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The European Union's Investment-Based Approach to Decarbonizing Its Economy

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I. Introduction: The European Union’s Investment-Based Approach To Decarbonizing Its Economy

In 2017, the European Union (“EU”) reaffirmed its and its Member States’ commitment to the swift and full implementation of the Paris Agreement,¹ by achieving a 40% domestic reduction in economy-wide greenhouse gas (“GHG”) emission levels by 2030, being measured against levels in 1990.² These emission reduction efforts are a follow-up of the European Green Deal, a sustainable economic growth strategy that imposes a legally binding target of climate neutrality by 2050.³ The so-called “Fit for 55” package includes a broad swathe of policy goals, including encouraging renewable energy adoption and energy-efficiency, establishing alternative fuels infrastructure, and setting binding emission targets for buildings, cars, and vans.⁴ This paper will assess the Fit for 55 package’s investment-based approach to stimulating the decarbonization of the European economy and serve as a framework for policymakers to implement similar efforts abroad.

In 2018, the European Council (“the Council”) directed the European Commission (“the Commission”) “[to] adopt a proposal [by 2019] for a Union long-term strategy for greenhouse gas emissions reduction in accordance with the Paris Agreement, taking into account the Member States’ draft integrated national energy and climate plans.”⁵ In its original communication

¹ European Commission, *Commission Communication—A Clean Planet For All A European Strategic Long-Term Vision For A Prosperous, Modern, Competitive And Climate Neutral Economy*, 2018 O.J. C 773/4 (Nov. 28, 2018).

² *Council Decision (Eu) 2016/1841 On The Conclusion On Behalf Of The European Union, Of The Paris Agreement Adopted Under The United Nations Framework Convention On Climate Change*, 2016 O.J. L 282/2 [hereinafter the Paris Agreement or the Paris Climate Agreement].

³ Dornoff, J., Mock, P., Baldino, C., Bieker, G., Díaz, S., Miller, J., Sen, A., Tietge, U., Wappelhorst, S., International Council On Clean Transportation, *Fit For 55: A Review And Evaluation Of The European Commission Proposal For Amending The CO₂ Targets For New Cars And Vans*, 1, 1 (Sept. 23, 2021); see European Council, Press Release, ‘Fit For 55’: EU Strengthens Emission Reduction Targets For Member States, 1, 1 (Nov. 8, 2022).

⁴ European Council, *supra* note 3, at 1.

⁵ *Council Regulation No. 2018/1999 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU)*

accompanying the proposal to sign the Paris Agreement, the Commission emphasized that the global transition towards clean energy required changes in investment behavior and incentives across the entire policy spectrum. The Council noted that it is a key priority of the EU to establish a resilient energy union to provide secure, sustainable, competitive and affordable energy to its citizens and that achieving this requires the continuation of ambitious climate action.⁶ According to the EU, the successful transition to a zero-emission economy requires coherent action at Union, national, regional and local levels.⁷

The Commission recognizes that the financial sector plays a key role in supporting the transition to clean energy as it can reorient capital flows and investments while improving efficiency of production process and reducing the cost of financing.⁸ EU climate legislation, therefore, contemplates that behavioral changes by individuals and companies must underpin the transition to clean energy.⁹ Taxation is among the most efficient tools for environmental policy.¹⁰ Accordingly, environmental taxation, carbon pricing systems and revised subsidy structures play a key in financing the transition to clean energy.¹¹

In line with the EU's efforts to fully implement the Paris Agreement, the "Fit for 55" package includes a variety of policies aimed at promoting renewable energy adoption, energy-efficiency, and emission reduction targets for buildings, cars, and vans. The Commission recognizes the importance of the financial sector in supporting the transition to clean energy and

No 525/2013 of the European Parliament and of the Council, 2018 O.J. L 328/24; see European Commission, *supra* note 1, at 773/4.

⁶ Paris Climate Agreement, *supra* note 1, 282/2.

⁷ *Parliament and Council Regulation 2019/631 Setting CO₂ Emission Performance Standards For New Passenger Cars And For New Light Commercial Vehicles*, 2019 O.J. L 111/15 (April 17, 2019) [hereinafter EPSR or the Regulation].

⁸ European Commission, *supra* note 1, at 773/15.

⁹ *Id.* at 773/11; see Economic Intelligence Unit N.A. Inc., Article, *Breaking Down The Impact Of "Fit For 55"*, 1, 2 (Jul. 30, 2021).

¹⁰ European Commission, *supra* note 1, at 773/18.

¹¹ *Id.* at 773/18.

is promoting changes in investment behavior and incentives. The EU's climate legislation also emphasizes the role of taxation, carbon pricing systems, and revised subsidy structures in financing the transition to clean energy. Overall, the EU's commitment to achieving climate neutrality by 2050 demonstrates its ambitious efforts to promote a sustainable and resilient energy union with coherent action at all levels. As this paper will discuss, the investment-based approach of the package is effectuated through the promotion of a circular economic model and industrial symbiosis.

II. ***Implementing Emissions Performance Standards Regulations For New Passenger and Light Commercial Vehicles***

The EU's transportation sector is responsible for around a quarter of its total GHG emissions.¹² Accordingly, the EU has bolstered the regulatory legislation of its entire transport sector to more strongly align EU law with the long-term goals of the Agreement.¹³ The Commission predicts that the totality of the EU's climate and energy policies will reduce its total GHG emissions by an estimated 45% by 2030.¹⁴ Of great consequence is *Parliament and Council Regulation 2019/631*, which sets CO₂ emission performance standards for new passenger vehicles and for new light commercial vehicles manufactured within the EU.¹⁵ Reiterating a desire for an investment-based approach to climate change legislation, the EPSR seeks to facilitate the automotive industry's emerging ventures into the development of zero and low-emission vehicle

¹² European Commission, *supra* note 1, at 773/10; *see also* Marotta, I., Guarino, F., Longo, S., Cellura, M., *Environmental Sustainability Approaches and Positive Energy Districts: A Literature Review*, Vol. 13, Sustainability, 1, 2 (Nov. 25, 2021) (explaining that the transport sector accounts for 24% of the world's CO₂ emissions).

¹³ *EPSR*, *supra* note 7, at 111/13; *see Parliament And Council Directive 2009/33/EC On The Promotion Of Clean Road Transport Vehicles In Support Of Low-Emission Mobility*, 2009 O.J. L 120/1; *see Parliament and Council Directive 98/70/EC Relating To The Quality Of Petrol And Diesel Fuels And Amending Council Directive 92/12/EEC*, O.J. L 350/1.

¹⁴ European Commission, *supra* note 1, at 773/5.

