U.S. CHEMICAL SUPPLY CHAIN: INDUSTRY PERSPECTIVE AMID COVID-19

Chemical Sciences Roundtable (CSR) webinar

Board on Chemical Sciences and Technology
National Academies of Sciences

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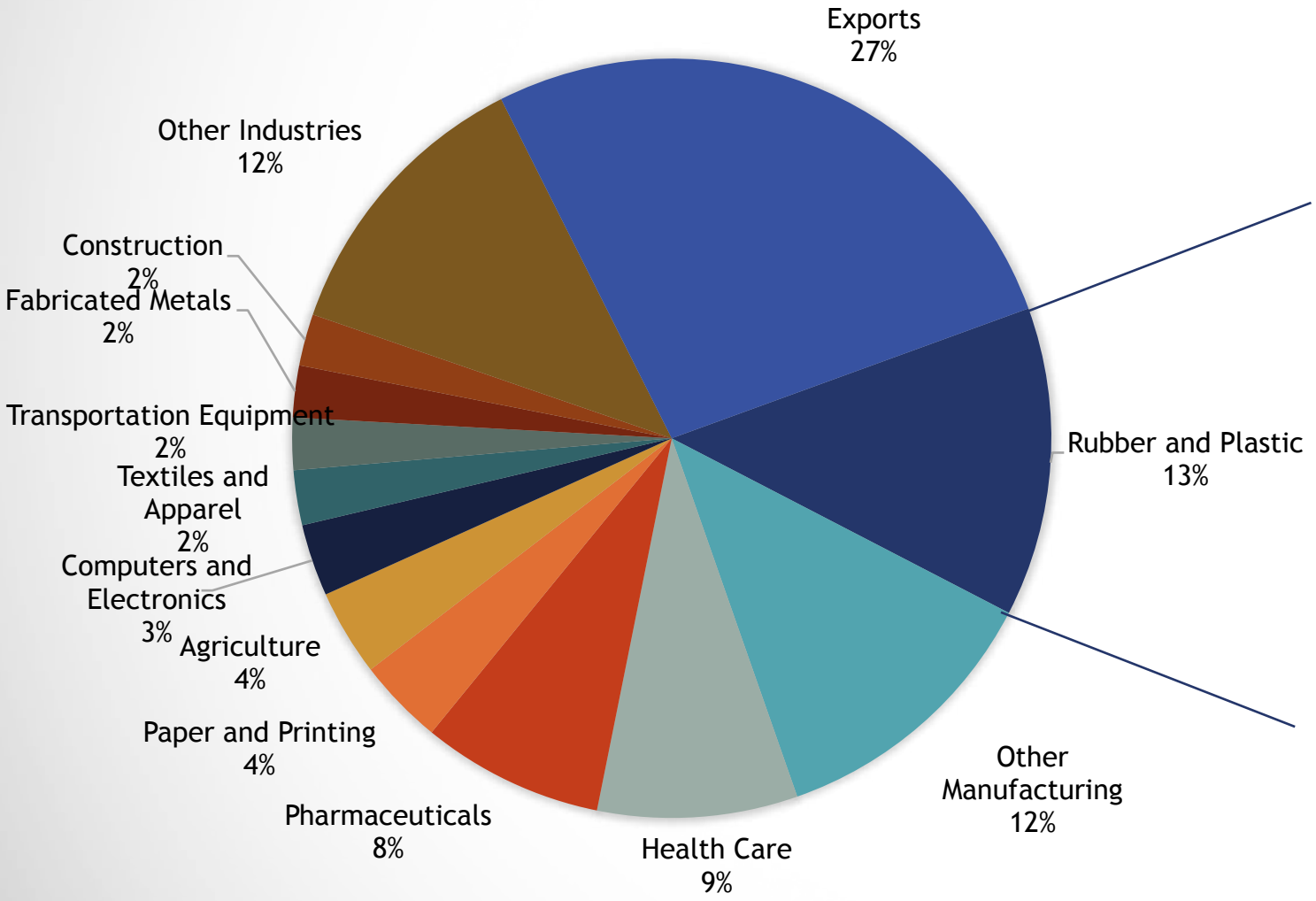
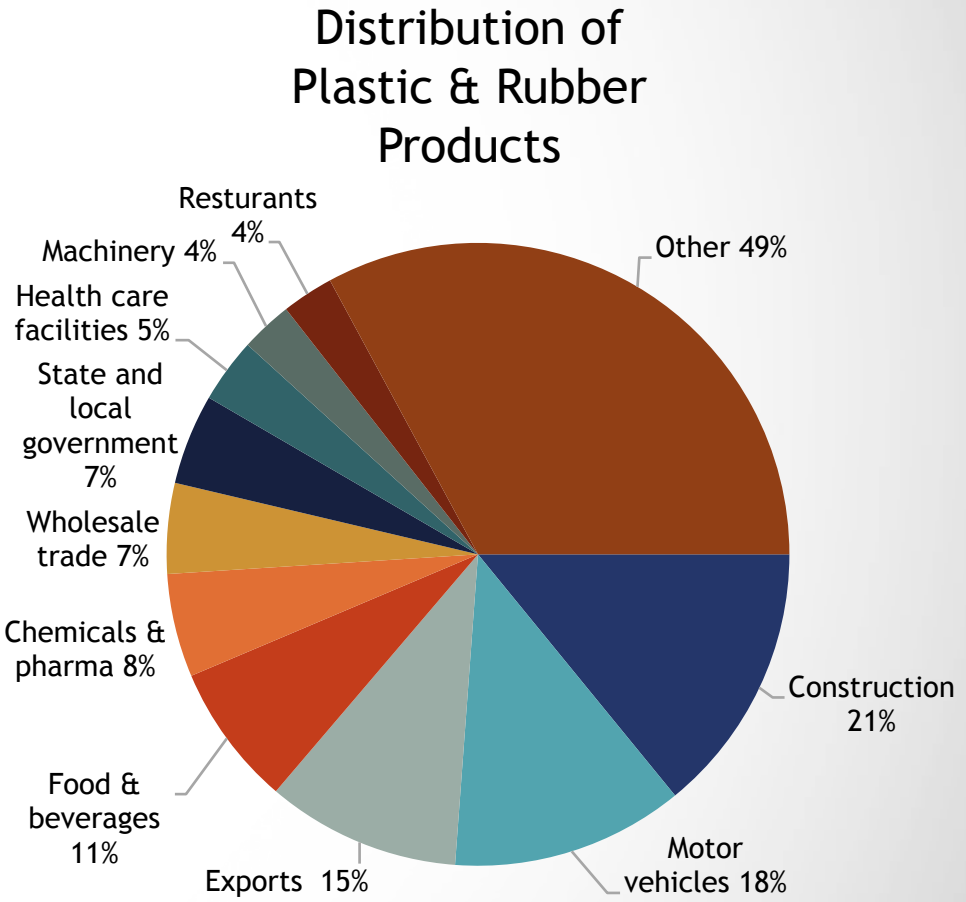
How Chemistry is Used in the Economy

