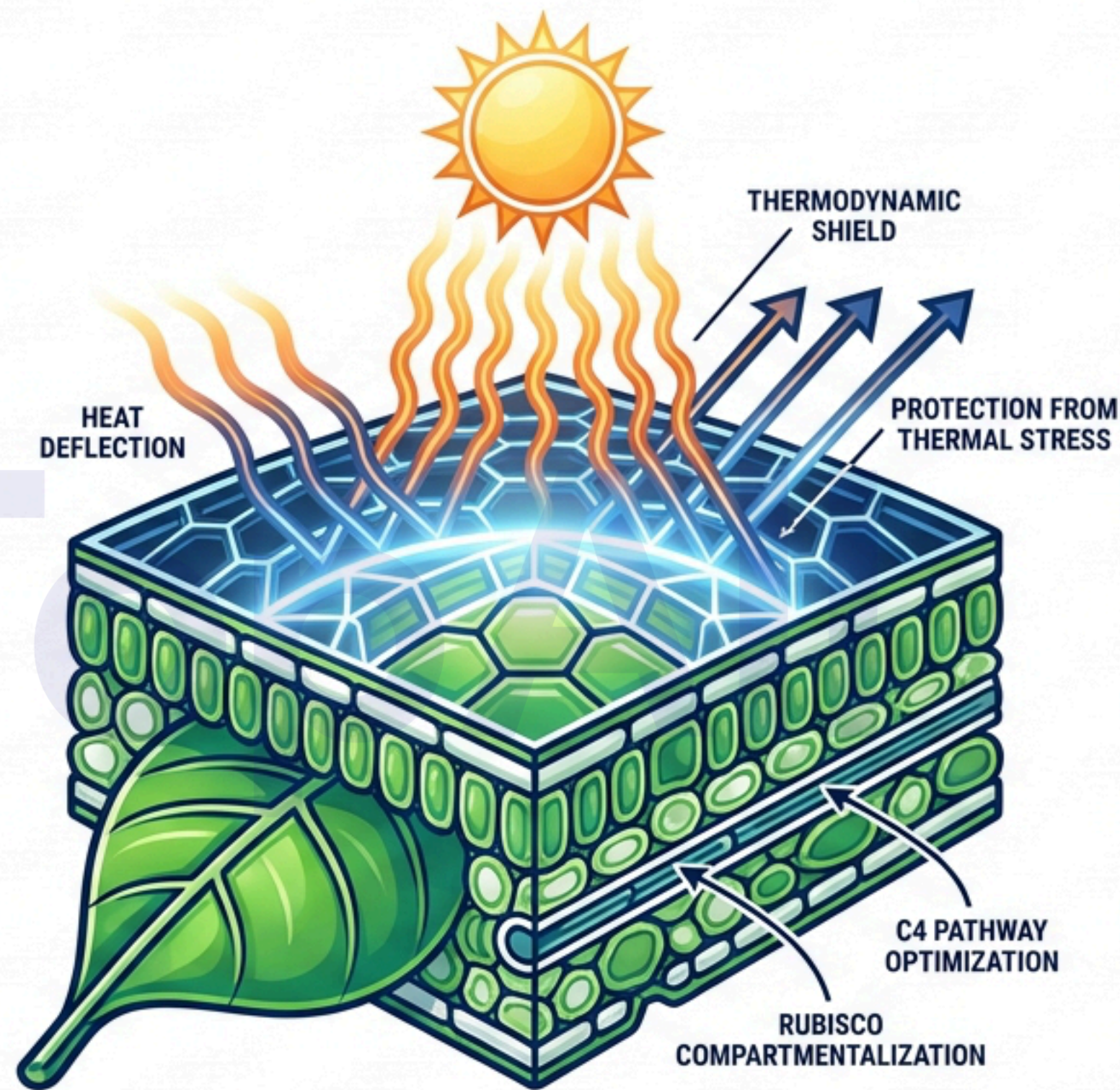


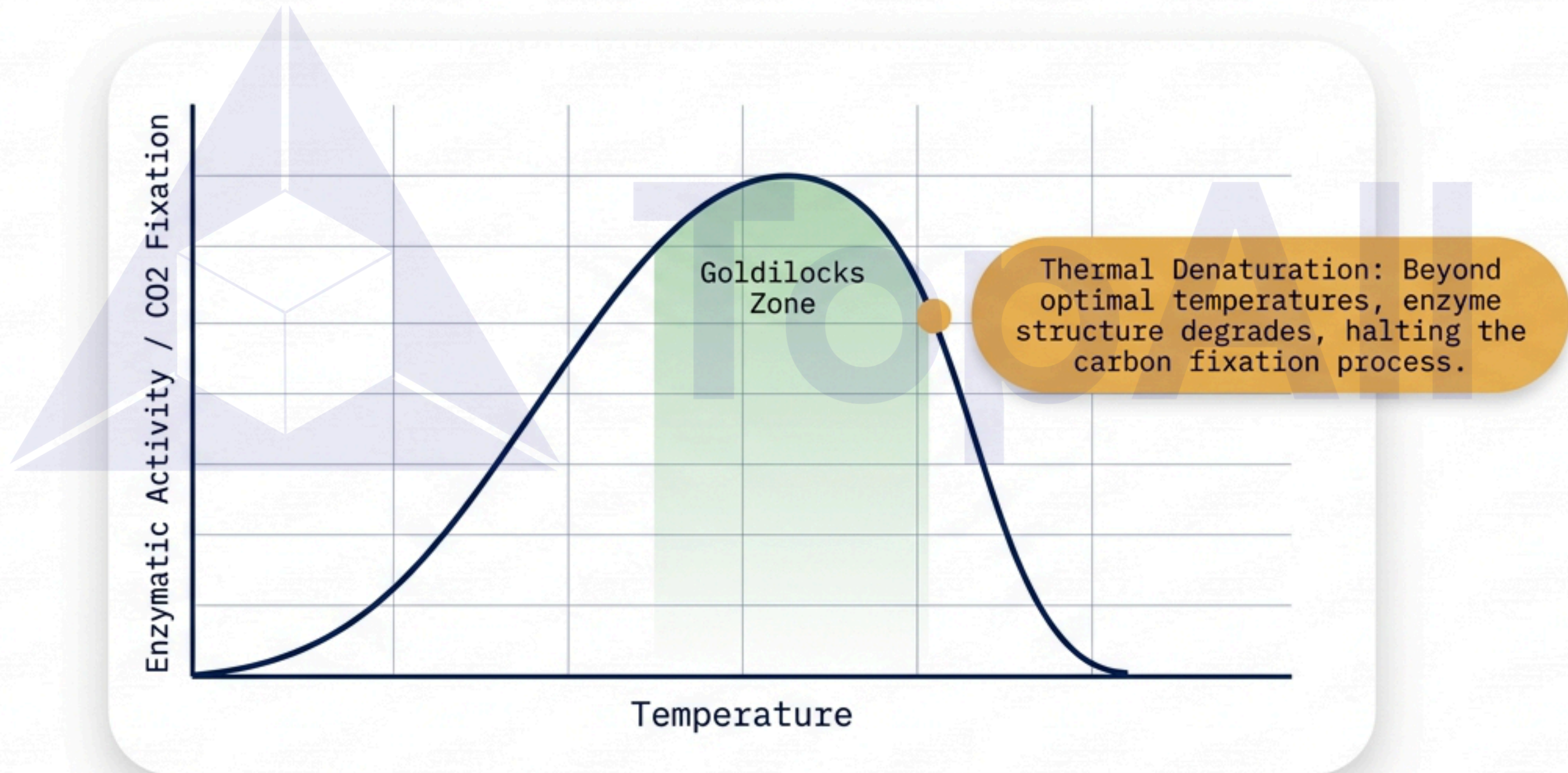
Why C4 Plants Handle Heat Better

The thermodynamic challenge of photosynthesis and the evolutionary engineering of the C4 pathway.



