

Value-Oriented Design of Electrocatalytic PET Upcycling: Integrating Product Selection, Cathodic Pairing, and System Design

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Abstract

The growing accumulation of polyethylene terephthalate (PET) waste has intensified interest in upcycling strategies that recover its chemical value beyond conventional recycling. Electrocatalytic PET upcycling is particularly attractive because PET-derived terephthalic acid can be recovered while ethylene glycol (EG) is further valorized through anodic oxidation, with the additional possibility of replacing the oxygen evolution reaction and coupling PET conversion with useful cathodic transformations. Despite rapid progress in catalyst development, however, the field has largely been evaluated through activity, selectivity, and current-density metrics, whereas the broader value of the overall electrolysis process has received comparatively less attention. In this Analysis, we discuss electrocatalytic PET upcycling from a value-oriented and system-level standpoint. We consider how anodic product selection, catalyst requirements, energy demand, product economics, and cathodic reaction choice are interconnected, and use representative EG oxidation pathways to illustrate why catalytic performance alone is insufficient for assessing practical relevance. We further examine cathodic pairing as a coupled design problem that must account not only for electrochemical feasibility, but also for market relevance, technological maturity, and compatibility with PET-derived EG oxidation. By integrating catalyst-level performance with product- and system-level considerations, this Analysis aims to provide a framework for designing PET electrolysis systems that are not only electrochemically efficient but also practically and economically meaningful.

Introduction

The rapidly growing accumulation of plastic waste has created an urgent need for sustainable strategies that extend beyond conventional disposal and enable the recovery and valorization of waste plastics. Cumulative primary plastic waste generation has increased continuously since 1950 and is projected to accelerate substantially over the coming decades, approaching 25,000 million metric tons by 2050 if current trends persist.¹ Although the cumulative amount of recycled plastic is also expected to increase, a substantial fraction of plastic waste is projected to remain discarded or incinerated (Fig. 1a). These trends underscore the need to move beyond conventional waste management toward strategies that recover plastic waste as a chemical resource. Within this context, polyethylene terephthalate (PET) represents a particularly attractive target for valorization owing to its widespread use, large production volume of approximately 70 million tons annually, and well-defined chemical composition that enables the recovery and further conversion of its constituent building blocks.² Current strategies for managing waste PET include landfilling, incineration, and various recycling approaches.^{3–5} While landfilling and incineration are associated with environmental burdens, conventional recycling can recover part of the material value of PET but remains subject to technical and economic limitations arising from feedstock quality, processing requirements, and progressive deterioration of material properties.⁶ These limitations have motivated the development of catalytic upcycling strategies that convert waste PET into value-added chemical products through thermocatalytic, photocatalytic, and electrocatalytic approaches.^{7–9}

Among these approaches, electrocatalytic PET upcycling provides a route in which PET is first depolymerized into terephthalic acid (TPA) and ethylene glycol (EG), after which the two components can be valorized through complementary pathways. TPA can be recovered and purified for potential reuse in PET production, whereas EG serves as an electrochemically active feedstock that can be oxidized at the anode into commercially relevant oxygenates such as glycolate and formate.^{10,11} Importantly, the oxidation of PET-derived EG can replace the conventional oxygen evolution reaction (OER), thereby lowering the anodic energy requirement while enabling simultaneous cathodic production in a paired-electrolysis configuration (Fig. 1b). Electrocatalytic PET upcycling therefore offers a broader opportunity than simple polymer depolymerization: it can integrate resource recovery, chemical conversion, and paired electrochemical synthesis within a single process platform.

Most studies in this area, however, have understandably focused on catalyst performance, particularly activity, selectivity, and current density for the oxidation of PET-derived EG. These metrics are essential for establishing catalytic feasibility, but they do not by themselves determine whether a given reaction pathway is attractive at the process level. PET-derived EG can be converted into products with markedly different chemical characteristics, economic values, and industrial relevance, while the choice of cathodic reaction introduces an additional layer of trade-offs associated with energy demand, product generation, and system integration. As a result, further progress in electrocatalytic PET upcycling requires a shift from evaluating isolated half-reactions toward considering how anodic product choice, catalyst requirements, cathodic pairing, and overall process value are connected.

This shift is particularly important because improvements at the catalyst level do not necessarily translate directly into a more practical or economically meaningful PET electrolysis process. The value of a given system depends not only on how efficiently PET-derived EG can be converted, but also on what products are generated, how those products fit within existing or emerging markets, and whether the two electrode reactions can be integrated within a compatible electrochemical architecture. The selection of anodic and cathodic reactions should therefore be treated as a coupled design problem rather than as two independent optimization tasks.

In this Analysis, we discuss electrocatalytic PET upcycling from this broader value-oriented and system-level standpoint. We first consider the electrochemical and economic rationale for converting PET-derived EG beyond simple depolymerization. We then examine representative anodic product pathways to illustrate how catalyst design and product choice are intrinsically linked. Finally, we discuss how cathodic reactions can be selected not merely as auxiliary processes, but as integral components of the overall PET electrolysis strategy. Through this framework, we aim to move the discussion of electrocatalytic PET upcycling beyond catalyst-centered performance metrics toward the integrated design of reaction pathways and electrolysis systems with practical and economic relevance.