- 85% of basic and specialty chemicals go into industrial and/or construction applications
- The largest intermediate end-use industry is plastic & rubber products which are used across the economy; other manufacturing and mining industries largely account for the rest
- Largest macroeconomic drivers are final (or ultimate) end-use markets including:
  - Retail (for packaging and materials for products)
  - Housing and other building and construction
  - Light vehicles and other transportation equipment
  - Appliances, furniture and home furnishings
  - Machinery and industrial
  - Exports
- Demand for chemistry depends upon health of these sectors and on health of foreign markets as 25% of chemicals are exported

Distribution of U.S. Chemical Sales





Note: does not include intra-industry sales

Our Industry's Role in the Fighting Coronavirus

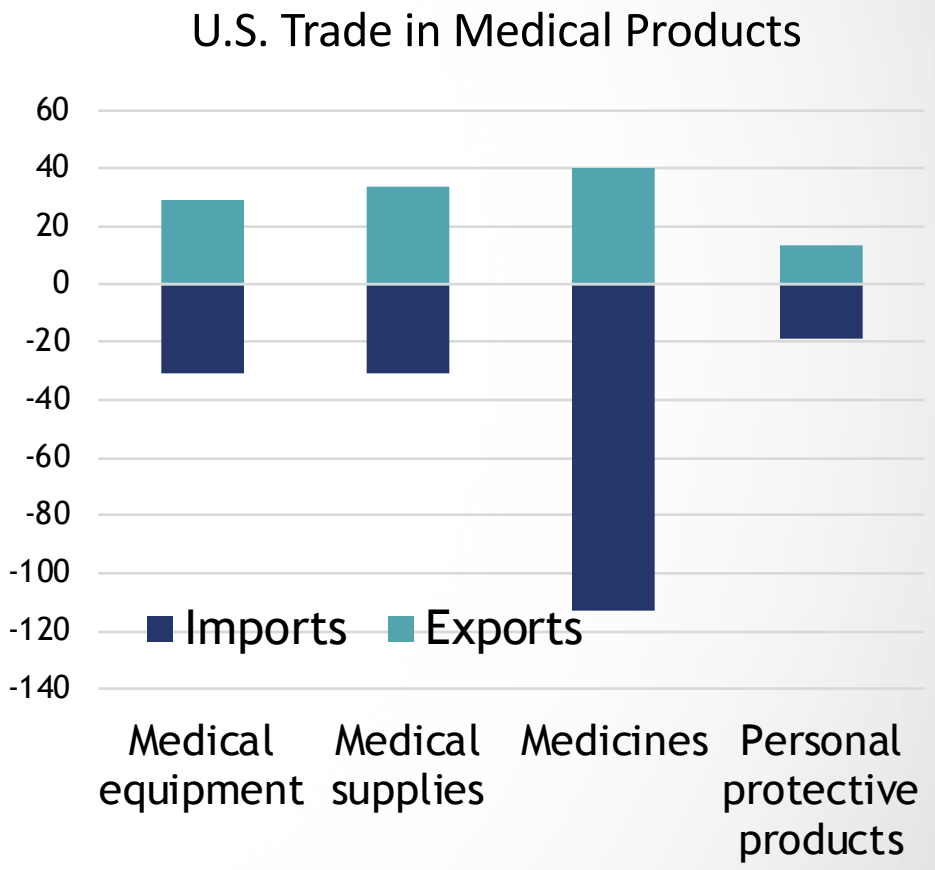
- From March/April survey, **73% of chemical manufacturers** surveyed indicated they produce or provide feedstock or intermediate chemicals used in the manufacture of products necessary to help the fight against COVID-19

# Companies	%	High-demand Finished Goods
42	46%	Biocides, bleach, antibacterial soap, hand sanitizers, antimicrobial disinfectants or detergents needed for sanitation
38	41%	Medical equipment (e.g. blood or IV bags, tubing, swabs, test kits or ventilators)
36	39%	Personal protective equipment (e.g. gloves, N95 masks, gowns, goggles, over-the-shoe booties or face shields)
33	36%	Packaging to maintain the sterility of medical goods and equipment
27	29%	Pharmaceuticals
25	27%	Other high-demand finished goods

Chemical Industry is Helping Stem the Spread

Chemistry Supports Medical Sector

- Chemistry contributes more than a quarter of the materials that go into medical equipment and medical supplies.
- The U.S. is the #1 importer and #2 exporter of medical products.
- The average U.S. tariff on medical supplies is 2.0% and the average tariff on personal protection products is 2.1%.
- China accounts for a quarter of world exports of face masks.

