

*Final Report*

Fueling Export Growth:  
U.S. Net Export Trade Forecast  
for Key Chemistries to 2030

Prepared For:

American Chemistry Council

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## Fueling Export Growth: U.S. Net Export Trade Forecast for Key Chemistries to 2030 *January 2015*

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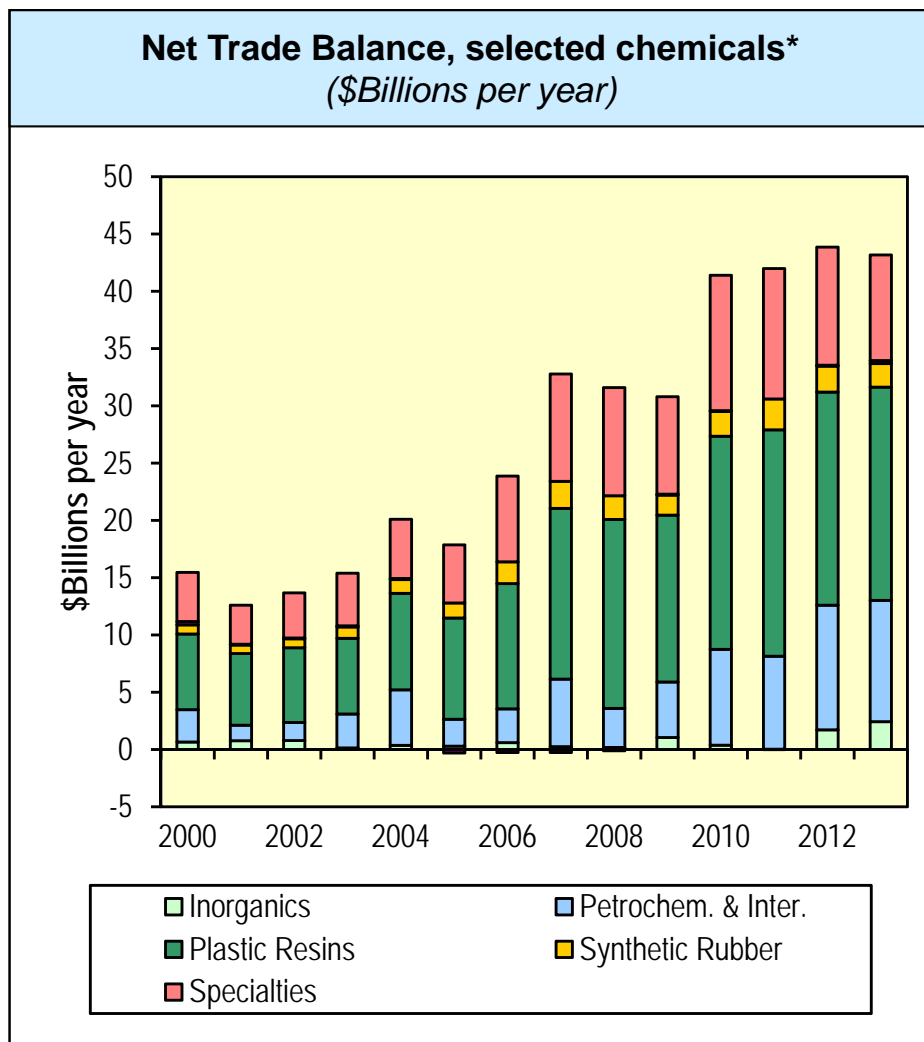
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**Section 1**  
**Executive Summary**

## Report Background: The ACC monitors trade statistics as part of its advocacy function



- The American Chemistry Council (ACC) issued a report in early 2013, “Keys to Export Growth”, that looked at the mix of policy and regulatory changes needed to capitalize on the improved competitiveness of the U.S. chemical industry and meet the Administration’s target of doubling U.S. exports by the end of 2014
- In 2013, the net trade surplus for the chemicals shown in the figure (which include all of the chemicals in this report, plus others\*\*) was \$43 billion, more than double the total from 2005
- Since the release of the ACC’s “Key” report, total announced investment in new or expanded chemical production facilities in the U.S. has risen to over \$100 billion, around half of which is foreign direct investment

\* Source: U.S. Department of Commerce, ACC analysis

\*\* The total 2013 net exports for the chemicals in this report was \$22.4 billion

## Report Background

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- These investments are being driven by low cost natural gas and associated gas liquids, especially ethane, a primary feedstock for ethylene production, the largest volume petrochemical intermediate
- Even assuming that only a proportion of this announced investment will actually be built, it is likely that U.S. chemical production will increase significantly in the next ten years, *and that this increased production is unlikely to be absorbed by the domestic market*
- To better project the outlook for U.S. chemical exports, the ACC authorized this report, which examines the anticipated increase in U.S. chemical production to 2030 and draws some conclusions about which foreign markets are likely destinations for this production
- Specifically, this report examines the trade outlook (2010 to 2030) and the subset of chemicals derived from unconventional oil, natural gas, and gas liquids that are expected to experience the greatest increase as a result of U.S. capacity increases over this period
- This report provides estimates of annual U.S. net trade volumes for the covered products over the forecast period and the expected destinations (countries and/or regions) for the chemicals examined in the report and potential value of these trade movements
- This report also provides an analysis of trade trends and policies that could impact the chemical industry

**Report Scope: This report provides a US net export trade forecast to 2030 for the following 66 chemicals and HTS codes at the Commodity and Category level:**

Commodity	Category	Chemical
Petro-chemicals	C1 Chemicals	Methanol
	C2 Chemicals	Styrene
		Vinyl Acetate
	C3 Chemicals	2-ethyl-1-hexyl Acrylate
		2-ethylhexanol (2-EH)
		Acrylic Acid
		Butyl Acrylate
		isoPropanol
		n-butyl Alcohol
	C4 Chemicals	Propylene Glycol
		1,3-Butadiene
	Aromatics	Benzene
		Mixed Xylene Isomers
		Phthalic Anhydride
Toluene		
Intermediates	C2 Chemicals	Ethylene dichloride (EDC)
		Ethylbenzene
		Ethylene Glycol
		Vinyl chloride monomer (VCM)
	C3 Chemicals	Acrylonitrile
		Cumene
		Phenol
		Polyether Polyols
		Propylene Oxide
	Aromatics	Adipic Acid
		Aniline
		Caprolactam
		Cyclohexane
		Methylene diphenyl diisocyanate (MDI)
Nitrobenzene		
Para-xylene		
Purified terephthalic acid (PTA)		
Toluene diisocyanate (TDI)		

Commodity	Category	Chemical
Polymers & Rubber	C2 Chemicals	Expanded polystyrene (EPS)
		Polyethylene
		Polystyrene (PS)
		Polyvinylchloride (PVC)
	C3 Chemicals	Acrylic Polymers
		Polycarbonates
		Polypropylene
	C4 Chemicals	Acrylonitrile butadiene styrene (ABS)
		Polybutadiene Rubber (PBR)
		Styrene butadiene rubber (SBR)
Aromatics	Polyethylene terephthalate (PET)	
Fertilizers	C1 Chemicals	Ammonia
	Inorganics	Urea
Inorganic Chemicals	Inorganics	Diammonium phosphate (DAP) and Monoammonium phosphate (MAP)
		Soda Ash
		Sodium Hydroxide
		Sulfuric Acid
Specialties	Coatings & Inks	Titanium Dioxide
		3208 Paint & Varnish From Synthetic Polymers, Nonaqueous
		3209 Paint & Varnish From Synth. Polymers, Aqueous
		3210 Paints & Varnishes Nesoi; Water Pigmts For Leather
	Other Specialties	3215 Ink, Printing, Writing, Drawing
		3801 Artificial Graphite; Collodial Graphite & Prep
		3809 Finishing Agents Etc For Textiles, Paper
		3810 Pickling Preps For Metal; Soldering
		3811 Antiknock Preps & Other Additives For Mineral Oils
		3812 Prepared Rubber Accelerators; Plasticizers Etc.
		3813 Prep & Charges For Fire-extinguishers
		3815 Reaction Initiators & Catalysts
		3818 Chem Elem Doped, Used In Electron, Discs Wafers
		3819 Hydraulic Brake & Transmission Fluids
		3821 Prepared Culture Media For Devel't of Microorganisms
		3822 Composite Diagnostic/lab Reagents, Exc Pharmaceut

**Report Scope and Abbreviations: This report provides a US net export trade forecast to 2030 for the chemicals listed on the previous page at the Commodity and Category level:**

The geographical composition of the above identified U.S. exports were divided into the following four geographical regions:

- Americas
  - Canada (added to scope)
  - Mexico (added to scope)
  - Brazil
  - Other Americas
- Europe
- Asia
  - China
  - India
  - Other Asia
- Rest of World. (Middle East, Africa, Oceania)

Net exports were classified into the following segments:

- Plastic Resins
- Petrochemicals
- Fertilizers
- Intermediates
- Inorganics
- Specialties

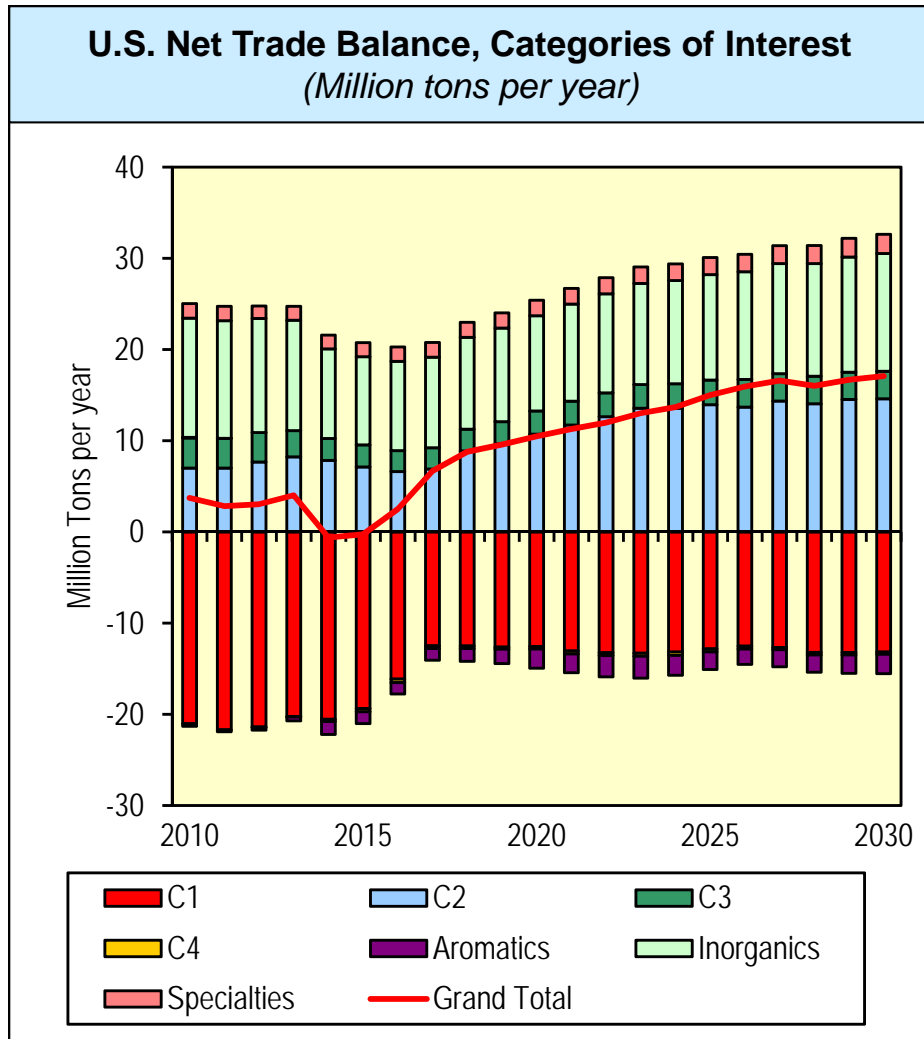
Abbreviations Used in this Report	
2-EH	2-ethylhexanol
ABS	Acrylonitrile butadiene styrene
APEC	Asia-Pacific Economic Cooperation forum
DAP	Diammonium phosphate
E&P	Exploration and Production (oil and gas)
EDC	Ethylene dichloride
EPCA	Energy Policy and Conservation Act of 1975
EPS	Expanded polystyrene
FTA	Free Trade Agreement
HDPE	High density polyethylene
LLDPE	Linear low density polyethylene
MAP	Monoammonium phosphate
MDI	Methylene diphenyl diisocyanate
NGL	Natural gas liquids (ethane, propane, butanes, and natural gasoline)
PBR	Polybutadiene Rubber
PE	Polyethylene
PET	Polyethylene terephthalate
PS	Polystyrene
PTA	Purified terephthalic acid
PVC	Polyvinylchloride
SBR	Styrene butadiene rubber
TDI	Toluene diisocyanate
TPP	Trans Pacific Partnership
TTIP	Transatlantic Trade and Investment Partnership (US-EU)
VCM	Vinyl chloride monomer



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**Section 1**  
**Executive Summary: Net Trade Balance Summary**

**Trade Trends by Category: On a weight basis, the U.S. trade balance for the selected chemicals is projected to increase from a small deficit in 2014 to a surplus of 17 billion tons by 2030**



The deficit in C1 chemicals will shrink by 35%, as additional methanol, ammonia and urea capacity based on natural gas feedstocks are constructed

Net exports of C2 chemicals, which includes polyethylene and PVC, will nearly double to 14.6 billion tons

Trade surplus for C3 chemicals will expand by 25% to 3 billion tons

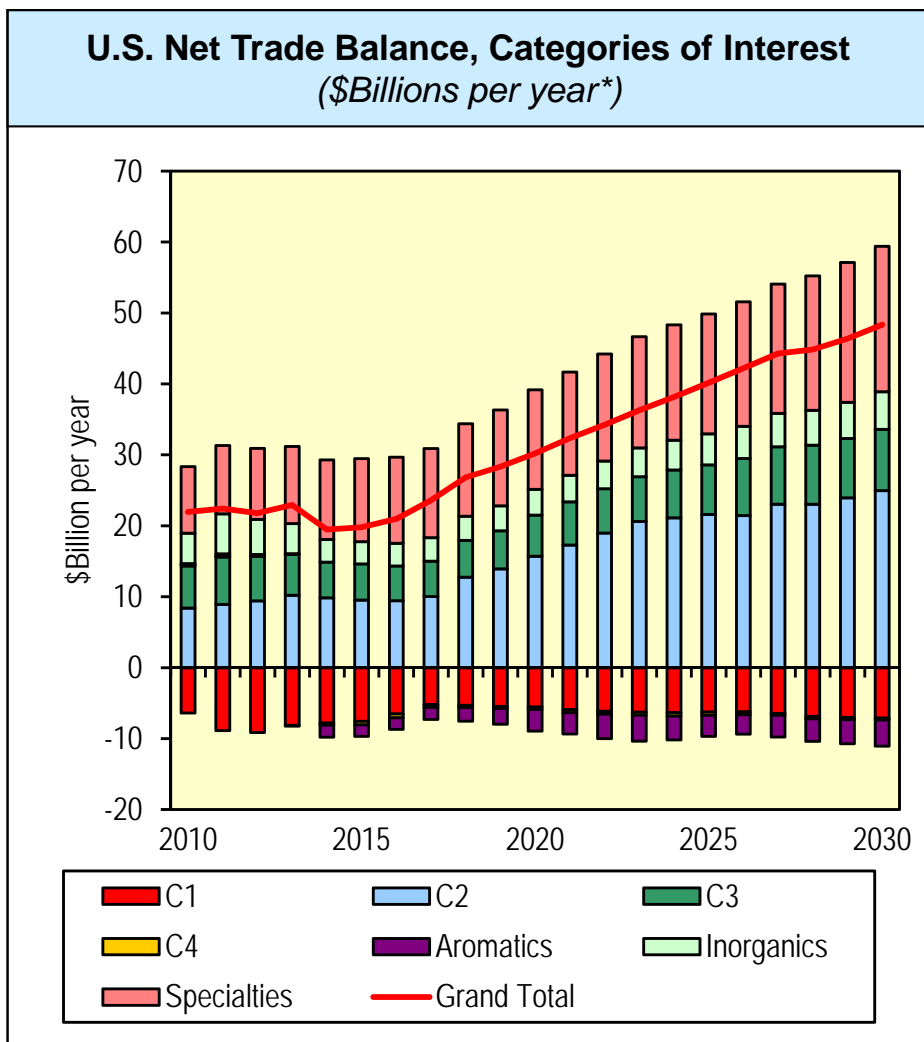
Due to the lightening of cracker feedstocks and continued importation of benzene and butadiene, the small trade deficit for C4s and aromatics will continue

The trade surplus for inorganics, which have lower average prices than the other materials, will increase from 10 billion tons to 13 billion tons

Due to relatively high prices, the trade surplus for specialties has a relatively small impact on a weight basis

**On a weight basis, the largest impact is reduced C1 net imports and increased C2 net exports**

**Trade Trends by Category: Due to higher “value-added” of exports compared to imports, the U.S. trade surplus for the selected chemicals is projected to increase from \$19.5 billion in 2014 to \$48.3 billion by 2030**



Although balanced on a weight basis, the U.S. is in surplus by \$19.5 billion on a value basis

The trade deficit in C1 chemicals will shrink as new natural gas based ammonia and methanol plants are built

Most importantly, driven by competitive advantage based on low cost ethane and a massive investment in new crackers to make ethylene, net exports of C2 chemicals will increase by \$15 billion

C3 chemical exports will recover after on-purpose sources of propylene are built

The trade deficit in aromatics and C4s will continue as the U.S. continues to import large quantities of benzene and butadiene

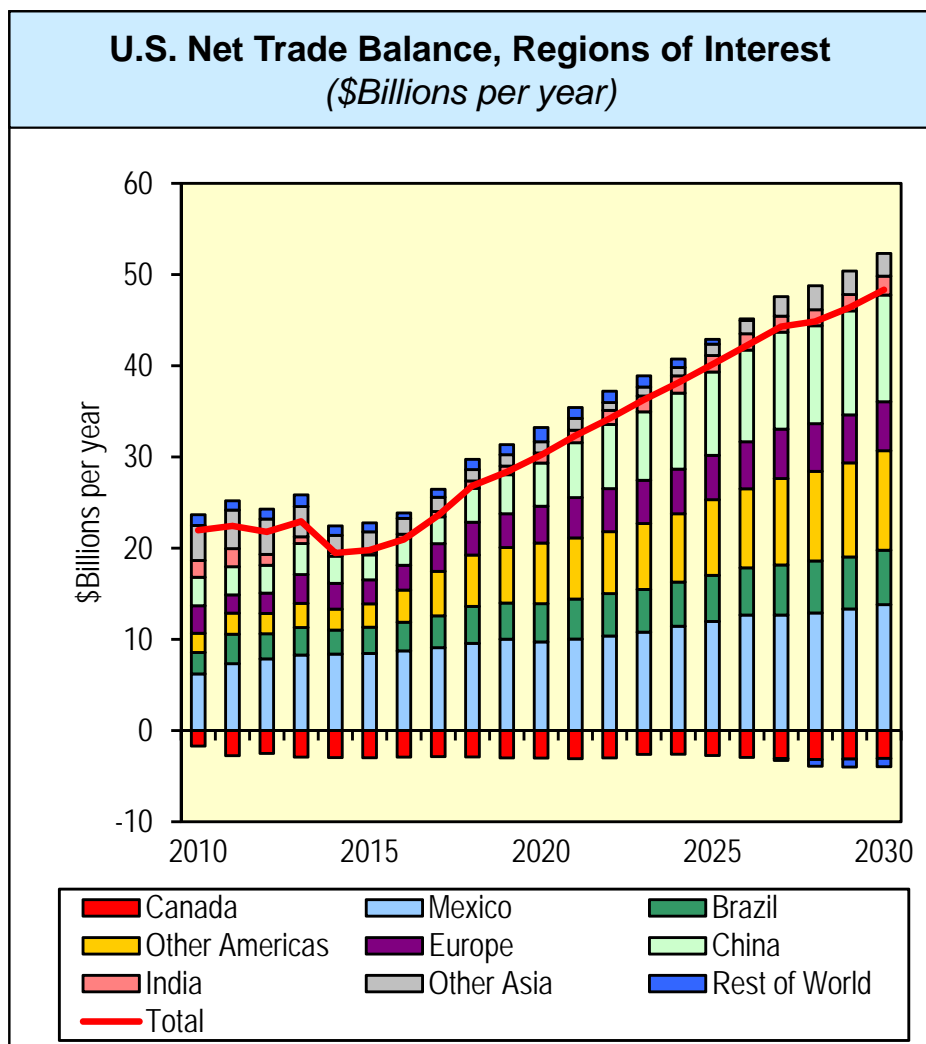
Note that net exports of specialties will increase from \$11.2 billion in 2014 to \$20.5 billion by 2030, based on intellectual property and competitive advantage

As a comparison, for 2013, total U.S. exports of goods were \$1,590.4 billion and imports were \$2,293.5 billion, resulting in a goods deficit of \$703 billion

**The 2014 trade surplus of \$19.5 billion for the selected chemicals represents 2.8% of the absolute value of the \$703 billion 2013 U.S. trade deficit in “goods”**

\* Current dollars, assuming 2% inflation

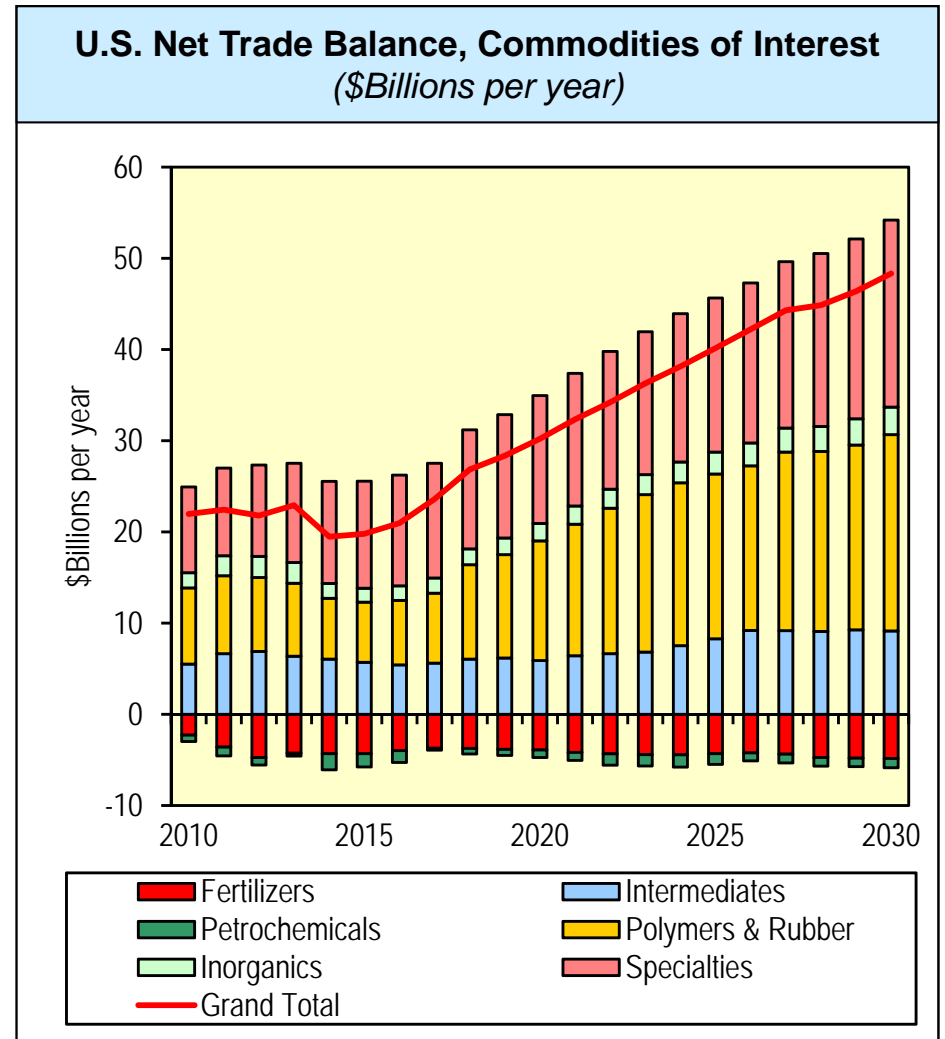
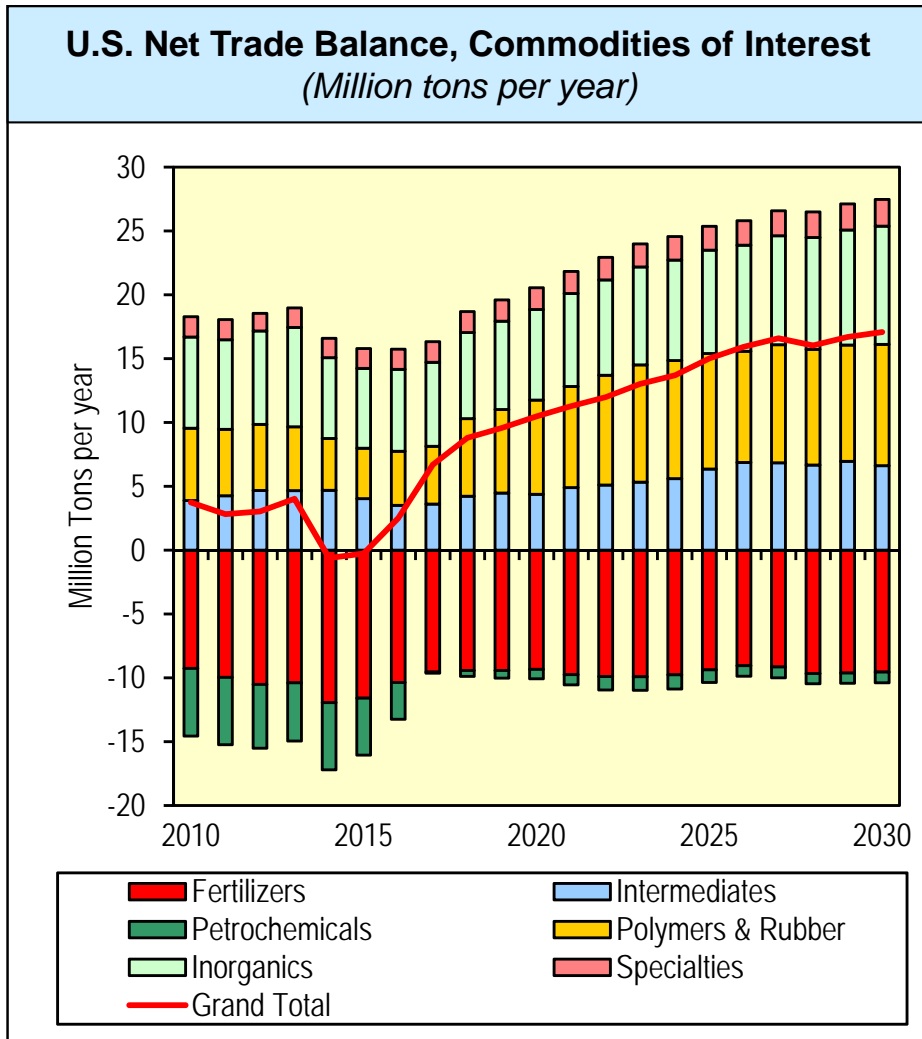
**Trade Trends by Region:** The value of chemical net exports reviewed herein will increase from \$19.5 billion in 2014 to \$48 billion per year by 2030, with the Americas (Canada, Mexico, Brazil, Other Americas) expected to remain the leading net export destination



- **Canada:** Deficit remains at \$3 billion by 2030
- **Mexico:** Surplus improves by \$8.4 billion to \$13.8 billion by 2030 (*growth of \$5.4 billion*), but is not growing as fast as the overall net trade surplus
- **Brazil:** Surplus more than doubles to \$6.0 billion by 2030
- **Other Americas:** Surplus improves from \$2.3 billion to \$10.9 billion by 2030 (*growth of \$8.6 billion*)
- **Europe** Surplus improves from \$2.8 billion to \$5.4 billion by 2030
- **China:** Surplus improves by \$3.0 billion to \$11.7 billion by 2030 (*growth of \$8.7 billion*)
- **India:** Surplus improves by \$0.4 billion to \$2.1 billion by 2030
- **Other Asia:** Surplus improves by \$1.9 billion to \$2.5 billion by 2030
- **Rest of World:** \$1.0 surplus becomes a deficit of \$0.9 billion by 2030