Electrocatalytic PET upcycling

Unlike conventional recycling, which primarily aims to recover the original material value of PET, upcycling seeks to convert waste PET into chemical products with greater functionality or economic value.¹² Within this landscape, electrocatalytic PET upcycling offers a distinct pathway with the potential for low-carbon operation through renewable electricity, together with relatively mild reaction conditions and scalable, modular electrochemical processing, while allowing the products obtained from PET depolymerization to be valorized through complementary routes. TPA can be recovered and potentially recycled for subsequent PET production, whereas EG can be further valorized through selective electrochemical oxidation into value-added products such as glycolate and formate.

Compared with the conventional oxygen evolution reaction (OER), the oxidation of EG toward glycolate and formate can proceed at substantially lower anodic potentials, corresponding to reductions of approximately 0.7 and 0.2 V vs. RHE, respectively, providing an opportunity to decrease the voltage requirement of the overall electrolysis process. Moreover, EG oxidation is not restricted to coupling with the hydrogen evolution reaction (HER) but can in principle be paired with a range of alternative cathodic reduction reactions. Such paired electrolysis enables PET-derived EG valorization at the anode to be integrated with the simultaneous production of useful chemicals at the cathode. Consequently, electrocatalytic PET upcycling offers a system-level opportunity to combine PET resource recovery, lower-voltage anodic oxidation, and value generation at both electrodes, distinguishing it from conventional recycling and OER-based electrolysis.

Beyond these electrochemical considerations, the further valorization of PET-derived EG also has important implications for the economics of PET recycling. As shown in Fig. 1c, a simplified techno-economic analysis (TEA) compared electrocatalytic PET upcycling with alkaline hydrolysis alone for an annual processing capacity of 3,000 tons of waste PET.¹³ While alkaline hydrolysis primarily recovers the constituent products of PET, subsequent electrochemical conversion of EG into GA and FA, together with simultaneous H₂ production at the cathode, introduces additional product-revenue streams. Under the assumptions adopted in the original analysis, including complete PET depolymerization and full EG conversion with molar selectivities of 56% toward GA and 43% toward FA, the electrocatalytic pathway was estimated to yield a net profit of USD 3.438 million yr⁻¹, corresponding to approximately USD 1,146 tPET⁻¹. In contrast, alkaline hydrolysis alone resulted in an estimated net loss of USD 10.64 million yr⁻¹, or approximately USD 3,547 tPET⁻¹. These values should be interpreted within the assumptions of the simplified TEA, as the economic outcome depends strongly on process costs and the assumed selling prices of the resulting products. Nevertheless, the comparison illustrates how further electrochemical valorization of PET-derived EG can substantially alter the economic balance relative to depolymerization alone.

Importantly, the economic performance of electrocatalytic PET upcycling is not uniform across product pathways. As shown in Fig. 1d, a reported techno-economic analysis compared the C₂ glycolate and C₁ formate routes by extending the electrochemical products through downstream processing to potassium glycolate–glycolic acid (PGGA) and potassium diformate (KDF), respectively.¹⁴ The estimated total production costs were USD 2,125.25 t⁻¹ for the glycolate pathway and USD 4,196.17 t⁻¹ for the formate pathway, reflecting their different electrochemical and processing requirements. Under the product-price assumptions adopted in the original analysis, the downstream PGGA and KDF routes were estimated to provide gross profits of USD 87,874.74 and USD 75,803.82 t⁻¹, respectively. These profitability estimates should not be interpreted as the bulk market prices of glycolic acid or formic acid, because they correspond to distinct downstream products and depend on the selling-price assumptions used in the TEA. Rather, the analysis illustrates how both the selected oxidation pathway and subsequent product formulation can substantially affect the economic outcome of PET-derived EG valorization.

Electrocatalytic ethylene glycol oxidation toward GA

Glycolic acid (GA) is widely used in personal care products, disinfectants, and biodegradable polymers, with personal care and cosmetics accounting for approximately 45% of global demand. GA has a relatively high price of USD 3,000 per ton, and its global market is valued at USD 511 million (Fig. 2a).^{15–17} In this context, the selective oxidation of EG to GA represents an attractive valorization pathway.

EG obtained from PET hydrolysis can be electrochemically oxidized to GA (Fig. 2b). Under strongly alkaline EGOR conditions, GA exists predominantly in its deprotonated form, glycolate. Following adsorption, EG undergoes two-electron dehydrogenation to form adsorbed glycolaldehyde (*GAD). Subsequent two-electron oxidation of the aldehyde group produces adsorbed glycolate (*glycolate), which then desorbs into the electrolyte. Glycolate production is influenced not only by intrinsic catalytic activity but also by surface adsorption-desorption kinetics and interfacial mass transport. Strongly adsorbed intermediates can block active sites, while prolonged retention of glycolate at the catalyst surface may promote further oxidation and undesired C–C bond cleavage. Because glycolate desorption can be kinetically limiting, facilitating its release from the catalyst surface is important for maintaining accessible active sites, suppressing overoxidation, and preserving C₂ selectivity.¹⁸

