

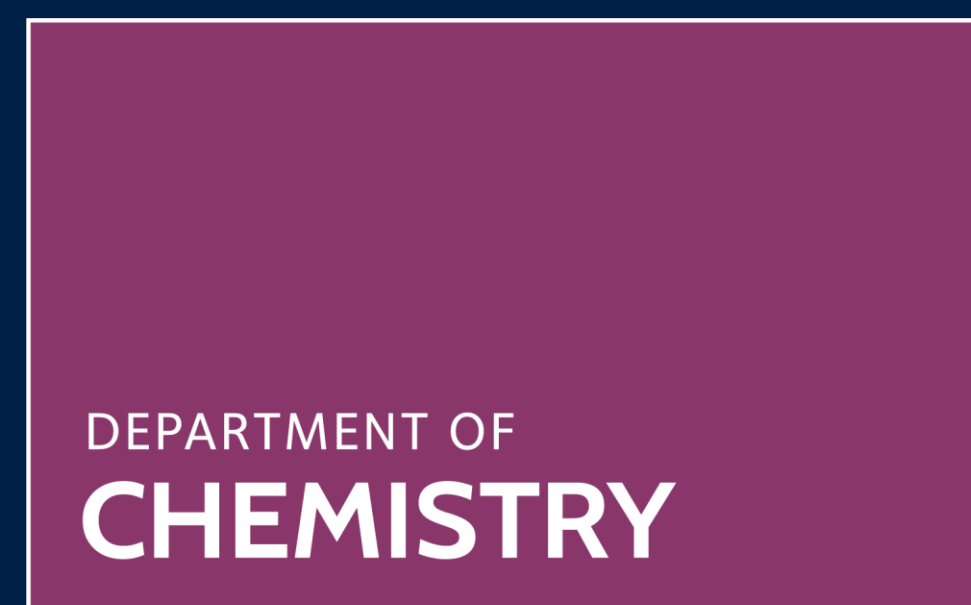
Catalyst Development for Circular Economy Plastics Production

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1 The Problem




Petrochemicals

Applications

Waste

 **Plastics are ubiquitous** in modern society, but a rise in plastic **waste generation** and the significant **carbon-dioxide emissions** associated with plastic production pose a serious challenge

 Transition to a **circular materials economy** is essential for a sustainable future

The Solution

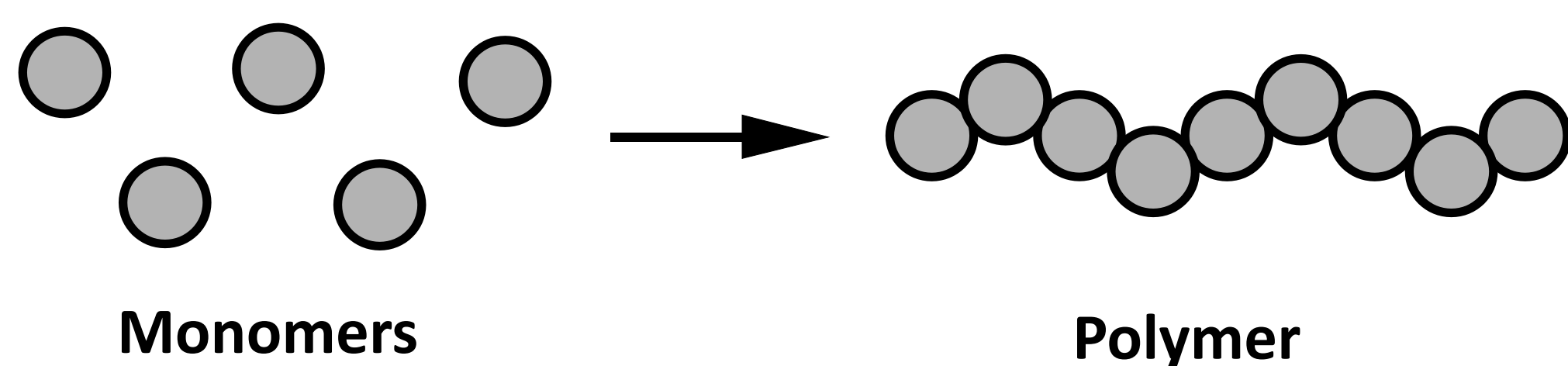
Bio- and waste-derived starting materials