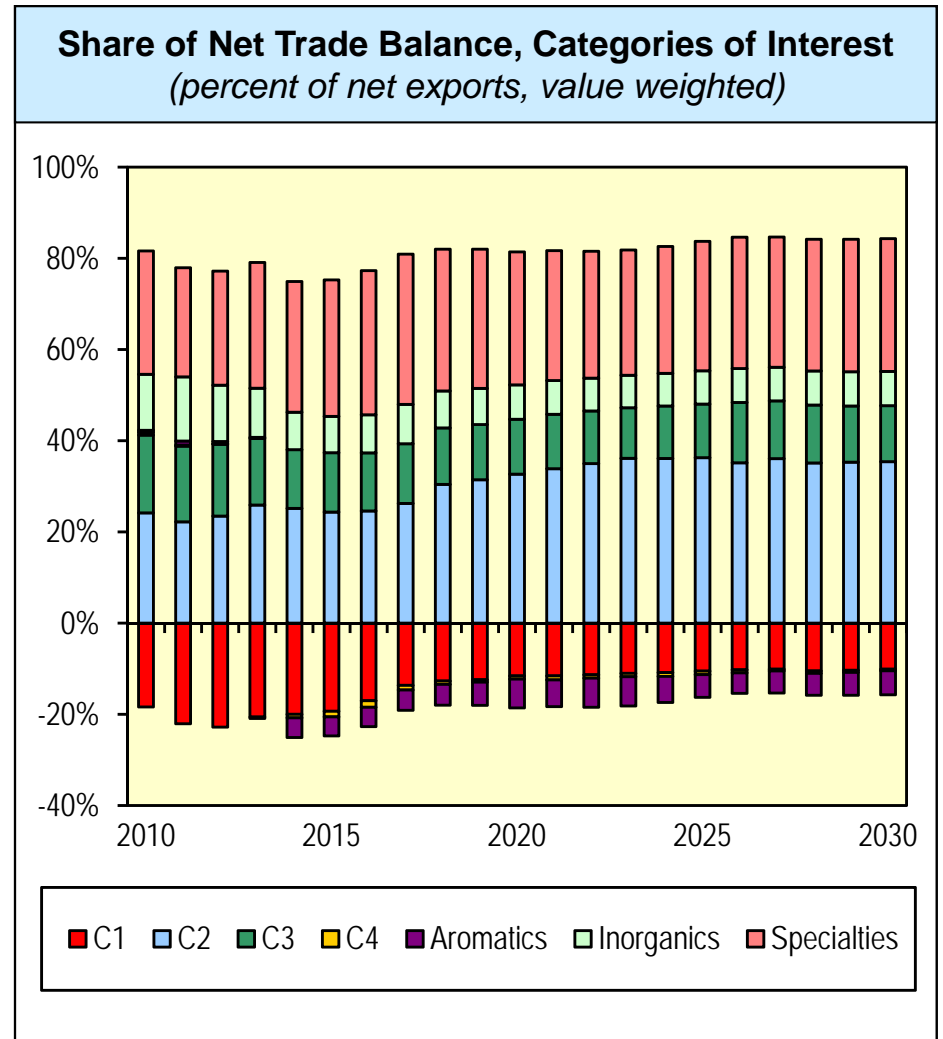
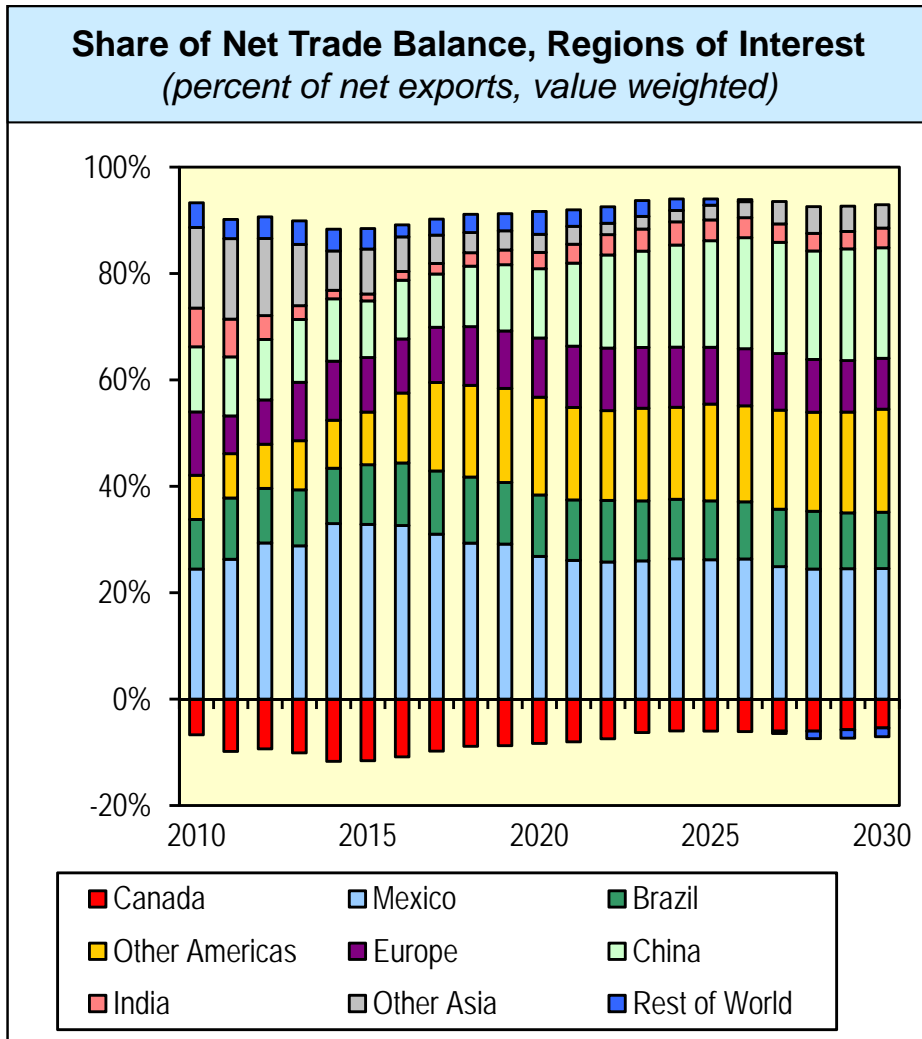
**Net exports to China, Mexico, and Other Americas and are forecast to account for \$22.7 billion of the \$28.5 billion in regional net export growth**

The biggest driver of the improving U.S. trade surplus will be polymers (with growth to \$21.5 billion of net exports by 2030), specialties (to \$20.5 billion), and intermediates (to \$9.15 billion of net exports)



**The U.S. will remain in deficit for petrochemicals and fertilizers, and realize a modest improvement for inorganics, with the value of net exports growing at 4.0% CAGR**

**On a share basis, net exports of chemicals and plastics to China and Other Americas will account for an increasing share of U.S. exports; while exports to Canada, Mexico, Europe and Other Asia will account for a declining share**



**Net exports of C2 chemicals will show the largest share gain, while C1 chemical net imports will decrease markedly**

**The value of U.S. net exports will increase to \$48.3 billion by 2030, representing 5.8% compounded value growth, with important improvements in the trade surplus for C1 chemicals, C2 chemicals and specialties**

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**On a category basis:** Shale gas and NGLs will have a positive impact on U.S. petrochemical investment and net exports for C<sub>1</sub>-C<sub>3</sub> petrochemicals, and a negative impact on supply of aromatics, with relatively little impact on C4 chemicals as follows:

- **C1** – much fewer imports of methanol, ammonia and urea as new domestic capacity is added
  - Trade deficit shrinks from \$20.5 billion to \$13.2 billion in 2030
- **C2** – much greater exports of ethylene derivatives based on feedstocks from new ethane steam crackers
  - Surplus more than doubles from \$9.8 billion to \$25 billion in 2030
- **C3** – C3 derivative exports will recover after on-purpose sources of propylene are built
  - Net exports grow from \$5.0 billion to \$8.6 billion by 2030
- **C4** – minor impact on net imports and exports of butadiene and derivatives
  - Deficit stays at approximately -\$0.3 billion
- **Aromatics** – a minor change, with fewer net exports (or greater net imports) of most aromatics and derivatives
  - Net imports increase from \$1.7 billion to \$3.7 billion
- **Inorganics** – driven by lower energy costs, U.S. surplus will increase
  - Net exports increase from \$3.2 billion to \$5.3 billion
- **Specialties** – driven by technology and lower energy costs, will significantly improve the U.S. net export position
  - Net exports grow from \$11.2 billion in 2014 to \$20.5 billion

## **Driven by increased exports of polymers and specialties to China, Mexico and Other Americas, the U.S. trade surplus for the commodities of interest will grow by \$28.8 billion**

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**On a regional basis**, there will be a significant increase in exports of chemicals and plastics to China (growing from \$3 billion to \$11.7 billion), as well as to Other Americas (growing from \$2.3 billion to \$10.9 billion), Mexico (growing from \$8.4 billion to \$13.8 billion), and Europe (growing from \$2.8 billion to \$5.4 billion)

- Exports to Brazil will remain relatively flat on a weight basis as domestic capacity is added during the next decade
- Canada and Rest of World will be a source of net imports

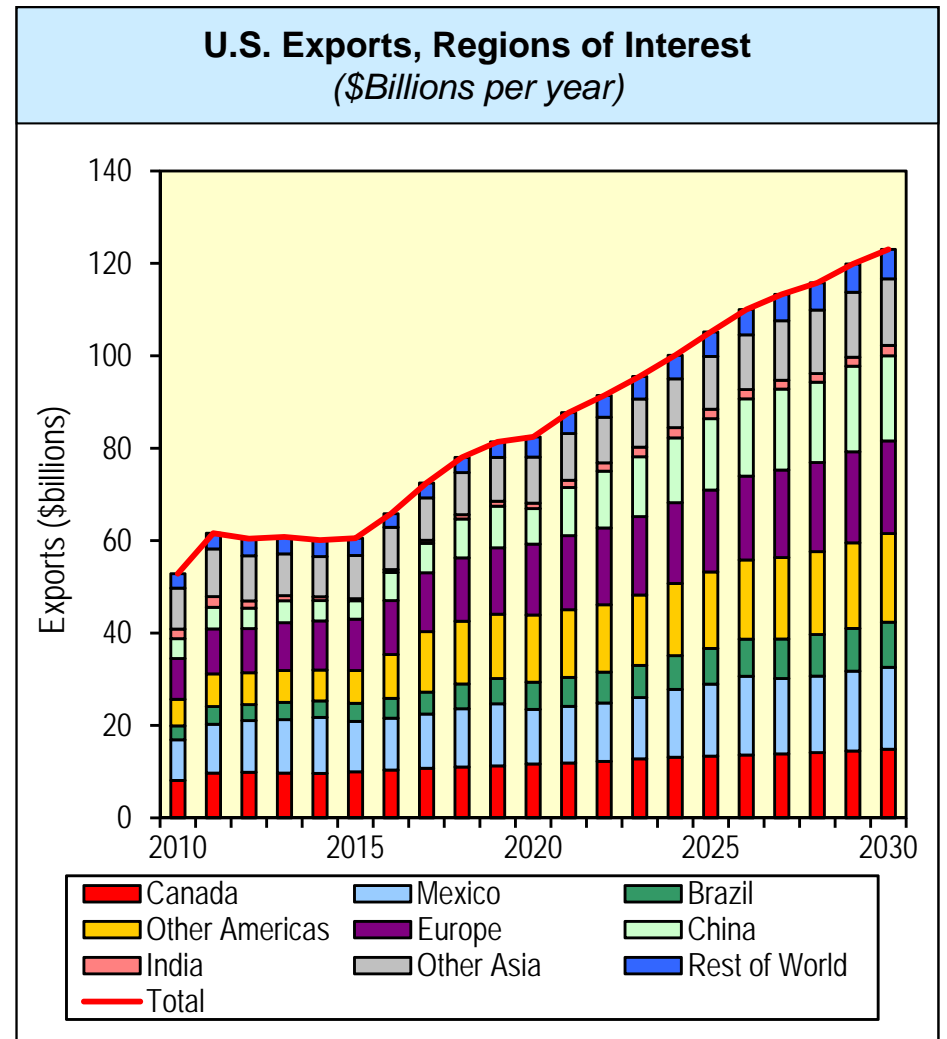
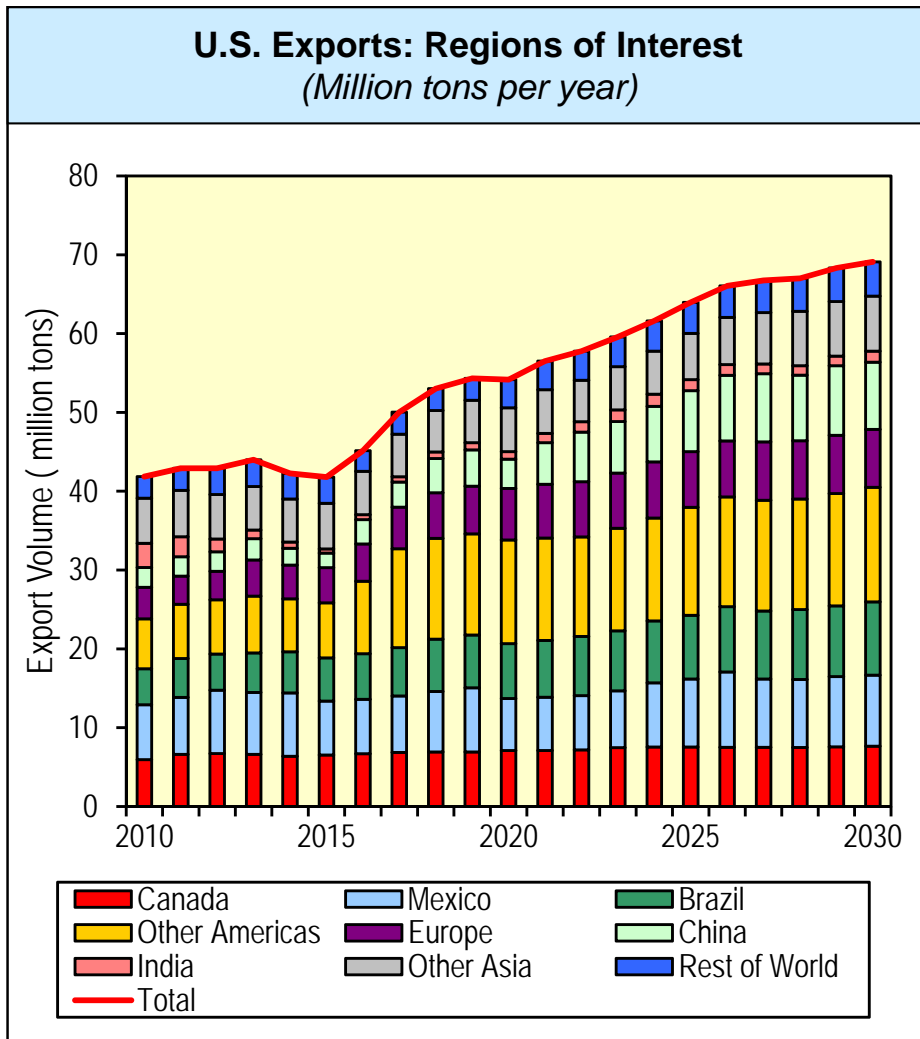
**On a commodity basis**, the biggest driver of the improving U.S. trade surplus will be polymers (with almost \$15 billion in net export growth) and specialties (\$9.3 billion of increased net exports), with moderate growth in intermediates (\$3.1 billion in net export growth)

- Although the overall position will improve, the U.S. will remain in deficit for petrochemicals (\$0.7 billion improvement – fewer imports)
- The U.S. will import less fertilizers (deficit shrinks by 2.4 million tons), but due to higher prices, net imports increases by \$0.5 billion

***Polymers and specialties will be the commodities that gain the most net export value***



**Although not part of the scope of this report, Nexant estimates that exports of “commodities of interest” will more than double from \$60 billion in 2014 to \$123 billion by 2030 with exports to the Americas expected to account for approximately half of total export value**



**Of the \$63 billion increase in exports, net exports are forecast to increase by \$29 billion**

\* Current dollars, assuming 2% inflation



**Section 1**  
**Executive Summary: Policy Implications**

## **Regulatory Environment: U.S. Government policies play an important supporting role for future chemicals investment based on how it regulates key feedstocks like oil, gas and NGLs**

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U.S. government currently limits its role relative to fossil fuels to the following:

- Ensuring energy security
- Controlling energy imports and exports (especially crude oil)
- Supporting advanced research and development

Although “crude oil” exports are prohibited except as exempted by regulation, the policy regime is gentler for other fuels. Exports of coal, petroleum products, natural gas and petrochemical feedstocks may be restricted at the discretion of the executive branch, but they are not blocked by EPCA

Hence, refined products and petrochemicals are internationally traded at will based on market supply and demand, and the shale revolution has created a multi-decade opportunity for increased petrochemical production and exports

*However, the uncertainty around global supply / demand dynamics for oil, as well as future government restrictions of gas and condensate exports, will be a critical factor in determining future feedstock costs*

***U.S. government control of energy exports plays an indirect role in supporting petrochemical investment***

**Shale Gas and NGLs: The success of U.S. E&P firms in shale gas and oil exploitation are unique to the U.S. in most cases and unlikely to be soon matched anywhere else in the world**

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**Factors and Policies supporting U.S. Shale Gas and Tight Oil Development:**

- Liberalized natural gas market
- Competitive industry with many entrepreneurial companies
- Industry's focus on technological innovation
- Vast, independent oil field service sector
- Extensive natural gas processing and pipeline infrastructure
- Financial markets offering many funding options
- Financial incentives for private landowners to provide land access
- Favorable fiscal and regulatory structure

***...However, eventually one or more other regions will find ways to profitably exploit their local shale resource***

**Foreign Direct Investment: In addition to low-cost gas and NGL feedstocks, one of the attractive features of investing in U.S. petrochemical production is access to the U.S. free market economy**

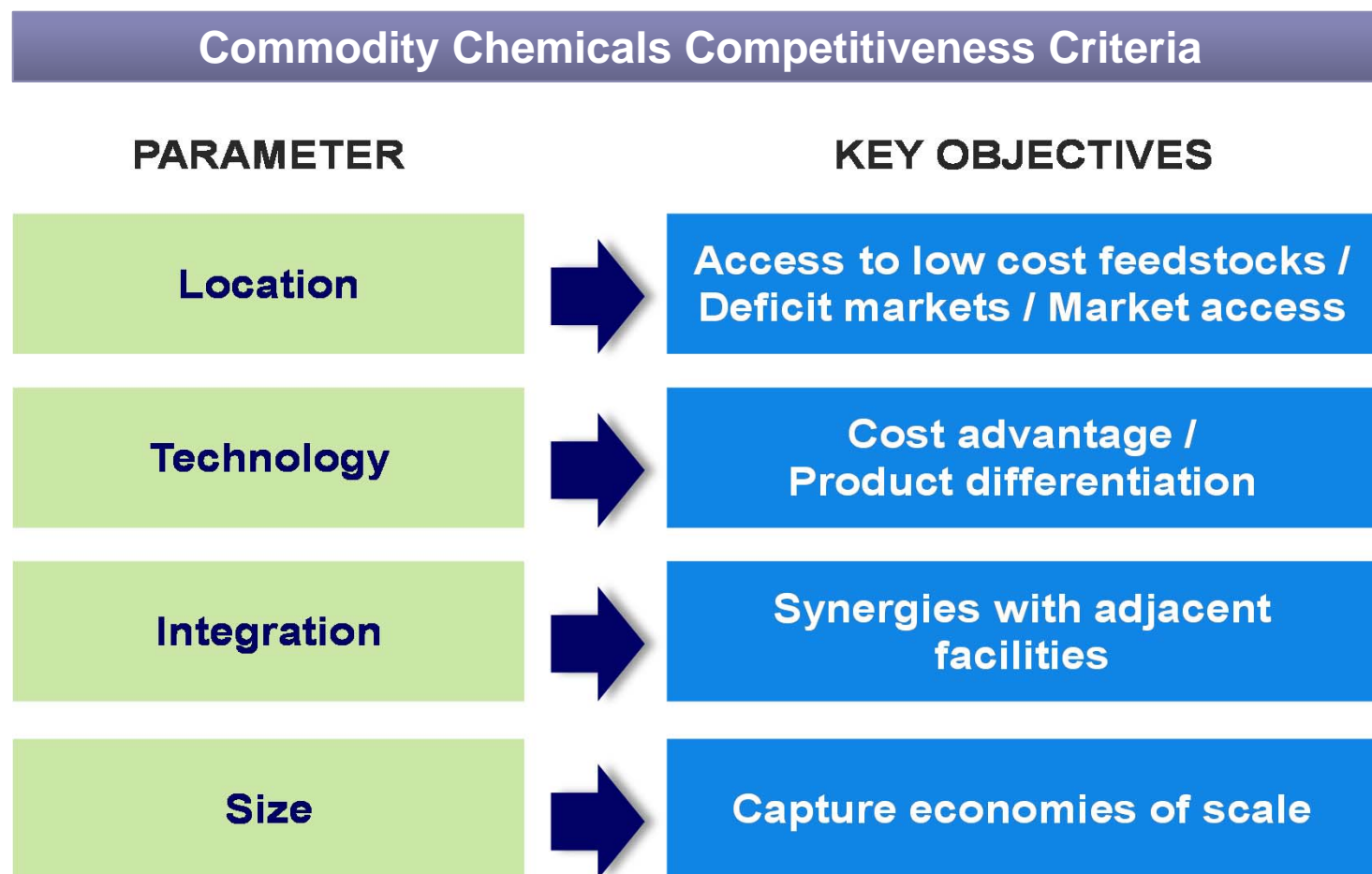
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- As a free market, most foreign companies are welcome to make an investment in the U.S.
- Investment can be with a local partner or independently, but the advantages of access to inexpensive feedstocks, land, labor, infrastructure, and shipping apply to everyone
- In addition, an investment in the U.S. can be made with confidence about the future of the country — the rule of law, the availability of gas and NGLs, and the well-balanced regulatory environment

***Access to advantaged feedstocks and U.S. infrastructure are key reasons for continuing local and foreign direct investment in the U.S.***

**Investment Drivers: Access to low-cost feedstocks and technology will drive investment in U.S. petrochemicals, fertilizers, polymers and specialty chemicals**

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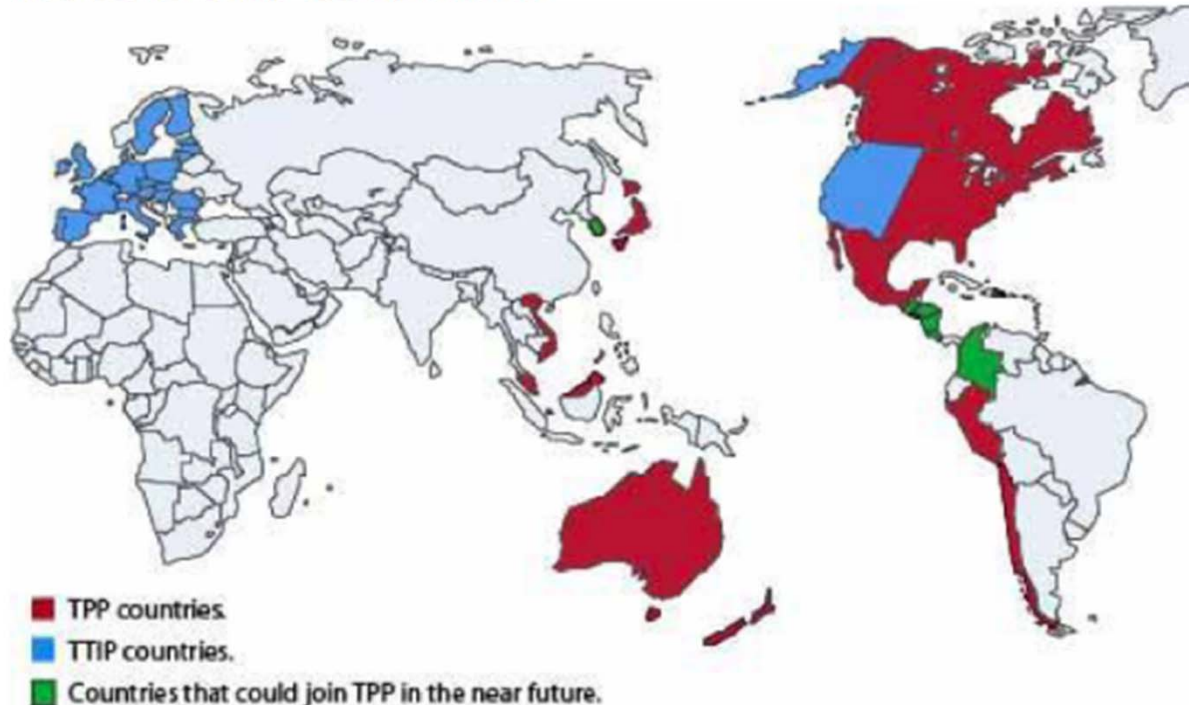


*There are very few places in the world where all of the factors necessary for competitive success in chemicals are available to domestic and outside investors*

**Tariffs and Global Trade Barriers: Historic movement towards greater free trade is expected to continue for leading export destinations, which will enable the U.S. to share its shale gas bounty with the world**

**TPP\* and TTIP\*\* Countries and potential new countries**

**TPP AND TTIP COUNTRIES**



**Example: For LLDPE**

- Assuming that TTIP is completed between the U.S. and the EU, Nexant assumes that 6.5% duties on LLDPE to Europe could be eliminated by 2017
- Furthermore, in the Pacific Region, the TPP would eliminate duties on polyethylene with Japan (6.5%) and Malaysia (15%). Korea's 4.5% tariff on LLDPE may also be eliminated as the FTA with Korea reaches maturity
- Chinese polyethylene tariffs of 6.5% could also decline if they eventually negotiate a FTA with the U.S. or join TPP

***Reducing or eliminating protective tariffs on polymers in particular could have a large impact on the growth of U.S. net exports***

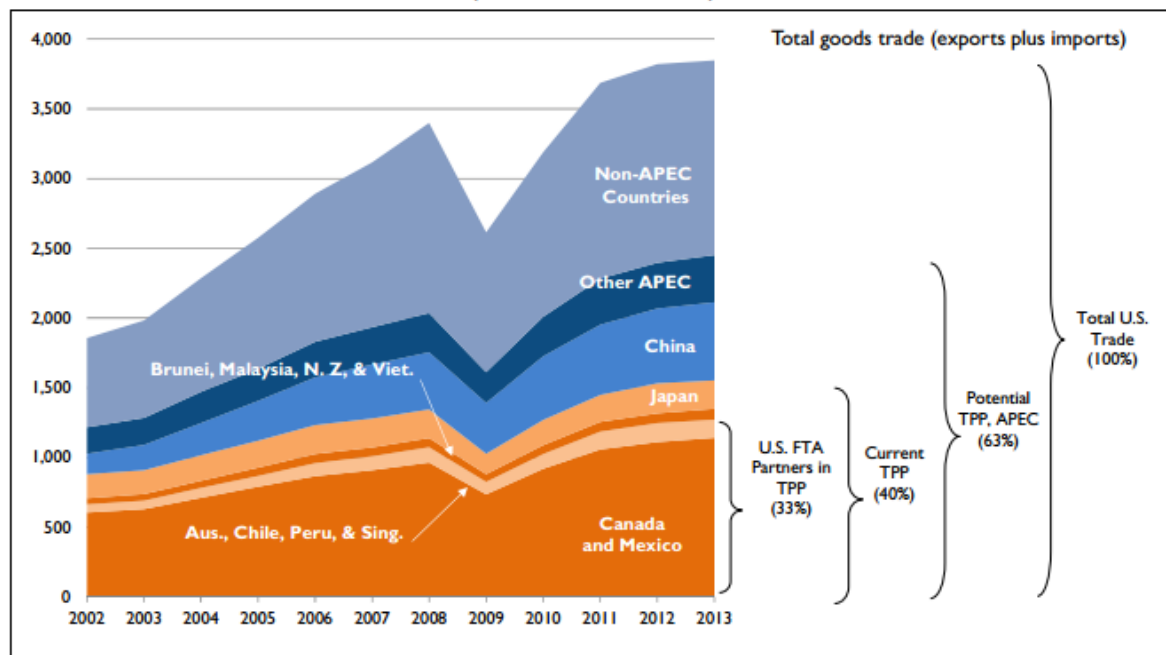
[http://www.cfr.org/councilofcouncils/global\\_memos/p32417?cid=rss-economics-the\\_high\\_stakes\\_in\\_regional\\_tr-111413](http://www.cfr.org/councilofcouncils/global_memos/p32417?cid=rss-economics-the_high_stakes_in_regional_tr-111413)

\* (TPP) – Trans Pacific Partnership

\*\* (TTIP) - US-EU Transatlantic Trade and Investment Partnership

## Tariffs and Global Trade Barriers: The current TPP countries would provide an incremental change in free trade for the U.S.

### U.S.-World, APEC, and TPP Goods Trade (in billions of U.S. dollars)



Source: Analysis by CRS. Data from the International Trade Commission.