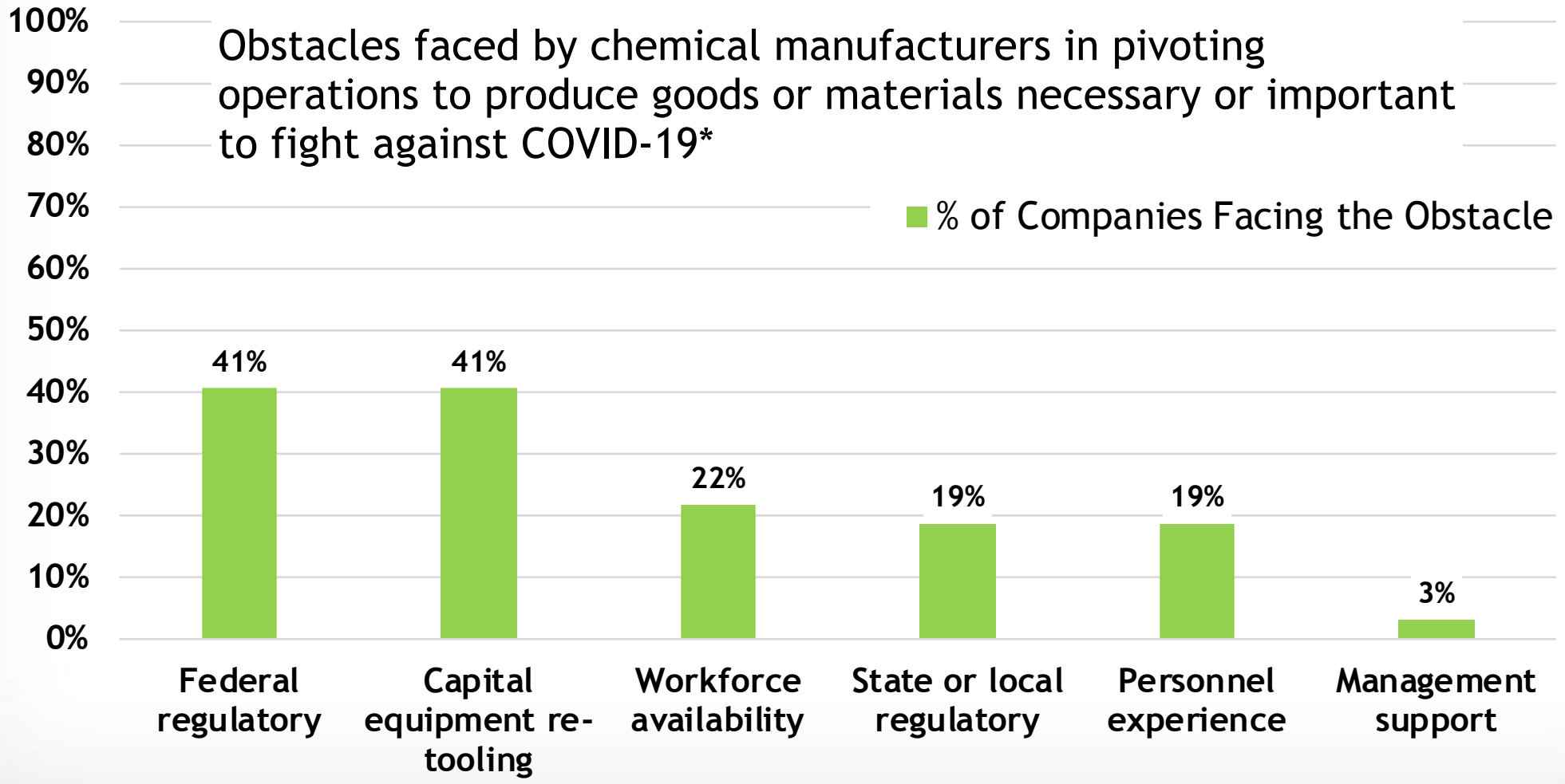


Source: World Trade Organization

Meeting Increased Demand

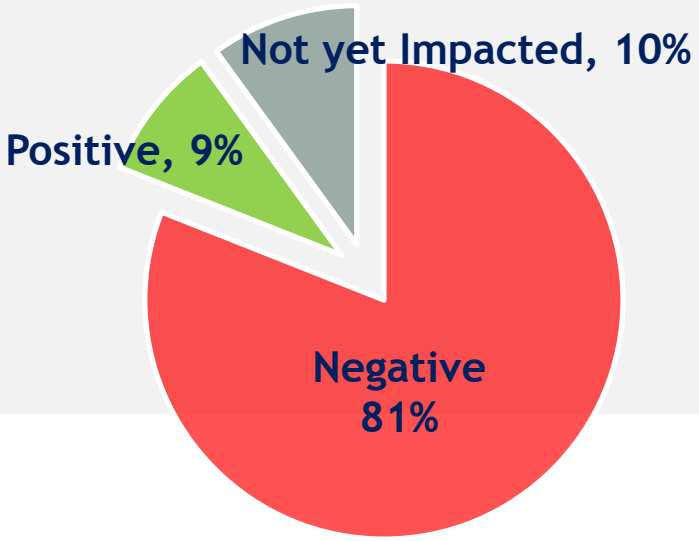
- **43% of companies** surveyed have the capability to pivot their manufacturing operations to produce goods or materials necessary to fight against COVID-19
  - Some may have already pivoted
- Many companies have increased capacity or shifted production lines to meet the demand for high priority product needs
- There are some supply-chain and market demand factors that are directly relevant in this area

Product Related Obstacles in March/April

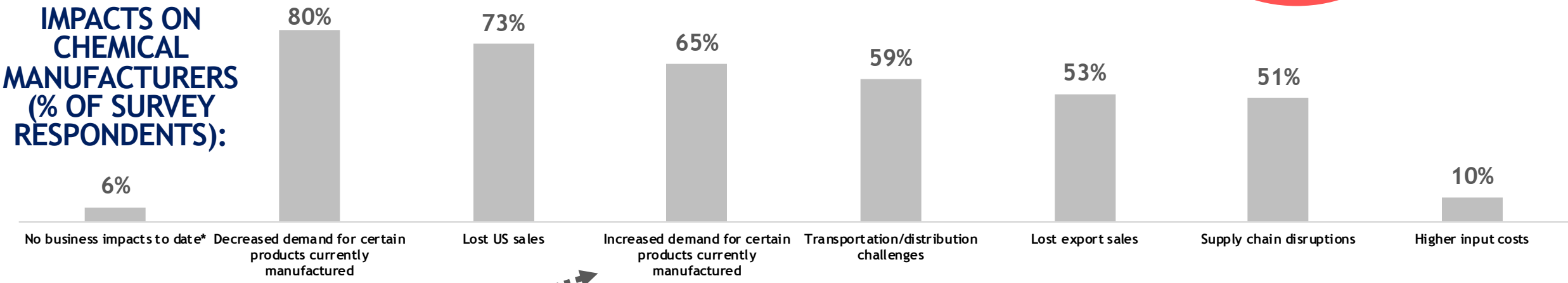


* Note: There are also important supply-chain issues and market factors that are relevant, so the survey data and any potential follow-up actions in this area needs to be carefully assessed

OVERALL IMPACT OF COVID-19 PANDEMIC ON CHEMICAL MANUFACTURERS:



IMPACTS ON CHEMICAL MANUFACTURERS (% OF SURVEY RESPONDENTS):



57% have experienced BOTH increased and decreased demand for certain products

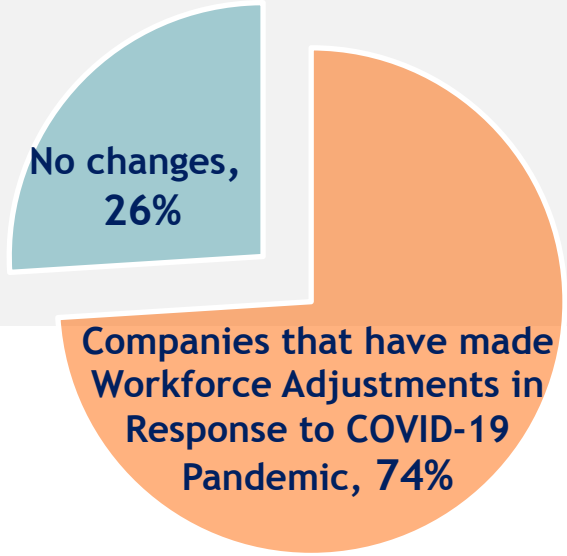
**Survey Period: April 29 - May 22, 2020*

ACTIONS TAKEN BY CHEMICAL MANUFACTURERS IN RESPONSE TO COVID-19 PANDEMIC (AS OF LATE MAY 2020)

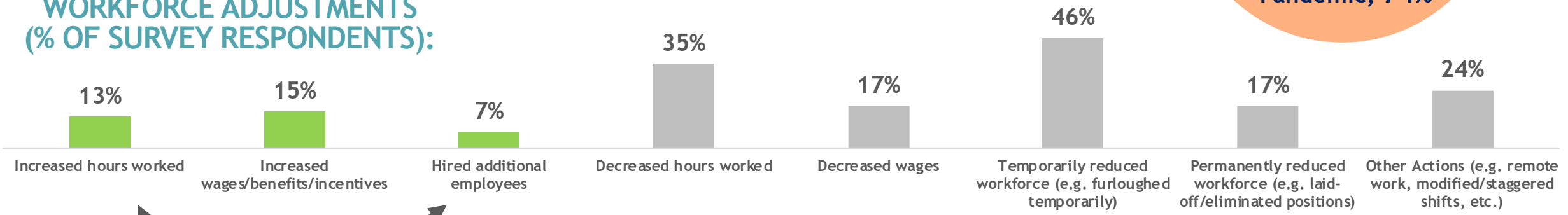
% of Companies	Actions Taken
73%	Cut capital expenditures
69%	Implemented workforce adjustments (e.g. reduced work hours, furloughs, layoffs, schedule modifications, reduced labor availability, etc.)
61%	Curtailed production
59%	Delayed or cancelled investment(s)
45%	Partial/Full shutdown some/all plants
39%	Pivoted operations to produce high-demand products
16%	Increased production volumes

**Survey Period: April 29 - May 22, 2020 (Preliminary results)*

CHEMICAL MANUFACTURING WORKFORCE ADJUSTMENTS MADE IN RESPONSE TO COVID-19 PANDEMIC



CHEMICAL MANUFACTURING WORKFORCE ADJUSTMENTS (% OF SURVEY RESPONDENTS):



24% have increased wages/ benefits/ incentives and/or expanded their workforce by increasing hours worked and/or hiring additional employees.