¹⁵ *EPSR*, *supra* note 7, at 111/1.

technologies, such as electric vehicles.¹⁶ The EPSR expressly proposes an investment-based approach that would enable the stimulation of public and private investments in the research and innovation of zero- and low-emission vehicles.¹⁷ Such stimulation requires the roll-out of recharging and refueling infrastructure, energy system integration, as well as the sustainable production of materials.¹⁸ Financial incentives and subsidies may sometimes be needed on a temporary basis to increase the sales of developing technologies.¹⁹

The Commission's stated justification for the need for an accelerated transformation of the entire transport sector towards zero-emissions is that the EU's transition towards clean energy has "spurred the modernisation of the European economy, driven sustainable economic growth and brought strong societal and environmental benefits for European citizens."²⁰ Further, the Commission had expressed fear that climate change, without regulatory intervention, would have severe consequences on the productivity of the EU's economy, infrastructure, ability to produce food, public health, biodiversity and political stability.²¹ A full transition to clean energy would result in an energy system where the EU's primary energy supply would largely come from renewable energy sources, thereby significantly improving the security of supply and fostering stability in domestic employment.²² The transition would also decrease Europe's dependence on

¹⁶ *Id.*; see European Commission, *supra* note 1, at 773/10; see Gómez Vilchez, J.J., Julea, A., Peduzzi, E., Pisoni, E., Krause, J., Siskos, P., Thiel, C., *Modelling The Impacts Of EU Countries' Electric Car Deployment Plans On Atmospheric Emissions And Concentrations*, Vol. 11, European Transport Research Review, 1, 12 (Aug. 20, 2019).

¹⁷ EPSR, *supra* note 7, at 111/15; see Camilleri, M.A., Vol. 28, Sustainable Development, *European Environment Policy For The Circular Economy: Implications For Business And Industry Stakeholders*, 1804, 1809 (Aug. 10, 2020).

¹⁸ EPSR, *supra* note 7, at 111/15.

¹⁹ Shetty, D.K., Shetty, S., Rodrigues, L.R., Naik, N., Maddodi, C.B., Malarout, N., and Sooriyaperakasam, N., *Barriers To Widespread Adoption Of Plug-In Electric Vehicles In Emerging Asian Markets: An Analysis Of Consumer Behavioral Attitudes And Perceptions*, Vol. 7, Cogent Eng'g, 1, 4 (2020); Sierzchula, W., Bakker, S., Maat, K., & Van Wee, B., *The Influence Of Financial Incentives And Other Socio-Economic Factors On Electric Vehicle Adoption*, Vol. 68, Energy Policy, 183, 183–94 (2014).

²⁰ European Commission, *supra* note 1, at 773/4.

²¹ European Commission, *supra* note 1, at 773/2; see *Parliament and Council Proposal For A Regulation On The Deployment Of Alternative Fuels Infrastructure, And Repealing Directive 2014/94/EU of the European Parliament and of the Council*, COM(2021)559 final, 1, 2 (2021) [hereinafter Alternative Fuels Infrastructure Proposal].

²² European Commission, *supra* note 1, at 773/8.

energy importation, positively impacting the EU's international trade and geopolitical position.²³ While noting the significant benefits of a transition towards clean energy in the transport sector, the EPSR anticipated some perceived barriers to hasty implementation.²⁴ For example, because the overall contribution of emissions from passenger cars is significantly higher than that of light commercial vehicles, the Regulation takes a differentiated approach between passenger cars and light commercial vehicles.²⁵ To the same end, the Regulation ensures that emissions reduction targets take into account the diversity of European automobile manufacturers.²⁶ Compliance with certain emissions targets would, of course, disproportionately impact smaller vehicle manufacturers.²⁷ Accordingly, the Regulation excludes from the scope of compliance manufacturers responsible for fewer than 1,000 new passenger cars and new light commercial vehicles annually.²⁸ The legislation further allows for flexibilities for small and ultra-small volume manufacturers if the manufacturer has agreed to a reduction plan with the EU.²⁹ Emissions reduction targets for new passenger cars and light commercial vehicles are set for 2025 and 2030 respectively; the rationale behind these deadlines is to provide a clear and early signal to the automotive industry not to delay the market introduction of energy-efficient technologies and zero and low-emission vehicles.³⁰

In an effort to facilitate faster adaptation of the automotive industry, the Regulation established an incentive mechanism that is intended to create a domestic market for and support

²³ *Id.* at 773/8.

²⁴ *EPSR, supra* note 7, at 111/15.

²⁵ *EPSR, supra* note 7, at 111/14; *see also* European Commission, *supra* note 1, at 773/10-11 (contemplating the lack of scientific clarity of whether battery technology for long-haul trucks and coaches will reach the requisite cost and performance level by 2030).

²⁶ *EPSR, supra* note 7, at 111/1

²⁷ *Id.* at 111/17.

²⁸ *Id.*

²⁹ Taylor, M., *Europe's Tough 2035 CO₂ Laws Give Supercar Makers A Free Pass*, *Forbes*, 1, 5 (Feb. 26, 2023).

³⁰ *EPSR, supra* note 7, at 111/16.

the development and innovation of zero and low-emission vehicle technologies.³¹ Such incentive mechanisms can promote successful market deployment of zero-emission vehicles.³² To this end, The Regulation establishes a super-credits system applicable to passenger cars with emissions of less than 50 g CO₂/km.³³ These vehicles are counted multiple times for the calculation of the average specific emissions of a vehicle manufacturer.³⁴ In other words, manufacturers are able to produce more vehicles insofar as they produce relatively low levels of GHG emissions. These credits will decrease in potency each year, and in 2025, a different crediting system is to be established for both car and van manufacturers.³⁵ The super-credits system incentivizes manufacturers to develop and deploy innovative technologies to further reduce the average emissions of new car fleets.³⁶

Manufacturers are also enabled to form pools for the purposes of meeting their obligations under Article 4 of the Regulation.³⁷ Manufacturers which form a pool are required to file certain information with the Commission, including the manufacturers who will be included, the manufacturer nominated as the pool manager who will be responsible for paying any excess emissions premium imposed on the pool, and evidence that the pool manager will be able to fulfill its emission obligations.³⁸ However, in the same vein, the Regulation imposes penalties for excessive emissions. If the average CO₂ emissions of a manufacturer's fleet exceed its specific emission target in a given year, the manufacturer has to pay an excess emissions premium of €95

³¹ *Id.*

³² *Id.*; see Shetty, et al., *supra* note 19, at 4.

³³ *EPSR*, *supra* note 7, at 111/23.

³⁴ *Id.*; Delbeke, J., Vis, P., *EU Climate Policy Explained*, 1, 72 (Oct. 21, 2015).

³⁵ *EPSR*, *supra* note 7, at 111/23-4.

³⁶ Delbeke, et al., *supra* note 34, at 72.

³⁷ *EPSR*, *supra* note 7, at 111/24.