### Impact of TPP

- For the U.S., the most important element of the current TPP is the addition of Japan as a free trade partner, which represented over \$200 billion in “total goods trade” in 2013
- All 12 TPP partners shown in orange on the chart are also members of the Asia-Pacific Economic Cooperation (APEC) forum
- China, which represented over \$500 billion in “total goods trade”, has expressed moderate interest in joining TPP, but this is clearly well down the road
- Several other APEC nations have also expressed varying levels of interest

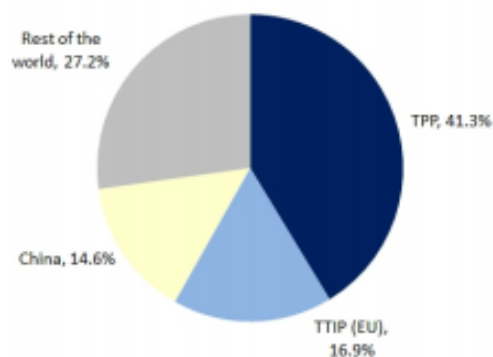
***The eventual inclusion of China and other non-TPP nations in APEC would have a more significant and positive impact on chemicals trade***



**Tariffs and Global Trade Barriers: The current TPP, which includes Canada, Mexico, Korea, and other countries with U.S. FTAs, would represent 41.3% of U.S. goods trade in 2013**

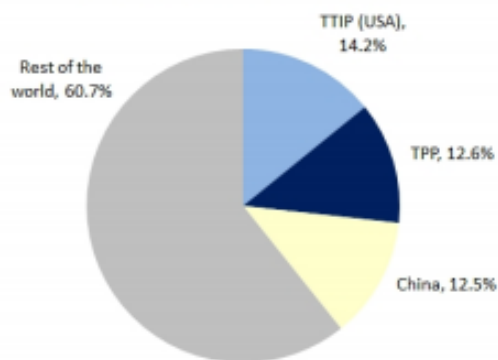
**U.S. and EU Goods Trade\***  
(in billions of U.S. dollars)

USA TRADE IN GOODS 2013



Source: own calculations based on US Census Bureau data

EU TRADE IN GOODS 2013



Source: own calculations based on DG TRADE, European Commission data

**Impact of TTIP**

- The TTIP, would represent 16.9% of “total goods trade” across the U.S. border and 14.2% across the EU’s border
- As a significant portion of C2 chemicals and specialties trade is expected to target Europe, the TTIP could have a significant impact on trade flows of chemicals
- Overall trade with Europe is greater than trade with new FTA partners in the TPP (Japan, Brunei, Malaysia, New Zealand, and Vietnam); therefore, Nexant expects that, compared to TPP, completion of the TTIP likely would have a larger impact on chemicals trade

***Relative to net exports of chemicals, the TTIP is probably the most important FTA under negotiation by the U.S. government***

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**Section 2**  
**Introduction**

## **Objectives**

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The objectives of this report are to:

- Provide projections that highlight the importance of increased U.S. chemicals production to U.S. export growth to 2030
- To provide data for the ACC to advocate for increased U.S. market access to priority countries, i.e. a forward-looking U.S. trade policy agenda

**Scope: This report provides a US net export trade forecast to 2030 for the following 66 chemicals and HTS codes at the Commodity and Category level:**

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		n-butyl Alcohol
	C4 Chemicals	Propylene Glycol
		1,3-Butadiene
	Aromatics	Benzene
		Mixed Xylene Isomers
		Phthalic Anhydride
Toluene		
Intermediates	C2 Chemicals	Ethylene dichloride (EDC)
		Ethylbenzene
		Ethylene Glycol
		Vinyl chloride monomer (VCM)
	C3 Chemicals	Acrylonitrile
		Cumene
		Phenol
		Polyether Polyols
		Propylene Oxide
	Aromatics	Adipic Acid
		Aniline
		Caprolactam
		Cyclohexane
		Methylene diphenyl diisocyanate (MDI)
		Nitrobenzene
		Para-xylene
Purified terephthalic acid (PTA)		
Toluene diisocyanate (TDI)		

Commodity	Category	Chemical
Polymers & Rubber	C2 Chemicals	Expanded polystyrene (EPS)
		Polyethylene
		Polystyrene (PS)
		Polyvinylchloride (PVC)
	C3 Chemicals	Acrylic Polymers
		Polycarbonates
		Polypropylene
	C4 Chemicals	Acrylonitrile butadiene styrene (ABS)
		Polybutadiene Rubber (PBR)
		Styrene butadiene rubber (SBR)
Aromatics	Polyethylene terephthalate (PET)	
Fertilizers	C1 Chemicals	Ammonia
	Inorganics	Urea
Inorganic Chemicals	Inorganics	Diammonium phosphate (DAP) and Monoammonium phosphate (MAP)
		Soda Ash
		Sodium Hydroxide
		Sulfuric Acid
Specialties	Coatings & Inks	Titanium Dioxide
		3208 Paint & Varnish From Synthetic Polymers, Nonaqueous
		3209 Paint & Varnish From Synth. Polymers, Aqueous
		3210 Paints & Varnishes Nesoi; Water Pigmts For Leather
	Other Specialties	3215 Ink, Printing, Writing, Drawing
		3801 Artificial Graphite; Collodial Graphite & Prep
		3809 Finishing Agents Etc For Textiles, Paper
		3810 Pickling Preps For Metal; Soldering
		3811 Antiknock Preps & Other Additives For Mineral Oils
		3812 Prepared Rubber Accelerators; Plasticizers Etc.
		3813 Prep & Charges For Fire-extinguishers
		3815 Reaction Initiators & Catalysts
		3818 Chem Elem Doped, Used In Electron, Discs Wafers
		3819 Hydraulic Brake & Transmission Fluids
		3821 Prepared Culture Media For Devel't of Microorganisms
		3822 Composite Diagnostic/lab Reagents, Exc Pharmaceut

**Scope: This report provides a US net export trade forecast to 2030 for the following 66 chemicals and HTS codes at the Category and Commodity level:**

Category	Commodity	Chemical
C1 Chemicals	Petro-chemicals	Methanol
	Fertilizers	Ammonia
		Urea
C2 Chemicals	Petro-chemicals	Styrene
		Vinyl Acetate
	Intermediates	Ethylene dichloride (EDC)
		Ethylbenzene
		Ethylene Glycol
		Vinyl chloride monomer (VCM)
	Polymers & Rubber	Expanded polystyrene (EPS)
		Polyethylene
		Polystyrene (PS)
		Polyvinylchloride (PVC)
		2-ethyl-1-hexyl Acrylate
C3 Chemicals	Petro-chemicals	2-ethylhexanol (2-EH)
		Acrylic Acid
		Butyl Acrylate
		isoPropanol
		n-butyl Alcohol
		Propylene Glycol
	Intermediates	Acrylonitrile
		Cumene
		Phenol
		Polyether Polyols
		Propylene Oxide
	Polymers & Rubber	Acrylic Polymers
		Polycarbonates
		Polypropylene
	C4 Chemicals	Petro-chemicals
Polymers & Rubber		Acrylonitrile butadiene styrene (ABS)
		Polybutadiene Rubber (PBR)
		Styrene butadiene rubber (SBR)

Category	Commodity	Chemical
Aromatics	Petro-chemicals	Benzene
		Mixed Xylene Isomers
		Phthalic Anhydride
		Toluene
	Intermediates	Adipic Acid
		Aniline
		Caprolactam
		Cyclohexane
		Methylene diphenyl diisocyanate (MDI)
		Nitrobenzene
		Para-xylene
		Purified terephthalic acid (PTA)
		Toluene diisocyanate (TDI)
	Polymers & Rubber	Polyethylene terephthalate (PET)
Inorganics	Fertilizers	Diammonium phosphate (DAP) and Monoammonium phosphate (MAP)
	Inorganic Chemicals	Soda Ash
		Sodium Hydroxide
		Sulfuric Acid
		Titanium Dioxide
Specialties	Coatings & Inks	3208 Paint & Varnish From Synthetic Polymers, Nonaqueous
		3209 Paint & Varnish From Synth. Polymers, Aqueous
		3210 Paints & Varnishes Nesoi; Water Pigmts For Leather
		3215 Ink, Printing, Writing, Drawing
	Other Specialties	3801 Artificial Graphite; Collodial Graphite & Prep
		3809 Finishing Agents Etc For Textiles, Paper
		3810 Pickling Preps For Metal; Soldering
		3811 Antiknock Preps & Other Additives For Mineral Oils
		3812 Prepared Rubber Accelerators; Plasticizers Etc.
		3813 Prep & Charges For Fire-extinguishers
		3815 Reaction Initiators & Catalysts
		3818 Chem Elem Doped, Used In Electron, Discs Wafers
		3819 Hydraulic Brake & Transmission Fluids
		3821 Prepared Culture Media For Devel't of Microorganisms
		3822 Composite Diagnostic/lab Reagents, Exc Pharmaceut

**Scope: This report provides a US net export trade forecast to 2030 for the chemicals on the previous page at the Commodity and Category level:**

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The geographical composition of the above identified U.S. exports were divided into the following geographical regions:

- Americas
  - Canada (added to scope)
  - Mexico (added to scope)
  - Brazil
  - Other Americas
- Europe
- Asia
  - China
  - India
  - Other Asia
- Rest of World. (Middle East, Africa, Oceania)

Net exports were classified into the following segments:

- Plastic Resins
- Petrochemicals
- Fertilizers
- Intermediates
- Inorganics
- Specialties

## Scope: This report provides a forecast the net U.S. trade position for 47 specific selected chemicals plus specialty chemicals

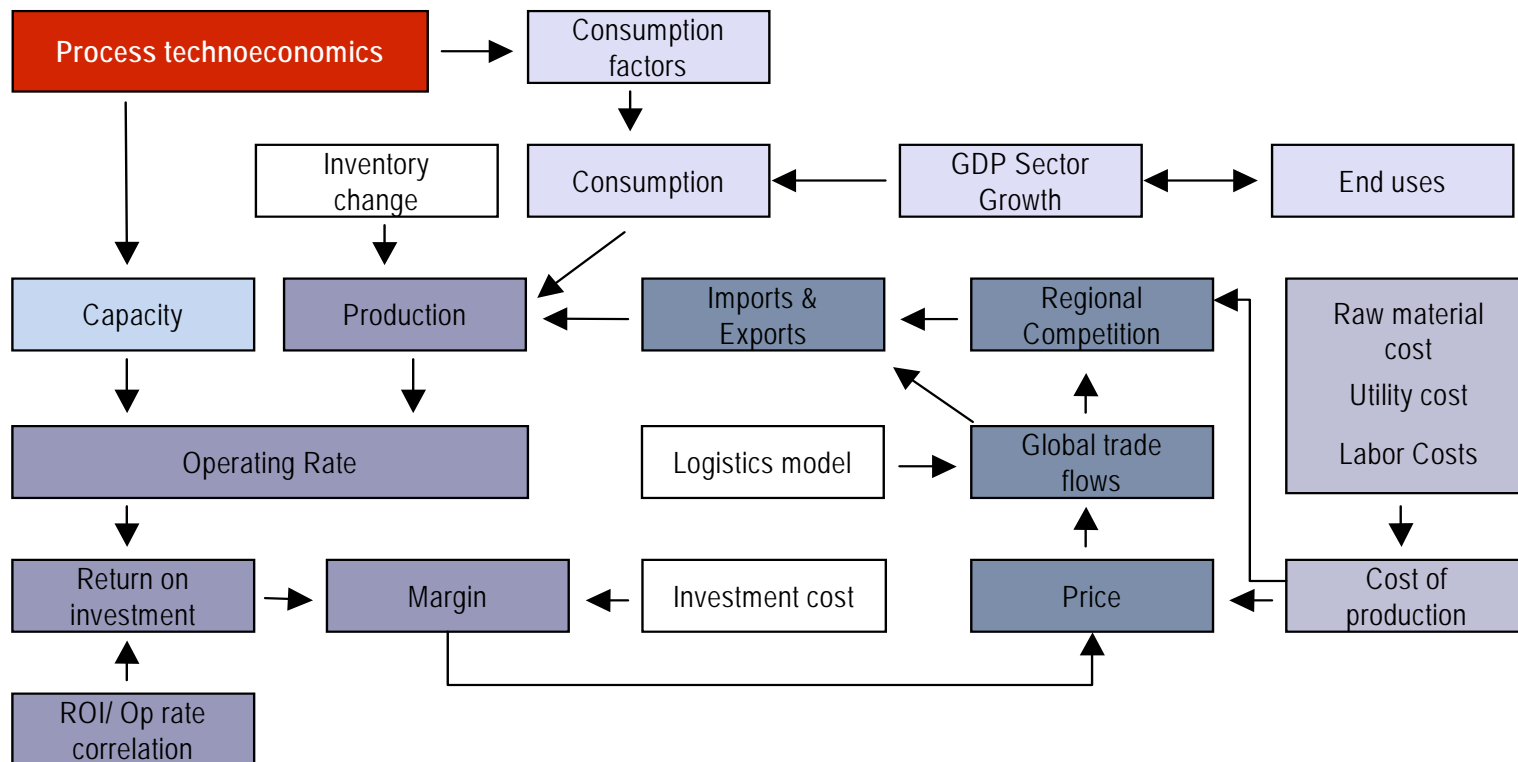
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Nexant developed a report containing annual forecasts of U.S. chemical net exports over the 2013-2030 time period. The chemical products included in each category are the following:

- **C<sub>1</sub> chemicals** and derivatives: methanol, ammonia, and urea
- **C<sub>2</sub> chemicals** and derivatives: polyethylene, ethylene glycols, styrene monomer, polystyrenes, EDC, VCM and PVC, and vinyl acetate
- **C<sub>3</sub> chemicals** and derivatives: polypropylene, propylene oxide, polyether polyols, propylene glycols, acrylonitrile, cumene, phenol, polycarbonate, isopropanol, *n*-butanol, butyl acrylate, 2-ethylhexanol, 2 EH acrylate, and polyacrylic acid (i.e., superabsorbent polymers)
- **C<sub>4</sub> chemicals** and derivatives: butadiene, SBR, ABS, and polybutadiene rubber
- **Aromatic chemicals** and derivatives: benzene, toluene, para-xylene, cyclohexane, adipic acid, caprolactam, nitrobenzene, aniline, MDI, TDI, PTA, PET, and phthalic anhydride
- **Inorganic chemicals**: caustic soda, soda ash, sulfuric acid, titanium dioxide, and diammonium phosphate
- **Specialty chemicals** to be developed as a single category by analysis of specialty company pronouncements on their export plans and by use of trade statistics
  - Coatings and Inks: HTS 3208, 3209, 3210, 3215
  - Miscellaneous Specialty Chemicals: HTS 38 (3809-3813, 3815, 3818, 3819, 3821, 3822)

**Nexant’s Approach and Methodology: Nexant’s petrochemical simulator forecasts the capacity, operating rates, and net trade position for major petrochemicals and over 40 regions**

The simulator relates market demand drivers to petrochemical consumption. From a database of petrochemical processes and plant capacity the regional consumption is then compared to the ability to produce. Global trade algorithms, driven by a comprehensive logistics model, add to the simulation of trade and build to a full supply, demand and trade model of the industry.



PP: PPE2003/PetchemProfForc/SEC\_2

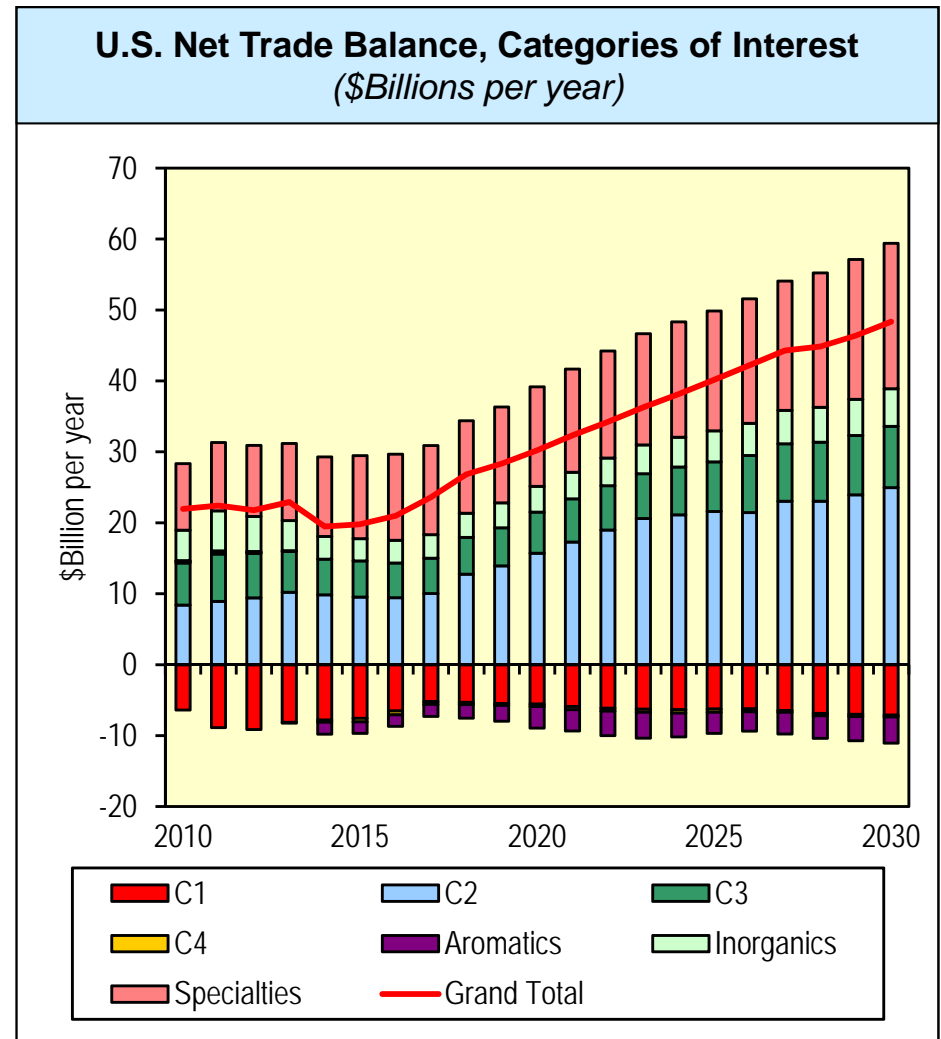
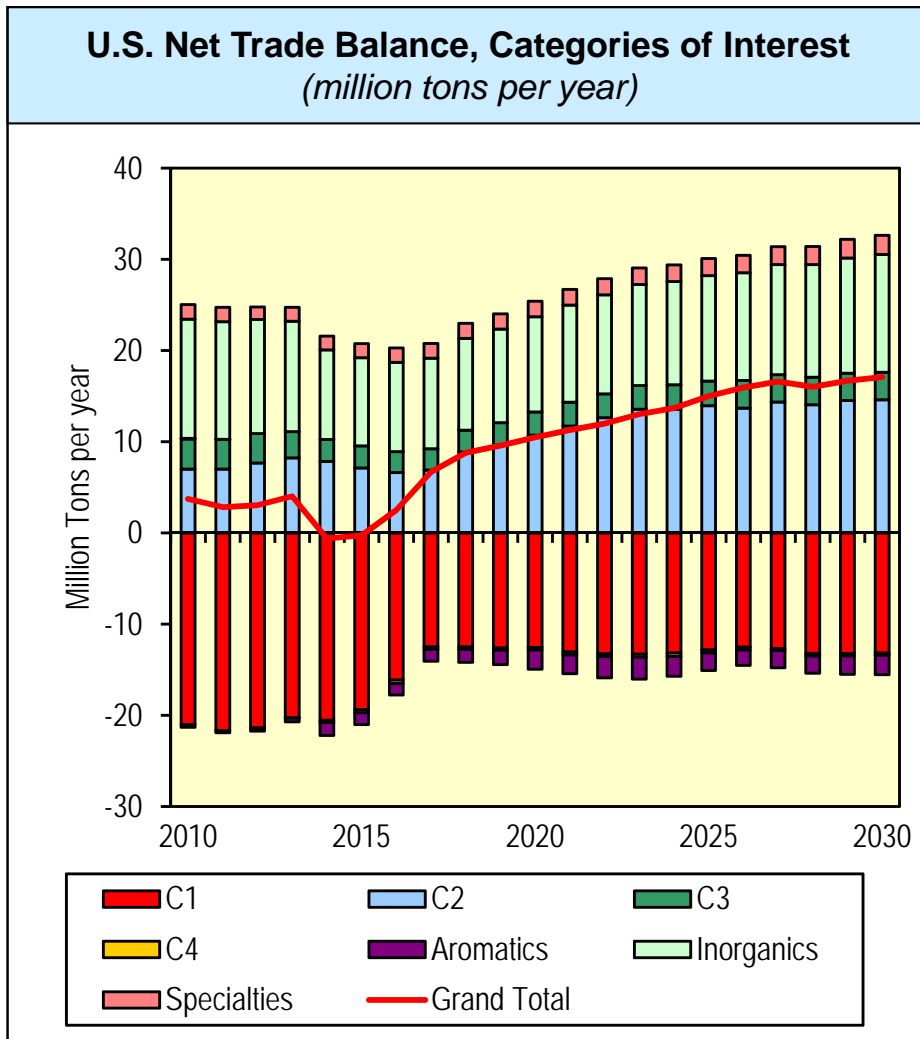
**The net trade forecasts for each region are assumed to not vary with the crude oil price**



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**Section 3**  
**Forecast Net Exports**

**Summary by Categories of Interest: U.S. trade surplus for the selected chemicals is projected to increase from \$19.5 billion in 2014 to \$48.3 billion\* by 2030; C2 and specialty chemicals will be major drivers of the surplus**

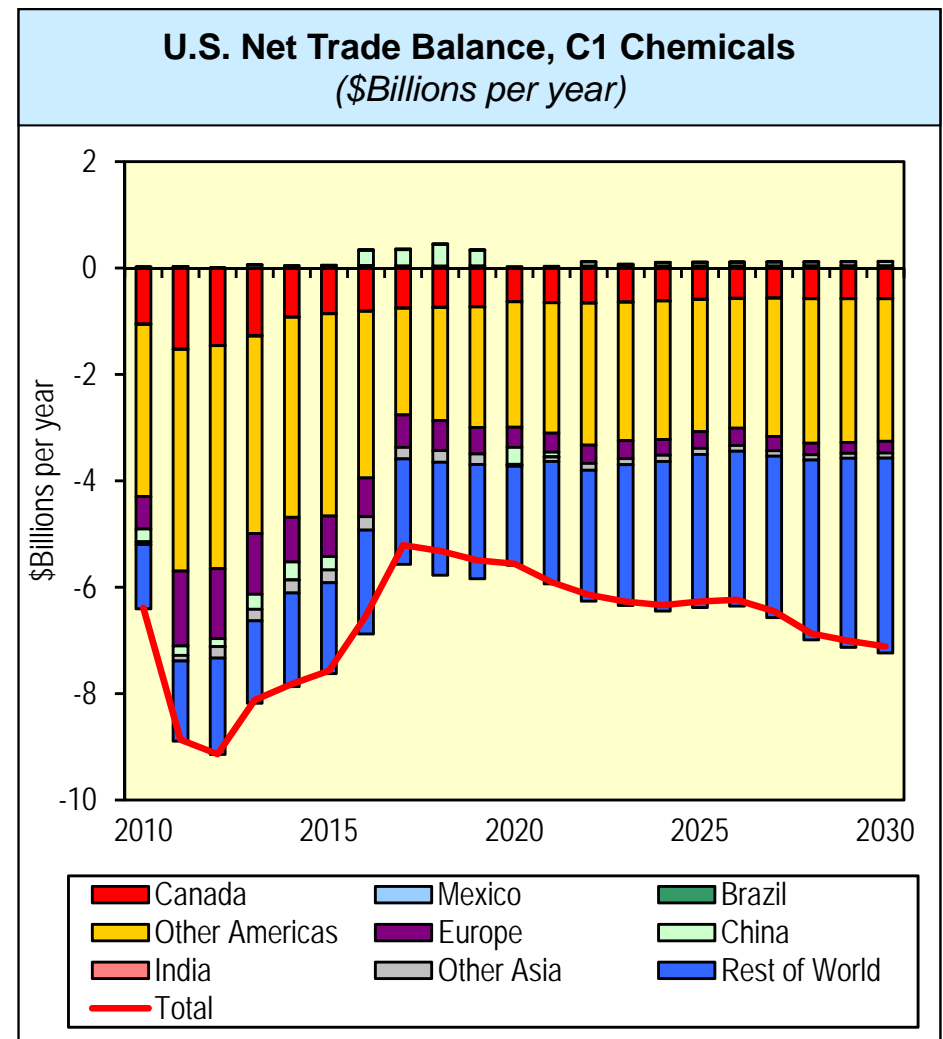
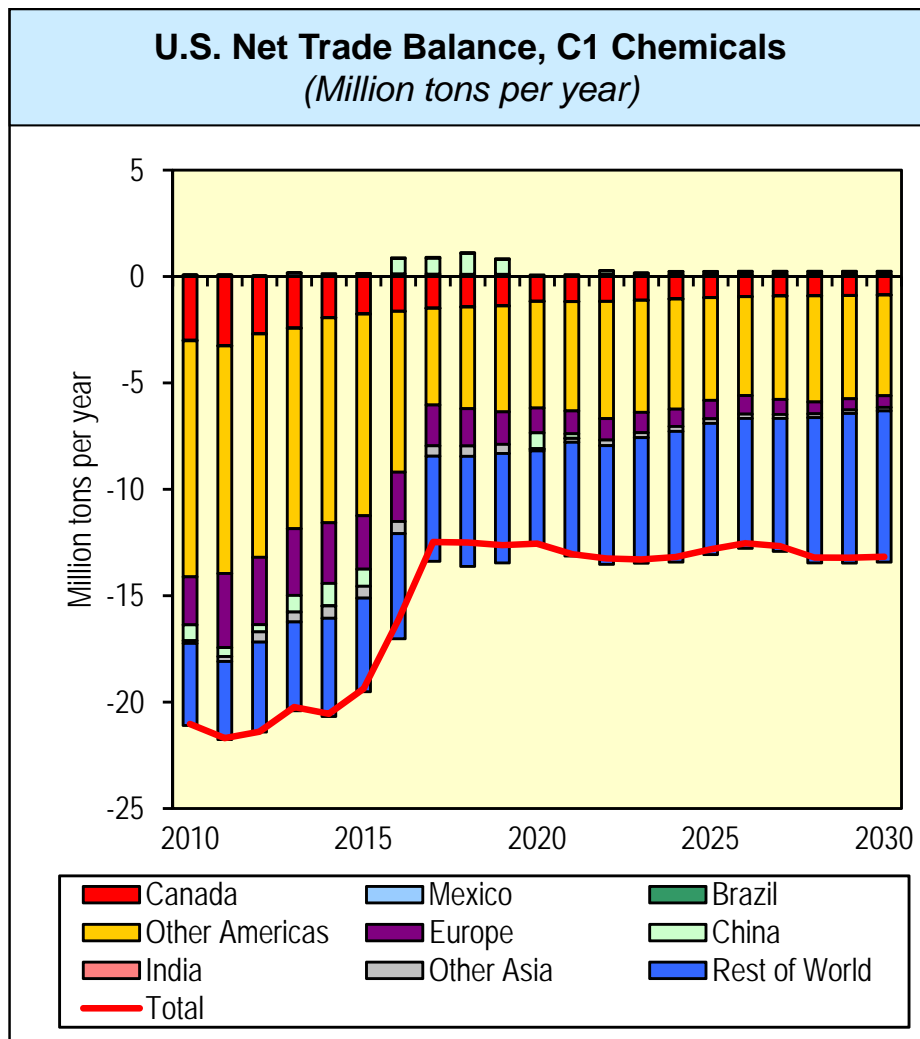