The Vulnerability: Dark Reactions are Enzymatic

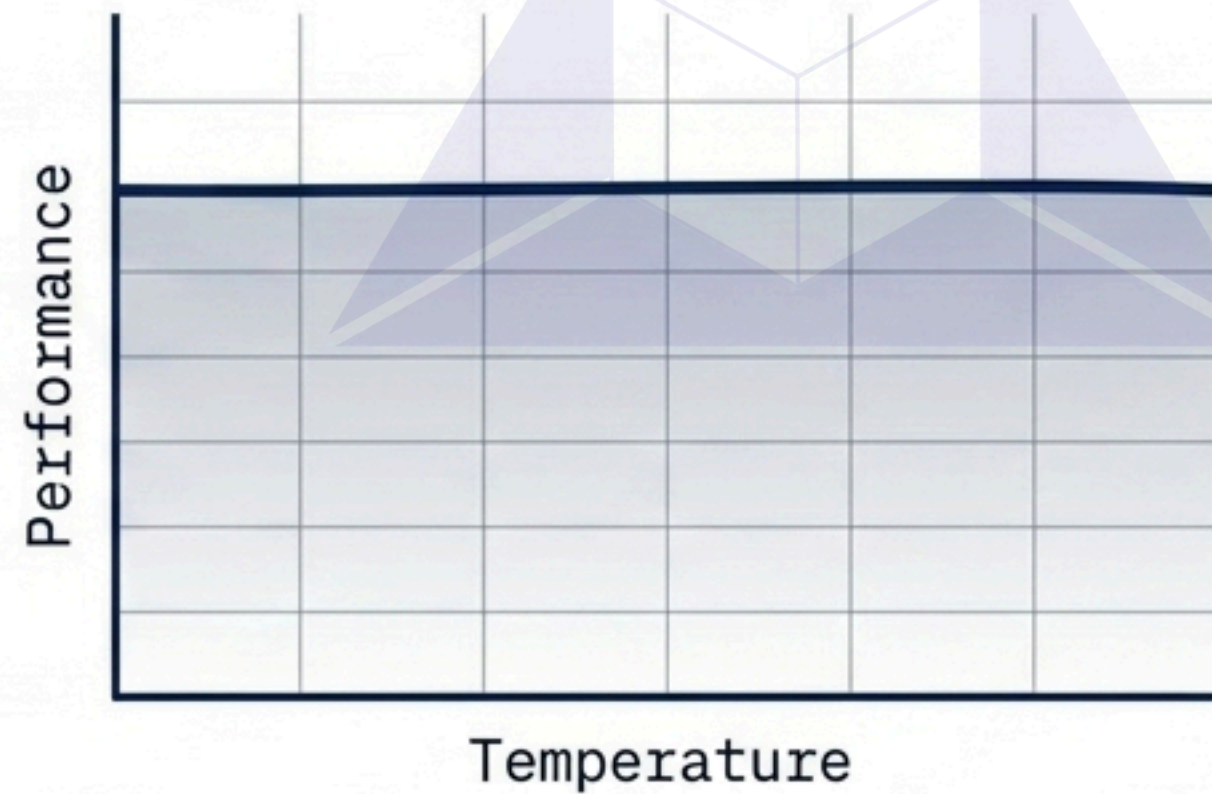
The biosynthetic phase of photosynthesis (carbon reactions) is primarily controlled by enzymes in the stroma. Because these reactions are enzymatic, they are highly temperature-dependent.