Selective EG-to-glycolate conversion therefore requires catalysts that balance efficient intermediate oxidation with rapid glycolate desorption. Noble metals such as Pt and Pd can activate the C–H bonds of EG at relatively low potentials, but excessively strong adsorption of oxygenated intermediates may block active sites and promote further oxidation. Combining noble metals with oxides provides one strategy for balancing these processes (Fig. 2c). Noble-metal sites activate EG through adsorption and dehydrogenation, whereas adjacent oxide domains supply surface hydroxyl species that promote the oxidation of adsorbed carbonyl intermediates. At the metal-oxide interface, electronic interactions can downshift the noble-metal d-band center, weakening glycolate adsorption and thereby facilitating its rapid desorption.¹⁹ Together, noble-metal and oxide sites promote intermediate oxidation and glycolate desorption, thereby maintaining catalytic activity, suppressing further oxidation and C–C bond cleavage, and preserving C₂ selectivity.

Figure 2d summarizes representative Pd- and Pt-based catalysts for electrochemical EG-to-glycolate conversion in H-cells, comparing their operating potentials and glycolate partial current densities (Supplementary Table 1). The partial current density was calculated by multiplying the reported total current density by the corresponding glycolate Faradaic efficiency. Nevertheless, because the values were obtained under different reaction conditions, the plot provides a general overview of reported catalytic performance rather than a direct comparison among catalysts.

Electrocatalytic ethylene glycol oxidation toward FA

Formic acid (FA) is an industrially important C₁ chemical with a wide range of industrial applications. Among its various end-use applications, animal feed represents the largest share of global FA consumption, accounting for approximately 34%, while FA is also consumed in the pharmaceutical and chemical industries, and leather tanning.²⁰ Despite wide industrial demand, even though FA is a relatively low-priced commodity chemical, with a global market price of approximately USD 762 per ton, its market size is valued at approximately USD 1.21 billion in 2026 and projected to expand at a compound annual growth rate (CAGR) of approximately 4% over the forecast period.^{21,22} Therefore, electrochemical conversion of ethylene glycol (EG) into formate should not be viewed solely as a strategy for producing a high-value product, but rather as a pathway for generating a commercially relevant chemical with established large-scale demand. (Fig. 3a)

Given the substantial industrial demand for FA, EGOR provides a promising route for its production from EG through a series of stepwise oxidation reactions. The reaction is initiated by the two-electron oxidation of one hydroxyl group of EG to an aldehyde group, yielding glycolaldehyde as the first oxidation intermediate. Subsequently, glycolaldehyde undergoes further two-electron oxidation primarily through oxidation of the remaining hydroxyl group to form glyoxal, while competing oxidation of the aldehyde group leads to glycolate formation.²³ Under alkaline conditions, glyoxal can also be partially converted into glycolate via a Cannizzaro rearrangement.²⁴ However, a key step toward formate production involves the two-electron oxidation of glyoxal accompanied by direct C–C bond cleavage, ultimately yielding two molecules of formate. (Fig. 3b)

Given the multiple intermediates and competing reaction pathways involved in this process, catalyst design plays a crucial role in directing the reaction pathway toward selective formate production. Modulation of the catalyst's electronic structure, such as an upward shift of the d-band center toward the Fermi level, can enhance the adsorption of glyoxal, a key intermediate preceding C–C bond cleavage (Fig. 3c). Stronger glyoxal adsorption promotes its retention on the catalyst surface, facilitating subsequent oxidative C–C bond cleavage toward formate while suppressing its desorption into the bulk alkaline electrolyte. By limiting glyoxal desorption, the catalyst can also reduce the opportunity for competing Cannizzaro conversion to glycolate, thereby favoring selective formate production.

As summarized in Fig. 3d, recently reported EGOR catalysts have achieved high formate selectivities and product partial current densities at relatively low operating potentials. (Supplementary Table 2) This combination of activity, selectivity, and energy efficiency highlights the potential of EGOR as a promising route for formate production.

Multidimensional framework for rational cathodic reaction selection in paired PET electrolysis.

Cathodic reaction selection is an important design variable in paired PET electrolysis because candidate reduction pathways differ substantially in thermodynamics, product value, industrial scale, electron stoichiometry, and technological maturity. Representative pathways include the hydrogen evolution reaction (HER), two-electron oxygen reduction reaction (2e[−] ORR), carbon dioxide reduction reaction (CO₂RR), nitrate reduction reaction (NO₃RR), nitrogen reduction reaction (NRR), and emerging C-N coupling reactions such as the co-reduction of CO₂ and nitrate to urea.^{25–42} These reactions should not be considered equally attractive simply because they can, in principle, be coupled with PET-derived EGOR. Figure 4 compares representative cathodic pathways using complementary electrochemical, market, technological, and system-level criteria.