**The trade deficit in C1 will shrink and continue for aromatics**

**C3 derivative exports will recover after on-purpose sources of propylene are built**

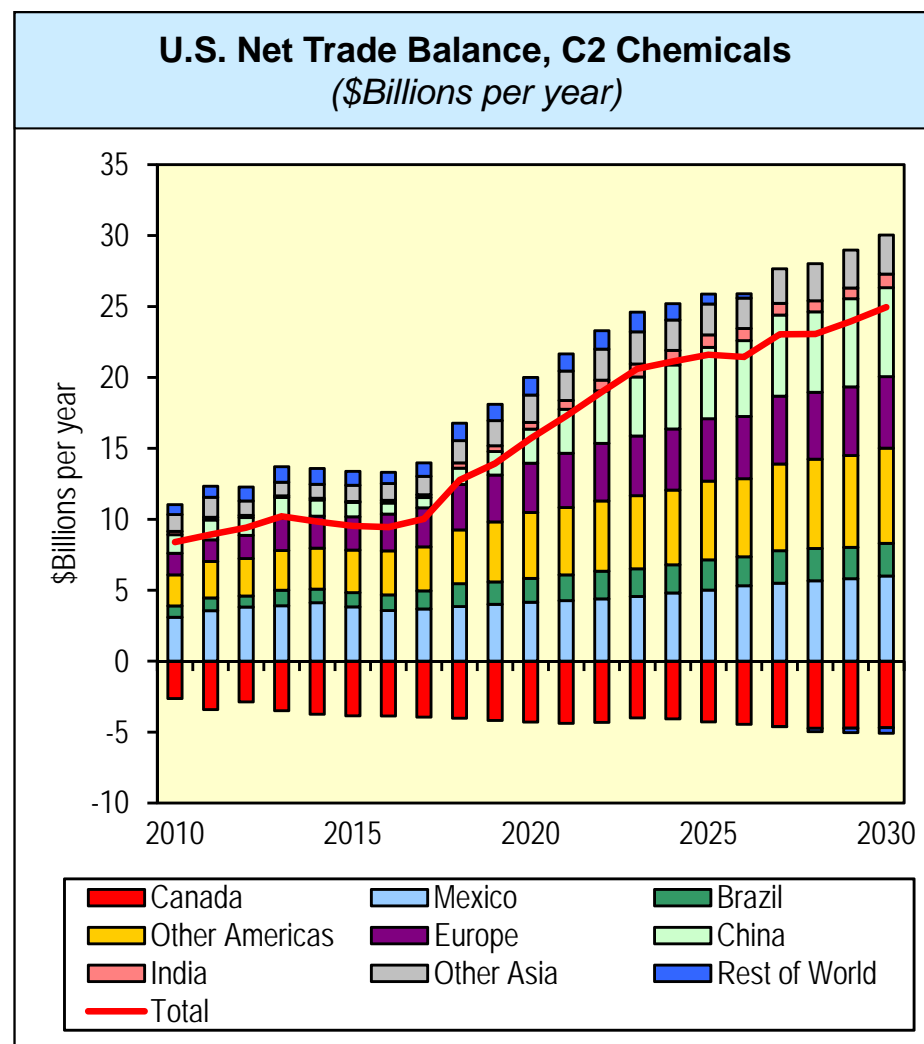
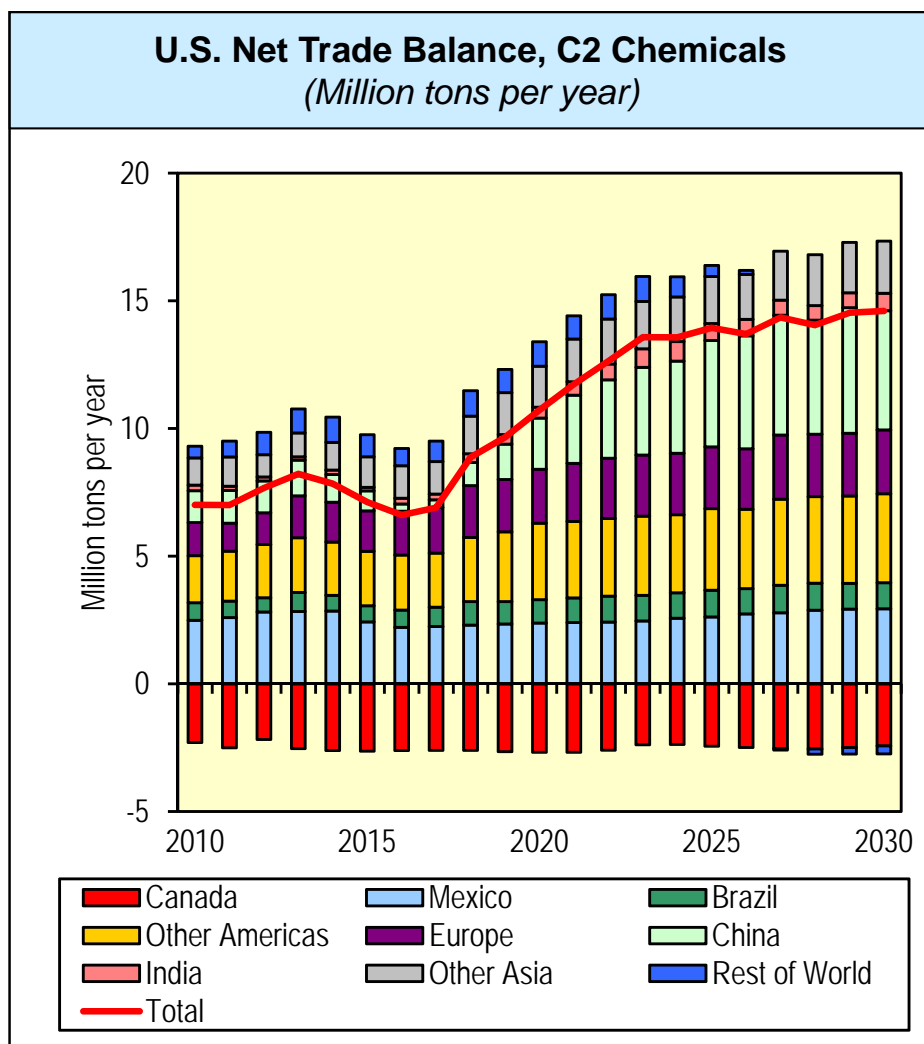
\* Current dollars, assuming 2% price inflation

**C1 Chemicals:** The deficit in C1 chemicals will decline to under \$6 billion by 2017, as the U.S. adds shale gas based capacity for methanol, ammonia and urea. Currently, the U.S. sources much of its C1 chemicals deficit from “Other Americas”



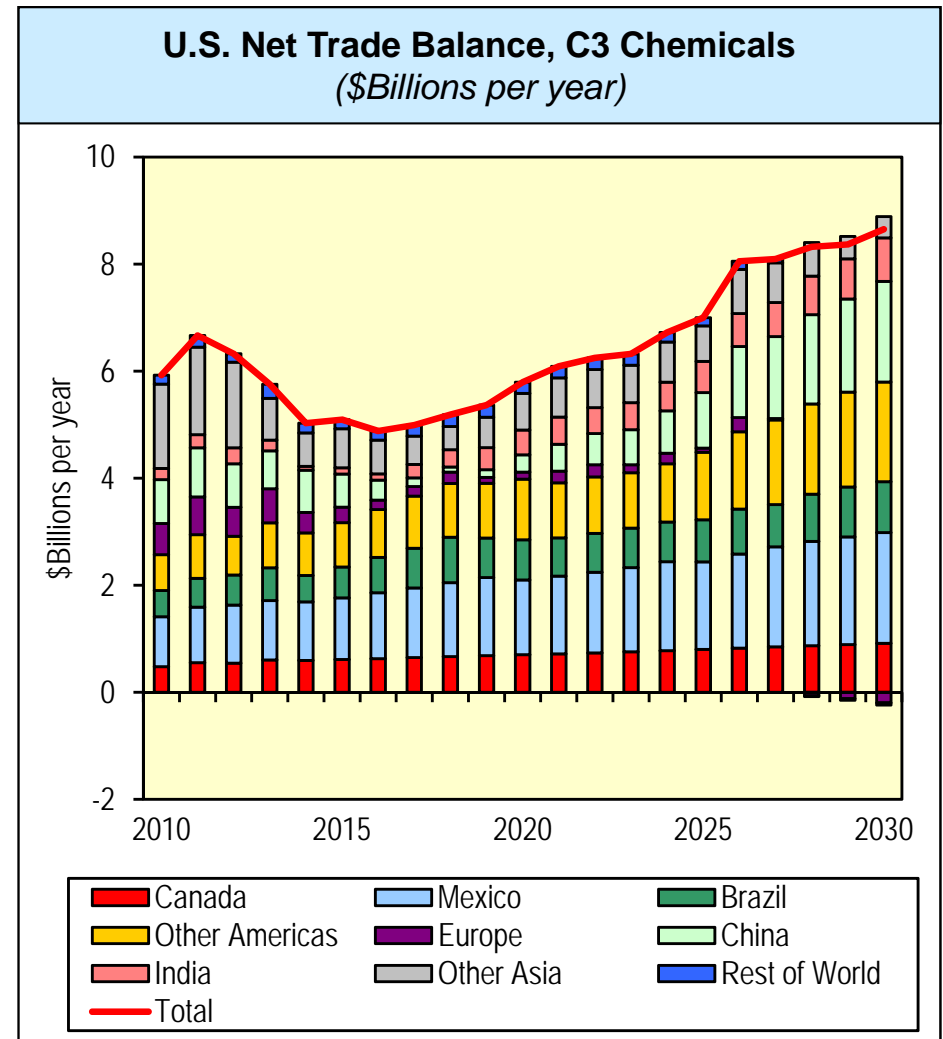
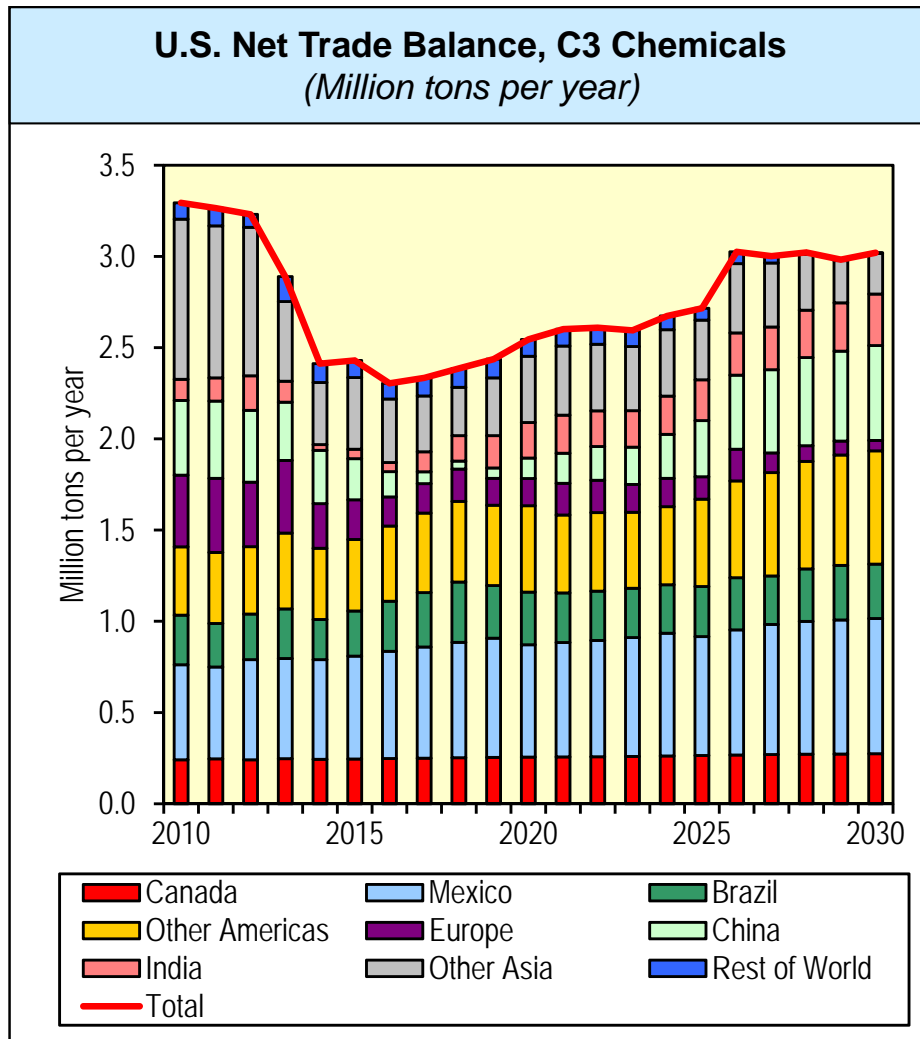
**C1 chemicals includes: ammonia, urea and methanol**

**C2 Chemicals: The C2 chemicals surplus will increase to nearly \$25 billion, as additional new ethylene supply from steam cracking of ethane creates competitive advantage for exports of polymers and intermediates to China, Europe, Mexico and Other Americas**



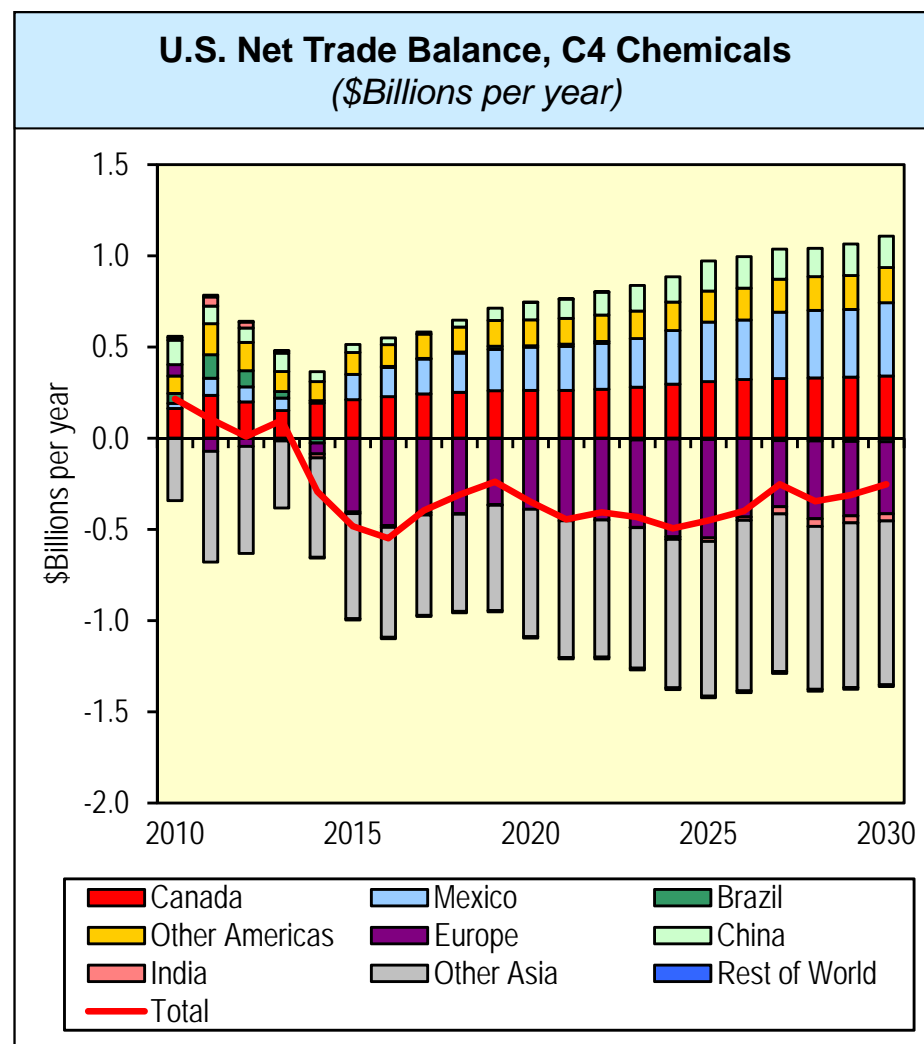
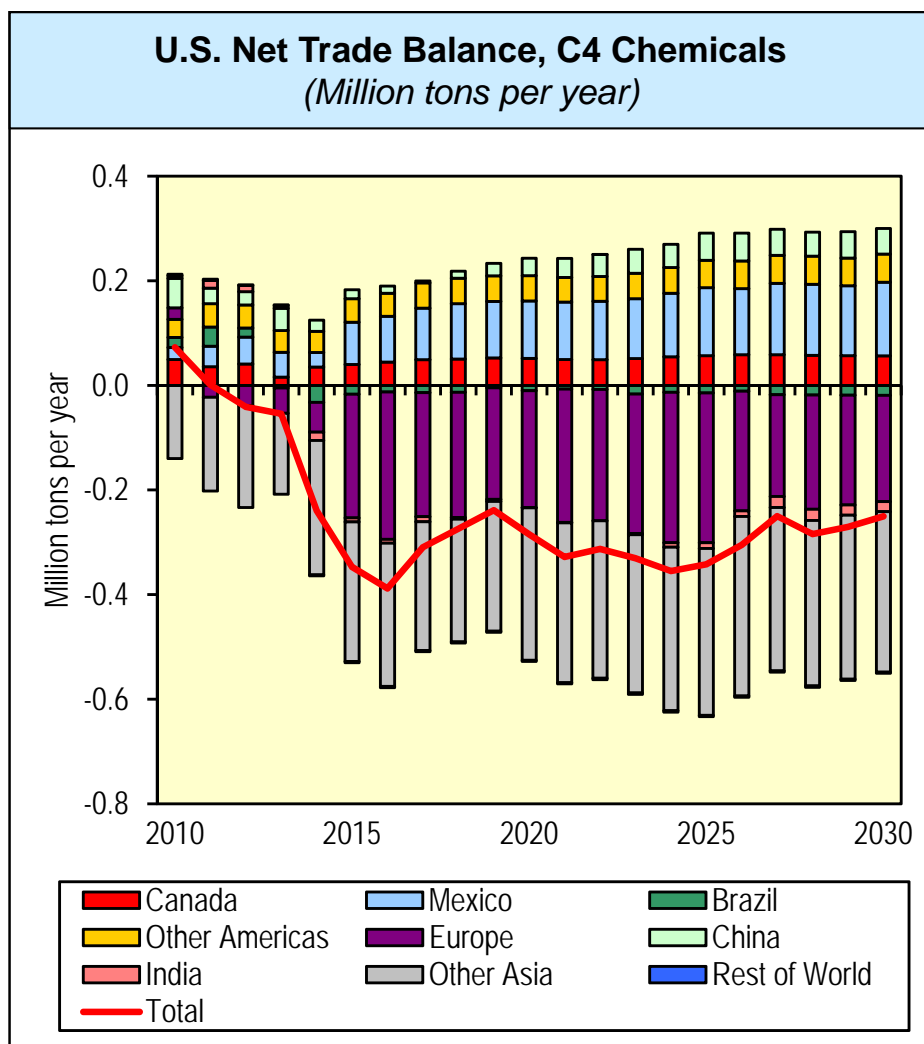
**C2 Chemicals includes: PE, PVC, PS, EDC, VCM, MEG, Styrene, and VAM**

**C3 Chemicals: With the reduction in propylene production from steam crackers, the C3 chemicals trade surplus has declined to under \$5 billion, but will recover with the addition of new on-purpose propylene supplies (from PDH and MTO)**



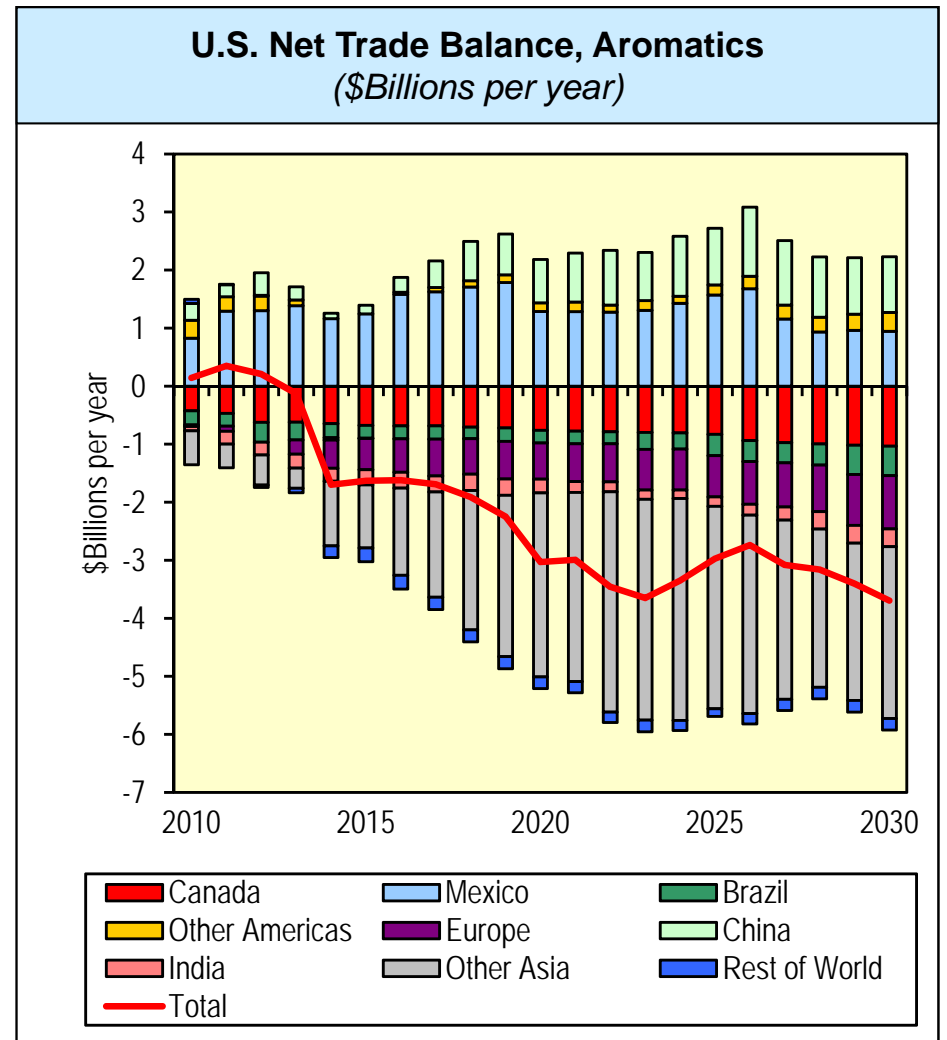
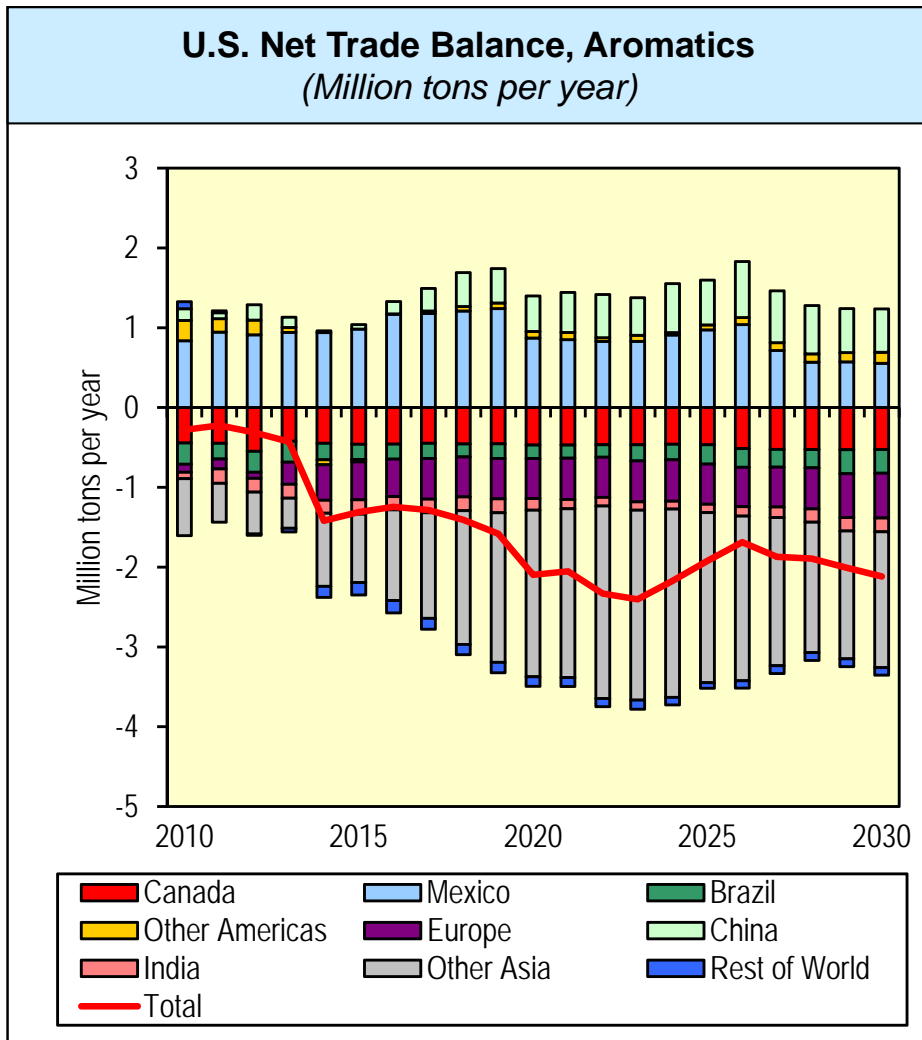
**C3 includes: polypropylene, propylene oxide, polyether polyols, propylene glycols, acrylonitrile, cumene, phenol, polycarbonate, iso-propanol, butyl acrylate, 2-ethylhexanol, 2 EH acrylate, and polyacrylic acid**

**C4 Chemicals: The 2010 surplus in C4 chemicals has shifted to deficit, as the U.S. will import significant amounts of butadiene from Europe and Other Asia**



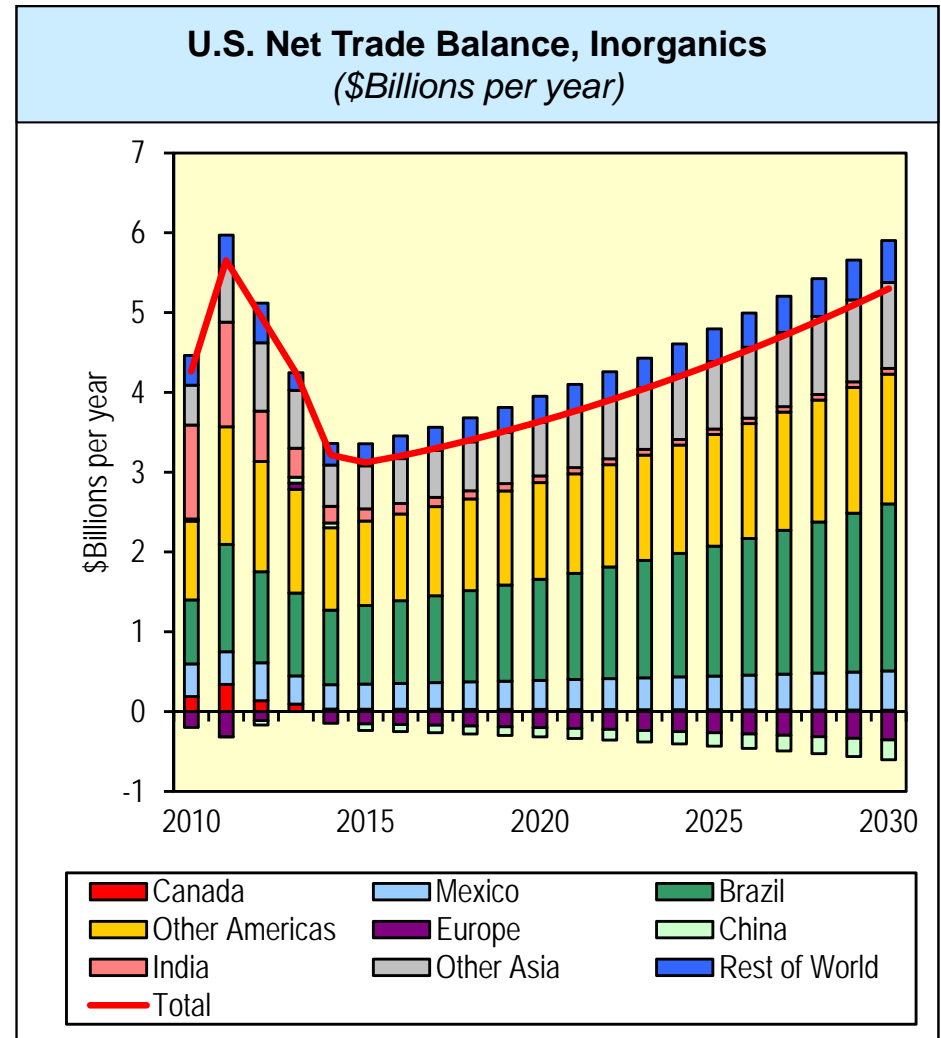
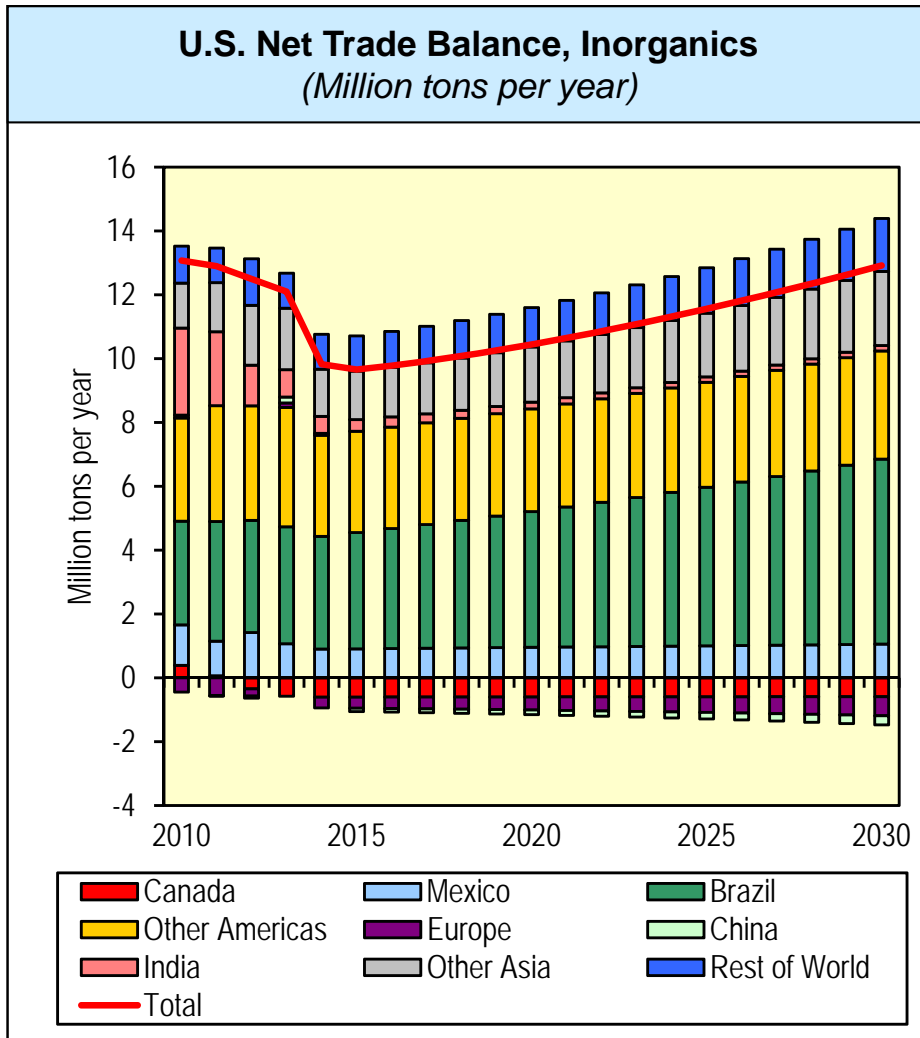
**C4 Chemicals includes: butadiene and the derivatives SBR, ABS, and polybutadiene rubber**

