic solvents while remaining scalable for industrial use.

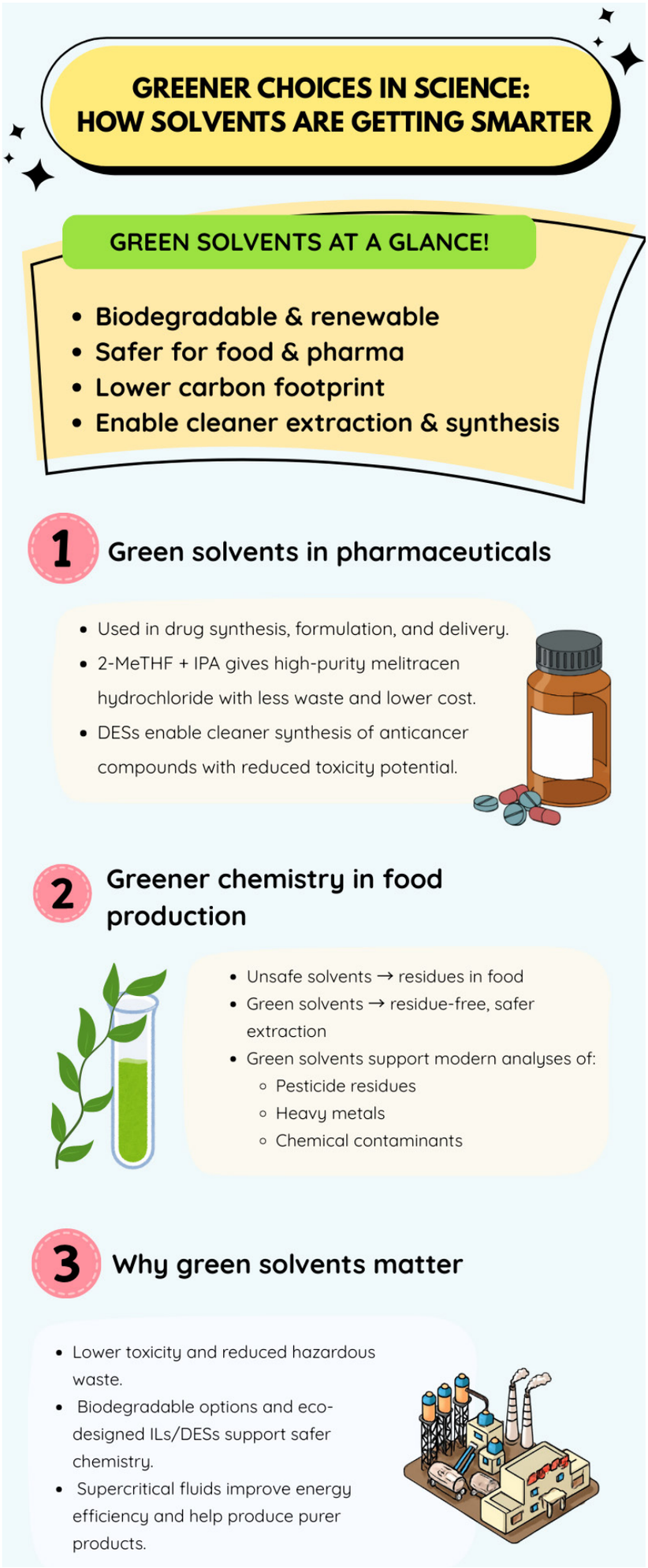
Many green solvents are biodegradable. Natural options like limonene and ethyl lactate break down easily, while newer solvents such as DESs and ILs are being developed for environmental safety. These solvents also improve energy efficiency. Supercritical fluids often require less heat and pressure, reducing energy use and operational costs. Additionally, they enhance drug purity by minimising toxic residues.

## BARRIERS TO BROADER USE

Although green solvents offer many benefits, their widespread adoption still faces some challenges. For instance, DESs can be highly viscous, slowing mass transfer in some processes. This can limit their use in fast-paced industrial operations. Scalability is another issue.

What works well in a research laboratory may not translate easily to a commercial production environment. Equipment and process changes may be needed, which can be costly and time-consuming.

The cost of green solvents is also a factor. While long-term savings are likely, the initial cost of switching from traditional methods may discourage some companies. Regulatory approval can also be slow, especially in highly regulated industries like pharmaceuticals and food.




"This shows how green chemistry can boost efficiency, cut costs, and protect the environment at the same time."

Despite these issues, the overall direction is clear. With growing consumer demand for safer, cleaner products and increasing regulatory support for sustainable practices, the shift to green solvents is becoming increasingly attractive.

### A SUSTAINABLE FUTURE IN A BOTTLE

Green solvents may not be the flashiest part of pharmaceutical or food production, but they are one of the most transformative. As research expands and regulations adapt, the path forward for green solvents is looking increasingly clear. In Islamic values, there is a strong emphasis on both safety and ethical consumption. Prophet Muhammad said:

"There should be neither harming nor reciprocating harm" (Sunan Ibn Majah 2340)

This principle aligns beautifully with the philosophy behind green chemistry. By reducing toxic exposure and environmental damage, green solvents embody the spirit of this teaching, protecting people, communities, and ecosystems from harm. Green solvents offer more than just technical benefits; they support the creation of products that are in harmony with both modern science and timeless values.

Green chemistry is proving that innovation and ethics can coexist. It is paving the way for a future where sustainability, safety, and spiritual integrity come together in every bottle, pill, and package.

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