³⁸ *Id.*

per g/km of target exceedance for each of its vehicles newly registered in that year.³⁹ These incentive systems relax each individual manufacturer's specific emission requirements to enable a more practical transition into full compliance.

In response to the EPSR, automotive manufacturers took decisive actions in turning around their product portfolios.⁴⁰ For example, Renault's share of battery electric vehicles tripled from 3% in December 2019 to 9% in January 2020.⁴¹ By December 2020, 29% of Hyundai's new car fleet consisted of battery electric vehicles, up from 7% in January 2020.⁴² Daimler increased its plug-in hybrid electric vehicles share to 34% in December 2020 up from 3% in January of that year.⁴³ In 2020, global electric vehicle sales reached three million, accounting for 4.1% of total global automobile sales.⁴⁴ In 2021, over 6.6 million electric vehicles were sold globally.⁴⁵ The European Union registered 2.3 million electric vehicles in 2021, which accounted for 34% of the worldwide stock.⁴⁶

The European Union has taken strong regulatory action to reduce GHG emissions in its transportation sector, which is responsible for approximately a quarter of the EU's total emissions. The EU's climate and energy policies are predicted to reduce its overall emissions by 45% by 2030. The Regulation establishes an incentive mechanism to create a domestic market for and support the development and innovation of zero and low-emission vehicle technologies. This includes a super-credits system for passenger cars with emissions of less than 50 g CO₂/km and the ability

³⁹ *Id.* at 111/26.

⁴⁰ Wappelhorst, S., Tietge, U., Bieker, G., Mock, P., *Europe's CO₂ Performance Standards for New Passenger Cars: Lessons from 2020 and Future Prospects*, International Council on Clean Transportation, 1, 24 (2021).

⁴¹ *Id.* at 16.

⁴² *Id.* at 24.

⁴³ *Id.*

⁴⁴ Razmjoo, A., Ghazanfari, A., Jahangiri, M., Franklin, E., Denai, M., Marzband, M., Astiaso Garcia, D., Maheri, A., *A Comprehensive Study on the Expansion of Electric Vehicles in Europe*, Vol. 12, Applied Sciences, 1, 4 (Nov. 16, 2022).

⁴⁵ *Id.*

⁴⁶ *Id.* at 5.

for manufacturers to form pools to meet their obligations. Excessive emissions result in penalties. In response to the EPSR, automotive manufacturers have taken significant steps to turn around their product portfolios, resulting in a rapid increase in global electric vehicle sales.

III. *Proposal For The Deployment Of Alternative Fueling Infrastructure*

One of the main challenges facing the implementation of the Regulation is the lack of adequate and suitable charging infrastructure.⁴⁷ Despite advancements in battery technology, electric vehicles are still unable to meet all of the power needs of consumers.⁴⁸ Completely new battery designs are promising but unlikely to achieve significant market penetration prior to 2030.⁴⁹ A robust network of charging stations is essential for electric car drivers.⁵⁰ The primary element of an infrastructure suitable for electric vehicles is the ability to recharge the batteries powering the vehicles.⁵¹ Electric vehicles may fail without proper infrastructure investment because they will not fit within the current mobility system and cannot compete with internal combustion engine cars.⁵² The current framework under Directive 2014/94/EU requires Member States to provide a minimum level of infrastructure for alternative fuels in line with their expectations on future demand for those fuels.⁵³ Each Member States' unique variation past the

⁴⁷ Razmjoo, et al., *supra* note 44, at 5.

⁴⁸ *Id.*

⁴⁹ Domenech, T., Doranova, A., Roman, L., Smith, M., Artola, I., Final Report, *Cooperation Fostering Industrial Symbiosis; Market Potential, Good Practice And Policy Actions*, 9, 153 (April 5, 2018).

⁵⁰ Razmjoo, et al., *supra* note 34, at 5); see Lebrouhi, B., Khattari, Y., Lamrani, B., Maaroufi(a), M., Zeraouli, Y., Kousksou, T., *Key Challenges For A Large-Scale Development Of Battery Electric Vehicles: A Comprehensive Review*, 4, 42, (Dec. 15, 2021).

⁵¹ Pollák, F., Vodák, J., Soviar, J., Markovič, P., Lentini, G., Mazzeschi, V., Luè A, *Promotion of Electric Mobility in the European Union—Overview of Project PROMETEUS from the Perspective of Cohesion through Synergistic Cooperation on the Example of the Catching-Up Region*, Vol. 13, Sustainability, 1, 4 (Feb. 1, 2021); see Lebrouhi, et al., *supra* note 50, at 42.

⁵² Pollák, et al., at 5.

⁵³ *Parliament And Council Directive 2014/94/EU On The Deployment Of Alternative Fuels Infrastructure*, 2018 O.J. L 307/9 [hereinafter Alternative Fuels Infrastructure Directive]; see Thiel, C., Andreea J., Acosta Iborra B., Nerea De Miguel E., Emanuela P., Enrico P., Gómez Vilchez J.J., and Jette K., *Assessing the Impacts of Electric Vehicle Recharging Infrastructure Deployment Efforts in the European Union*, Vol. 12, ENERGIES, 1, 3 (June 22, 2019).

EU floor has allowed for an economic laboratory in terms of infrastructure deployment.⁵⁴ However, critics of the existing framework argue that the level of ambition and coherence of the Member States is low.⁵⁵ Member States' plans are divergent; for countries with more ambitious emissions targets, such as Austria, France, Germany, and Luxemburg, the climate, energy, and air quality impacts are significant and show what would be achievable if the EU would increase its pace of electric vehicle manufacturing and infrastructure deployment.⁵⁶ Experts predict that under the current framework, the ratio of publicly accessible alternative fueling stations to electric vehicles will be 1:20, which is far below the ambition of the existing framework.⁵⁷ The Commission has proposed a Regulation that would repeal Directive 2014/94/EU.⁵⁸ After carrying out an *ex post* evaluation of Directive 2014/94/EU, the Commission concluded that the Directive was not well adapted to facilitate the coherent distribution of infrastructure within the Member States.⁵⁹ That Directive required Member States to set up national policy frameworks to establish markets for alternative fuels and ensure that an appropriate number of publicly accessible recharging and refueling points is put in place.⁶⁰ Further, the existing framework lacked transparency in consumer information which limited user acceptance of zero-emissions vehicles.⁶¹ The Proposal seeks to create a stable policy framework to establish a competitive market, and, ultimately, stimulate private and public investment in recharging and refueling infrastructure

⁵⁴ Thiel, et al., *supra* note 53, at 19.

⁵⁵ *Id.* at 1; *see* Alternative Fuels Infrastructure Directive, *supra* note 53, at 307/2.