**Aromatics: The shift to lighter cracker feedstocks has resulted in significant deficit in benzene, which along with *para*-xylene, is the most important aromatic feedstock**



**Aromatics and derivatives includes: benzene, toluene, *para*-xylene, cyclohexane, adipic acid, caprolactam, nitrobenzene, aniline, MDI, TDI, PTA, PET, and phthalic anhydride**

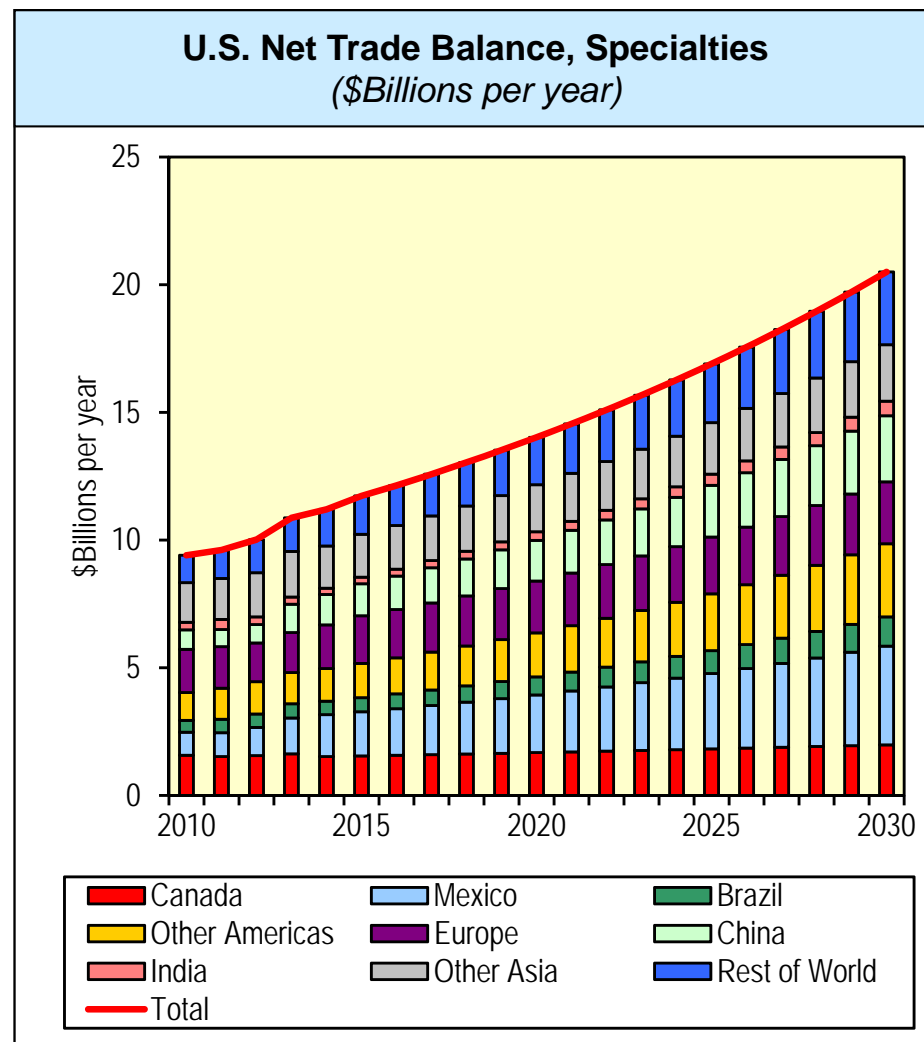
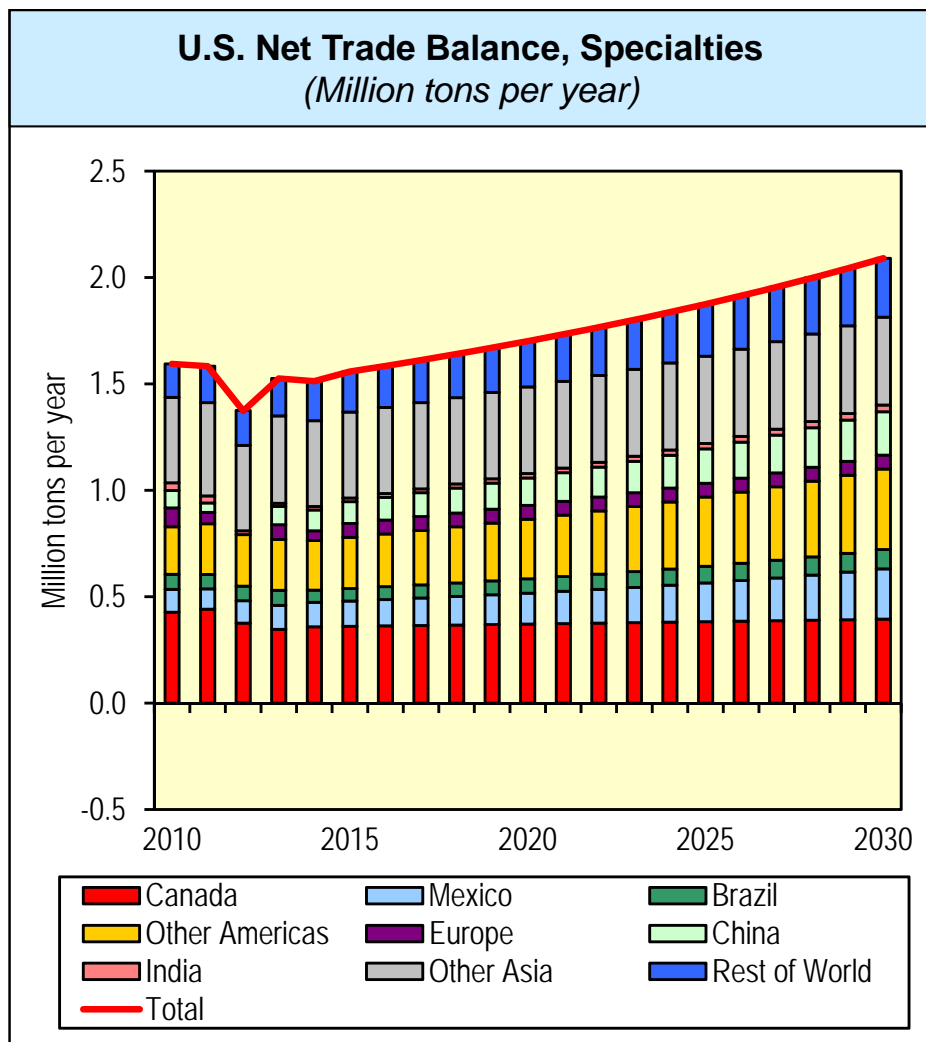
**Inorganics: As India has become more self sufficient in DAP and MAP, the net trade surplus for inorganics of interest has declined to \$3.2 billion. Growing demand from Brazil and Other Americas will push the surplus back over \$5 billion by the end of the period**



***Inorganics include: caustic soda, soda ash, sulfuric acid, titanium dioxide, and diammonium phosphate (DAP) and monoammonium phosphate (MAP)***



**Specialties: The surplus in Specialties will grow from \$11.2 billion to \$20.5 billion, with a trade surplus in every region, especially China, Mexico, Other Americas and Rest of World**



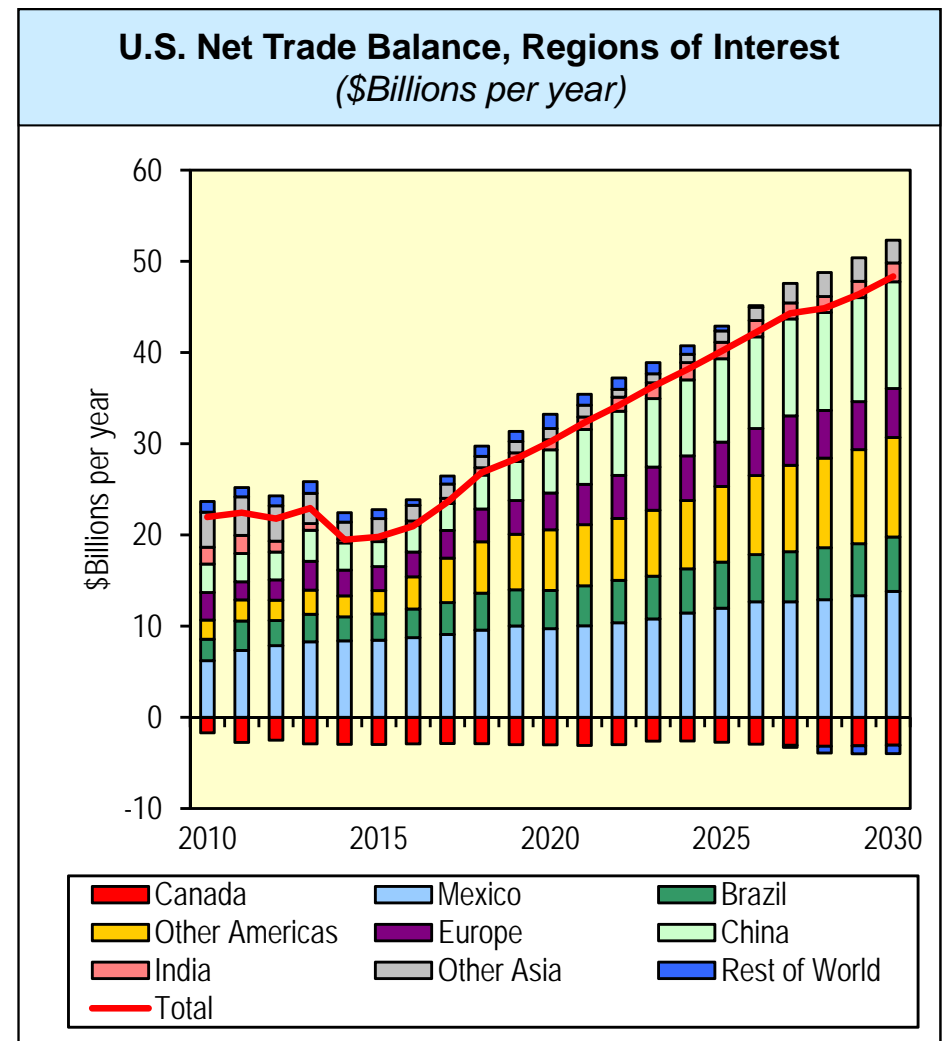
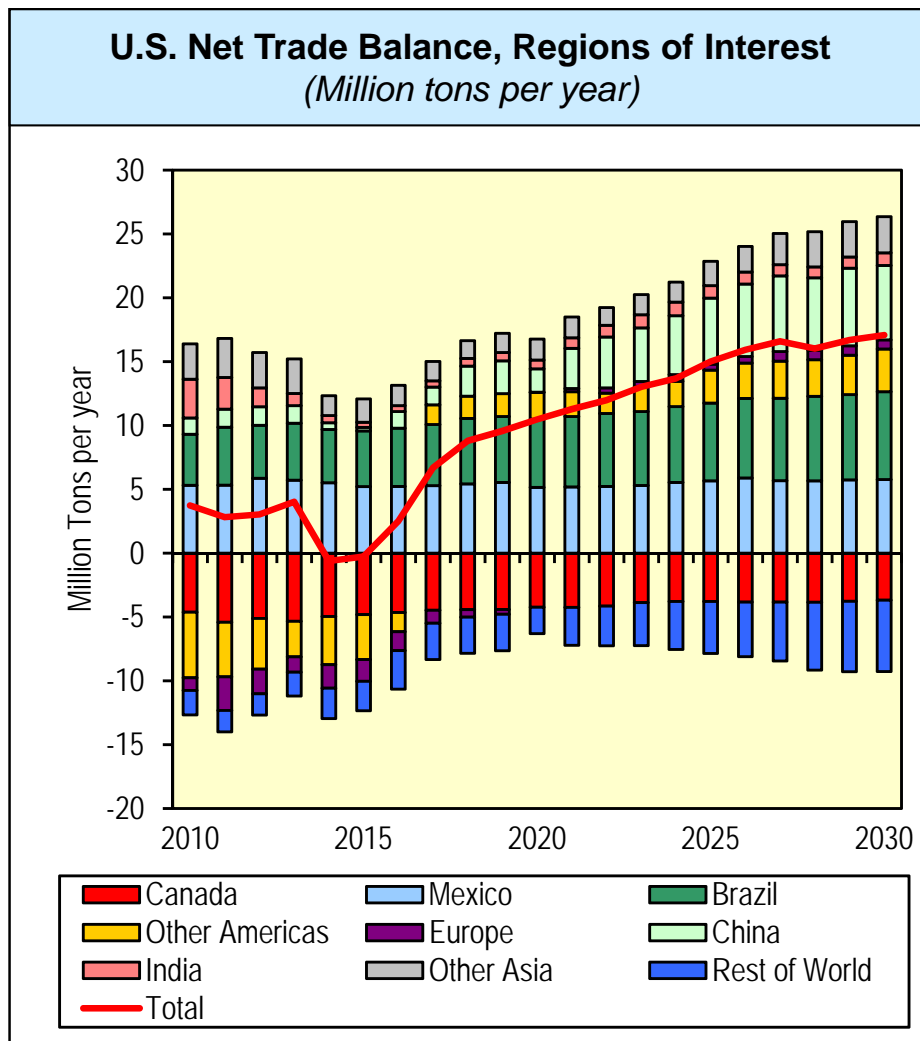
**Specialties includes: coatings, inks and miscellaneous chemicals (HTS 38)**

**Summary on a Category Basis: The value of U.S. net exports will increase to \$48.3 billion by 2030, representing 5.8% CAGR value growth, with important improvements from C2 chemicals, specialties and C1 chemicals**

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- **C1** – The deficit in C1 chemicals will decline to under \$6 billion by 2017, as the U.S. adds shale gas based capacity for methanol, ammonia and urea. Currently, the U.S. sources much of its C1 deficit from “Other Americas”
  - Trade deficit shrinks from \$20.5 billion to \$13.2 billion
- **C2** – The C2 surplus will improve as additional low cost ethylene supply based on feedstocks from new ethane steam crackers creates competitive advantage for exports of polymers and intermediates to China, Europe, Other Americas and Mexico
  - Surplus grows from \$9.8 billion to \$25 billion in 2030
- **C3** – C3 chemical exports will recover after on-purpose sources of propylene are built (via PDH and MTO)
  - Net exports grow from \$5.0 billion to \$8.6 billion by 2030
- **C4** – The 2010 surplus in C4 chemicals falls into deficit, as the U.S. will import significant amounts of butadiene from Europe and Other Asia
  - Deficit stays at approximately -\$0.3 billion
- **Aromatics** – As supplies of benzene have declined, imports have increased to support exports of aromatics derivatives to Mexico, China and Other Americas. Overall, a minor change . . .
  - Net imports increase from \$1.7 billion to \$3.7 billion
- **Inorganics** – As India has become more self sufficient in DAP and MAP, the net trade surplus for inorganics of interest has declined to \$3.2 billion. Growing demand from Brazil and Other Americas will push the surplus back over \$5 billion by the end of the period
  - Net exports increase from \$3.2 billion to \$5.3 billion (with 4.0% CAGR)
- **Specialties** – Increased sales to China, Mexico, Other Americas, and Rest of World will significantly improve the U.S. net export position (3.8% CAGR)
  - Specialties net exports grow from \$11.2 billion in 2014 to \$20.5 billion in 2030

**Summary by Region: Although the U.S. is nearly in balance on a tons basis in 2014, the mix of higher value chemicals that are exported drives the over trade balance (for the selected chemicals) to a \$19.5 billion surplus in 2014**



***The rapid growth of exports to China, Other Americas and Mexico will drive the chemicals trade surplus to \$48.3 billion by 2030***

**The value of U.S. net exports will increase to \$48.3 billion by 2030, representing 5.8% compounded value growth driven by increased exports to China and Other Americas**

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**On a regional basis**, there will be a significant increase in exports of chemicals and plastics to China (growing from \$3 billion to \$11.7 billion), as well as to Other Americas (growing from \$2.3 billion to \$10.9 billion), Mexico (growing from \$8.4 billion to \$13.8 billion), and Europe (growing from \$2.8 billion to \$5.4 billion)

- Exports to Brazil will remain relatively flat on a weight basis as domestic capacity is added based during the next decade
- Canada and Rest of World will be a source of net imports

**On a commodity basis**, the biggest driver of the improving U.S. trade surplus will be polymers (with almost \$15 billion in net export growth) and specialties (\$9.3 billion of increased net exports), with moderate growth in intermediates (\$3.1 billion in net export growth)

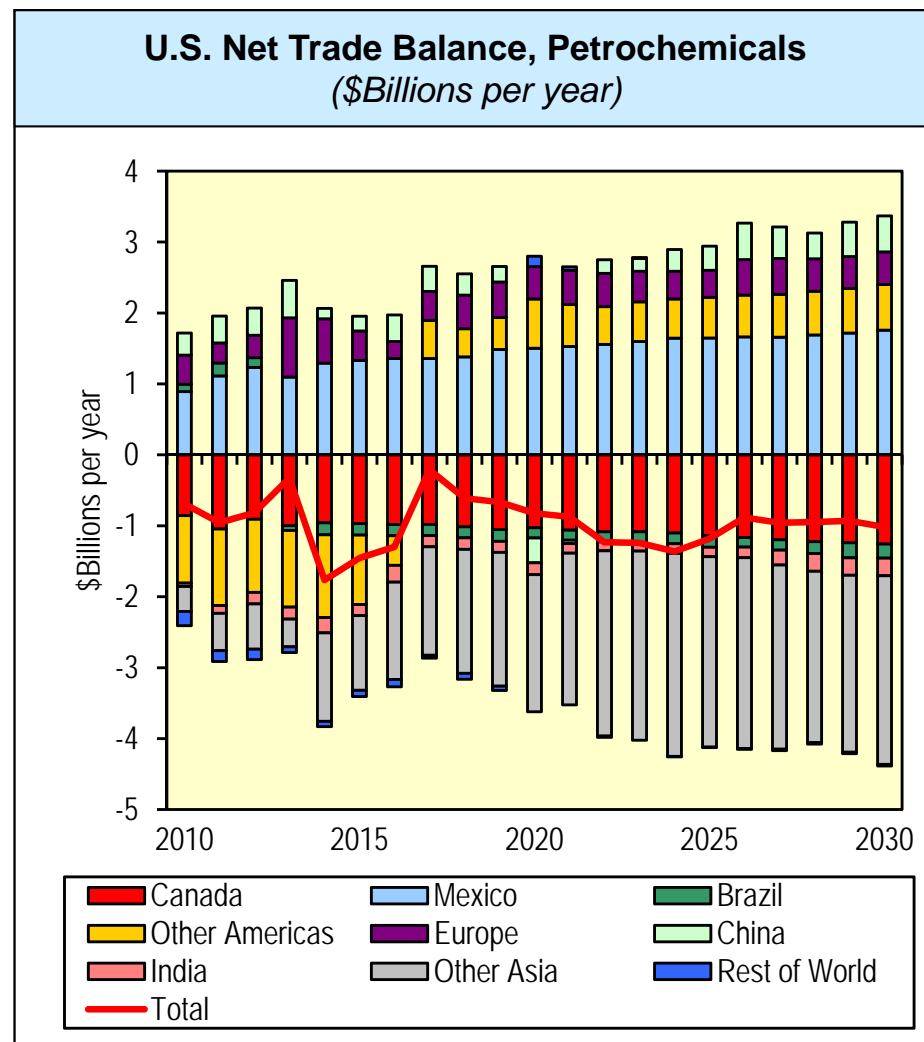
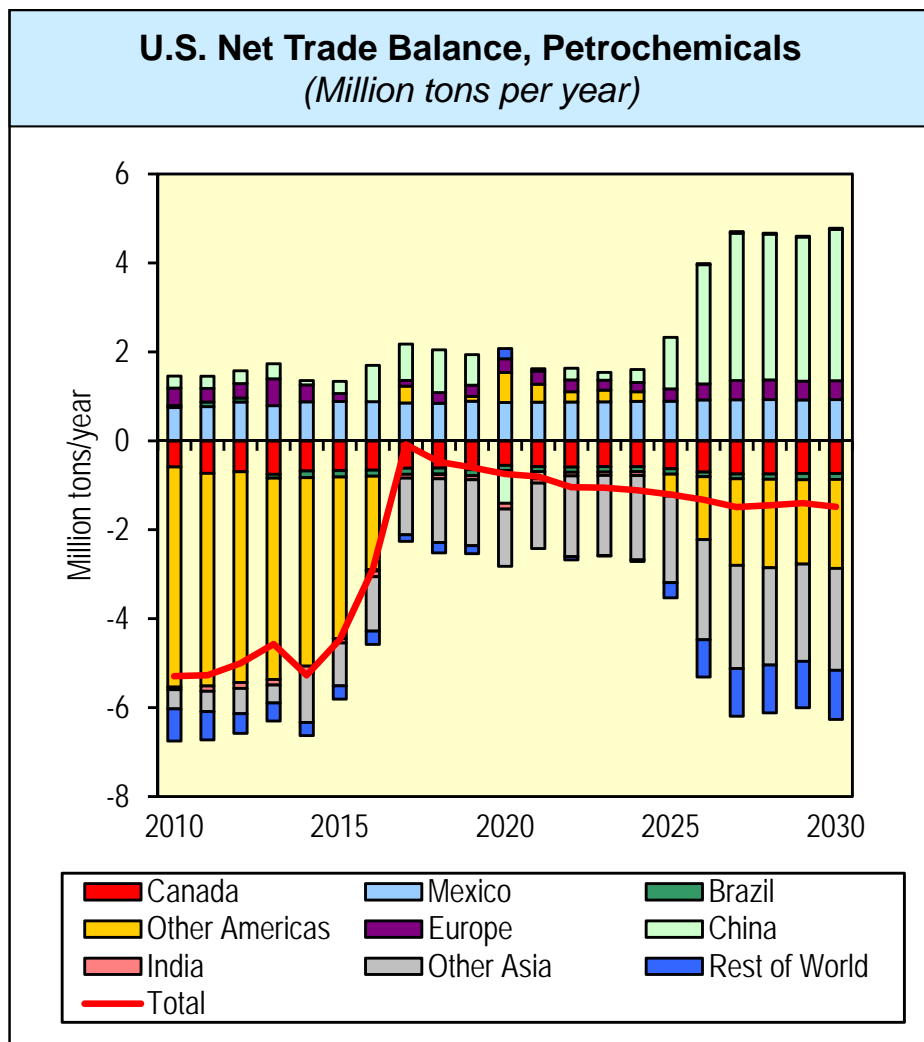
- Although the overall position will improve, the U.S. will remain in deficit for petrochemicals (\$0.7 billion improvement – fewer imports)
- The U.S. will import less fertilizers (deficit shrinks by 2.4 million tons), but due to higher prices, net imports increases by \$0.5 billion

**Exports of “commodities of interest”:** Although not part of the scope of this report, Nexant estimates that exports of “commodities of interest” will more than double from \$60 billion in 2014 to \$123 billion by 2030, with exports to the Americas expected to account for half of total export value

In comparison, for 2013, total U.S. exports of goods were \$1,590.4 billion and imports were \$2,293.5 billion, resulting in a goods deficit of \$703.2 billion

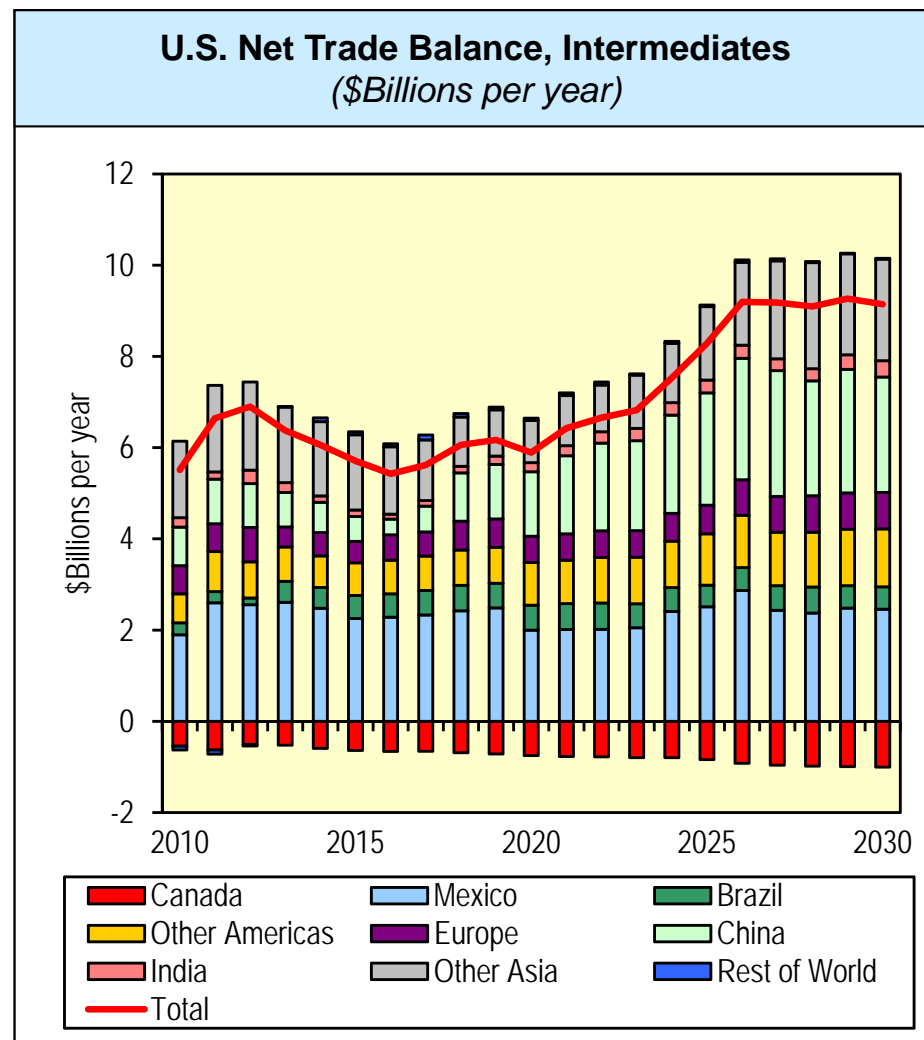
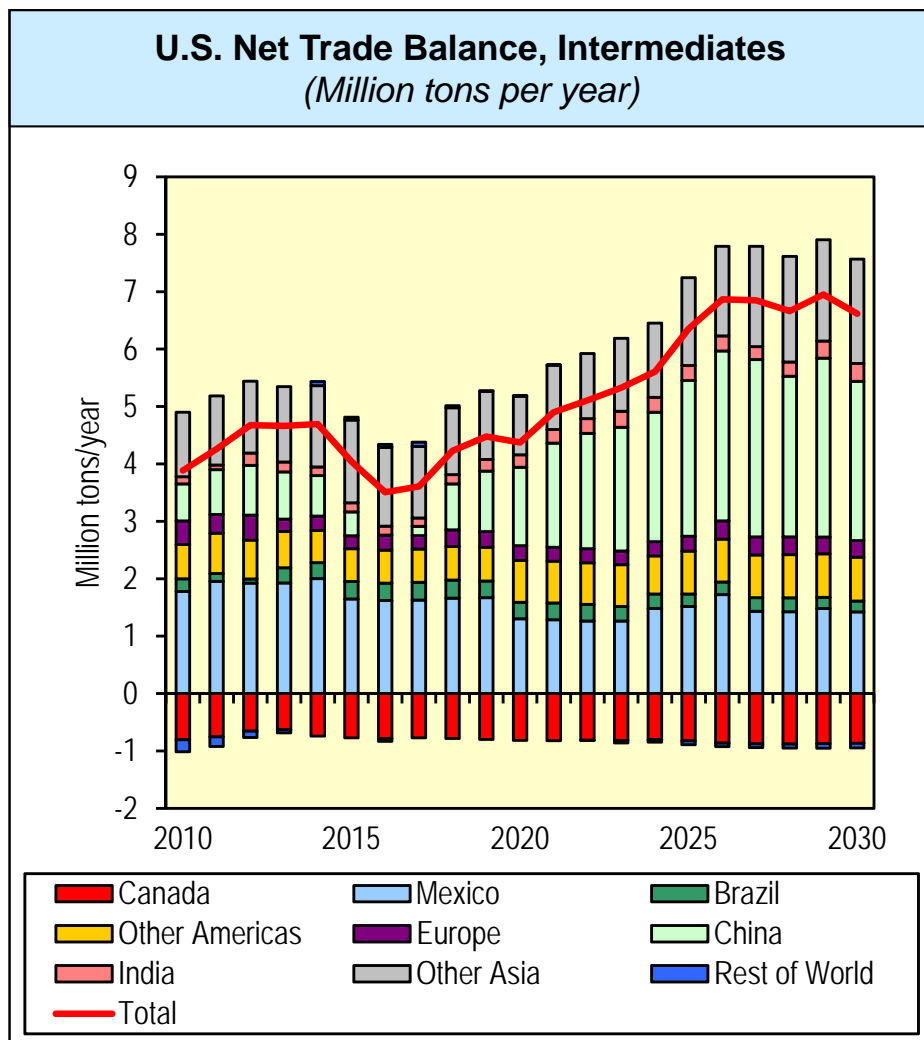
***Polymers and specialties will be the commodities that capture the most net export value***

