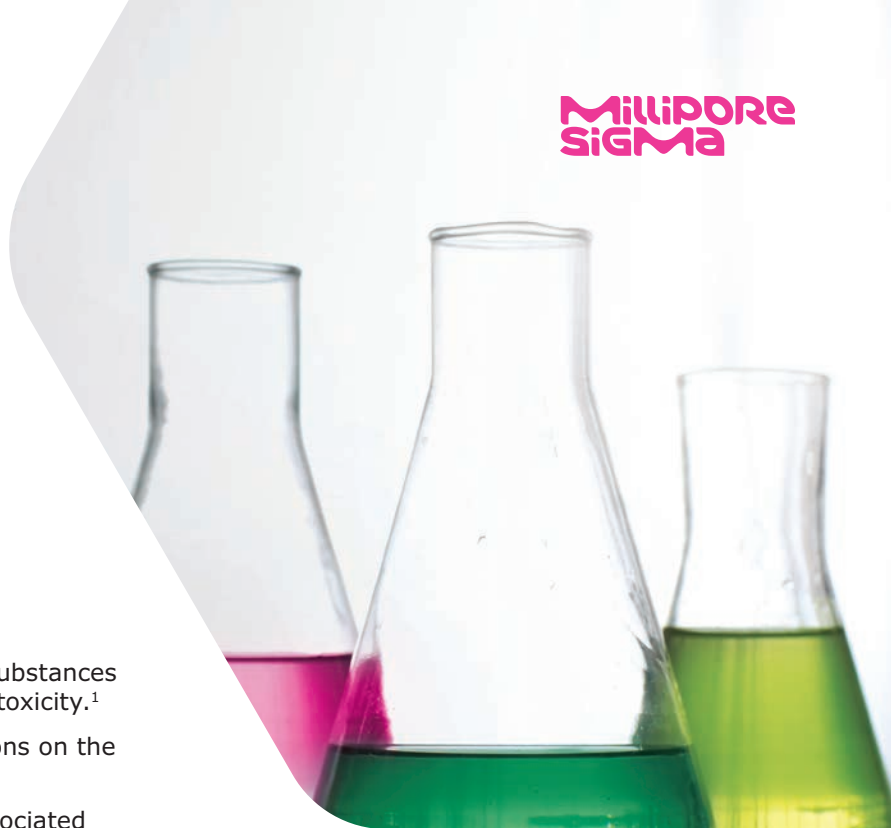




# CYRENE™

A bio-based alternative to petroleum-based DMF and NMP solvents



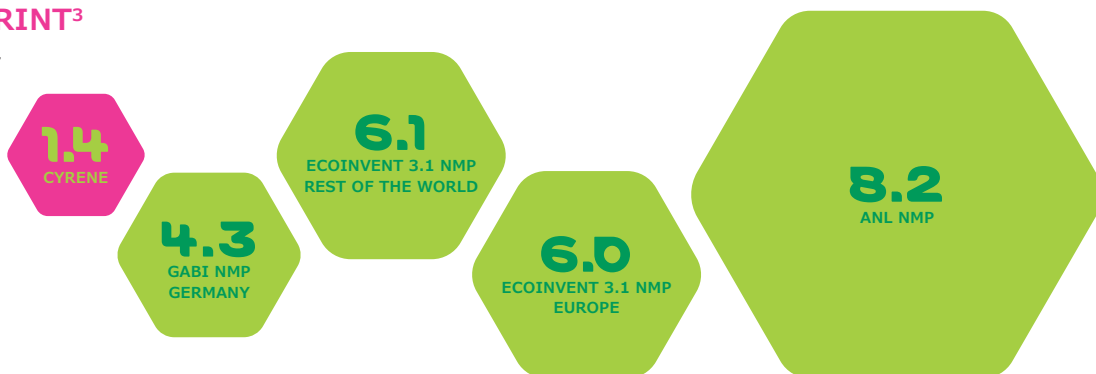
## A SAFER SOLVENT

NMP and DMF are on the European ECHA list of substances of very high concern because of their mutagenic toxicity.<sup>1</sup>