⁵⁶ Thiel, Christian, Andreea Julea, Acosta Iborra Beatriz, Nerea De Miguel Echevarria, Emanuela Peduzzi, Enrico Pisoni, Jonatan Gómez Vilchez J., and Jette Krause, *Assessing the Impacts of Electric Vehicle Recharging Infrastructure Deployment Efforts in the European Union*, Vol. 12, ENERGIES, 1, 1; Gómez Vilchez, et al., *supra*, at 12.

⁵⁷ Alternative Fuels Infrastructure Directive, *supra* note 53, at 307/4.

⁵⁸ Alternative Fuels Infrastructure Proposal, *supra* note 21, at 1.

⁵⁹ *Id.* at 2.

⁶⁰ Alternative Fuels Infrastructure Directive, *supra* note 53, at 307/1; Alternative Fuels Infrastructure Proposal, *supra* note 21, at 2.

⁶¹ Alternative Fuels Infrastructure Proposal, *supra* note 21, at 2.

throughout the entire transportation sector.⁶² The Commission's stated justification for the enactment of a Regulation, as opposed to a Directive, is that there is a need for clearly established and binding obligations for Member States in order to ensure coherent and timely implementation of the EU's policy goals.⁶³ A Regulation avoids the risk of delays and inconsistencies in national processes, ensuring a consistent Union-wide roll-out of recharging and refueling infrastructure.⁶⁴ In a report on the application of Directive 2014/94/EU, the Commission noted that the current policy framework provides no detailed and binding methodology for Member States to calculate targets and adopt measures.⁶⁵ The Proposal asserts that without further EU action, the lack of interoperable recharging and refueling infrastructure is a barrier to the needed market growth of low and zero-emission vehicles.⁶⁶ To that end, the Proposal would implement mandatory minimum targets for Member States set at a national level.⁶⁷ This approach may provide policy orientation for Member States to ensure that electric vehicle manufacturing in every Member State is matched with the deployment of sufficient publicly accessible recharging infrastructure.⁶⁸

The deployment of alternative fueling infrastructure is equally important in the context of private ownership. Among the major vehicle manufacturers, nearly all have already publicly announced plans to transition largely to electric vehicles within the next approximately ten years.⁶⁹ The Proposal therefore urges Member States to take measures to ensure that the appropriate infrastructure is provided for privately owned depots.⁷⁰ The Commission also advocates for the

⁶² *Id.* at 7.

⁶³ *Id.* at 8.

⁶⁴ *Id.*

⁶⁵ *Id.* at 2.

⁶⁶ *Id.*

⁶⁷ *Id.* at 8.

⁶⁸ *Id.* at 17.

⁶⁹ Dornoff, et al., *supra* note 3, at 23.

⁷⁰ Alternative Fuels Infrastructure Proposal, *supra* note 21, at 18 (explaining that the deployment of recharging infrastructure in private depots and logistic centers ensures availability of overnight and destination charging).

development of a competitive market for the establishment and operation of recharging points.⁷¹ To that end, the Proposal encourages Member States to competitively award new concessions specifically for recharging stations on or adjacent to rest areas in order to enable new market entrants.⁷² In furtherance of the concept of the single market, the Proposal underscores that users should be able to pay easily and conveniently at all publicly accessible recharging and refueling points.⁷³ Similarly, price transparency is crucial to ensuring that users of alternative fuel vehicles are given accurate price information and identify different cost components.⁷⁴ Therefore, all publicly accessible recharging and refueling points should accept payment instruments that are widely used in the EU, and in particular should allow for electronic payments through terminals and devices used for payment services.⁷⁵ Stakeholders have asserted that a massive deployment of strategically located ‘smart charging’ infrastructure is necessary to enable drivers to charge without severely affecting, or overloading, Europe’s existing electricity grids.⁷⁶ Stakeholders state that existing EU funding instruments must be better leveraged to speed up the roll-out of the infrastructure in order to meet its climate ambitions.⁷⁷

Consumer perceptions of electric vehicles also influence their economic viability.⁷⁸ Accordingly, stakeholders have advocated for the removal of the stress associated with recharging

⁷¹ *Id.* at 20.

⁷² *Id.*

⁷³ *Id.*

⁷⁴ *Id.*

⁷⁵ *Id.* at 21.

⁷⁶ ACEA, Press Release, *Access To Electric Vehicle Chargers Must Be Guaranteed, Urge Auto Makers, Electricity Sector and NGO*, 1, 1 (Sept. 4, 2019); Simon, F., EURACTIV, *Massive Rise In EV Charging Points Needed To Reach EU Climate Goals, Analysis Finds* (Jan. 8, 2020).

⁷⁷ ACEA, *supra* note 76, at 1-2; Nooraini, I., Osman, N.H., Zamani, S.N.M., Vol. 184, *Advances In Economics, Business And Management Research, The Factor That Affects The City’s Readiness To Adopt Electric Vehicles: A Conceptual Paper*, 80, 83 (Jan. 2021).

⁷⁸ Nooraini, et al., *supra* note 77, at 81; *see* Graham, J.D., & Brungard, E., *Future Transportation, Consumer Adoption of Plug-In Electric Vehicles In Selected Countries*, 304, 305 (Aug. 10, 2021).

electric vehicles in order to convince more customers to make the switch to electric vehicles.⁷⁹ One of the reasons that electric vehicles have penetrated the near-premium and premium sedan market is that consumers of such vehicles tend to value performance.⁸⁰ Perceived convenience can also influence the rate of adoption of electric vehicles within the EU.⁸¹ Electric vehicle's most tangible advantage is lower operating cost.⁸² The comparison between operating costs of an electric vehicle and gasoline powered vehicles is significant because fuel prices in Europe are high.⁸³ Therefore, the prospect of market penetration for electric vehicles is elevated because, due to heavy taxation and geopolitical realities, fuel prices in the EU are two to three times higher than US fuel prices.⁸⁴ Owners that can charge their vehicles at home or at work avoid the hassle of making special trips to gasoline refueling stations.⁸⁵ A well-developed public charging system may allow motorists that lack home and workplace charging to routinely charge while engaged in other activities such as grocery shopping.⁸⁶ During vehicle operation, an electric vehicle is quieter than a gasoline or diesel powered vehicle.⁸⁷ Disadvantages to the purchase of an electric vehicle include higher purchase cost, limited driving range, long charging times, uncertain battery life, and poor resale value.⁸⁸ Consumer demand for light trucks is growing faster than demand for sedans in

⁷⁹ ACEA, *supra* note 76, at 2.

⁸⁰ Nooraini, et al., *supra*, at 83 (Jan. 2021); *see* Graham, et al., *supra* note 78, at 305.

⁸¹ Graham, et al., *supra* note 78, at 306.