**Net exports of Petrochemicals have been dragged down by methanol, which has been in deficit, but will reach near parity in the next 3 years**



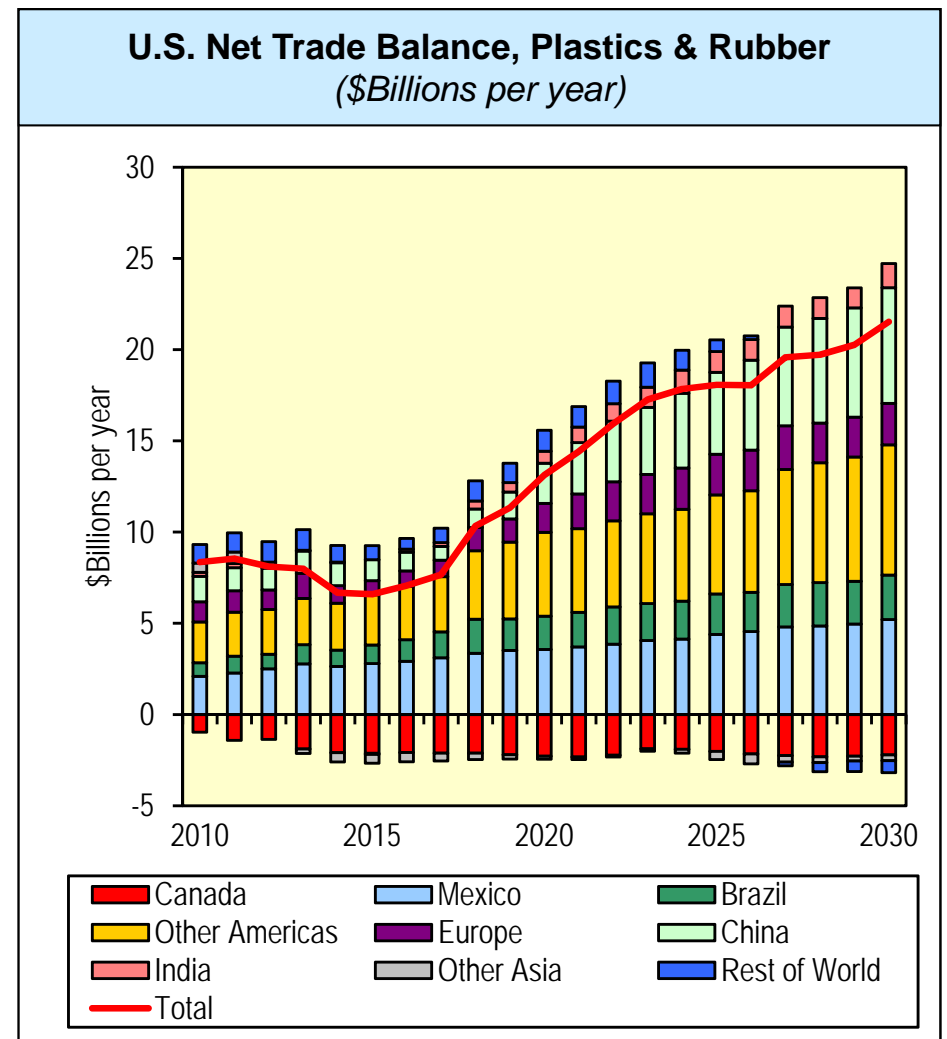
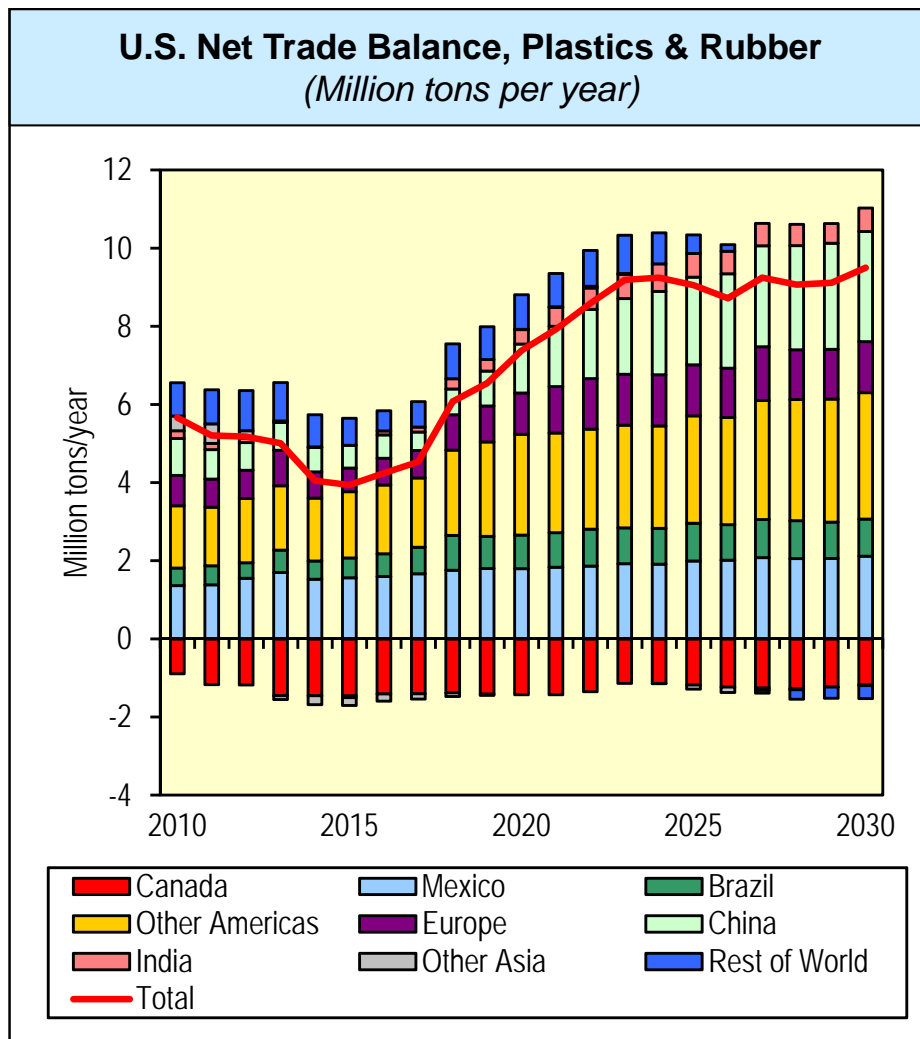
**Benzene and butadiene will remain key petrochemical net import items**

**Intermediates are in surplus, with exports to China expected to more than triple by 2030, leading to category surplus growth of \$3 billion**



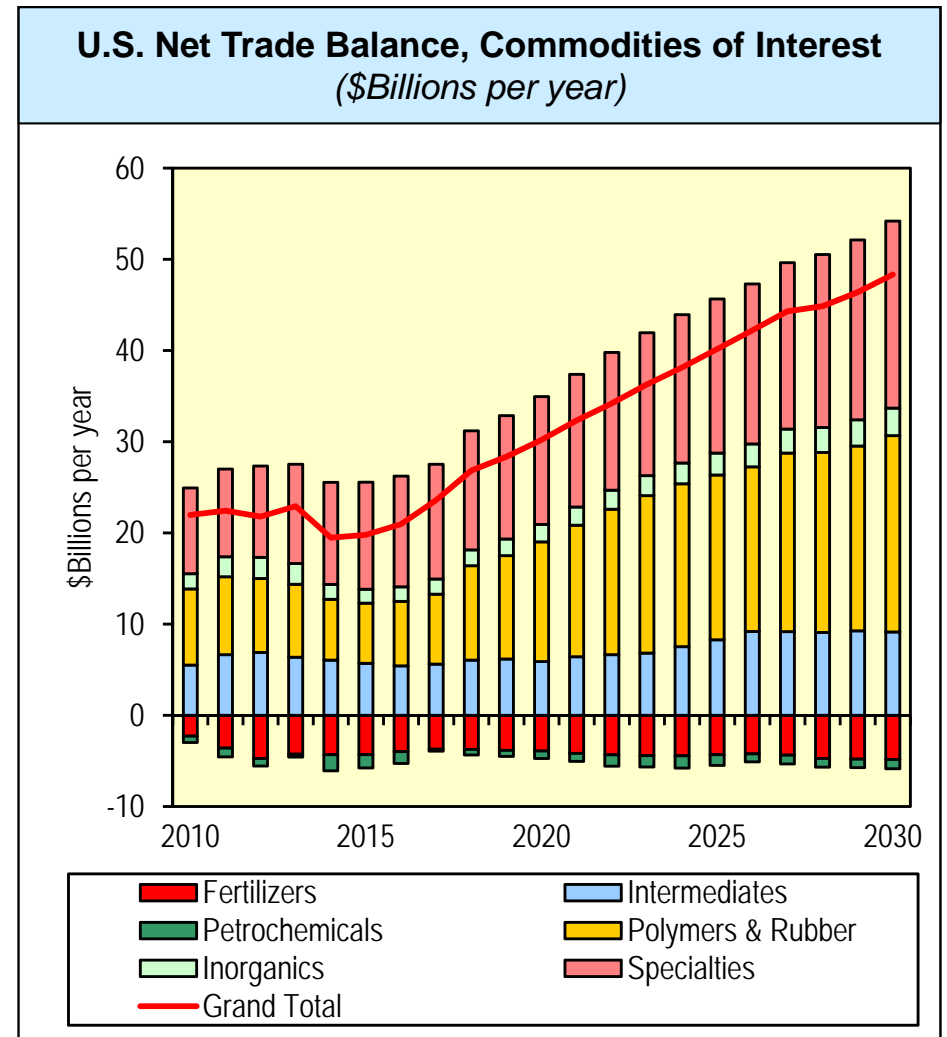
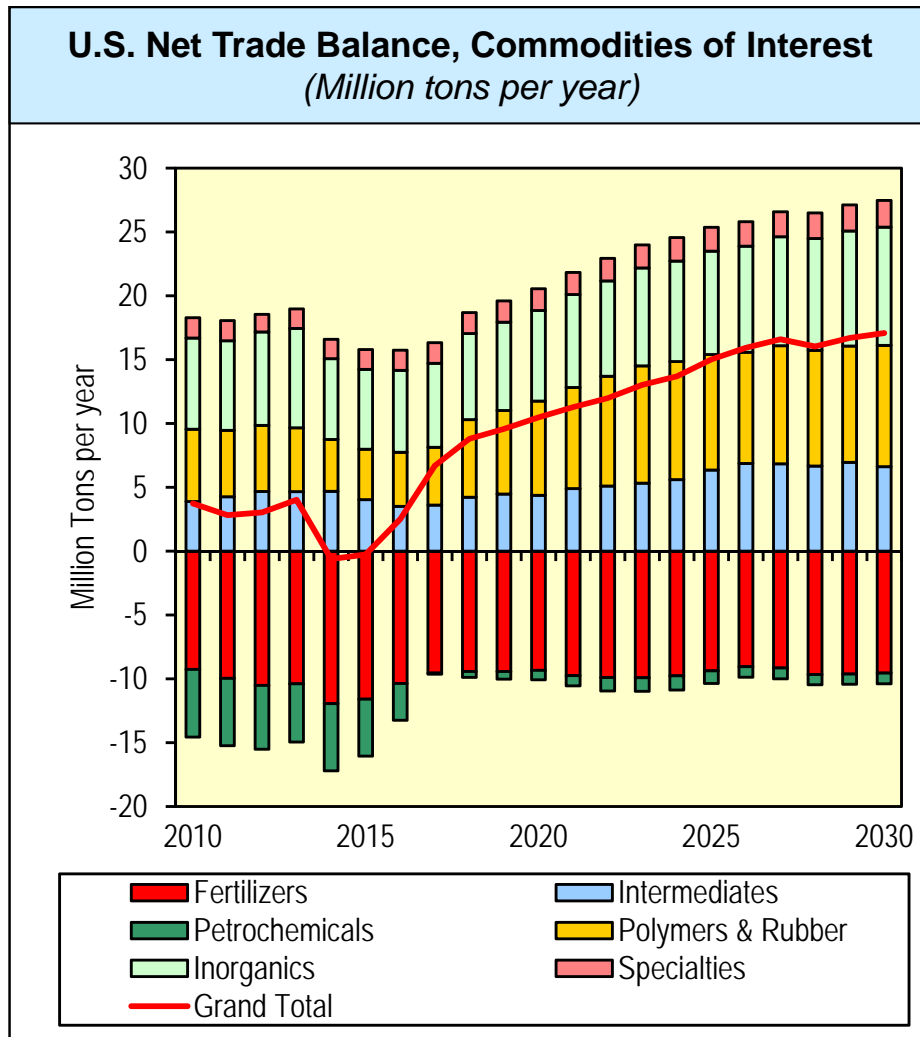
**Canada will remain a key source of PTA and MEG (PET intermediates)**

**Polyethylene and PVC are expected to drive the exports for Plastics Resins, with sales to Other Americas, China and ROW likely to expand, leading to surplus growth of \$14.8 billion**



**Canada will continue to be a key source of polymer supply**

**Summary Commodities of Interest: Change in tons is driven by all categories except specialties; but the change in net export surplus value is clearly driven by polymers (\$14.8 billion increase) and specialties (\$9.3 billion increase)**



***The deficit in fertilizers will shrink on a weight basis, but increase on a value basis***  
***Intermediates will exhibit modest growth***



**The value of U.S. net exports will increase to \$48.3 billion by 2030, representing 5.8% compounded value growth driven by increased exports of polymers and specialties**

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**On a commodity basis**, the biggest driver of the improving U.S. trade surplus will be polymers (with almost \$15 billion in net export growth) and specialties (\$9.3 billion of increased net exports), with moderate growth in intermediates (\$3.1 billion in net export growth)

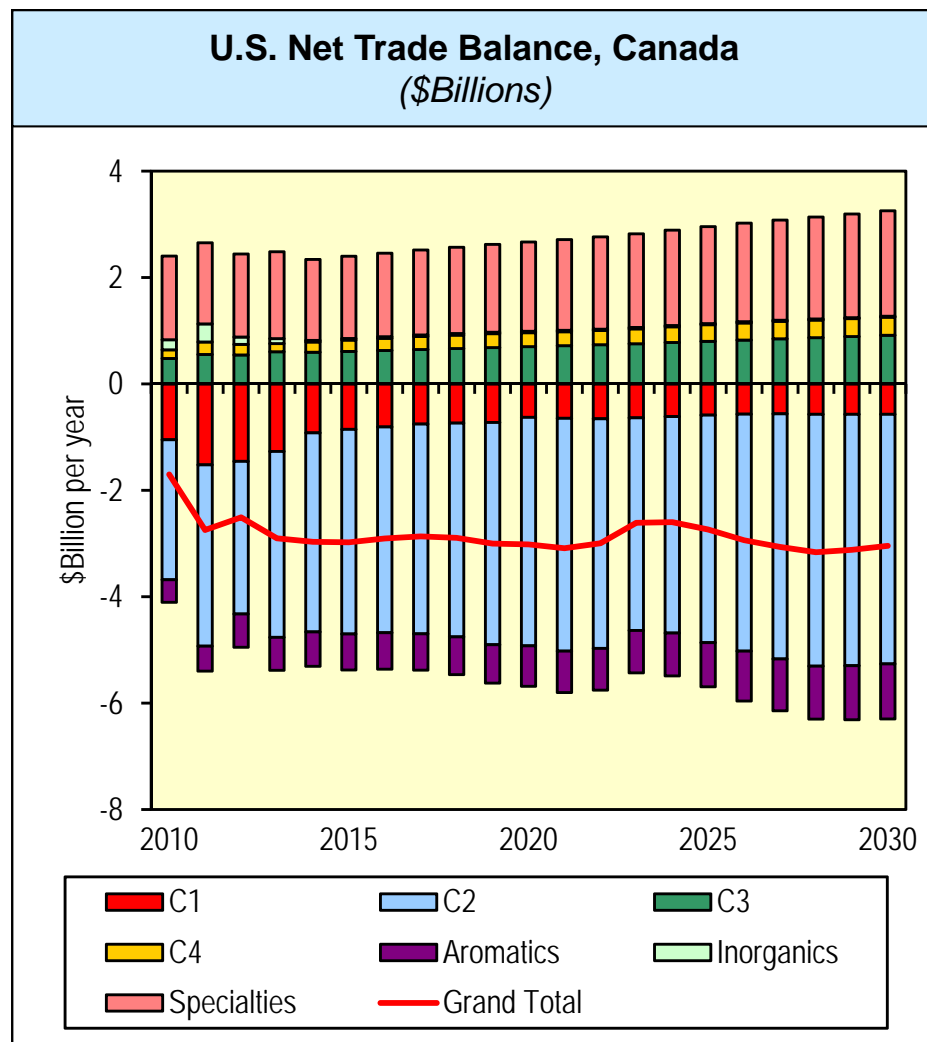
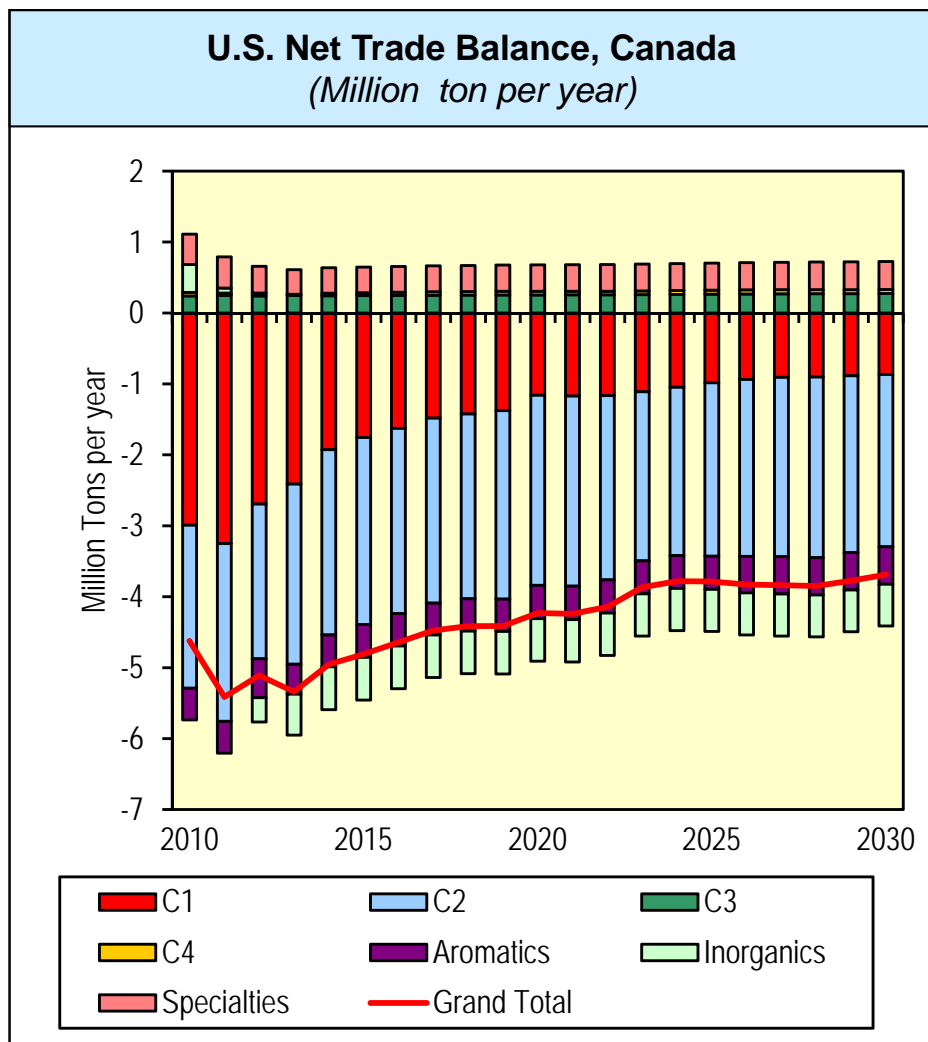
- Polyethylene and PVC are expected to drive the exports for plastic resins, with sales to China, Other Americas, and ROW forecast to expand significantly
- Although the overall position will improve, the U.S. will remain in deficit for petrochemicals (\$0.7 billion improvement – due to fewer imports). Petrochemicals have been dragged down by methanol, which has been in deficit, but will reach parity in the next 3 years; Benzene and butadiene will remain key petrochemical import items
- Intermediates are in surplus, with exports to China expected to more than triple by 2030. Canada will remain a key source of PTA and MEG
- The U.S. will import less fertilizers (deficit shrinks by 2.4 million tons), but due to higher prices, net imports increases by \$0.5 billion

***Polymers and specialties will be the commodities that gain the most net export value***

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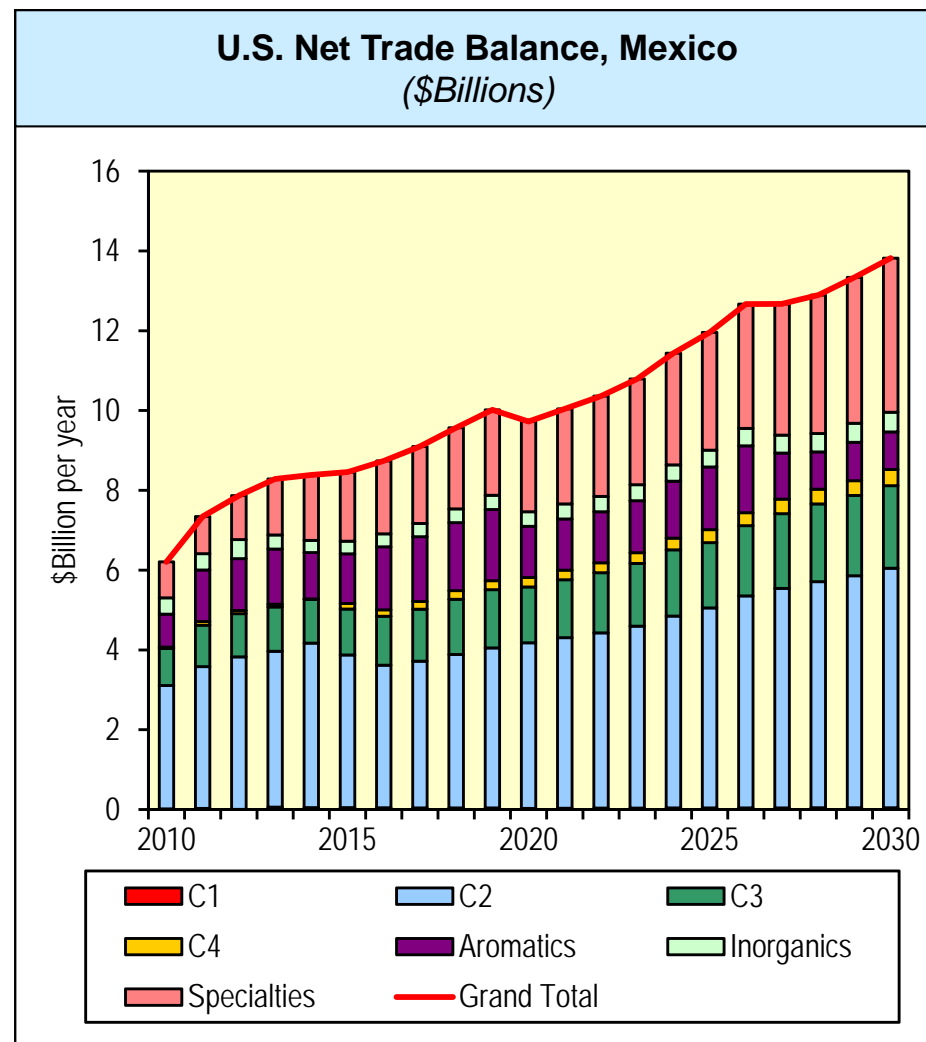
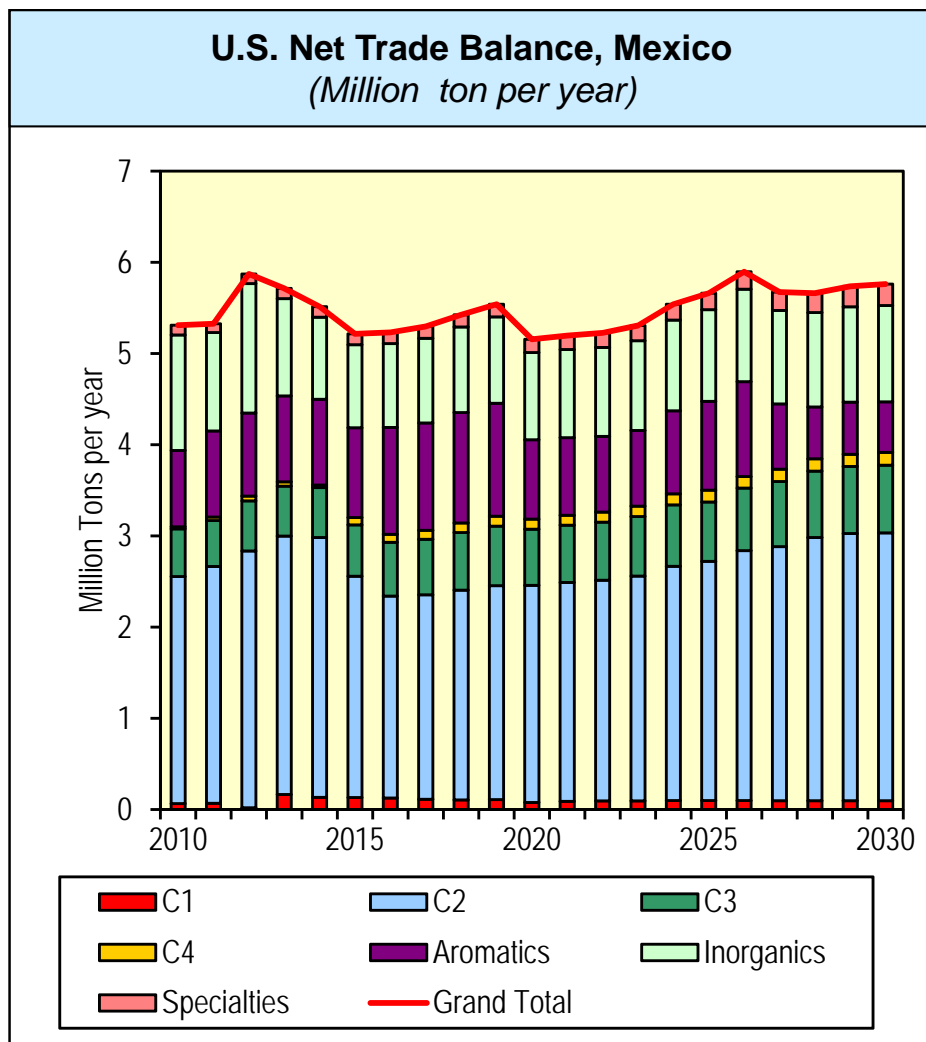
**Section 4**  
**Forecast: Net Exports by Region**