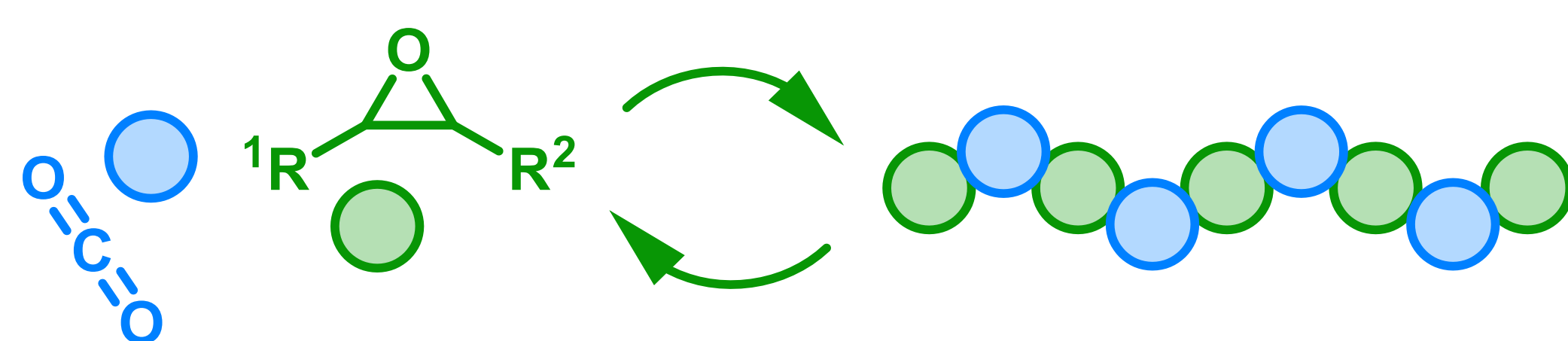
Applications

2 Our Approach

 **Polymers**, the primary component in plastics, are sourced from **petrochemicals** and are **non-recyclable**




 We use **carbon-dioxide** and **biomass** directly to make polymers that are **recyclable**...




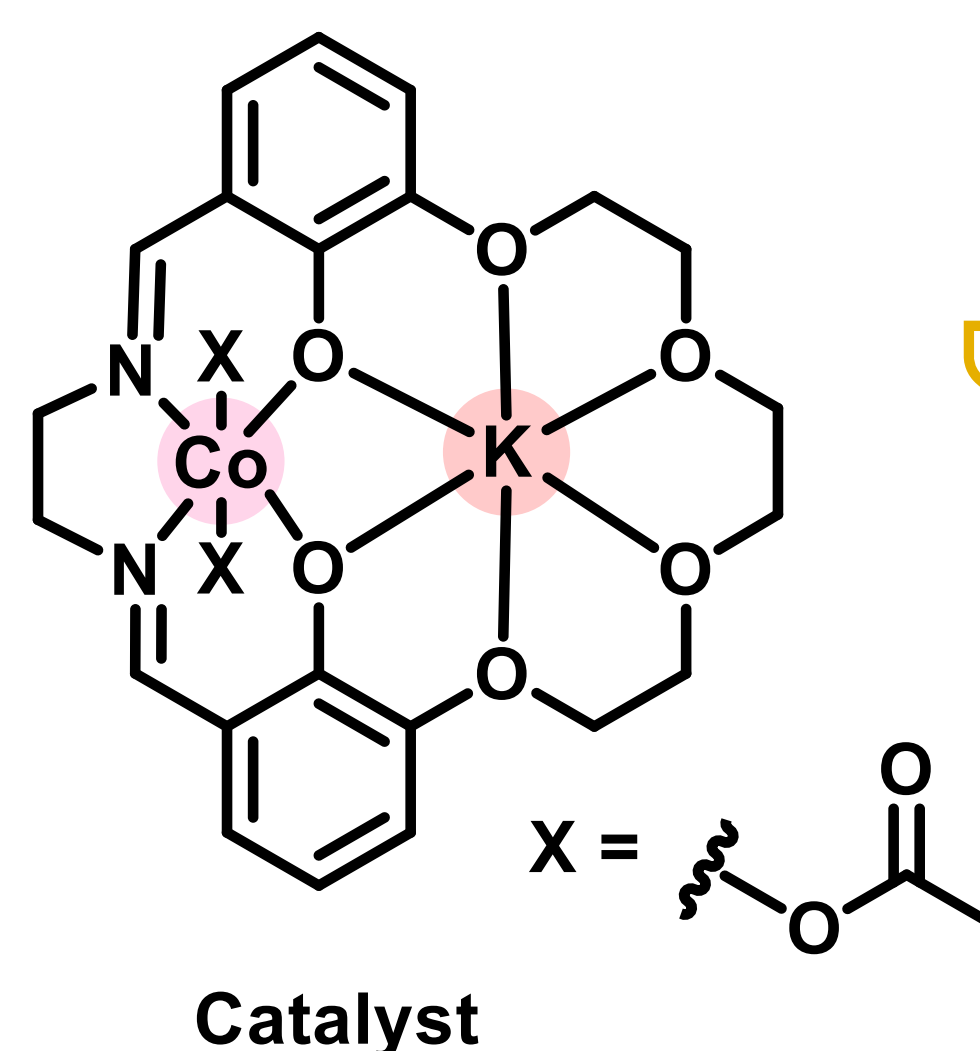
Monomers


Polycarbonate

...and investigate how to make the manufacturing process as efficient as possible 