⁸² *Id.* at 305; *but see* Kurani, K., Hardman, S., UC Davis Institute of Transportation Studies, *Automakers And Policymakers May Be On A Path To Electric Vehicles; Consumers Aren't*, (Jan. 18, 2018) (arguing that despite the installation of approximately 11,500 electric vehicle charges in California in 2014, Californians, by and large, did not enthusiastically adopt their use).

⁸³ Graham, et al., *supra* note 78, 305); European Commission, Commission Communication, *Closing The Loop—An EU Action Plan For The Circular Economy*, COM(2015) 614, 1, 6 (Dec. 2, 2015) [hereinafter *Closing The Loop*].

⁸⁴ *Id.* at 305.

⁸⁵ *Id.* at 306.

⁸⁶ *Id.*

⁸⁷ Nooraini, et al., *supra* note 77, at 81; Graham, et al., *supra* note 78, at 306; *see* McDonald, L., *EV Adoption Study, Supply: Model Availability and Price Discrepancy Between EVs and ICE Vehicles Remain a Top Hurdle to Mass Adoption in the US*, (May 19, 2019).

⁸⁸ Graham, et al., *supra* note 78, at 306.

Europe.⁸⁹ One reason that limited driving ranges are problematic for consumers is that consumers expect their vehicle to meet their predictable peak transport needs, not their average needs.⁹⁰ Further, marketing electric vehicles in colder climates is especially challenging because cold weather reduces the driving range of electric vehicles.⁹¹ A further barrier to implementation of widespread battery recycling is that there is no standardization in the design and location of battery packs in vehicles.⁹² Auto manufacturers and their suppliers are resistant to standardization because they seek competitive advantages with regard to innovation in battery design and location.⁹³ There is also uncertainty about electric vehicle's repair-cost advantage when considering current battery technology.⁹⁴ The frequency of battery failure is unknown because few commercial electric vehicles have been used for more than a decade; and it is the second decade of a vehicle's lifetime when battery failure is the most likely to occur.⁹⁵ Replacement costs are a large concern for individual retail consumers as opposed to industrial or fleet-level consumers.⁹⁶

In summary, the lack of adequate and suitable charging infrastructure is one of the main challenges facing the implementation of the EU's policy goals for electric vehicles. A robust network of charging stations is essential for consumer adoption, and without proper investment, electric vehicles will not fit within the current mobility system and cannot compete with internal

⁸⁹ *Id.* at 307.

⁹⁰ European Environment Agency, Publication, *Electric Vehicles From Life Cycle And Circular Economy Perspectives*, 1, 44 (Nov. 9, 2018); see Graham, et al., *supra* note 78, at 307 (considering that despite the robust intercity train services existing within Europe, many households own or rent a private vehicle to drive from northern Europe for extended vacations in Spain, southern France, Italy and Greece).

⁹¹ Graham, et al., *supra* note 78, at 307.

⁹² Fulari, S.C., Kaa, G. Vol. 10, *Electronics, Overcoming Bottlenecks For Realizing A Vehicle-to-Grid Infrastructure in Europe Through Standardization*, 1, 12 (Mar. 2, 2021); see Graham, et al., *supra* note 78, at 307.

⁹³ Fulari, et al., *supra* note 92, at 12; Graham, et al., *supra* note 78, at 308 (noting that brand reputation and credibility and compatibility have been found to be substantial motivators for resistance to standardization).

⁹⁴ Graham, et al., *supra* note 78, at 308; Nooraini, et al., *supra* note 77, at 83.

⁹⁵ *Parliament and Council Proposal For A Regulation Concerning Batteries And Waste Batteries, Repealing Directive 2006/66/EC And Amending Regulation (EU) No 2019/1020*, COM(2020)798 final, 1, 23 (2020) [hereinafter Battery Proposal]; Graham, et al., *supra* note 78, at 307.

⁹⁶ Graham, et al., *supra* note 78, at 308.

combustion engine cars. The current framework requires Member States to provide a minimum level of infrastructure for alternative fuels in line with their expectations on future demand for those fuels. However, the level of ambition and coherence of the Member States is low, and the existing framework lacks transparency in consumer information, which limits consumer acceptance of zero-emissions vehicles. To address these issues, the Commission has proposed a Regulation that would create a stable policy framework to establish a competitive market and stimulate private and public investment in recharging and refueling infrastructure throughout the entire transportation sector.

IV. *Facilitating The Circular Economy*

The EU, in drafting its emissions reduction legislation, has employed a circular economy theoretical framework.⁹⁷ The Commission defines the circular economy model as a regenerative growth model that gives back to the planet more than it takes.⁹⁸ The circular economy is a widespread concept that draws attention both at the EU and global level as it is an alternative theory that synthesizes economic, environmental, and social needs.⁹⁹ The increased use of a circular economy economic framework would support resource-efficient use of materials, while reducing EU dependency on materials from foreign countries.¹⁰⁰

In order for electric vehicle charging infrastructure to be most effective, it is necessary to invest in electric vehicle batteries, making them more robust, durable, and with greater

⁹⁷ European Commission, *supra* note 1, at 773/12; European Commission, *Commission Communication—A New Circular Economy Action Plan For A Cleaner And More Competitive Europe*, 2020 O.J. COM(2020)98 final, 1, 12 [hereinafter *Circular Economy Action Plan*; see Avdiushchenko, A., & Zając, P., *Circular Economy Indicators As A Supporting Tool For European Regional Development Policies*, Vol. 11, Sustainability, 1, 1 (May 28, 2019).

⁹⁸ *Circular Economy Action Plan*, *supra* note 97, at 3; see European Commission, *Commission Communication, The European Green Deal*, COM (2019)640, 1, 1 final.

⁹⁹ Păcurariu, R.L., Lakatos, E.S., Nan, L.M., Bacali, L., Seitoar, D., *An Analysis Of European Union's Circular Economy Indicators With Focus On Materials: Implications For The Manufacturing Industry*, Vol. 1169, IOP Conference Series: Materials Science And Engineering, 1, 1 (May 28, 2021).

¹⁰⁰ Graham, et al., *supra* note 78, at 305.

capacities.¹⁰¹ The biggest contributor to the cost of electric vehicles is the lithium-ion battery that powers the engine.¹⁰² With successive uses of electric vehicle batteries, their capacity decreases, which consequently influences the energy that the owner of the electric vehicle can put back on the grid.¹⁰³ Battery degradation is influenced by several factors including how the charging and discharging process is carried out, ambient temperatures, and consumer driving cycles.¹⁰⁴ Market values for recovered batteries are unclear, some sources indicate the increasing scarcity of lithium may make recycling of lithium batteries more attractive over time despite the current lack of cost effectiveness.¹⁰⁵ The cost issue is especially concerning for light trucks since such vehicles require relatively large battery packs because of their weight and poor aerodynamics.¹⁰⁶ Battery failure may be a smaller risk for premium vehicles with large battery packs and long driving range.¹⁰⁷ Larger battery packs may also experience fewer full charging events, which means that they will less frequently experience the lower rates of charge that trigger accelerated battery degradation.¹⁰⁸ Further, electric vehicles have a constrained resale market; lower-income households are a big force in the market for used vehicles.¹⁰⁹ Such households may only be able to afford one vehicle. Lower-income households are also less likely to own a private garage where they can charge their vehicle at home.¹¹⁰

¹⁰¹ Barreto, R., Faria, P., Vale, Z. *Electric Mobility: An Overview of the Main Aspects Related to the Smart Grid*, Vol. 11, Electronics, 1, 15 (April 20, 2022).