Locating the Thermal Bottleneck

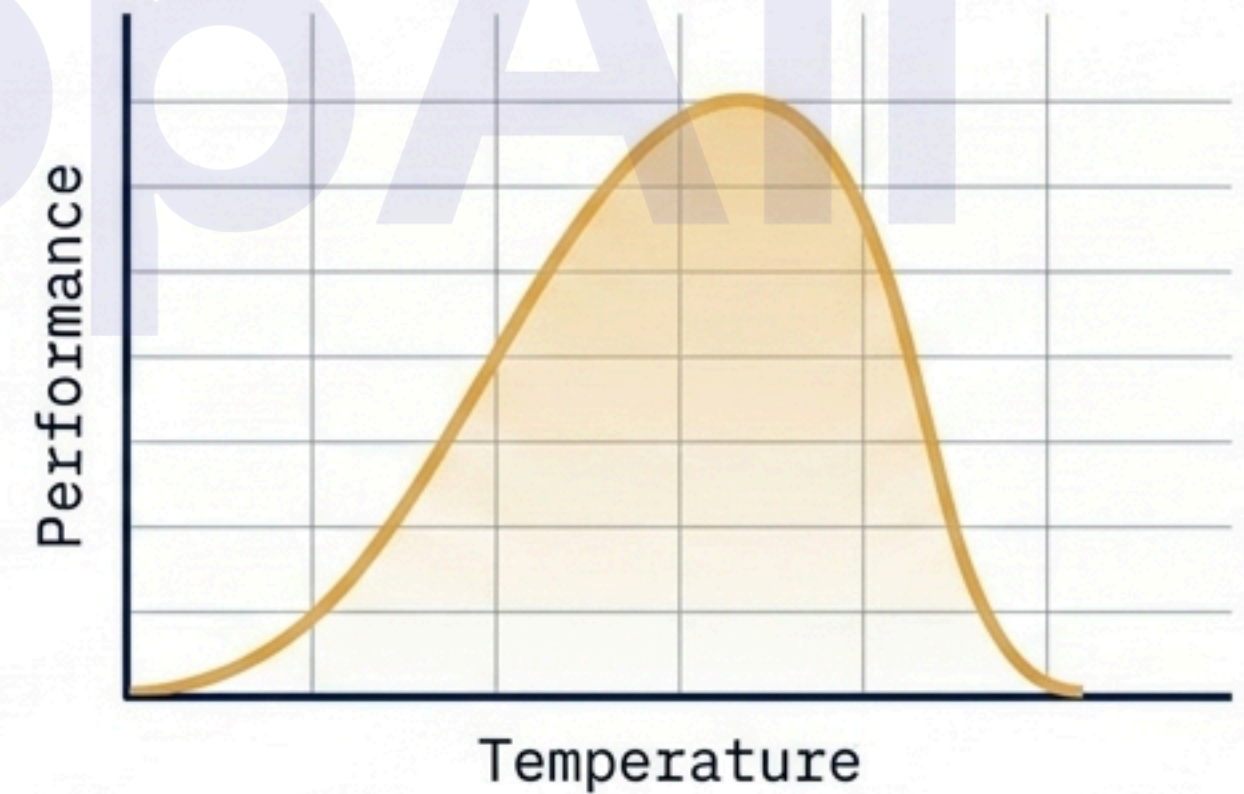
PHOTOCHEMICAL

Photochemical Phase. Driven by photons trapping light energy.



ENZYMATIC

Biosynthetic Phase. Driven by enzymes in the stroma fixing CO₂.





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$$E=mc^2$$



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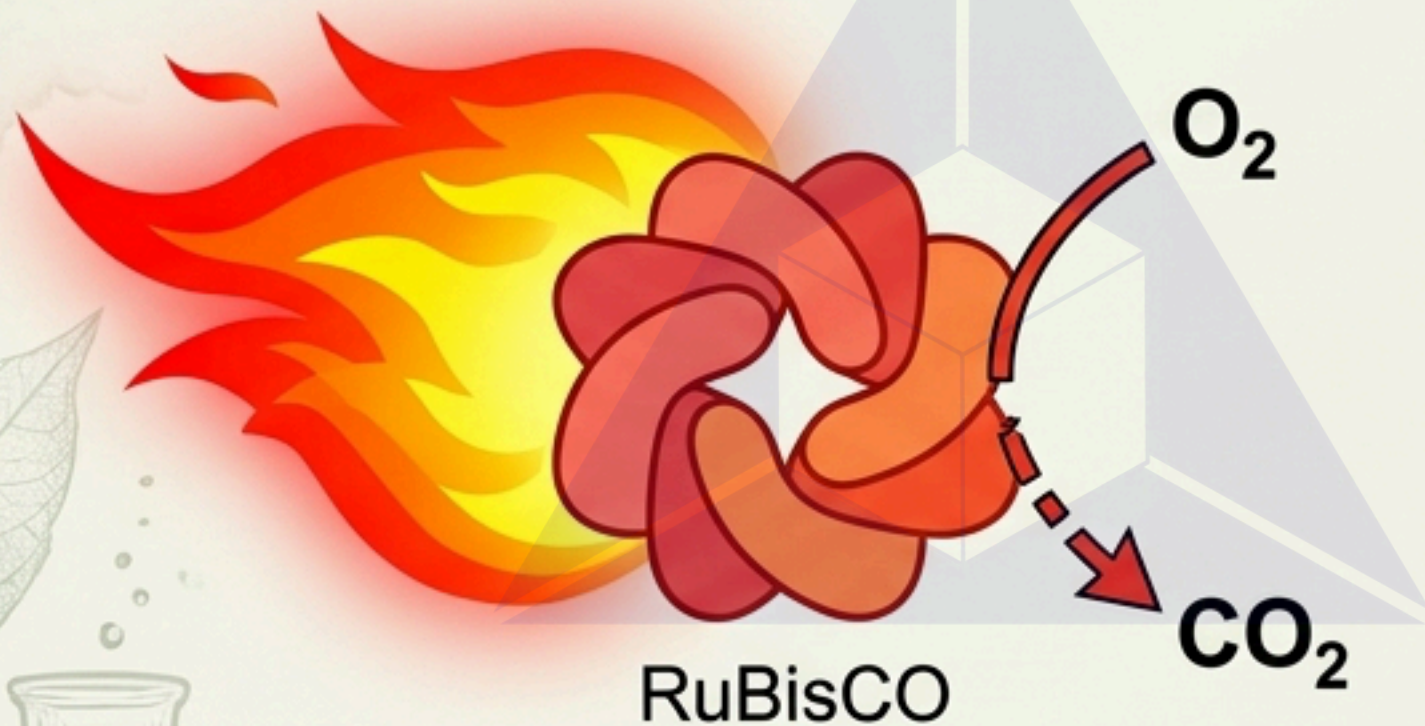
Key Highlights