Figure 4a compares the thermodynamic reduction potentials of representative cathodic reactions with the reported market prices of their corresponding products. The equilibrium potential provides an energetic reference because, together with the anodic oxidation potential, it defines the thermodynamic voltage of the paired process. Among the pathways considered, 2e[−] ORR ($E^0 = 0.76 \text{ V}_{\text{RHE}}$) toward H₂O₂ and NO₃RR ($E^0 = 0.69 \text{ V}_{\text{RHE}}$ at pH 14) to NH₃ exhibit relatively positive thermodynamic potentials, whereas HER and many CO₂RR pathways occur at more negative potentials. These values should not, however, be interpreted as practical operating potentials because overpotential, mass transport, local reaction environments, and competing reactions can substantially alter the potential required under realistic electrolysis conditions.

Thermodynamic favorability also does not necessarily coincide with product value. Large-volume products such as H₂, CO, CH₄, CH₃OH, NH₃, and urea generally have moderate unit prices, whereas H₂O₂ and higher alcohols can provide greater value on a mass basis.^{35,43–46} CO₂RR illustrates this trade-off particularly well because the same feedstock can yield products ranging from relatively simple two-electron C₁ products, such as CO and formic acid, to multielectron reduction products including methanol, methane, ethylene, ethanol and n-propanol. Thus, thermodynamic potential and market price represent complementary rather than interchangeable criteria. Glycolic acid and formic acid derived from EGOR are included as anodic reference products to place the cathodic products within the broader value landscape of paired PET electrolysis.

Figure 4b adds the representative annual industrial scale of each product. H₂, methanol, ethylene, NH₃ and urea are associated with industrial scales of tens to hundreds of millions of tonnes per year, whereas H₂O₂, formic acid, glycolic acid, and n-propanol occupy substantially smaller markets.^{25,27,35,46} Large-volume products may provide greater capacity for high-throughput electrochemical production, whereas smaller volume products can remain

attractive when their higher unit value compensates for more limited market capacity. Market price and annual industrial scale should therefore be considered together when assessing the potential relevance of a cathodic product.

Electron stoichiometry provides an additional consideration that is particularly important in paired electrolysis. Because the same charge passes through both electrodes, the electron requirements of the anodic and cathodic reactions determine the theoretical ratio of products generated at the two electrodes. According to Faraday's law,

$$N_p = \frac{FE_p Q}{n_p F}$$

Where N_p is the amount of product, FE_p is its Faradaic efficiency (FE), Q is the transferred charge, and n_p is the number of electrons required per mole of product. At a given charge and Faradaic efficiency, product formation therefore scales inversely with the electron-transfer requirement. For example, coupling a four-electron EG-to-GA pathway with a two-electron cathodic reaction would ideally generate two moles of cathodic product per mole of glycolic acid. Higher electron-transfer requirements also generally accompany more complex reaction networks, particularly for deeply reduced and multicarbon products involving multiple intermediates and competing pathways.

Although product value can, in principle, be normalized by transferred charge, such a metric does not necessarily provide an equivalent comparison across the cathodic pathways considered here. These technologies are at markedly different stages of development and differ substantially in Faradaic efficiency, product-specific current density, product concentration, operational stability, and reactor-scale validation. Assuming identical FE would emphasize the intrinsic value of the target product but could overstate the practical attractiveness of less-developed reactions, whereas using literature-reported efficiencies would make the comparison strongly dependent on catalyst, reactor, and operating conditions. We therefore retain market value and electron stoichiometry as separate descriptors and consider cathodic technology maturity independently in Fig. 4c.

Figure 4c qualitatively groups the cathodic pathways as relatively mature, developing, or emerging based on demonstrated productivity and selectivity, product concentration, operational stability, and reactor-scale validation.^{26,28,47} This classification refers specifically to the relative maturity of the cathodic technologies and should not be interpreted as the readiness of the overall paired PET electrolysis system. HER and CO₂ reduction to CO or formic acid are relatively mature among the cathodic pathways considered, whereas 2e⁻ ORR, several multielectron CO₂RR pathways, and NO₃RR remain developing technologies with pathway-specific limitations in concentration, selectivity, mass transport, durability, or product recovery. NRR, CO₂RR to n-propanol, and electrochemical urea synthesis are classified as emerging because of limitations such as low productivity, analytical reliability, complex coupling chemistry, or limited scale-up. These representative challenges illustrate why an attractive target product does not necessarily correspond to an equally developed electrochemical process.

Importantly, even a relatively mature cathodic technology is not necessarily ready for integration with PET-derived EGOR, which itself remains a developing anodic platform. Practical pairing requires compatibility between the two half-reactions within a common electrolyzer. Relevant considerations include pH and electrolyte compatibility, membrane selection and crossover, product stability and separation, and the ability of both electrodes to sustain matched current densities during long-term operation. Organic substrates or oxidation products may cross the membrane and interfere with cathodic chemistry; H₂O₂ may undergo crossover or decomposition; carbonate formation can reduce carbon efficiency during CO₂RR; and nitrate- or ammonia-containing species can introduce additional transport and separation constraints. Thus, performance demonstrated in an isolated cathodic half-cell does not directly translate into readiness for paired PET electrolysis.