- In 2020, the ECHA implemented strict restrictions on the use of NMP within the EU<sup>2</sup>
- Cyrene™ does not contain the amide group associated with mutagenic toxicity and is therefore not subjected to the same regulatory restrictions as NMP and DMF<sup>1</sup>

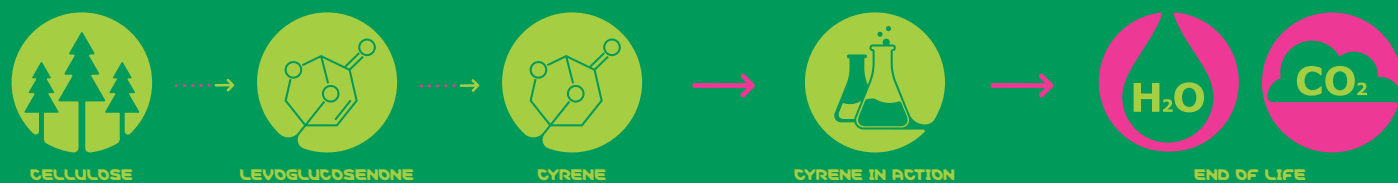
## A SMALLER FOOTPRINT<sup>3</sup>

When compared to other solvents, Cyrene™ has a drastically smaller cradle-to-gate global warming potential (kg CO<sub>2</sub>e/kg Solvent).



IPCC 2013 Impact Assessment Method

## A SUSTAINABLE OPTION



Solvents constitute more than half the waste of a typical pharmaceutical process.<sup>4</sup>

Cyrene™ does not contain chlorine, sulfur, or nitrogen heteroatoms, which can present pollution issues or create corrosive by-products if incinerated.<sup>1-5</sup>

The production of Cyrene™ is energy neutral and sustainable. It is produced in only two steps from waste cellulose and releases only carbon dioxide and water at end of life.<sup>1-6</sup>

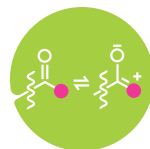
# APPLICATIONS OF CYRENE™

Cyrene™ can replace DMF and NMP in a number of common organic chemistry transformations:



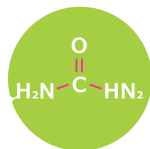
## CROSS COUPLING

Both mild and robust methods for the Sonogashira reaction have been developed employing Cyrene™<sup>7</sup>



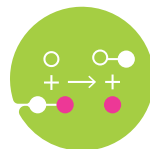
## AMIDE BOND FORMATION

Cyrene™ may offer considerable potential in amide bond formation, one of the most common reactions in the pharmaceutical industry<sup>7</sup>



## UREAS

Cyrene™ enables an efficient, waste-minimizing method for synthesizing ureas from isocyanates and secondary amines<sup>8</sup>



## GRAPHENE INK PRODUCTION

The highest quality graphene inks ever reported have been produced using Cyrene™ as an alternative to NMP<sup>10</sup>



## FLUORINATION

Cyrene™ has the correct attributes to promote the fluorination reaction and was found to match the performance of NMP<sup>5</sup>

Visit [SigmaAldrich.com/cyrene](https://www.sigmaaldrich.com/cyrene) for more information and to order.

Because Cyrene™ has optimum solvent polarity and a high viscosity compared to NMP and DMF, it has demonstrated superior performance in the production of graphene. Graphene is 200x stronger than steel, efficiently conducts heat and electricity, and is nearly transparent.<sup>9</sup> Its potential applications are promising:<sup>9</sup>



Lightweight, more energy-efficient aircraft



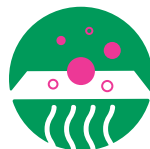
Longer-lasting, flexible batteries that could be built into clothing and uniforms



Ultra-sensitive sensors that can detect minute dangerous particles



Biomedical delivery systems, sensors, tissue engineering, and antimicrobials



Filtration technology that can remove carbon dioxide released into the atmosphere by power stations

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