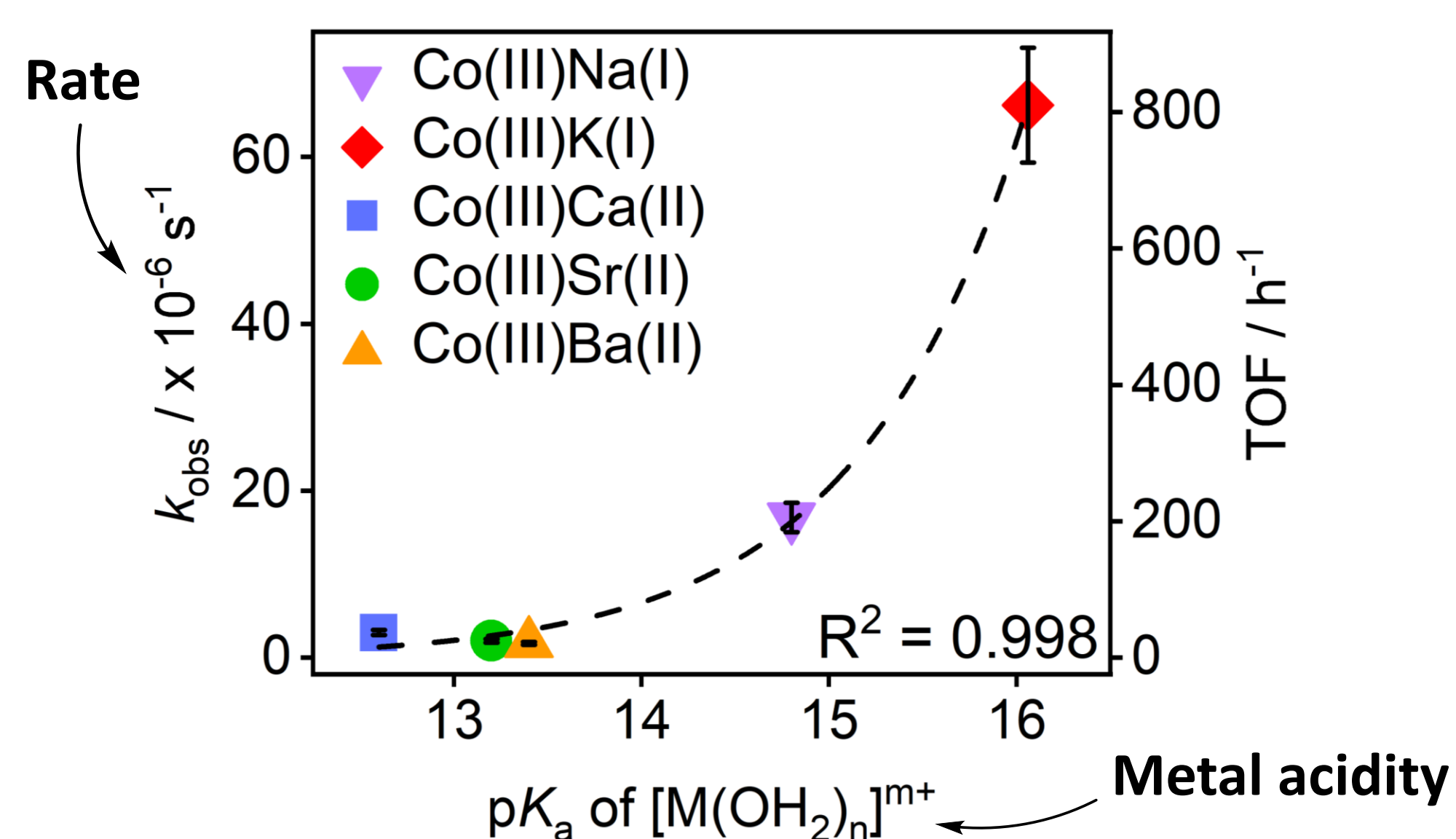
3 Key Results

 A **catalyst** can be added to the reaction to improve the **process efficiency**



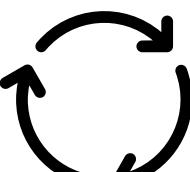
 Our best catalyst contains **cobalt** and **potassium** coordinated by an organic molecule

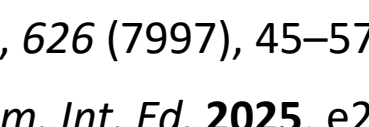
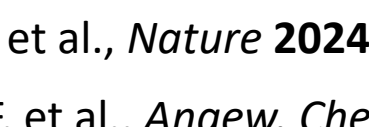
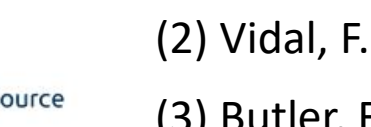
 We perform **systematic structural modifications** to the catalyst to optimise its performance



4 Future Impact

 **Capture industrial carbon-dioxide emissions** and convert to useful materials

 **Replace plastics** sourced from **petrochemicals** with **recyclable** and **bio- or waste-derived** plastics



References

- (1) Pottinger, A. S. et al., *Science* **2024**, *386* (6726), 1168–1173.
- (2) Vidal, F. et al., *Nature* **2024**, *626* (7997), 45–57.
- (3) Butler, F. et al., *Angew. Chem. Int. Ed.* **2025**, e202422497.
- (4) Fiorentini, F. et al. *Nat. Commun.* **2023**, *14* (1), 4783.