Figure 4d therefore frames cathodic reaction selection as the combined assessment of three complementary dimensions: electrochemical and market screening, cathodic technology maturity, and PET-EGOR compatibility. No single descriptor is sufficient to identify an optimal cathodic pathway. Rather, rational pairing requires a balanced consideration of electrochemical feasibility, market relevance, relative technological maturity, and system compatibility. This multi-dimensional framework avoids ranking fundamentally different cathodic technologies using a single economic or performance metric and provides a more realistic basis for identifying promising reaction pairs for future PET electrolysis systems.

Outlook

Electrocatalytic PET upcycling has emerged as a promising strategy for moving beyond conventional PET recycling by combining the recovery of PET-derived building blocks with the generation of additional chemical value. As discussed in this Analysis, its potential extends across both electrochemical and economic dimensions. Replacing the conventional OER with the oxidation of PET-derived EG can lower the anodic potential requirement while enabling simultaneous value generation through paired electrolysis. Techno-economic analyses further indicate that electrochemical valorization of EG can provide substantial economic advantages over PET depolymerization alone, while also demonstrating that these benefits depend strongly on the product pathway selected. Collectively, these advances suggest that future progress should be evaluated not simply by how efficiently PET-derived EG can be converted, but by how much practical and economic value can be generated across the entire upcycling process.

For the anodic reaction, a key priority is to develop product-oriented catalyst design principles rather than optimizing EG oxidation activity in isolation. Different oxidation pathways place different demands on intermediate adsorption, transformation, desorption, and C–C bond cleavage, and these mechanistic differences ultimately determine which products can be generated selectively and sustainably.⁴⁸ Future catalyst development should therefore place greater emphasis on maintaining high product selectivity at practically relevant current densities and over extended operation, while

considering whether the targeted product justifies the catalytic and processing requirements needed to produce it. In this context, catalytic accessibility and industrial relevance should be treated as coupled criteria for selecting anodic product pathways rather than as separate considerations.

Cathodic reaction selection will require a similarly broader framework. The most suitable cathodic reaction is unlikely to be identified solely by the most positive reduction potential, the highest product price, or the lowest resulting cell voltage.⁴⁹ Instead, its suitability will depend on the combined balance among electrochemical feasibility, electron requirement, market capacity, technology maturity, feedstock availability, and compatibility with PET-derived EG oxidation. Importantly, this compatibility must ultimately be demonstrated in an integrated electrolyzer, where electrolyte conditions, membrane transport, product stability and separation, and matched operation of the two electrodes become critical. Accordingly, the relevance of a cathodic pathway should ultimately be judged by its performance within a coupled PET electrolysis system rather than in isolation.

Ultimately, progress in PET electrolysis will depend on co-designing the catalyst, target products, reaction pair, and electrolysis architecture rather than optimizing each component independently. This requires performance metrics that reflect the value generated by the overall process rather than only the activity of an individual electrode. Demonstrating high current density or selectivity in a half-cell will remain important, but practical relevance will increasingly depend on sustained paired-cell operation, product recovery, energy demand, and the economic and industrial significance of the products formed at both electrodes. By integrating these considerations from the outset, electrocatalytic PET upcycling can develop from a collection of catalyst-level demonstrations into a more rationally designed platform for chemical manufacturing from waste PET.

Declarations

Author Contribution

S.B., Y.D.K., Y.K., and B.-H.L. conceived and designed the perspective. S.B., Y.D.K., and Y.K. conducted the literature review, analyzed the relevant studies, prepared the figures, and wrote the original manuscript. S.P. and B.-H.L. reviewed and edited the manuscript. B.-H.L. supervised the work. All authors reviewed and approved the final manuscript. S.B., Y.D.K., and Y.K. contributed equally to this work.