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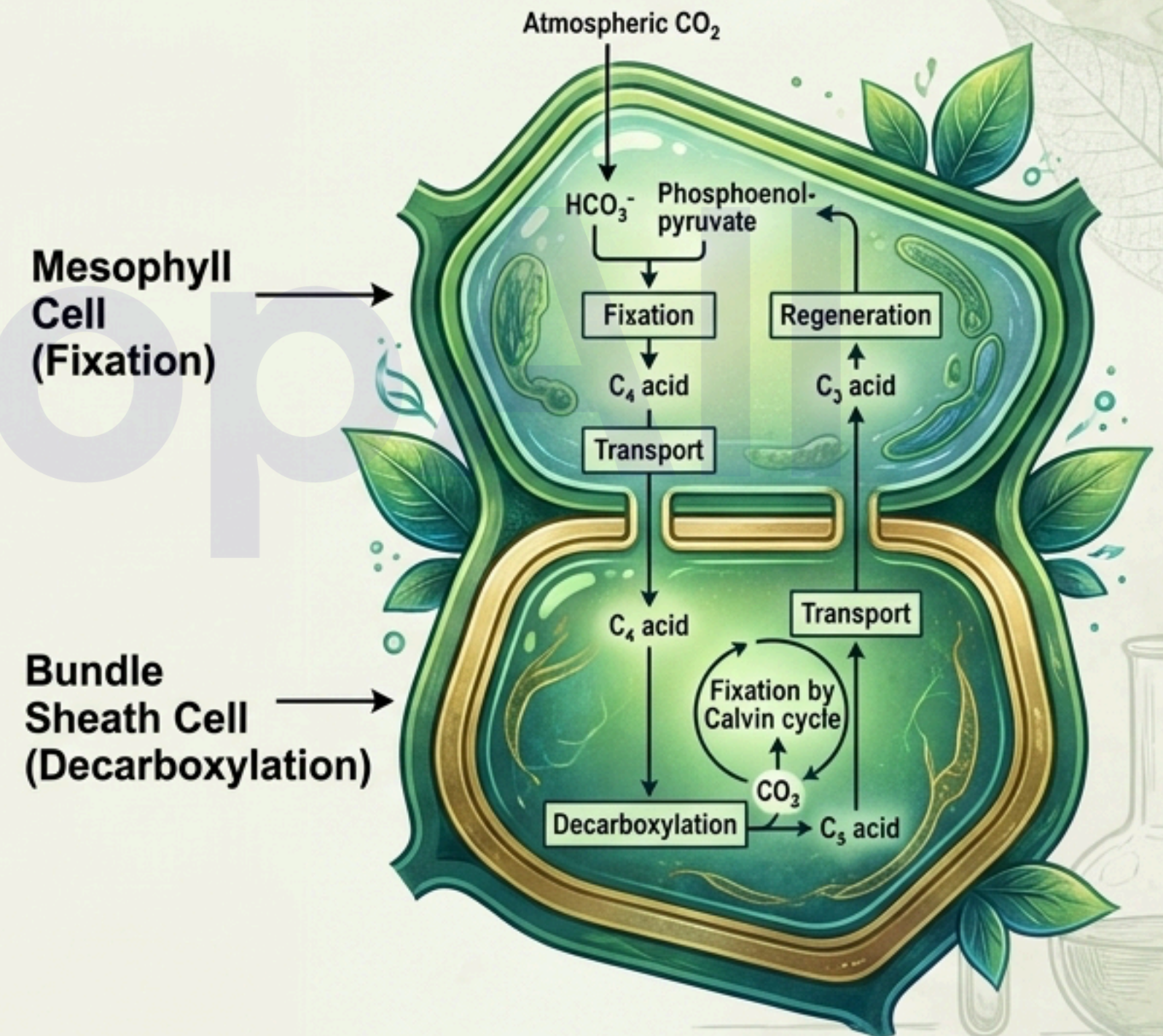
The C4 Solution: Responding to Higher Temperatures

