The Future of Petrochemicals

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The IEA is shining a light on areas of the energy system that do not garner as much attention as they deserve.
Petrochemicals today

Chemicals, society, the energy system and the environment
Petrochemicals are all around us

Our everyday lives depend on products made from petrochemicals, including many products for clean energy transitions.
Petrochemical products have been growing fast

Demand for plastic has grown faster than for any other bulk material, nearly doubling since the millennium.
Higher-income countries consume up to 20 times as much plastic per capita as lower-income economies, indicating significant global growth potential.
Today, petrochemicals account for 14% of global oil, and 8% of global gas demand.
Feedstocks” fly under the radar

Feedstock accounts for half of the chemical sector’s energy inputs, of which oil and gas account for more than 90%.
Asia dominates both global primary chemical production and naphtha feedstock consumption. North America is the leader in ethane-based petrochemical production.
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Among the main costs of production, feedstock is the most influential factor in determining regional production advantages.
For integrated refiners, the petrochemical path can offer higher margins than fuels.
The bulk of the US petrochemical capacity is located on the Gulf Coast, coinciding with substantial refining capacity. The region is a hotspot for both natural gas and crude oil processing.
What is the current trajectory for petrochemicals?

The Reference Technology Scenario (RTS)
Production of key thermoplastics more than doubles between 2010 and 2050, with global average per capita demand increasing by more than 50%.
Petrochemicals grow more than any other oil demand driver

Petrochemicals are the fastest growing sector of oil demand – over a third of growth to 2030 and nearly half to 2050.
Regions with a feedstock advantage and a strong source of domestic demand account for the lion’s share of production increases in the longer term.
The Middle East and North America utilise available ethane, while Europe and Asia Pacific stick to naphtha and coal.
An alternative, more sustainable pathway

The Clean Technology Scenario (CTS)
Despite being the largest industrial energy consumer, the chemical sector ranks third among industrial CO₂ emitters.
By 2050, environmental impacts under the Clean Technology Scenario decrease across the board, including CO₂, air and water pollutants.
By 2050, the collection rate for recycling nearly triples in the CTS, resulting in a 7% reduction in primary chemical demand.
Plastic waste leakage is an urgent pollution problem

The recycling infrastructure necessary in the CTS lays the groundwork to drastically reduce plastic pollution from today’s unacceptable levels. Cumulative leakage more than halves by 2050, relative to the RTS.
Chemical sector emissions of CO₂ decline by 45% by 2050 in the CTS, with energy-related emissions declining much less steeply than process emissions.
A more sustainable chemical sector is achievable

A ambitious, balanced portfolio of options are required to deliver emissions reductions; 24% cumulative reduction from RTS to CTS from 2017 to 2050.
CCUS delivers more than one third of CO$_2$ savings in the CTS.

Additional CO$_2$ capture capacity deployed in the CTS relative to the RTS is primarily for storage applications.
The CTS can be pursued cost-effectively

Savings due to recycling and coal-to-gas feedstock switching mean the CTS (USD 1.5 trillion) is less capital-intensive than the RTS (USD 1.7 trillion).
Oil demand in the CTS

The share of chemical feedstock in total oil demand in the CTS is much higher, as oil demand for other sectors declines much more sharply.
Petrochemical feedstock is the only oil growth segment in the CTS. By 2050, per capita oil demand for plastics overtakes road passenger transport in several regions.
Top ten policy recommendations (1/2)

Production of chemicals

1. Directly stimulate investment in R&D of sustainable chemical production routes and limit associated risks.

2. Establish and extend plant-level benchmarking schemes for energy performance and CO₂ emissions; incent adoption through fiscal incentives.

3. Pursue effective efforts to reduce CO₂ emissions.

4. Pursue stringent air quality standards, including for industry.

5. Fuel and feedstock prices should reflect actual market value.
Top ten policy recommendations (2/2)

Use and disposal of chemical products

1. Reduce reliance on single-use plastics other than for essential non-substitutable functions.
2. Improve waste management practices around the world.
3. Raise consumer awareness about the multiple benefits of recycling.
4. Design products with disposal in mind.
5. Extend producer responsibility to appropriate aspects of the use and disposal of products.
Conclusions: Shining a light on a “blind spot” of global energy

- Petrochemicals are deeply embedded in our economies and everyday lives; they also play a key role in many clean energy technologies.
- Petrochemicals are the largest driver of global oil demand – more than a third of growth to 2030, and nearly half to 2050.
- The United States, China and the Middle East lead the growth in petrochemicals production.
- The production, use and disposal of chemicals take an environmental toll, but achievable and cost-effective steps can be taken.
- The IEA will continue to shine a light on energy “blind spots”: trucks, air conditioners, modern bioenergy...now petrochemicals...and more to come.