59% have implemented workforce adjustments including decreasing hours worked, decreasing wages, temporarily and/or permanently furloughed employees.

15% of companies have taken BOTH types of actions in response to the pandemic.

For example, some companies have increased hours worked and hired additional employees in some areas of their workforce while in other areas, they have had to decrease hours worked and implement both temporary and permanent workforce reductions. In interpreting this information, it's helpful to consider that 57% of companies have experienced both increased and decreased demand for certain products that they currently manufacture, however, overall, 81% of companies state that the impact from the covid-19 pandemic has been negative for their company.

**Survey Period: April 29 - May 22, 2020*

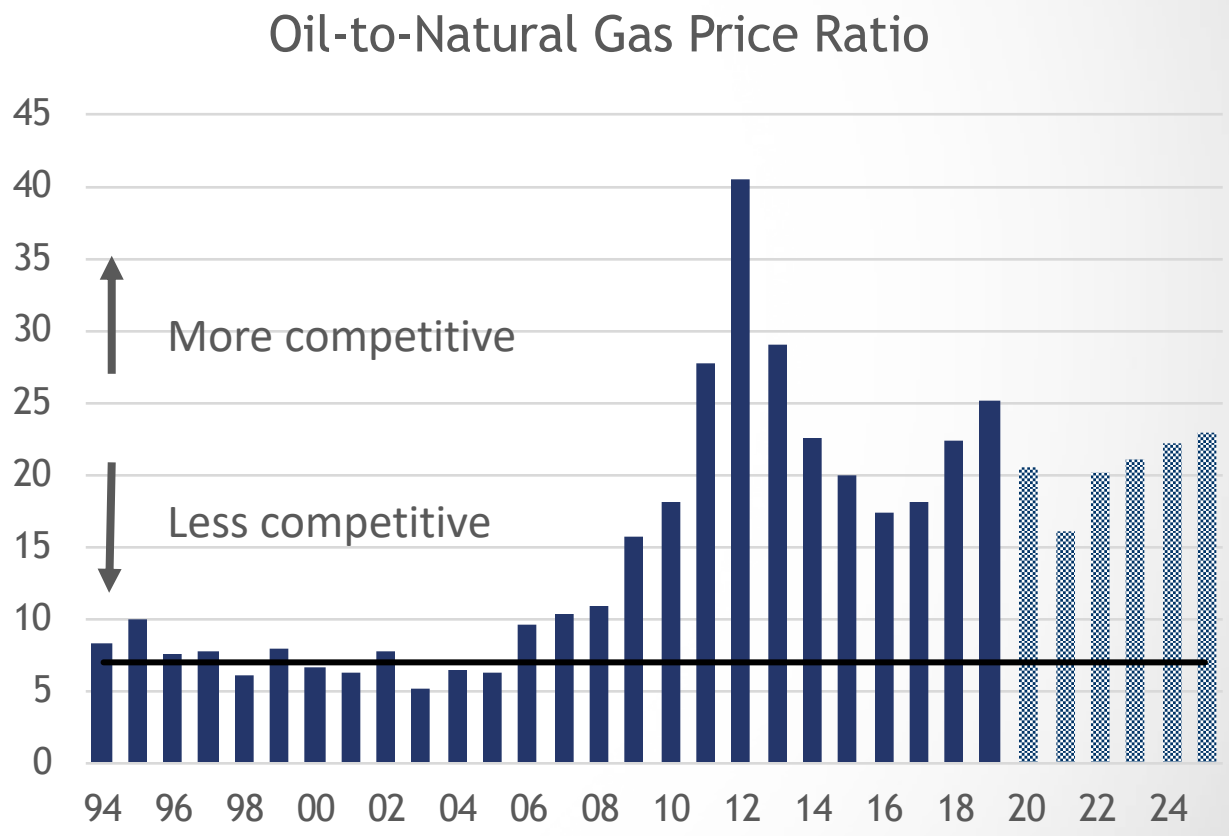
Outlook for U.S. End-Use Industries

- Industrial activity started the year on a weak note even before supply disruptions from Covid-19 emerged in February.
- Pandemic lockdowns shuttered many industries. Even industries deemed essential by DHS faced demand destruction from the sudden collapse in economic activity.
- Industrial production suffered the sharpest pullback on record in April, but many sectors are showing signs of recovery.
- In 2020, **industrial production** is set to fall 10.5% before growing by 3.1% in 2021
- All industries are expected to contract in 2020, with the best performance in food, beverages & tobacco; semiconductors; paper; and construction.

	2018	2019	2020	2021	2022	2023
Food, Beverages & Tobacco	1.9	0.0	-0.9	3.8	1.4	1.4
Semiconductors & Electronic C	9.1	4.2	-2.9	16.2	5.5	4.0
Paper	-1.1	-3.1	-3.4	7.2	1.5	0.4
Construction	3.1	1.4	-3.5	4.0	1.7	1.3
Oil & Gas Extraction	16.8	10.8	-3.9	-2.8	0.9	0.6
Computers	5.3	5.2	-4.8	14.9	4.5	2.9
Petroleum Refining	1.7	-1.8	-8.8	8.4	1.9	0.5
Structural Panels	3.1	-1.0	-9.6	10.7	2.9	1.2
Appliances	-0.6	-3.5	-11.2	11.6	2.8	1.9
Furniture	-0.1	-0.2	-13.0	11.0	2.0	1.5
Rubber & Plastic Products	1.9	-1.7	-13.2	12.6	3.7	2.7
Fabricated Metal Products	5.0	1.1	-13.8	14.4	1.8	1.1
Textile Mill Products	-0.9	-7.9	-15.6	4.4	-0.8	-1.8
Printing	-2.5	-4.0	-15.8	10.8	0.9	-0.5
Iron & Steel	6.0	0.2	-16.0	18.3	1.9	1.1
Aircraft & Parts	-1.7	2.3	-19.5	17.1	4.0	2.5
Apparel	-3.5	-12.2	-21.4	4.3	-0.8	-2.0
Motor Vehicles & Parts	4.3	-2.4	-26.7	24.7	6.9	1.3