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Figures

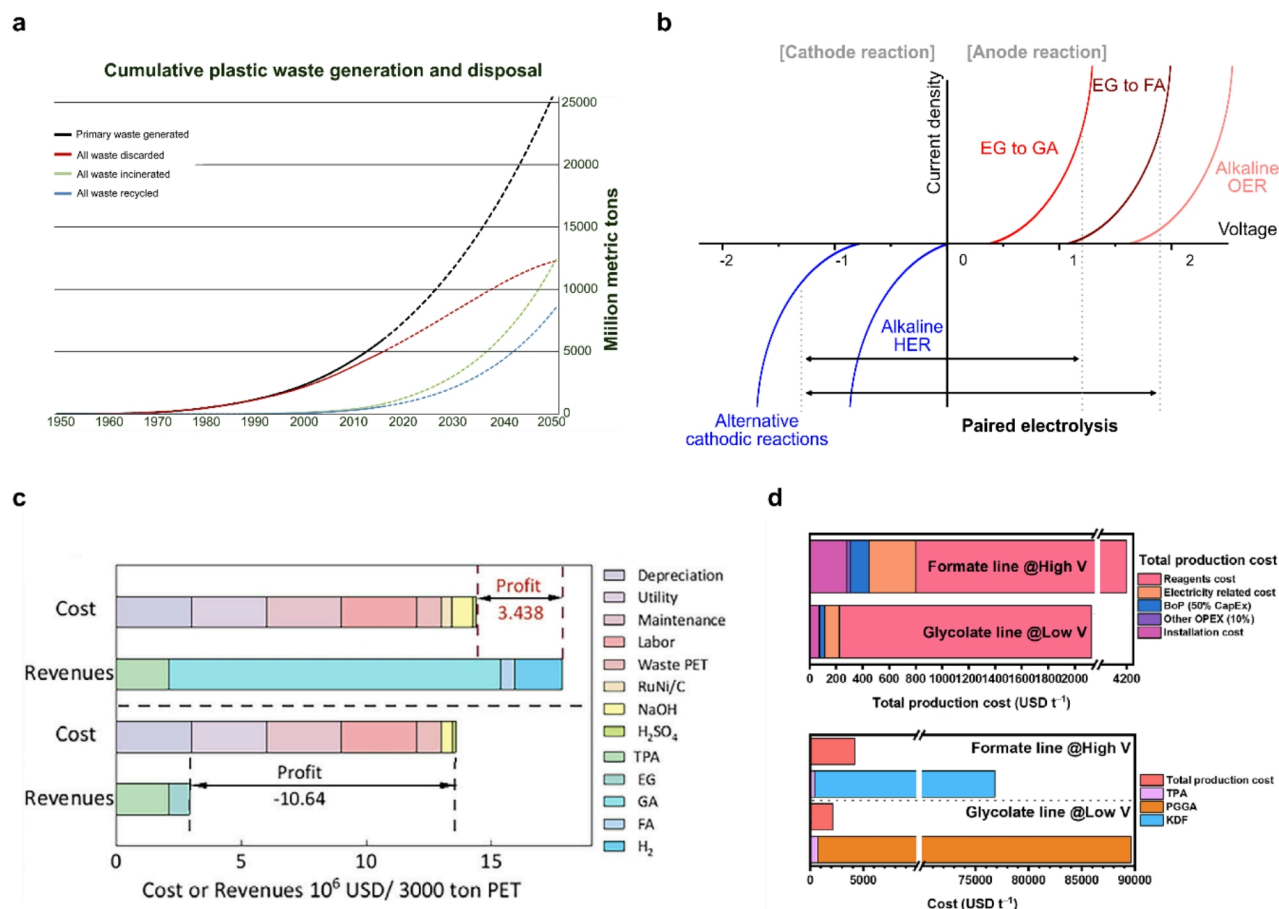


Figure 1

Electrochemical and techno-economic rationale for electrocatalytic PET upcycling. (a) Historical and projected cumulative plastic waste generation and disposal through 2050. (b) Schematic comparison of anodic reaction potentials for EGOR and OER coupled with HER or alternative cathodic reactions. (c) Techno-economic comparison of electrocatalytic PET upcycling and conventional alkaline hydrolysis for processing 3,000 tons of waste PET annually. Reproduced with permission from,¹³ Copyright © 2026 Elsevier. (d) Techno-economic comparison of production costs and profitability for low- and high-potential PET upcycling pathways. Reproduced with permission from,¹⁴ Copyright © 2026 Wiley-VCH GmbH.