¹⁰² Domenech, et al. *supra* note 49, at 153; Graham, et al., *supra* note 78, at 306.

¹⁰³ Barreto, et al., *supra* note 101, at 14.

¹⁰⁴ *Id.* at 15.

¹⁰⁵ Domenech, et al., *supra* note 49, at 153.

¹⁰⁶ Graham, et al., *supra* note 78, at 307; *see* European Environment Agency, *supra* note 90, at 34.

¹⁰⁷ Graham, et al., *supra*, at 309 (explaining that larger battery cells experiences less load and achieves longer range); *see* European Environment Agency, *supra* note 90, at 18.

¹⁰⁸ Graham, et al., *supra* note 78, at 309.

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

The emergence of large amounts of variable electricity generation requires the move towards an interconnected, smart and flexible electricity system.¹¹¹ Smart grid systems can extract information from the battery in more detail and in real-time are crucial to enable monitoring and control of the phases of battery life, to keep consumers well-informed.¹¹² Monitoring and tracking changes caused by circular economic development plays an important role by offering policymakers a chance to adapt and correct strategies and actions according to information obtained through regular evaluation.¹¹³ Without regular feedback about the circular economy's effects, it is impossible to implement the best solutions at the regional level.¹¹⁴ Some critics of the current framework argue that it is not comprehensive enough “for monitoring the effects of critical circular economic areas like social innovations, eco-innovations, sharing economy initiatives, the level of greening of the main economic sectors, new business models’ implementation, ecodesign and architecture initiatives.”¹¹⁵ Member States as experimental administrative units are vital in the context of EU economic policy, necessitating the selection of regional scale circular economy monitoring.¹¹⁶ Some examples of indicators that can fill this monitoring gap include: share of recycled input materials, domestic material consumption, use of ecological building materials, and percentage of infrastructure built with recycled materials.¹¹⁷

To this end, the Commission has proposed a regulation concerning electric vehicle batteries and waste batteries.¹¹⁸ The Commission has stated that the Proposal is in direct response to the

¹¹¹ Delbeke, et al., *supra* note 34, at 63.

¹¹² Barreto, et al., *supra* note 101, at 15; *see* Delbeke, et al., *supra* note 34, at 72.

¹¹³ Avdiushchenko, et al., *supra* note 90, at 16; *see* Barreto, et al., *supra* note 101, at 15.

¹¹⁴ European Environment Agency, *supra* note 90, at 43.; Avdiushchenko, et al., *supra* note 90, at 3.

¹¹⁵ Avdiushchenko, et al., *supra* note 90, at 16.

¹¹⁶ *Id.* at 17; *see* Marotta, et al., *supra* note 12, at 34.

¹¹⁷ Marotta, et al., *supra* note 12, at 21; *see* Delbeke, et al., *supra* note 34, at 29.

¹¹⁸ *Parliament and Council Proposal For A Regulation Concerning Batteries And Waste Batteries, Repealing Directive 2006/66/EC And Amending Regulation (EU) No 2019/1020*, COM(2020)798 final, 1, 1 (2020) [hereinafter Battery Proposal].

concerns that stakeholders have expressed in regards to encouraging consumer uptake of electric vehicles.¹¹⁹ According to estimates from the World Economic Forum, there is a need to scale up global battery production by a factor of 19 to accelerate the transition to a low-carbon economy.¹²⁰ The proposal identifies 13 measures to address problems related to the lack of framework to provide incentives for investments in production capacity for sustainable batteries, the sub-optimal functioning of recycling markets, and the social and environmental risks that are currently not covered by the EU's environmental laws.¹²¹ It is necessary, in the view of the Commission, to set out rules on sustainability parameters, performance, safety, collection, recycling and second life of batteries and to have transparency in information about batteries.¹²² Demand for batteries is increasing rapidly and is predicted to increase 14-fold by 2030, with the EU accounting for 17% of that demand.¹²³ The exponential growth in demand for batteries will lead to an equivalent increase in demand for raw materials.¹²⁴ If the Battery Proposal enters into force, sustainability requirements on carbon footprint, recycled content and performance and durability will be introduced gradually from 2024 onwards.¹²⁵ All collected batteries are required to be recycled and high levels of recovery have to be achieved, in particular of valuable materials including copper, lithium, nickel and lead.¹²⁶ Recycling ensures that valuable materials are recovered and brought back into the economy by the EU's adoption of stricter targets for recycling efficiency and material

¹¹⁹ *Battery Proposal*, *supra* note 118, at 12.

¹²⁰ World Economic Forum, Insight Report, *A Vision For A Sustainable Battery Value Chain in 2030 Unlocking The Full Potential To Power Sustainable Development and Climate Change Mitigation*, 1, 25 (Sept. 2019); *Battery Proposal*, *supra* note 118, at 1.

¹²¹ *Battery Proposal*, *supra* note 118, at 7.

¹²² *Id.* at 23-27.

¹²³ European Commission, Press Release, *Green Deal: EU Agrees New Law On More Sustainable And Circular Batteries To Support EU's Energy Transition And Competitive Industry*, 1, 3 (Dec. 9, 2022).

¹²⁴ *Id.*

¹²⁵ *Id.* at 2.

¹²⁶ *Id.*

recovery over time.¹²⁷ The study cited by the Commission estimates that applying circular economy principles across the EU economy has the potential to increase EU GDP by an additional .5% by 2030 and create around 700,000 new jobs.¹²⁸ By building on the concept of the single market, the circular economy model can provide to consumers high-quality, functional and safe products, which are efficient and affordable, last longer and designed for reuse, repair, and high quality recycling.¹²⁹ The Commission noted that the linear pattern of “take-make-use-dispose” does not provide producers with sufficient incentives to make their products compatible with the circular economy model.¹³⁰ To enhance the participation of consumers in the circular economy, the Commission proposes a revision of EU consumer law to ensure that consumers receive trustworthy and relevant information on products at the point of sale, including on their lifespan and on the availability of repair services, spare parts and repair manuals.¹³¹ As opposed to a linear economy model, the circular economy provides a reduction in the use of raw materials to optimize the use of by-products, waste and recycling of rejected products as the primary source of materials for the production and reduction of pollution at all stages in the cycle.¹³² An essential roadblock to macro scale adoption of the circular economic model is the issue of financing activities that service the implementation and functioning of economies of the European Union’s countries according to circular economic principles.¹³³ The differentiated levels of advancement of individual EU countries towards a circular economic model also result from the adoption by some of them of

¹²⁷ *Id.*

¹²⁸ European Commission, Press Release, *Changing How We Produce And Consume: New Circular Economy Action Plan Shows The Way To A Climate-Neutral, Competitive Economy Of Empowered Consumers*, 1, 4 (Dec. 9, 2022).