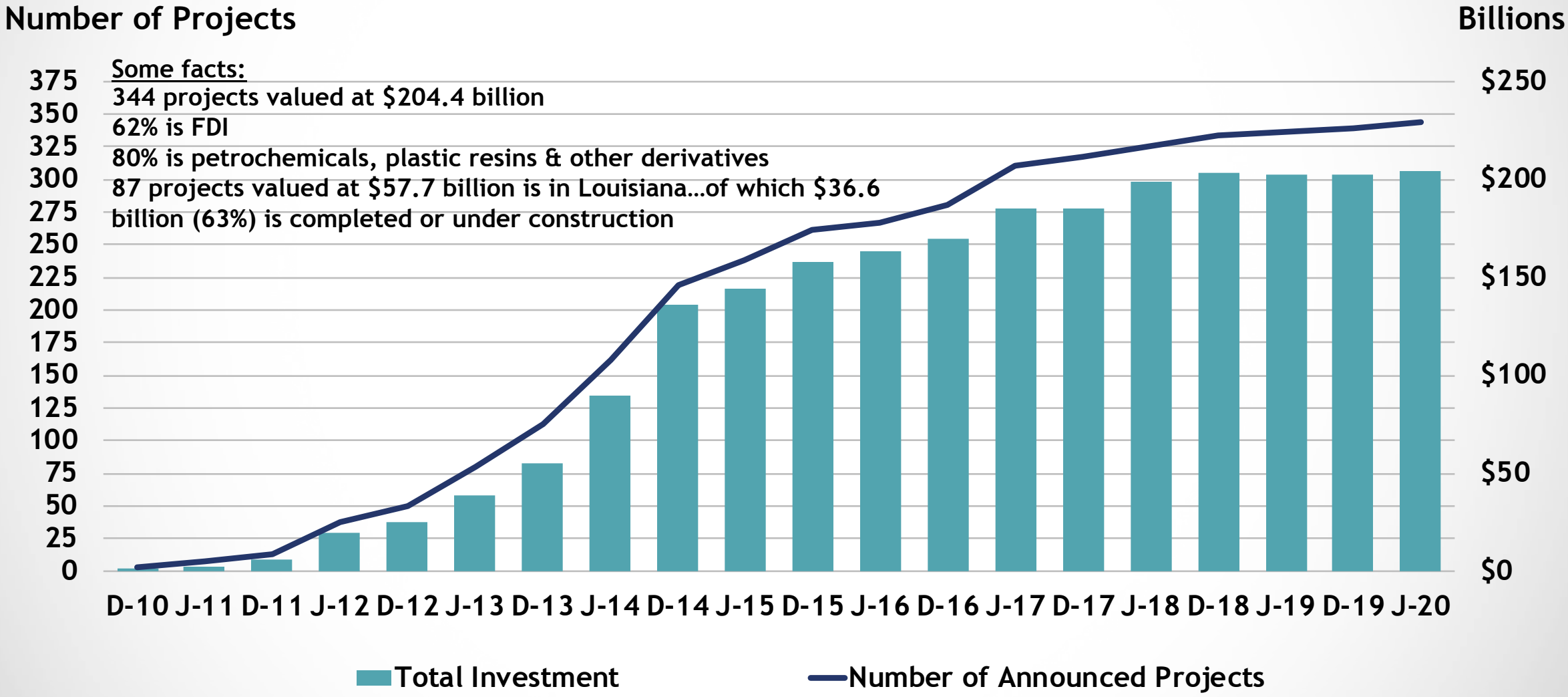
Natural Gas Based Petrochemicals Remain Competitive

- **Naphtha** is a petroleum product whose price is closely tied to oil.
- **Ethane** is a natural gas liquid (NGL) co-produced with natural gas production. Its price is correlated with natural gas prices.
- Because competing producers in Europe and Asia generally use naphtha feedstocks and North American producers generally use ethane and other NGL feedstocks, we look to the **relative price of oil to natural gas** as a proxy measure for U.S.-based petrochemicals competitiveness.
- As a rough rule-of-thumb, when the oil-to-natural gas price ratio is above 7, U.S. petrochemicals are relatively advantaged.
- When the ratio is below 7, U.S. petrochemicals are less advantaged.