**Canada is a key source of C1 and C2 chemicals to the U.S. including: polyethylene, styrene, MEG, urea and ammonia**



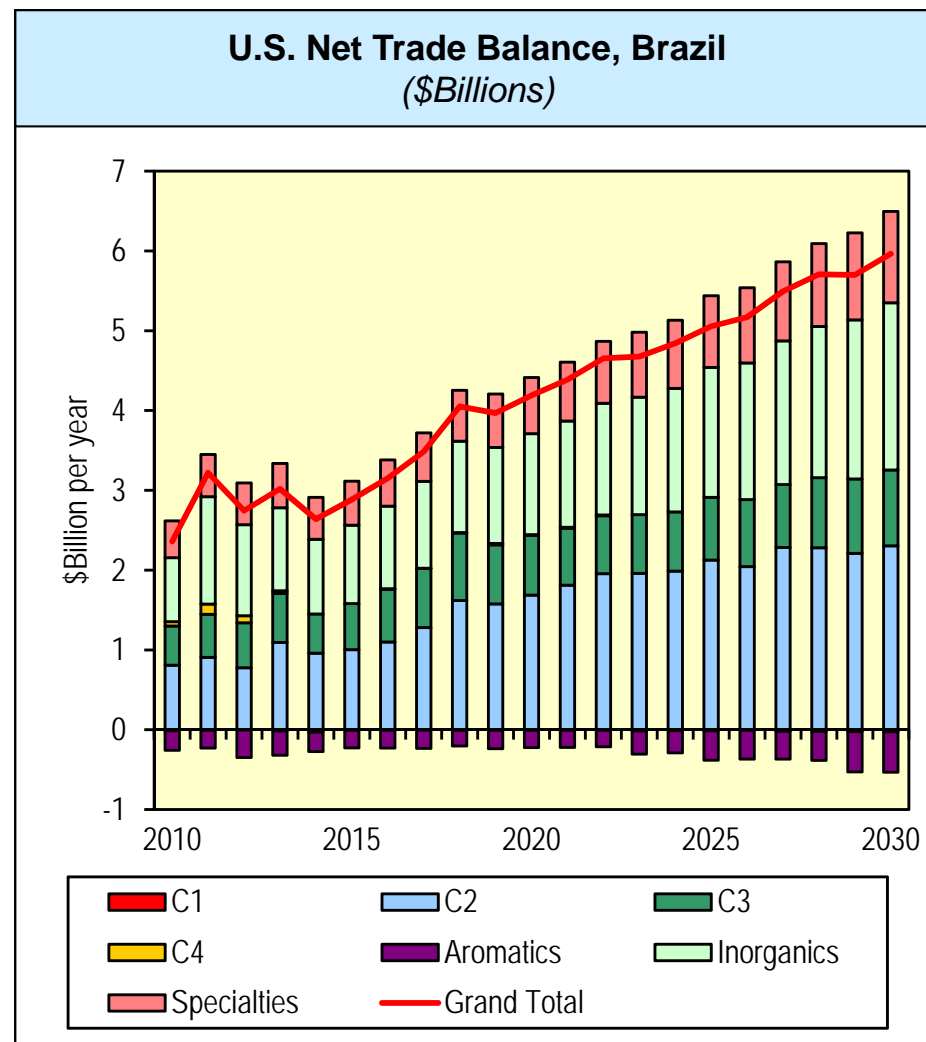
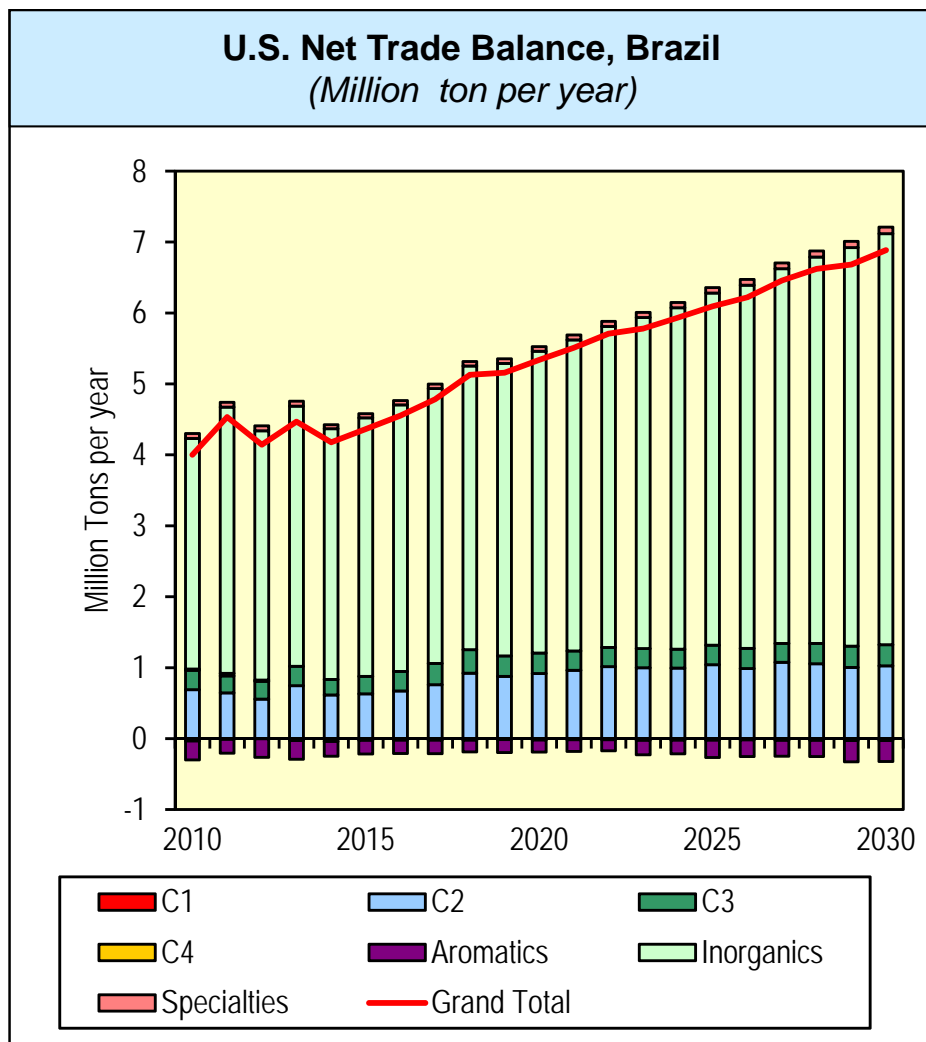
**Canada, which also supplies PTA and butadiene, while receiving C4 rubbers and polypropylene, will remain in deficit as net trade partner with the U.S.**

**Mexico is an important destination for para-xylene, polyethylene, styrene, polypropylene, polycarbonates, polyether polyols, and VCM from the U.S.**



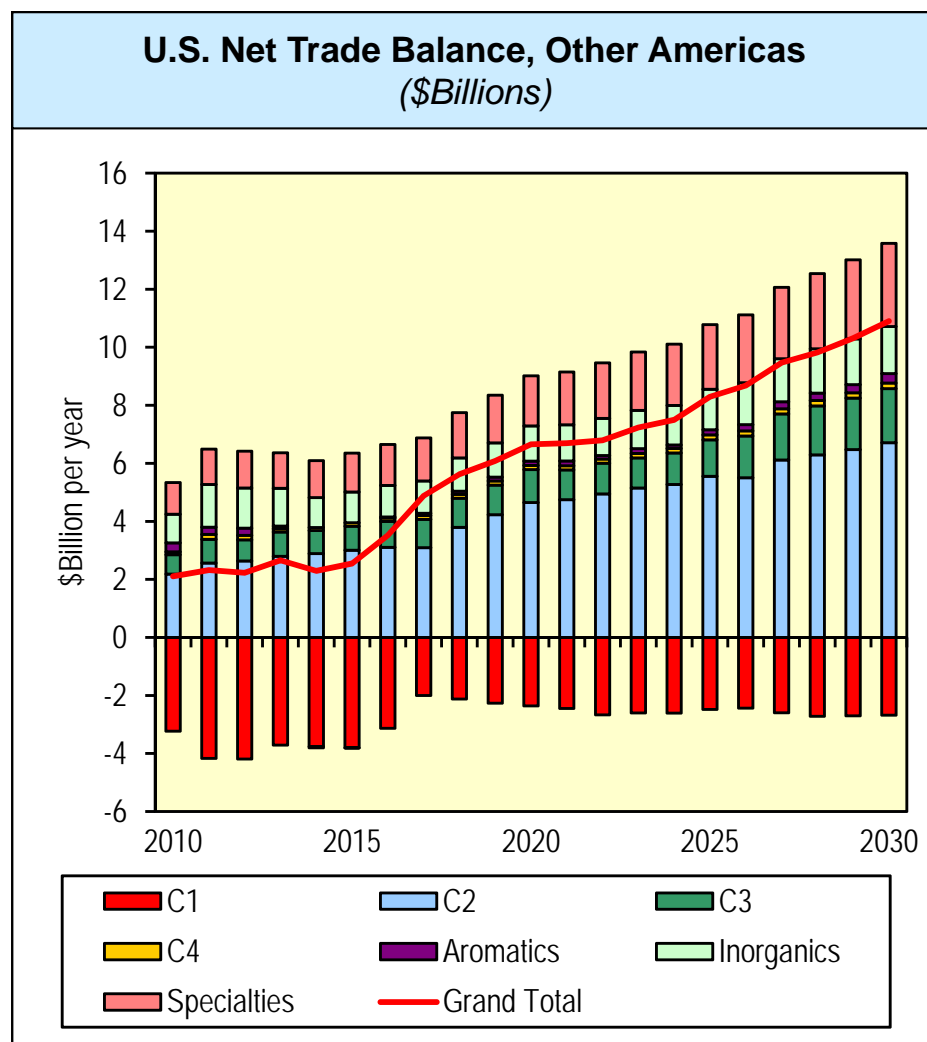
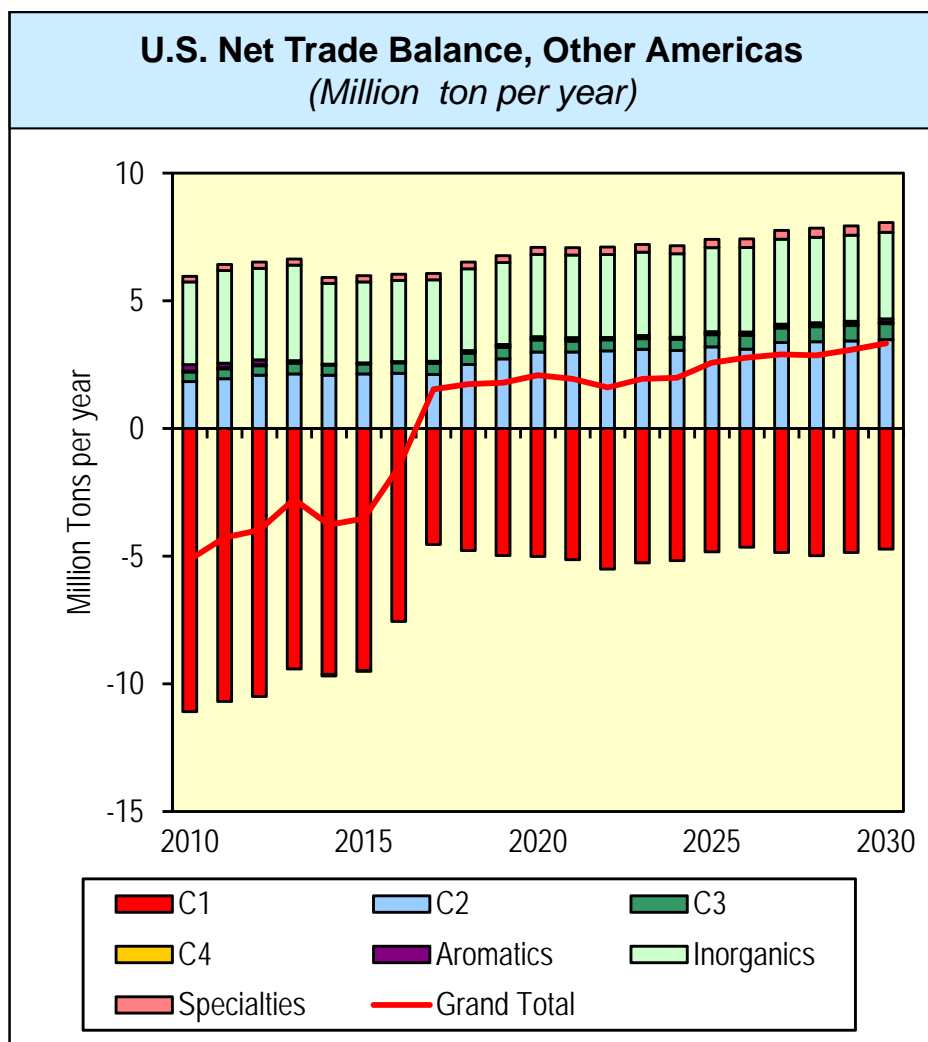
**Mexico will increase its net imports from the U.S. by \$5.4 billion, based largely on greater net imports of C2 chemicals (\$1.9 billion of growth) and specialties (\$2.5 billion)**

**Brazil is an important destination for styrene, sodium hydroxide, polyether polyols, DAP, acrylic polymers and polyethylene from the U.S.**



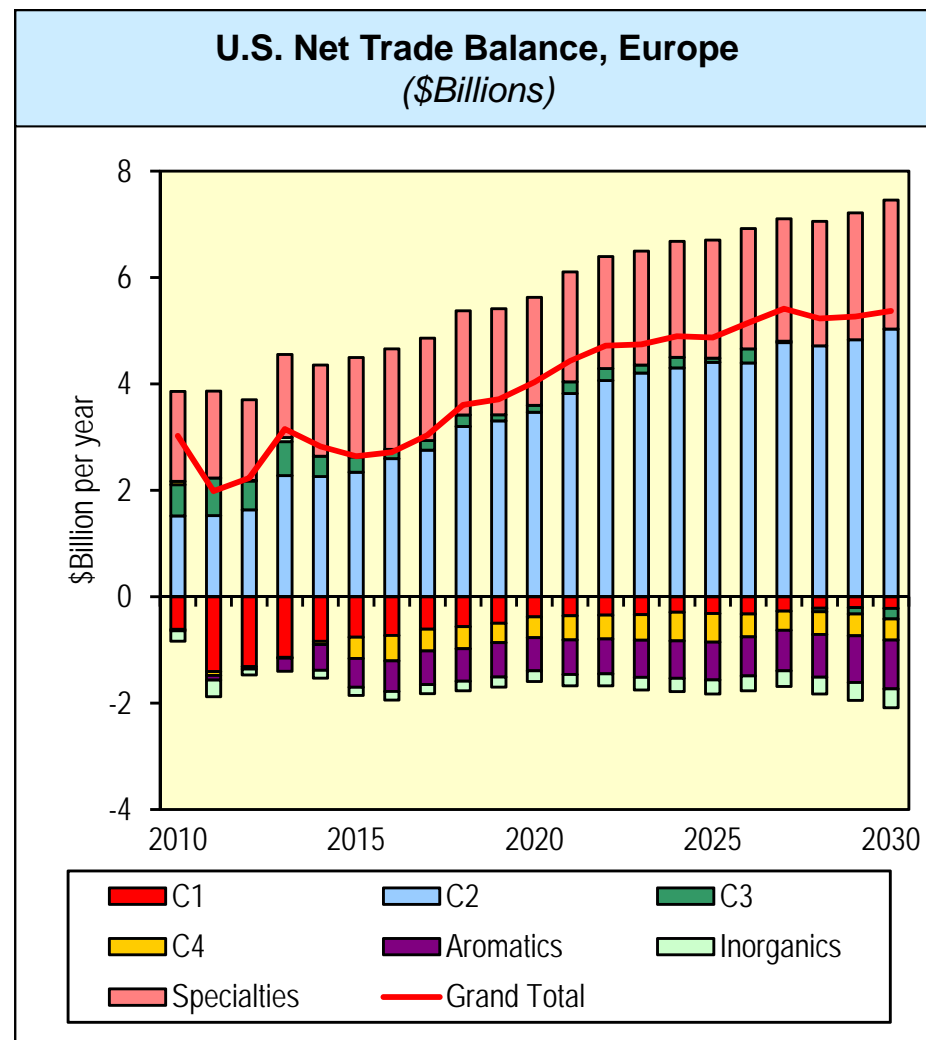
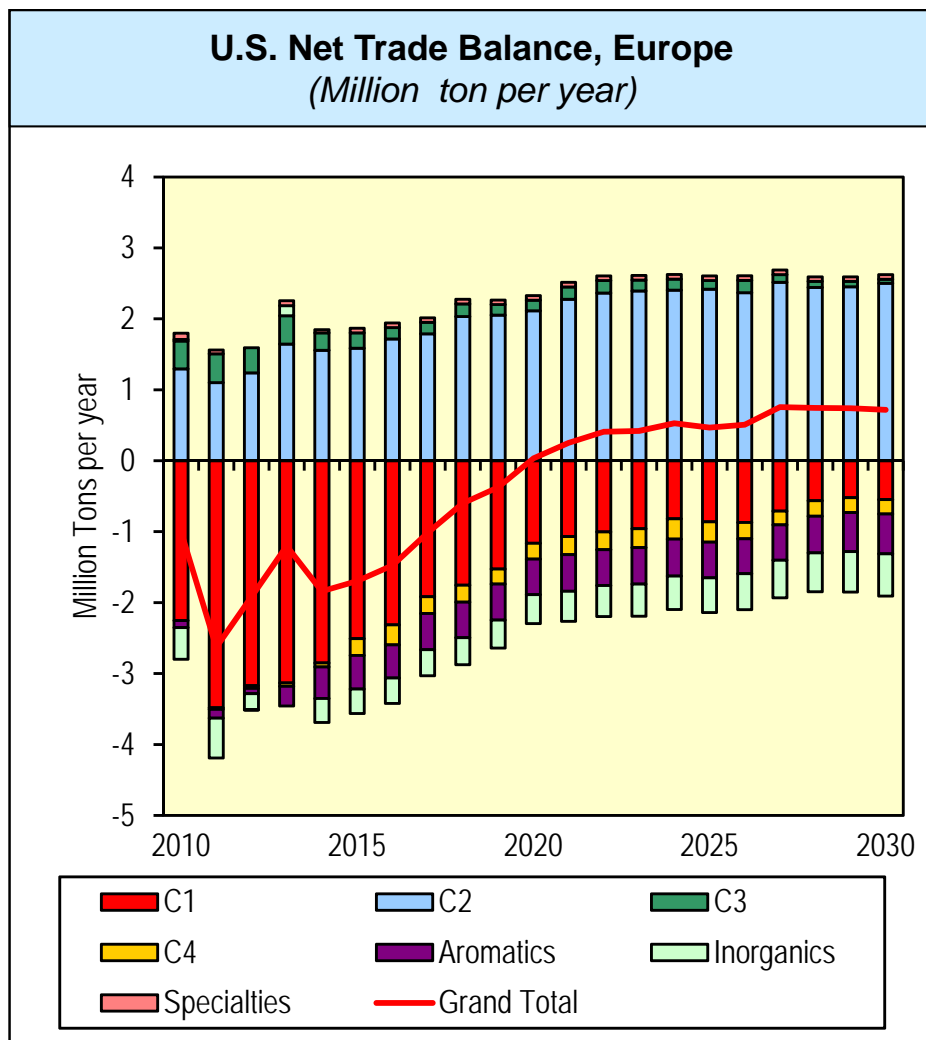
**Brazil, which is a notable source of benzene, toluene and para-xylene, will increase its net imports from the U.S. by \$3.3 billion, based on greater imports of C2 chemicals and inorganics**

**Other Americas is an important destination for PE, PVC, DAP, styrene, acrylic polymers, sodium hydroxide, soda ash, and TiO2 from the U.S.**



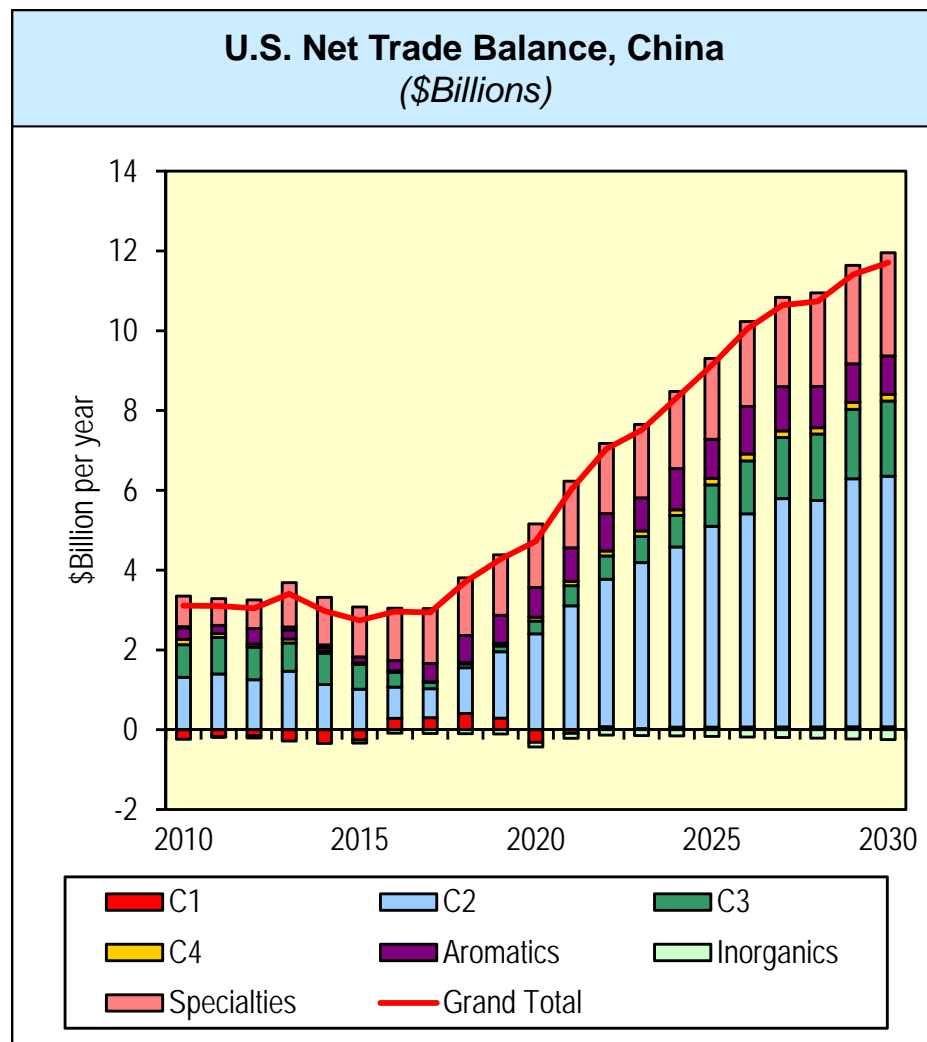
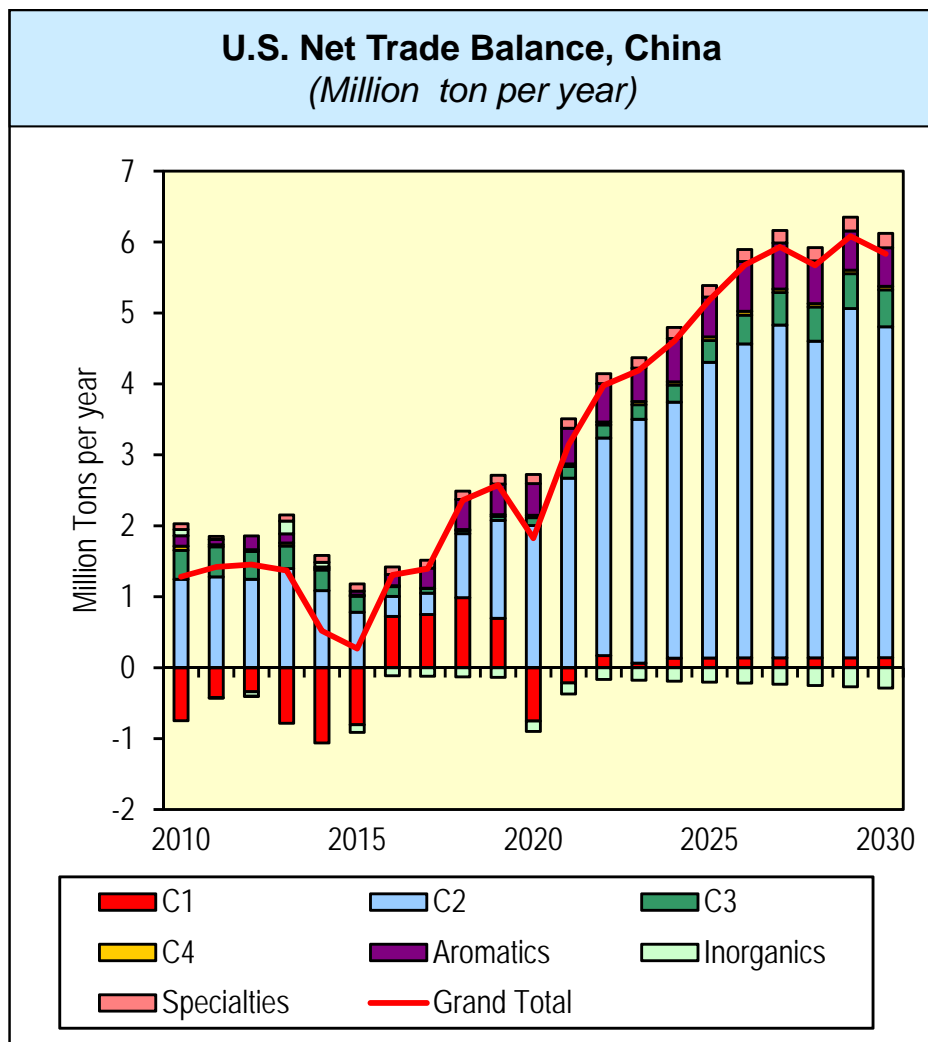
**Other Americas, which is a key source of ammonia and methanol, will increase its net imports from the U.S. by \$8.6 billion based on less C1 net exports and greater C2 net imports**

**Europe is an important destination for TiO<sub>2</sub>, PVC, butadiene rubber, styrene, ethylene copolymers, acrylic polymers and polyether polyols from the U.S.**



**Europe, which is a key source of ammonia, urea, butadiene, benzene and para-xylene, will increase its net imports from the U.S. by \$2.5 billion based on greater C2 net imports**