¹²⁹ European Commission, *supra* note 123, at 2.

¹³⁰ *Id.*

¹³¹ European Commission, *supra* note 123, at 3.

¹³² Desnica, E., Nikolić, M., Ivanović, L., & Vulić, M., *Collecting ELV Recycling Centers For Circular Economy Requirements*, *Bulletin of Engineering*, Vol. 13, 101, 105 (Jan. 18, 2020).

¹³³ Mazur-Wierzbicka, E., *Circular Economy: Advancement of European Union Countries*, Vol. 33, *Environmental Sciences Europe*, 1, 9 (Sept. 27, 2021).

different development strategies concerning their economies' transition.¹³⁴ Manufacturing entities have the most important role in the circular economy transition.¹³⁵ Studies show that circular economy implementation in manufacturing companies cannot be done at the entity level, implicating the contribution and commitment of all stakeholders.¹³⁶

V. *Monitoring Indicators of A Successful Transition to A Circular Economy*

In order to strengthen the transition to a circular economy model, proponents argue that the EU's existing economic monitoring framework requires improvements.¹³⁷ Such a monitoring framework must cover and address the entire potential of the circular economy through specific indicators.¹³⁸ The monitoring process is a difficult task, as there is no single generally acceptable set of indicators which may result from a different understanding of the circular economy model by individual stakeholders.¹³⁹ For example, some Member States have created their own system of indicators which in consequence makes it difficult to compare the effects of circular economy related activity between individual countries.¹⁴⁰

Accordingly, in 2018, the Commission undertook action on establishing a circular economy monitoring framework.¹⁴¹ This monitoring framework implements indicators grouped into four areas of circular economy policy relating to production and consumption, waste management, secondary raw materials, and competitiveness and innovation.¹⁴² To this end, the Commission envisions a close cooperative relationship with the European Environment Agency

¹³⁴ *Id.* at 1.

¹³⁵ Păcurariu, et al., *supra* note 99, at 2.

¹³⁶ *Id.*

¹³⁷ *Id.* at 7.

¹³⁸ *Id.*

¹³⁹ Mazur-Wierzbicka, *supra* note 133, at 2.

¹⁴⁰ *Id.* at 7.

¹⁴¹ Closing The Loop, *supra* note 83, at 1.

¹⁴² *Id.* at 3.

(“EEA”) as well as Member States to implement a simple and effective monitoring framework for the economy.¹⁴³ Some researchers have concluded that the implementation of the circular economic model has led to the emergence of a “two-speed-Europe.”¹⁴⁴ On the one hand, those countries most advanced in pursuing fulfillment of circular economic principles include Germany, Belgium, Spain, France, Italy, and the Netherlands.¹⁴⁵ These countries comprise what is known as the “Old Union,” or those countries to which have been joined by other European countries after 2004.¹⁴⁶ The opposite pole includes EU countries which are transitioning towards a circular economic model at the slowest pace. This group consists of Cyprus, Czechia, Malta, Lithuania, Latvia, Hungary, Ireland, Slovakia, Romania, Estonia, Croatia and Bulgaria; mainly countries of Central and Eastern Europe and the countries of south Europe.¹⁴⁷

The EU has employed a circular economy theoretical framework in drafting its emissions reduction legislation. The circular economy concept, which emphasizes environmental, economic, and social needs, supports resource-efficient use of materials and reduces dependence on material imports. Battery limitation is a recurrent concern, especially for light trucks that require large battery packs, but larger battery packs may have fewer full charging events and therefore experience less battery degradation. Smart grid systems are crucial to successfully monitoring, in turn, it is important for policymakers to adapt and correct strategies and actions according to information obtained through regular evaluation. If the Battery Proposal enters into force, sustainability requirements on carbon footprint, recycled content, and performance and durability will be introduced gradually and has the potential to increase EU GDP by an additional .5% by

¹⁴³ *Id.* at 20.

¹⁴⁴ Mazur-Wierzbicka, *supra* note 133, at 9; Economic Intelligence Unit N.A. Inc., *supra* note 9, at 4-5.

¹⁴⁵ Mazur-Wierzbicka, *supra* note 133, at 9.

¹⁴⁶ *Id.*

¹⁴⁷ *Id.*

2030 and create around 700,000 new jobs. The transition to a circular economy model is a necessary step towards achieving sustainable development goals, and proponents argue that the EU's existing economic monitoring framework needs improvements to effectively track progress. By building on the concept of the single market, the circular economic model can provide high-quality, functional and safe products, which are efficient and affordable, designed for reuse, repair, and high-quality recycling.

VI. *Ameliorating A Two-Speed-Europe Through Industrial Symbiosis*

One proposed solution to the two-speed Europe dilemma is the further implementation of policy objectives that promote “industrial symbiosis.”¹⁴⁸ Industrial symbiosis refers to the mutual benefit that can be obtained from the relationship between different companies or industries.¹⁴⁹ Industrial symbiosis can best be understood as a model of industrial ecology, where collaboration and production synergies between different economic activities result from the exchange and sharing of resources.¹⁵⁰ This approach allows value to be created from materials that would otherwise be discarded and so the materials remain economically valuable for longer than in traditional industrial systems.¹⁵¹ Different industrial sectors have different competitive advantages in the exchange of materials, energy, water, or other by-products of their processes.¹⁵² However, such relationships do not necessarily rely on a direct flow of materials and can lead to more efficient use of resources, such as sharing infrastructure or equipment.¹⁵³ To implement the concept of industrial symbiosis, the EU has funded EU cluster actions; clusters are groups of firms, related

¹⁴⁸ Castellet-Viciano, L., Hernández-Chover, V., Bellver-Domingo, Á., & Hernández-Sancho, F., *Industrial Symbiosis: A Mechanism To Guarantee The Implementation Of Circular Economy Practices*, Vol. 13, Sustainability, 1, 4 (Nov. 2022).

¹⁴⁹ *Id.* at 5.

¹⁵⁰ *Id.*

¹⁵¹ European Commission, Publication, *Industrial Symbiosis*, 1, 2 (2018).

¹⁵² *Battery Proposal, supra*, at 20; Castellet-Viciano, et al., *supra* note 148, at 5.