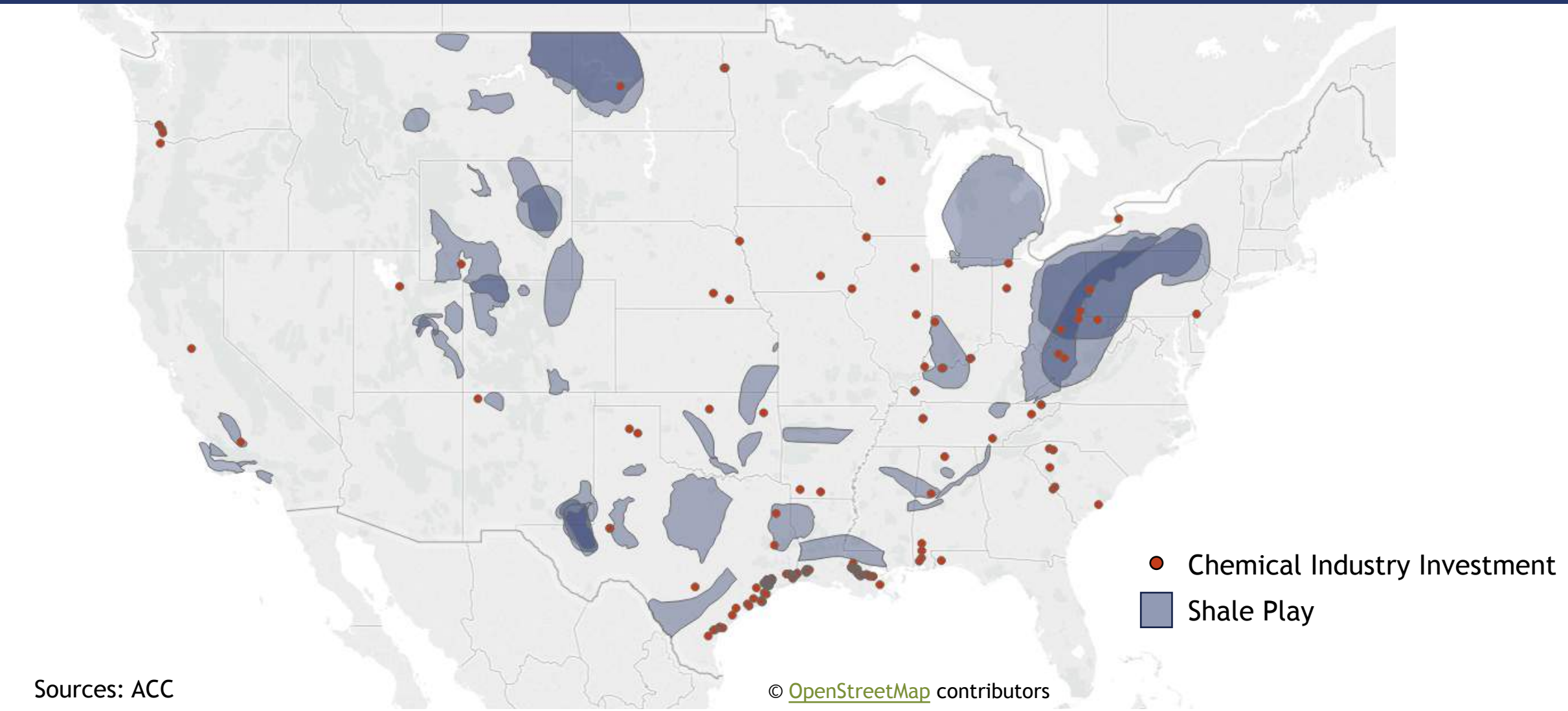
Sources: EIA, NYMEX, Oxford Economics

Cumulative Announced U.S. Chemical Industry Investments from Shale Gas



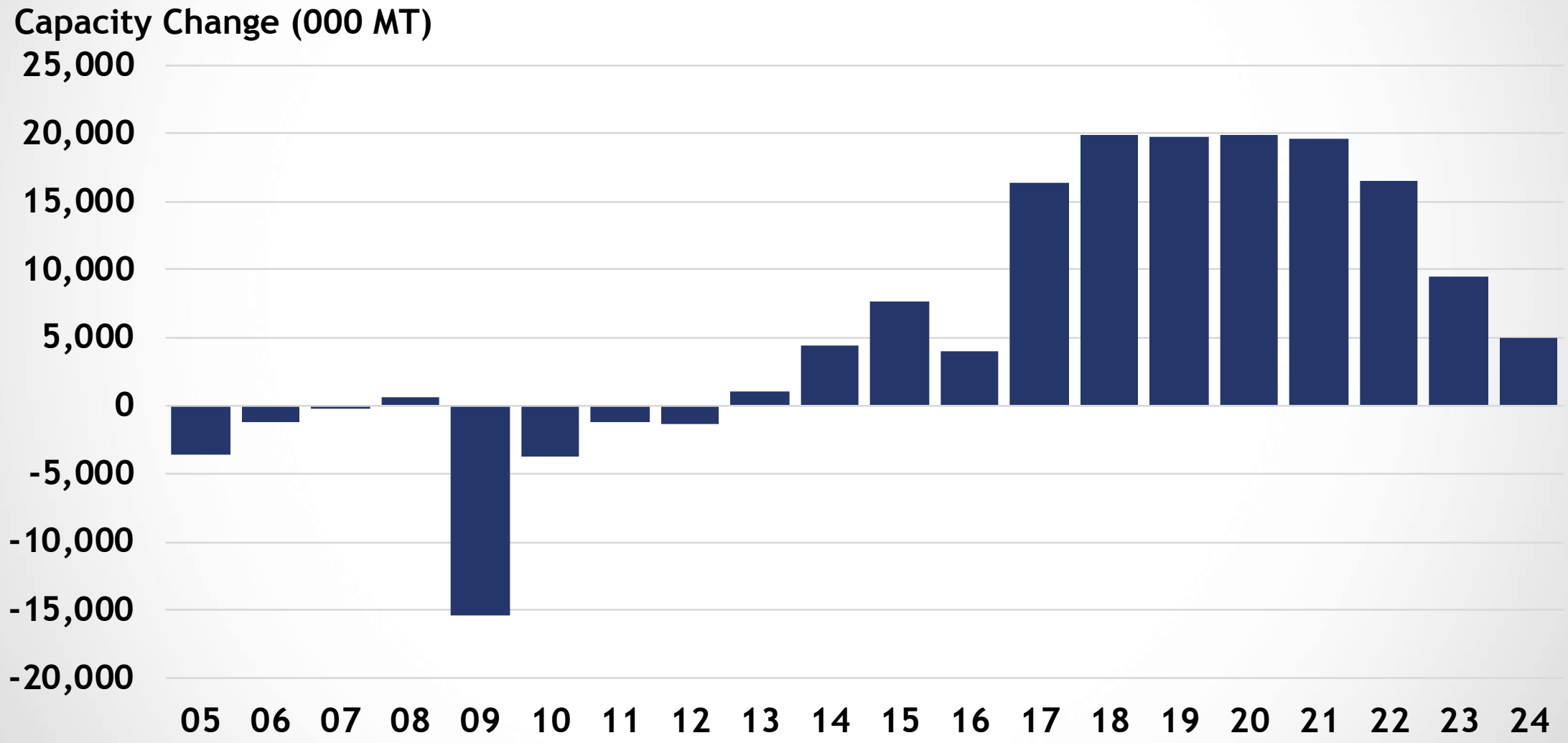
Source: ACC analysis

Geography of Shale-Advantaged Chemical Industry Investment



Sources: ACC

Annual Change in U.S. Basic Chemical and Synthetic Materials Capacity



Sources: ACC, AFPM, AMFA, CI, USGS and ACC analysis

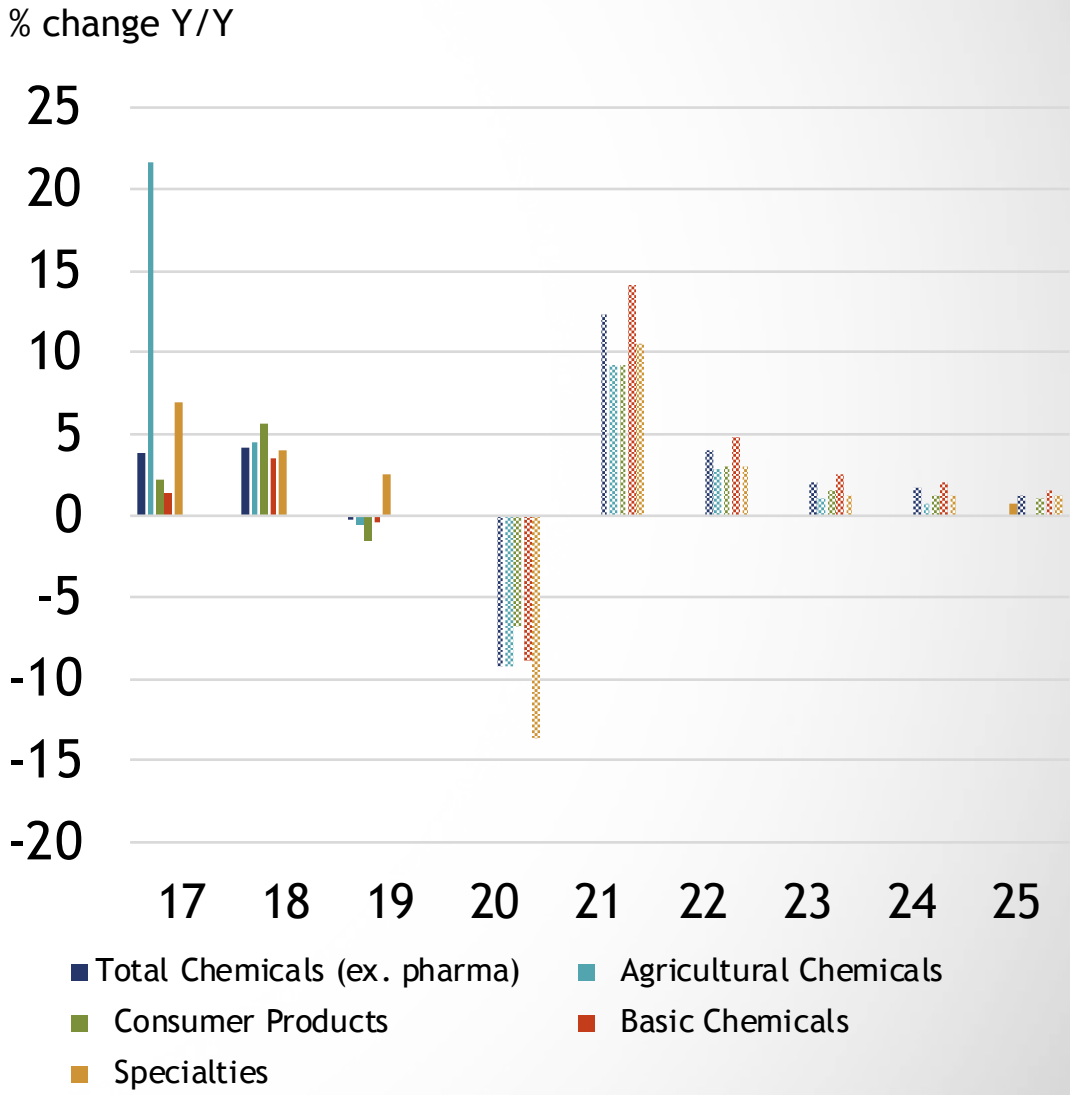
U.S. Basic Chemical and Synthetic Materials Producer Inventories

