

Appendix 1: Sources of Data and Information

Industry Structure

The locations of sites in the PVC chain, the plants in operation on the sites, the specific technologies employed by the plants and their capacities, and the capacities and feedstocks used by the crackers associated with the chain were obtained through published company annual reports and confidential interviews.

Plant Performance

The energy requirements of the plants, their input-output balances and cost information were obtained from a variety of sources, summarized below for each technology.

Ethylene Steam Crackers

“Best Available Techniques (BAT) Reference Document for the Production of Large Volume Organic Chemicals,” H. Falcke et al., Industrial Emissions Directive, European Union, 2017

“Decarbonization Options for Large Volume Organic Chemicals Production, Sabic Geleen,” C Oliveria and T Van Dril, MIDDEN, PBL Netherlands Environmental Assessment Agency, 2021

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“Understanding Variability to Reduce the Energy and GHG Footprints of US Ethylene Production,” Y. Yao et al., *Environmental Science & Technology* 49:14704–16, (2015)

“Prevention of Significant Deterioration Permit for Greenhouse Gas Emissions, Permit Application,” ExxonMobil Chemical Company Baytown Olefins Plant, 11/25/13

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Chlor-Alkali Plants

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“Decarbonization Options for the Dutch Chlor-Alkali Industry,” E. Scherpbier and H. Eerens, MIDDEN, PBL Netherlands Environmental Assessment Agency, 2021

“Brine Electrolysis,” T. Bommaraju and T. O’Brien, Electrochemistry Encyclopedia, The Electrochemical Society, 2015

“Results of the Second 2011–2020 Programme and Introduction to the Third 2021-2030 Programme, The Euro Chlor Sustainability Programme,” EuroChlor 17, 2021

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Ethylene Dichloride, Vinyl Chloride and Polyvinyl Chloride Plants

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“Reference Document on Best Available Techniques in the Production of Polymers,” European Union, 2007

“Cradle-to-Gate Life Cycle Analysis of Polyvinyl Chloride (PVC) Resin,” Franklin Associates, 2021

“Decarbonization Options for the Dutch PVC Industry,” V. Semeijn and K. Schure, MIDDEN, PBL Netherlands Environmental Assessment Agency, 2020

“Vinyl Chloride (VCM) and Polyvinyl Chloride (PVC),” Plastics Europe, The European Council of Vinyl Manufacturers (ECVM), 2015

“Vinyl Chloride and Polyvinyl Chloride: The Vinnolit EDC/VCM/PVC Process – a Climate-Friendly Technology,” ThyssenKrupp, 2021

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Combined Heat and Power Plants

“US Department of Energy Combined Heat and Power and Microgrid Installation Databases,” <https://doe.icfwebservices.com/chp>, downloaded January 6, 2022

“Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2021,” US Energy Information Administration, www.eia.gov/outlooks

“Net-Zero America: Potential Pathways, Infrastructure, and Impacts—Interim Report,” E. Larson et al., Princeton University, 2020

“Robert Wholey: Building America’s First Power Plant to Burn Cleaner Hydrogen Fuel,” *Engineering News Record* Jan 13, 2022

“US Construction Costs of Installed Natural Gas Generators by Type, 2019,” N. Sonnichsen, 2021, www.statistica.com/statistics/55732

“O&M Costs of New Power Plants in the US by Technology 2020,” 2021, B. Alves,
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Ethanol and Ethanol to Ethylene Plants

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“Low-Carbon Futures for Bioethylene in the United States,” G. Foster, *Energies* 12, 1958, 2019

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Technologies Under Development

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Carbon Dioxide Capture, Use, Transportation and Disposal

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- “Active Carbon Management: Critical Tools in the Climate Toolbox,” S. Koester and D. Hart, 2022
- “Cost of Capturing CO₂ from Industrial Sources” DOE/NETL-2013/1602, National Energy Technology Laboratory, 2014
- “A Comparison of Physical Solvents for Acid Gas Removal,” B. Burr and L. Lyddon, 2008, from <https://www.semanticscholar.org/paper/A-COMPARISON-OF-PHYSICAL-SOLVENTS-FOR-ACID-GAS-Burr-Lyddon/02a69d76747ddb2513ad43249c823dd620c57bac>
- “Parametric Process Design and Economic Analysis of Post-Combustion CO₂ Capture and Compression for Coal-and Natural Gas-Fired Power Plants,” E. Adu et al., *Energies* 2020, 13(10):2519
- “As CCS Investment Grows, Can Government and Industry Avoid Past Mistakes?” K. Adler, Net-Zero Business Daily™ News, Jan 2022, <https://cleanenergynews.ihsmarket.com/research-analysis>
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- “Net-Zero America: Potential Pathways, Infrastructure, and Impacts – Interim Report,” E. Larson et al., 2020, Princeton University
- “Net-Zero Europe, Decarbonization Pathways and Socioeconomic Implications,” McKinsey & Company, 2020
- “Carbon Dioxide Enhanced Oil Recovery,” National Energy Technology Laboratory, March 2010
- “Houston as a Global Hydrogen Hub,” Center for Houston’s Future, February 2022
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- “The Challenge of Decarbonizing Heavy Industry,” Samantha Gross, Brookings Institution, 2021
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- “Manufacturing Energy and Greenhouse Gas Emissions Associated with Plastics Consumption,” N. Rorrer et al., 2021

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