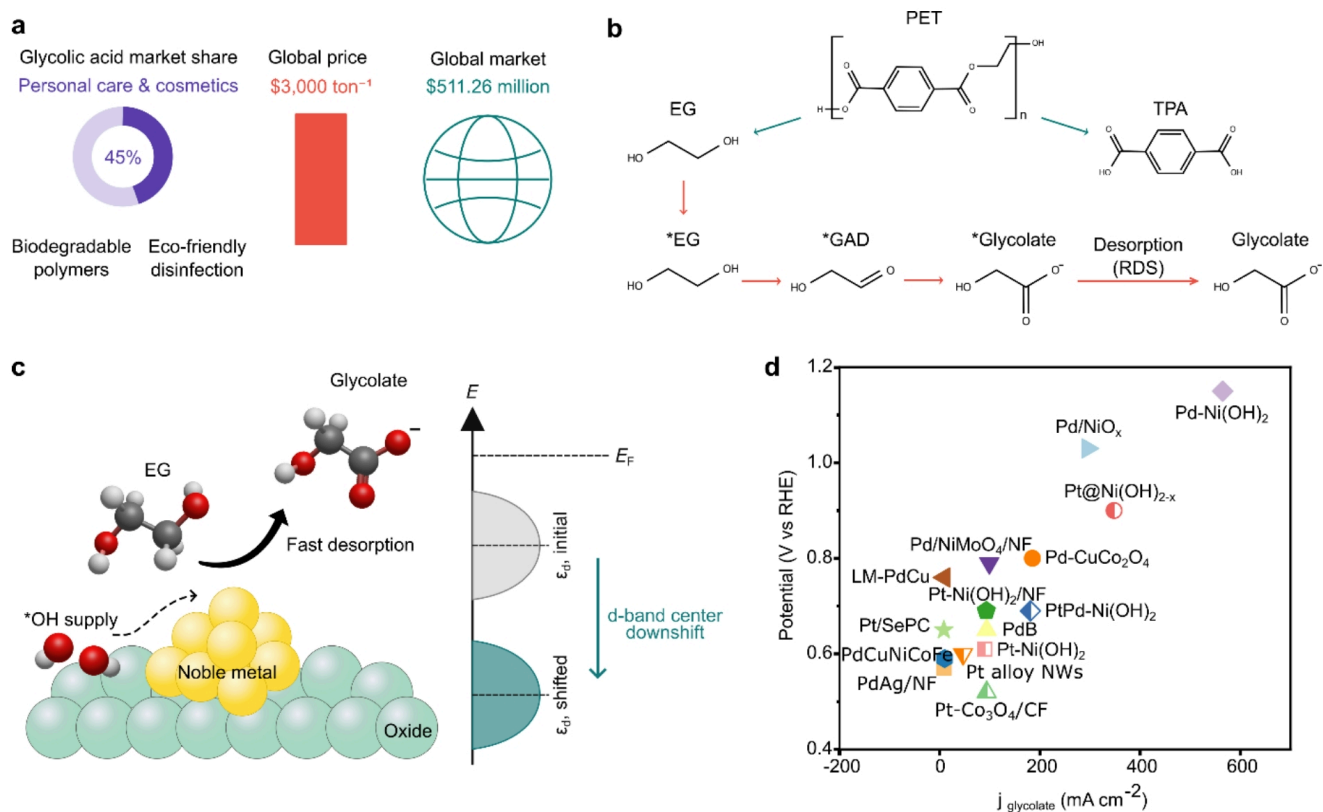


Figure 2

Value-oriented electrochemical conversion of EG to GA. (a) Applications, price and market size of GA. (b) PET hydrolysis and selective EG-to-GA conversion. (c) Noble-metal/oxide synergy for EG activation, OH supply and GA desorption. (d) Reported activity of Pd- and Pt-based catalysts for EG-to-GA conversion; values are shown for qualitative comparison only.

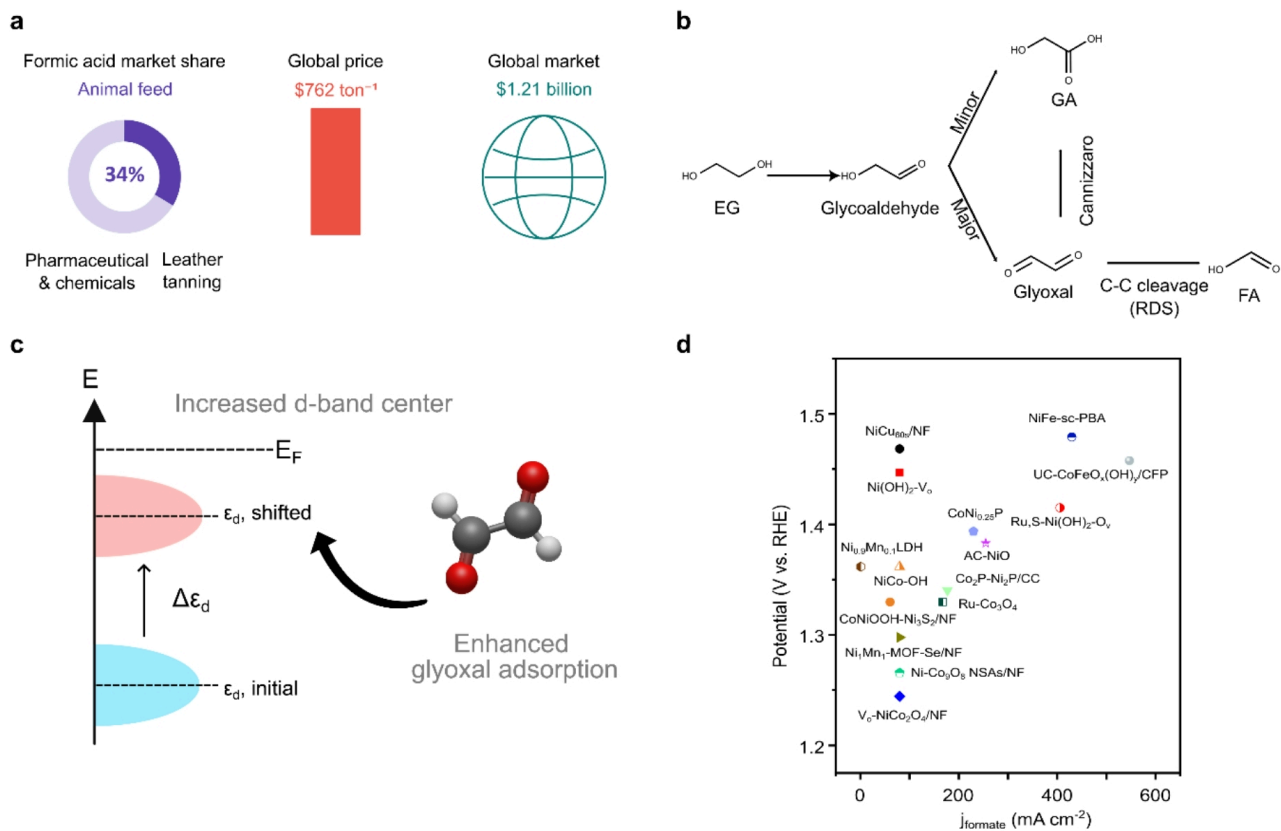


Figure 3

Electrocatalytic ethylene glycol oxidation toward formate. (a) End-use distribution, price, and global market size of formic acid. (b) Reaction pathway of EG oxidation to FA (c) Schematic illustration of the upward shift in the d-band center toward the Fermi level, enhancing glyoxal adsorption and promoting formate selectivity. (d) Comparison of operating potential and current density among previously reported electrocatalysts for EGOR to formate.