Sources: ACC, AFPM, USGS and ACC analysis

U.S. Chemicals Outlook: By Segment

While demand for some chemical products rose significantly in 2020 as part of the response to Covid-19, most demand channels for chemistry products weakened substantially in 2020. As a result, **total chemical production** is expected to fall by 9.3% in 2020 before rebounding by 12.3% in 2021.

Production of **basic chemicals**, which eased in 2019, is expected to fall 8.9% in 2020 before rising by 14.2% in 2021. **Specialty chemicals** are expected to weaken further, down 13.6% in 2020 before recovering by 10.6% next year. Various segments depend upon health and structural dynamics of end-use markets. Production of **agricultural chemicals** will fall 9.3% before improving by a similar amount the following year. Bolstered by sales of cleaning and disinfecting products, **consumer products** production is expected to fall by only 6.8% this year and grow by 9.3% in 2021.

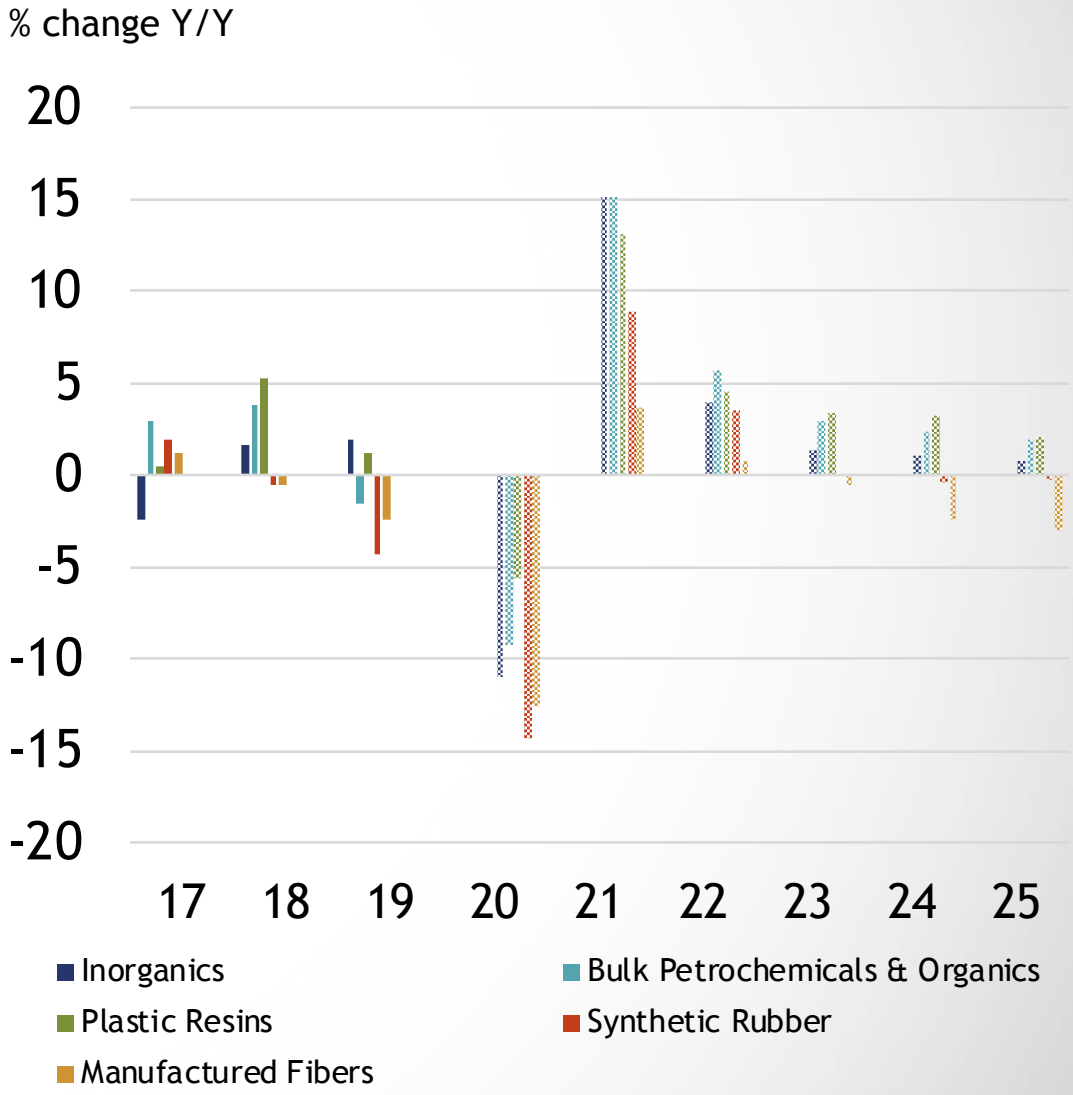


U.S. Basic Chemicals Outlook: By Segment

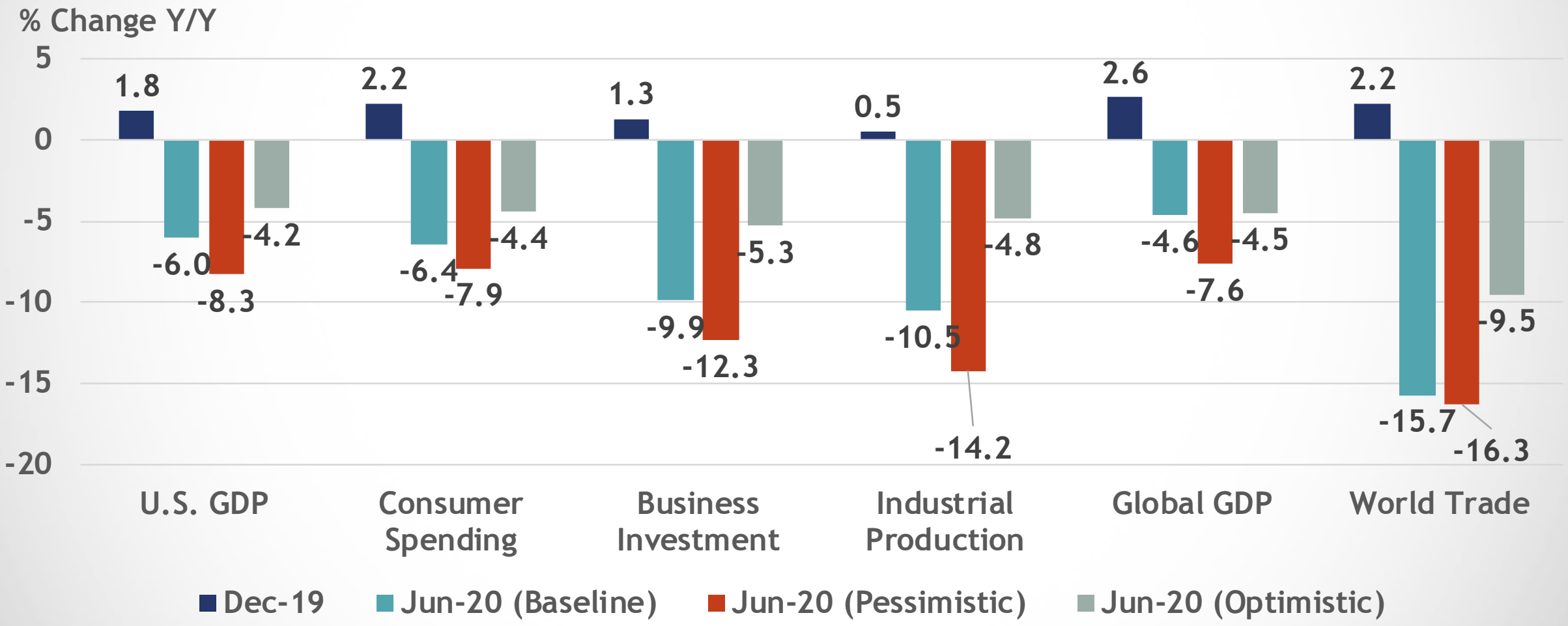
With demand destruction along key supply chains, **basic chemicals production** is expected to fall 8.9% in 2020, before rebounding by 14.2% in 2021.

Bulk petrochemicals and organic chemicals are expected to decline by 9.3% before rebounding by 15.2% in 2021. **Inorganic chemicals** are expected to fall 11.0% this year before recovering to a 15.2% pace in 2021.

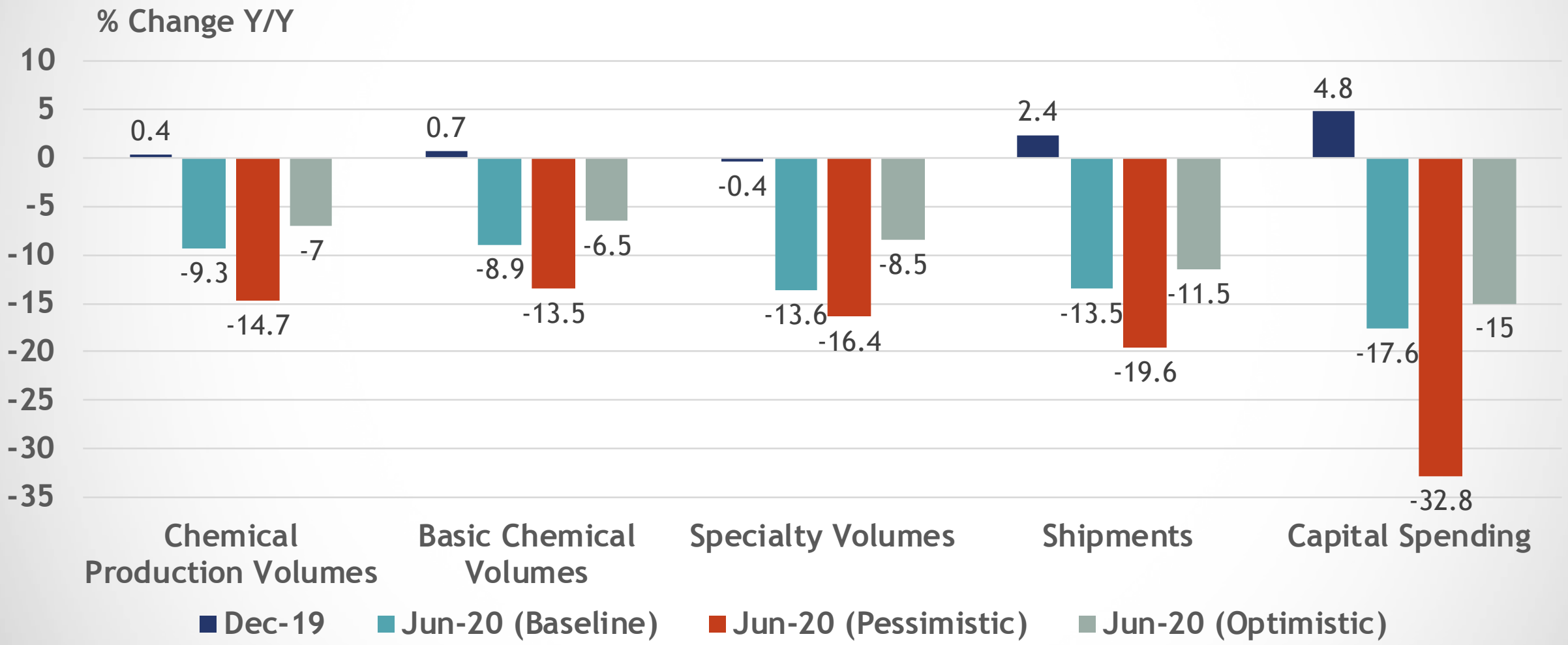