C3 Plant Profile: Low temperature tolerance. High heat triggers wasteful photorespiration.



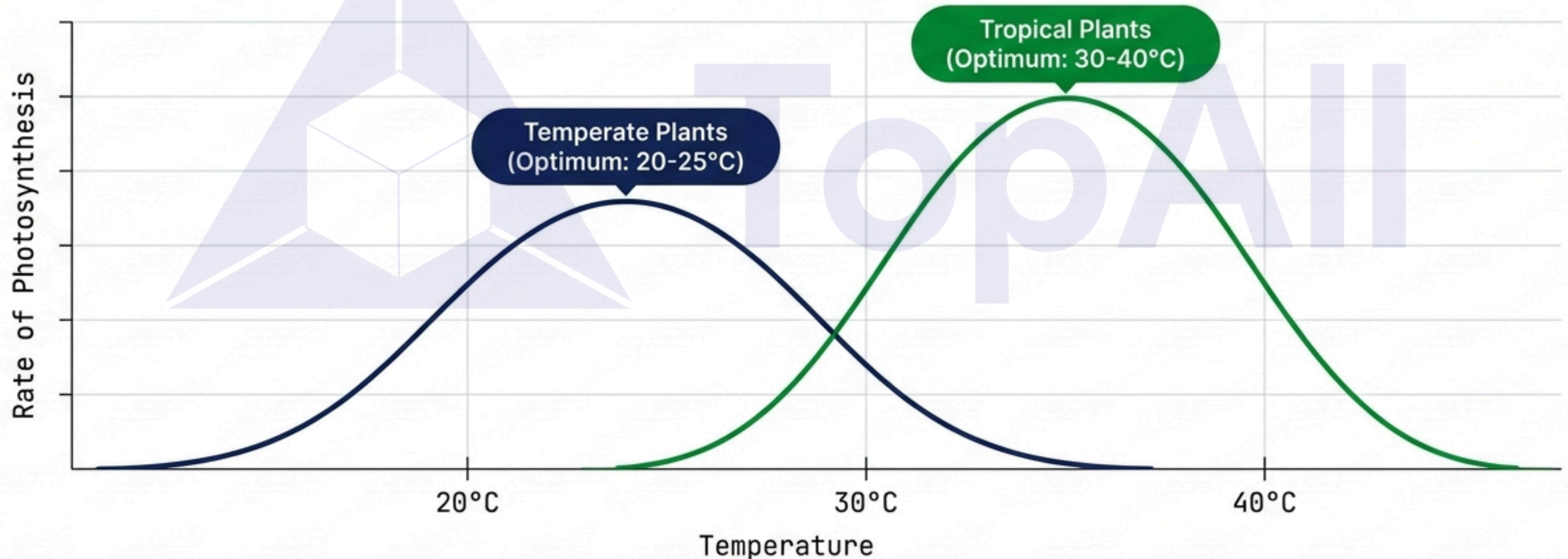
**Photorespiration
Limits Yield**

C4 Plant Profile: High temperature tolerance. Uses a cellular pump to concentrate CO_2 , shielding enzymes from oxygenase activity.



Ecological Mapping: Temperate vs. Tropical Optimums

A plant's temperature optimum directly correlates to its evolutionary habitat. C4 plants dominate high-heat environments.





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Key Takeaway

C4 anatomy functions as a physiological heat shield. By mechanically concentrating carbon dioxide in specialized bundle sheath cells, tropical plants bypass the thermal limitations of standard enzymatic reactions.

This evolutionary workaround allows C4 plants to maintain maximum photosynthetic productivity at temperatures (30-40°C) where C3 plants would otherwise suffer from photorespiration and enzyme failure.





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