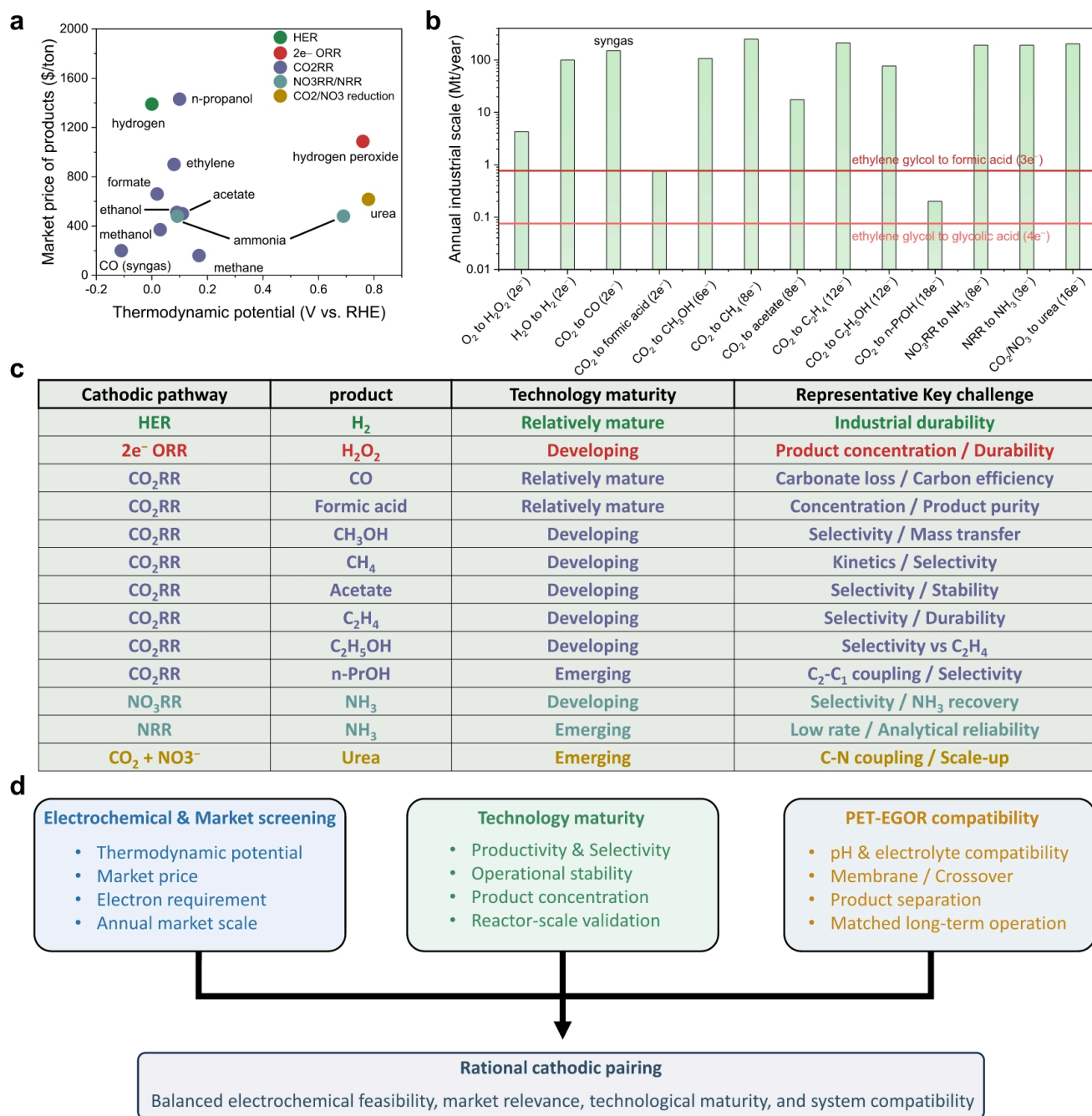


Figure 4

Multidimensional framework for rational cathodic reaction selection in paired PET electrolysis. (a) Comparison between thermodynamic reduction potentials (E^0 , V vs RHE) and market prices (USD ton⁻¹) of representative cathodic products. (b) Representative annual industrial scales (Mt year⁻¹) and electron-transfer requirements of the corresponding products; electron numbers are expressed per mole of product. Market-price and industrial-scale data were compiled from Refs. 25-47. (c) Relative maturity of representative cathodic technologies and their key remaining challenges. (d) Integrated framework for rational cathodic pairing based on electrochemical and market screening, cathodic technology maturity, and PET-derived EGOR compatibility.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryinformationValueOrientedDesignofElectrocatalyticPETUpcyclingIntegratingProductSelectionCathodicPairingandSystemDesign.docx](#)