¹⁵³ Castellet-Viciano, et al., *supra* note 148, at 5.

economic actors, and institutions located near each other and with sufficient scale to develop specialized expertise, services, resources, suppliers and skills.¹⁵⁴

Industrial symbiosis can be classified by taking into consideration the kind of element that generates the synergy between different industrial entities.¹⁵⁵ Mutuality synergies involve sharing services, facilities, or infrastructures.¹⁵⁶ Substitution synergies refer to the transfer of products where the waste of one company or industrial process is part of the resource flow of another.¹⁵⁷ Genesis synergies involve the creation of an original activity to satisfy the reuse requirement of any flow or company.¹⁵⁸ Similarly, industrial symbiosis relationships can be grouped according to their origin or type of management, differentiating between different types of networks.¹⁵⁹ Self-managed networks, or “bottom-up” networks, refer to those relationships that arise spontaneously from the interactions between different industrial actors, because both parties benefit from such collaboration.¹⁶⁰ Although usually driven entirely by private activity, such relationships in many cases can be benefitted by involvement of Member State and local governments.¹⁶¹ These networks are often local in nature and linked to a cluster of manufacturing activities.¹⁶² Similarly, facilitated networks, or “intermediary” networks, refer to those relationships with a third actor, typically a government body, acting as an intermediary in the cooperative activity.¹⁶³ This type of relationship

¹⁵⁴ Parliament and Council Regulation 2021/690, *Establishing A Programme For The Internal Market, Competitiveness Of Enterprises, Including Small And Medium-Sized Enterprises, The Area Of Plants, Animals, Food And Feed, And European Statistics (Single Market Programme) And Repealing Regulations (EU) No 99/2013, (EU) No 1287/2013, (EU) No 254/2014 and (EU) No 652/2014*, O.J. L 153/1 (April 28, 2021); see European Commission, Publications, *Internal Market, Industry, Entrepreneurship and SMEs: Cluster Policy* (2022).

¹⁵⁵ Castellet-Viciano, et al., *supra* note 138, at 5.

¹⁵⁶ *Id.*

¹⁵⁷ *Battery Proposal*, *supra*, at 38; Castellet-Viciano, et al., *supra* note 148, at 5.

¹⁵⁸ Castellet-Viciano, et al., *supra* note 148, at 5.

¹⁵⁹ *Id.* at 6.

¹⁶⁰ *Id.*

¹⁶¹ *Id.*

¹⁶² Delbeke, et al., *supra* note 34, at 21; Castellet-Viciano, et al., *supra* note 148, at 6; see, e.g., Volkswagen News Group, *Cross-Industry CEO Alliance Backs EU Plan To Cut Carbon Emissions By 55% By 2030* (July 7, 2021).

¹⁶³ Castellet-Viciano, et al., *supra* note 148, at 6.

can be applied at the local, regional and Member State levels.¹⁶⁴ Finally, planned networks, or “top down” networks, are those relationships that are planned for given industrial areas that often share infrastructures and services that ensure the flow of resources between them.¹⁶⁵ Scholars have noted that spontaneously emerging symbiosis are rare, not because of lacking demand, but because perceived hurdles to full implementation are great.¹⁶⁶ For example, companies simply lack awareness of the impacts and potential size of their waste streams; lack awareness of other companies with which to establish synergies; or lack the resources necessary to implement full collaboration with such companies.¹⁶⁷ Other challenges to full implementation of symbiosis across industrial sectors include managing close cooperation between governing bodies, stakeholders and the general public, and achieving public acceptance.¹⁶⁸ Good waste management systems take time and persistence to develop, and there is a need for good waste sorting efficiency at household and consumer levels to ensure cost efficiency.¹⁶⁹ Therefore, business and industry are encouraged under EU law to embrace circular economy strategies and collaboration to reduce their dependence on resource depleting systems usually characterized by high externalities, including emissions and waste generation.¹⁷⁰ The transformation of waste into economic value is an important policy goal at the EU level that can improve the supply of raw material, reduce waste and preserve natural capital.¹⁷¹

¹⁶⁴ *Id.* at 14.

¹⁶⁵ *Id.* at 6; *See Battery Proposal*, *supra* note 118, at 41.

¹⁶⁶ Castellet-Viciano, et al., *supra* note 148, at 6; *see* Nooraini, et al., *supra*, at 81.

¹⁶⁷ Castellet-Viciano, et al., *supra* note 148, at 6-7.

¹⁶⁸ European Commission, Publication, *Industrial Symbiosis*, 1, 2 (2018).

¹⁶⁹ European Commission, Publication, *Industrial Symbiosis*, 1, 2 (2018).

¹⁷⁰ Camilleri, *supra* note 17, at 1804.

¹⁷¹ World Economic Forum, *supra* note 120, at 7 (explaining that five policy considerations are most impactful: electric shared mobility, smart charging, refurbishment and repair, repurposing of electric vehicle batteries after use, and recycling); Păcurariu, et al., *supra* note 99, at 4.

The EU has been actively pursuing a transition to a circular economy model through the establishment of a regulatory framework that monitors specific indicators measuring progress in critical policy areas. However, this has resulted in a "two-speed-Europe" where some Member States are more advanced in pursuing circular economic principles than others. One solution proposed to address this barrier is the promotion of industrial symbiosis. Industrial symbiosis can generate economic value from materials that would otherwise be discarded, leading to more efficient use of resources and reducing dependence on resource-depleting systems. Further, the EU has funded cluster actions to support the implementation of industrial symbiosis. However, challenges remain in achieving full collaboration between industrial sectors, managing close cooperation between governing bodies, stakeholders, and the general public, and achieving public acceptance. Nonetheless, the transformation of waste into economic value is an important policy goal for the EU in preserving natural capital and reducing overall GHG emissions.

VII. *Conclusion And Summary*

The EU is committed to reducing GHG emissions and has implemented the "Fit for 55" package, which includes policies aimed at promoting renewable energy adoption, energy-efficiency, and emission reduction targets for buildings, cars, and vans. In the transportation sector, the EU has taken strong regulatory action to reduce emissions and set CO₂ emission performance standards for new vehicles. However, the lack of adequate and suitable charging infrastructure remains the main challenge for electric vehicles' implementation. To address this, the Commission proposed a regulation that would create a stable policy framework to establish a competitive market and stimulate private and public investment in recharging and refueling infrastructure throughout the entire transportation sector. The EU is also employing a circular economy theoretical framework in drafting its emissions reduction legislation, which can support resource-

efficient use of materials and reduce dependence on foreign materials. The transition to a circular economy model is seen as a necessary step towards achieving sustainable development goals, and proponents argue that the EU's existing economic monitoring framework needs improvements to effectively track progress. Ultimately, the 'Fit for 55' package has created a stable policy framework for establishing a competitive market and stimulating private and public investment in zero and low-emission vehicles.