Of the major basic chemical segments, **plastic resins** fares the best with an expected decline of only 5.6% in 2020. This reflects offsetting demand for plastics used in PPE, barriers, medical supplies, and packaging. Plastic resins are expected to grow by 16.1% in 2021 and grow throughout the forecast period. **Synthetic rubber** is expected to decline 14.3% this year and grow by 8.9% in 2021. **Manufactured fiber** production is expected to decline 12.6% before growing by a modest 3.6% in 2021.



Comparison with December 2019 Outlook U.S. and Global Macro Indicators - 2020



Comparison with December 2019 Outlook
U.S. Chemicals - 2020



U.S. Chemical Industry Outlook Depends On…

Access to Abundant and Affordable Energy

Favorable Regulatory Environment

State of the U.S. and Global Economy

Access to Global Supply Chains

Access to Export Markets

Concluding Thoughts

- Shale gas has been a game changer in US natural gas markets with US first mover advantages and has improved the competitiveness of the US manufacturing, especially chemicals
- With renewed competitiveness, US exports gain as share of global output with reaccelerating growth and US capturing market share in shifting global demand patterns
- Reshoring of supply chains, digitalization of manufacturing customers, etc.
- Circular economy and sustainability
- In addition to shale gas, new materials (e.g., nanotechnology) and processes (e.g., bio-based chemistry) will also lead to enhanced growth
- In summary, a promising future!
- But challenges remain...

For Further Information

Please feel free to address questions to:

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