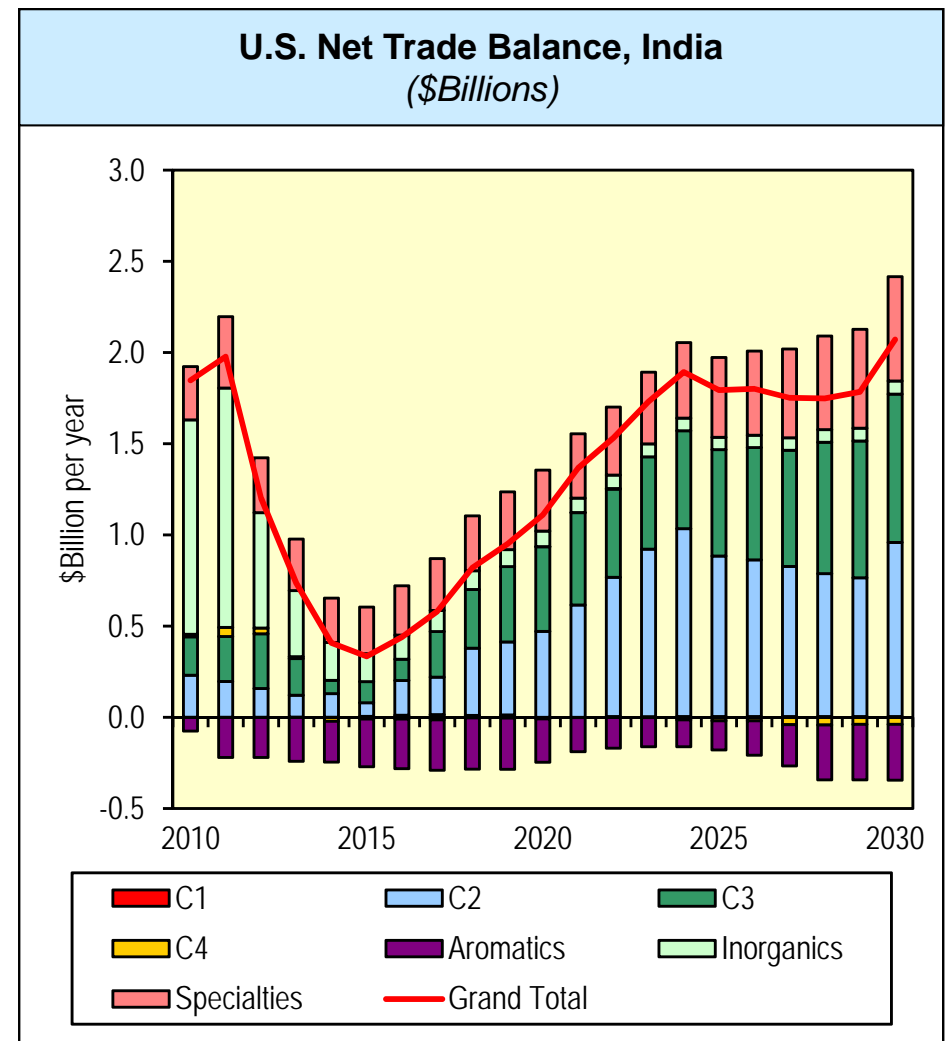
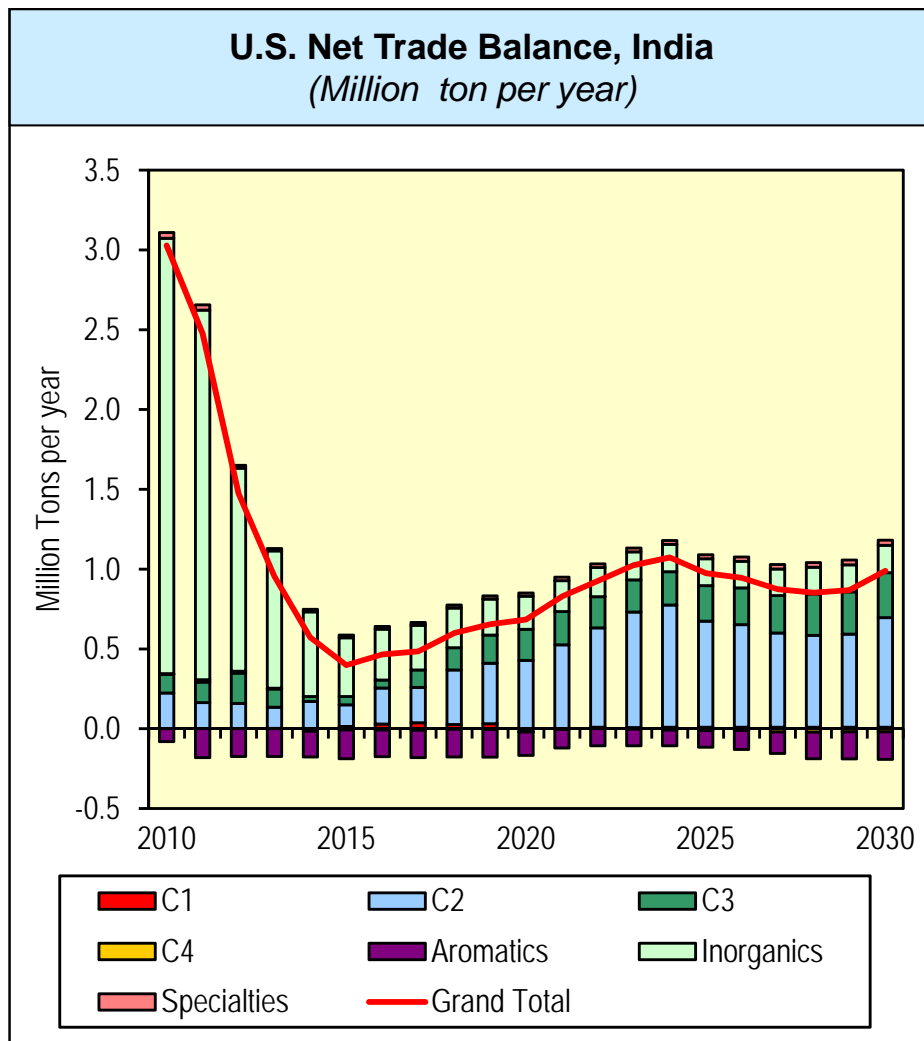
**China is an important destination for polycarbonates, PVC, para-xylene, styrene, caprolactam, MEG, polypropylene, PE and polyether polyols from the U.S.**



**China will increase its net imports from the U.S. by \$8.7 billion based largely on greater C2 net imports with \$5.1 billion of growth**

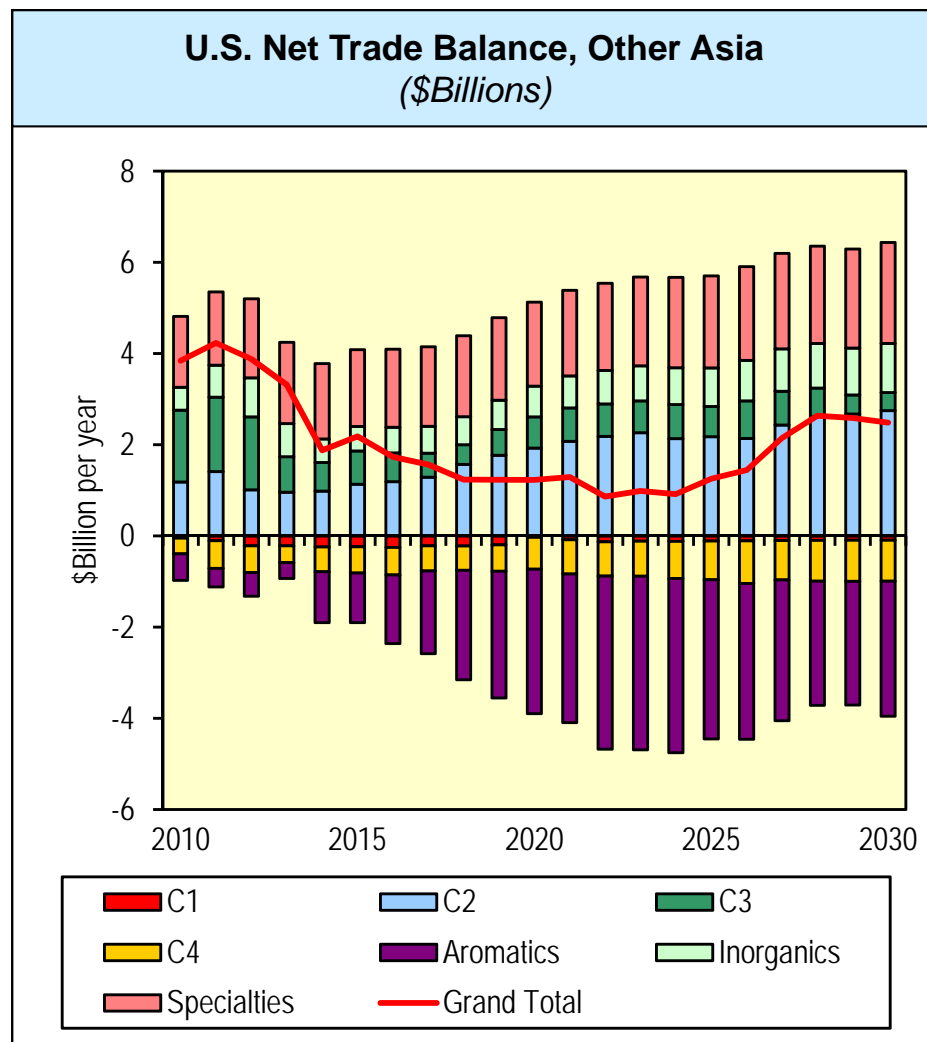
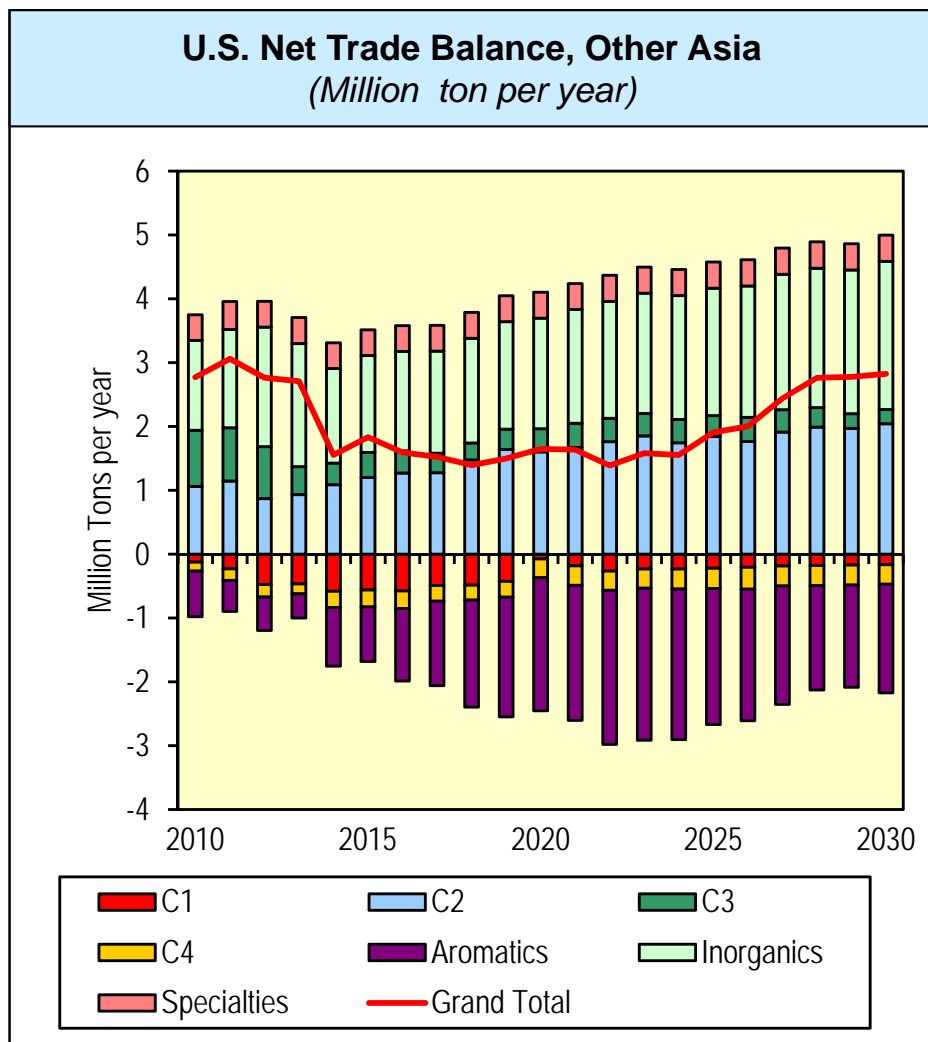


**India was an outlet for DAP from the U.S., but is apparently sourcing inorganics (DAP) from China now and is currently an important destination for phenol and acrylonitrile from the U.S.**



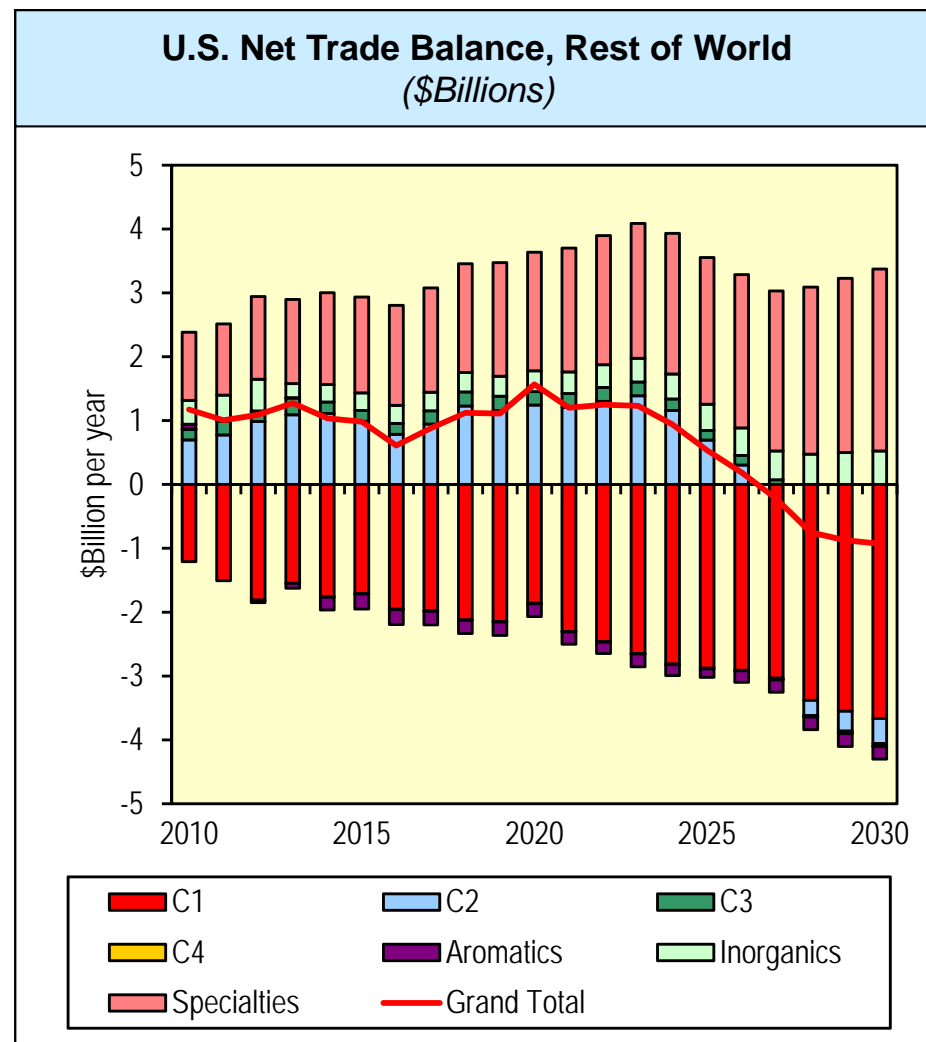
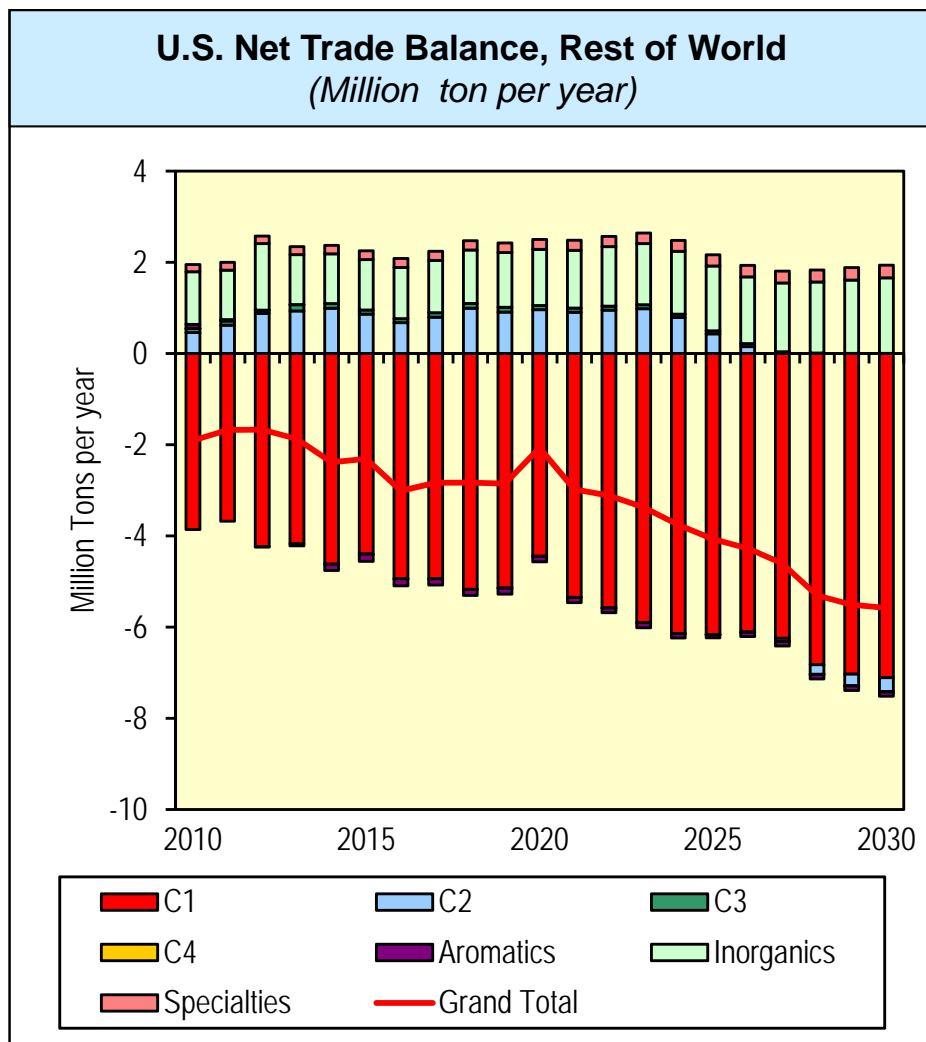
**India will increase its net imports from the U.S. by \$1.6 billion based on greater net imports of C2, C3 and specialties**

**Other Asia is an important destination for acrylonitrile, TiO<sub>2</sub>, ethylene copolymers, xylenes, polyether polyols, polycarbonates and phenol from the U.S**



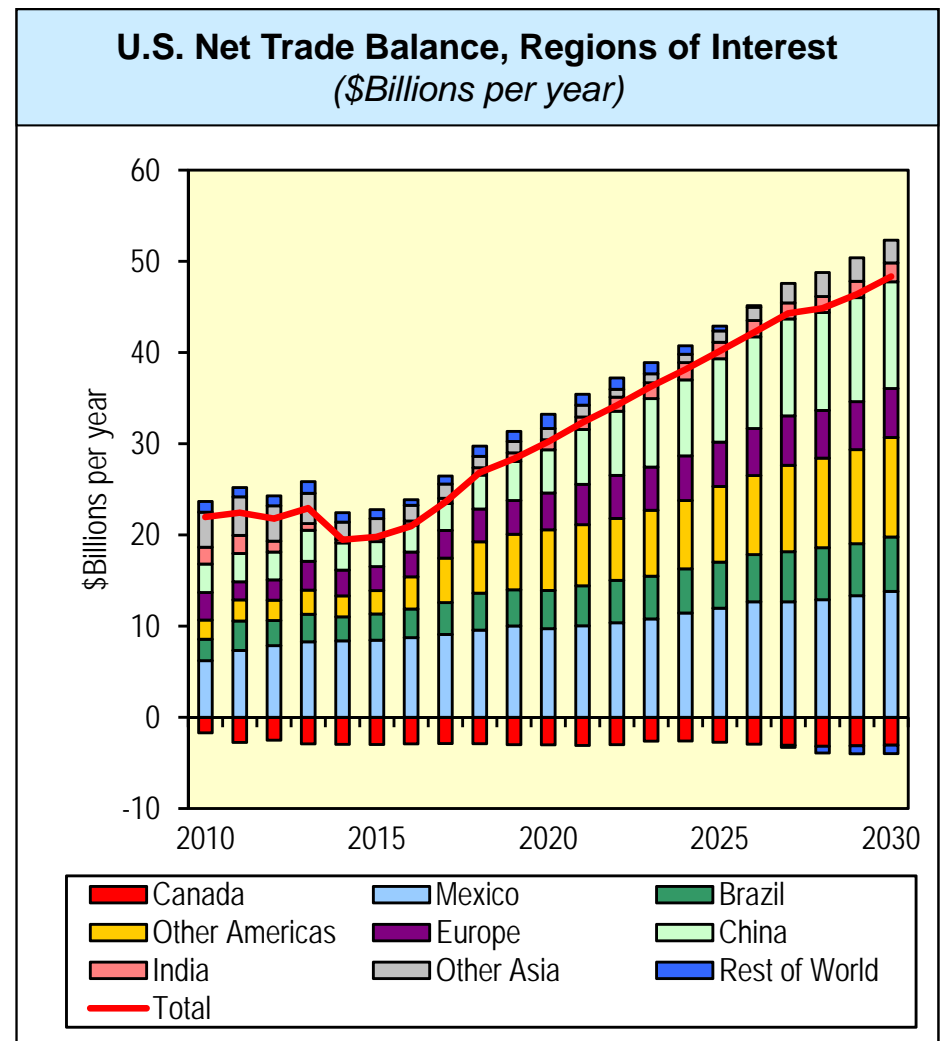
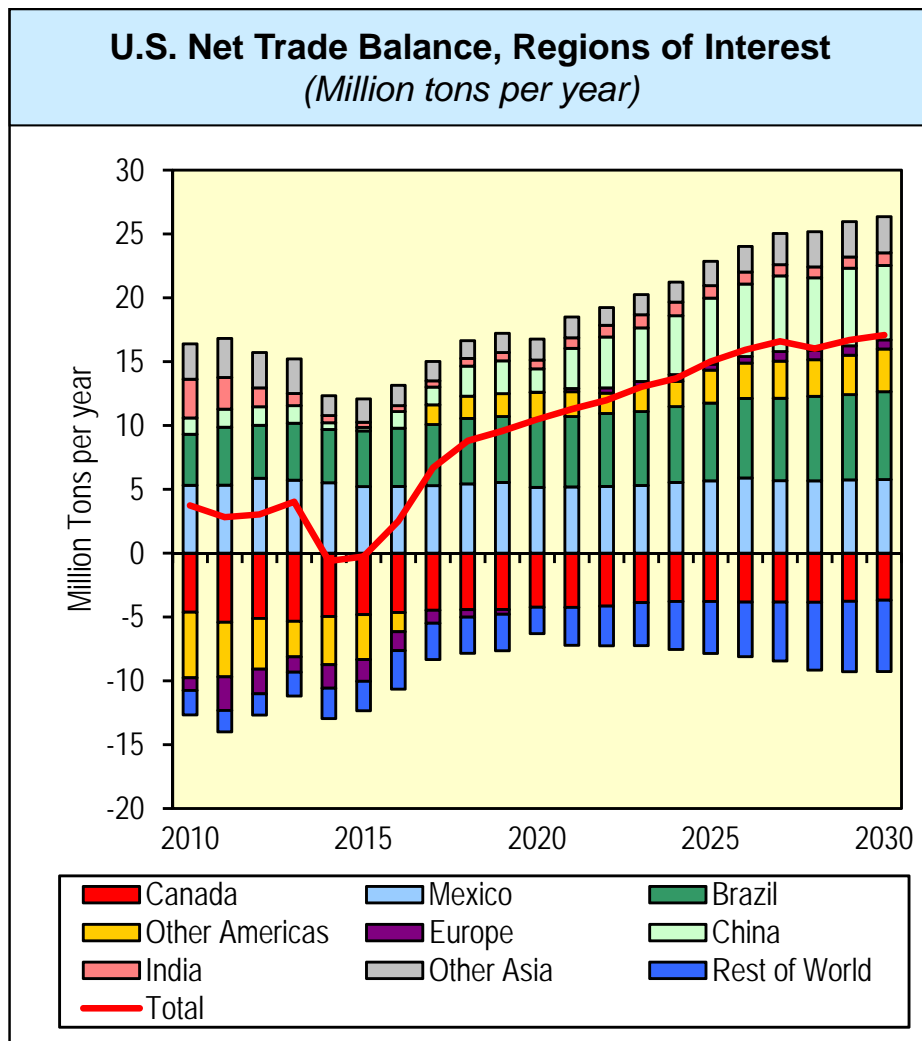
**Other Asia, which is an important source of benzene, ABS, toluene, and urea, will increase its net imports from the U.S. by \$0.5 billion based on a mix of greater C2 and specialty imports, along with greater exports of aromatics**

## Rest of World is an important destination for PVC from the U.S



**Rest of World, which is an important source of urea and ethylene glycol, will decrease its net imports from the U.S. by \$2.1 billion based on greater exports of C1 chemicals to the U.S.**

**Summary by Region: Although the U.S. is nearly in balance on a tons basis in 2014, the mix of higher value chemicals that are exported drives the over trade balance (for the selected chemicals) to a \$19.5 billion surplus in 2014**



**Net exports to China, Other Americas and Mexico are forecast to account for \$22.7 billion of the \$28.5 billion in regional net export growth by 2030**

**Summary: Net Trade by Region – With the exception of Canada and ROW, the U.S. has a positive net trade balance with all the other regions/countries as defined in this report**

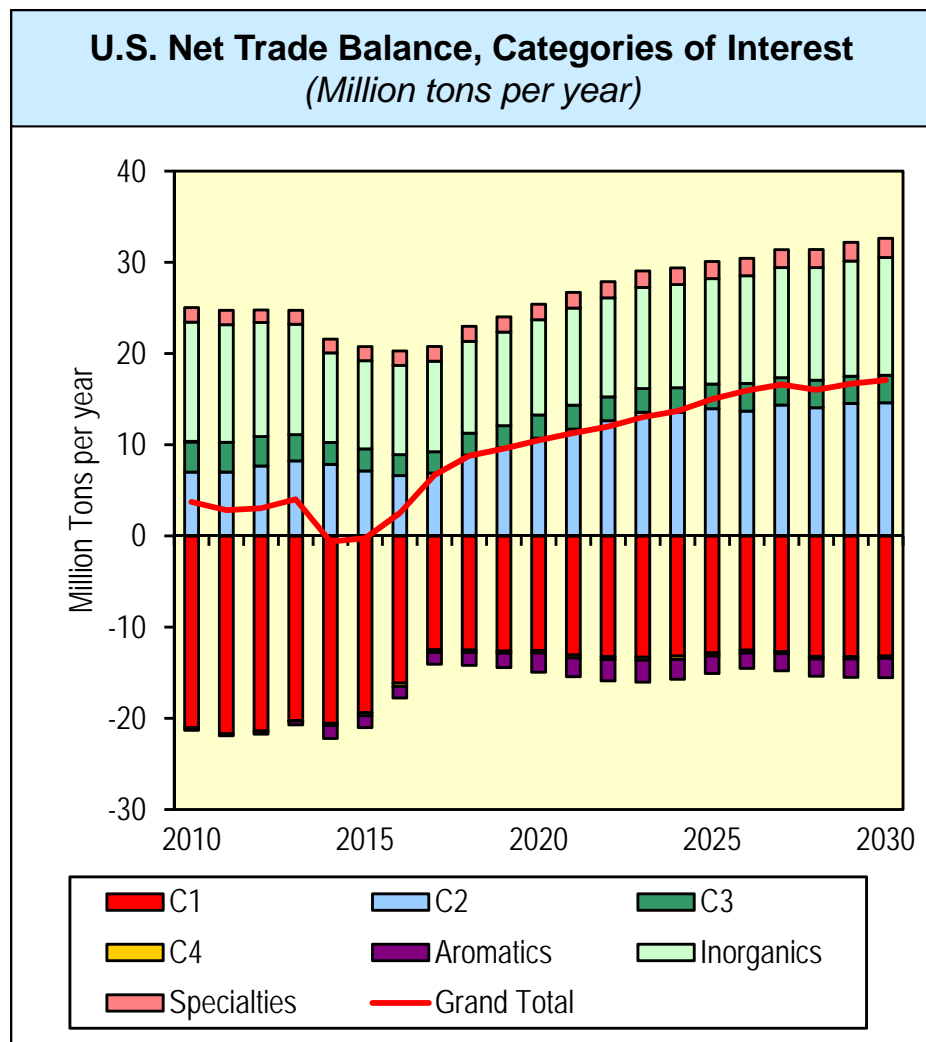
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- **Canada** is a key source of C1 and C2 chemicals including: Polyethylene, Styrene, MEG, Urea and ammonia; Canada also supplies PTA and butadiene, while receiving C4 rubbers and polypropylene (Deficit remains at \$3 billion by 2030)
- **Mexico** is an important destination for para-xylene, polyethylene, styrene, polypropylene, polycarbonates, polyether polyols, and VCM (Surplus improves by \$8.4 billion to \$13.8 billion by 2030, *growth of \$5.4 billion*)
- **Brazil** is an important destination for styrene, sodium hydroxide, polyether polyols, DAP (Surplus more than doubles to \$6.0 billion by 2030)
- **Other Americas** is an important destination for PE, PVC, DAP, styrene, acrylic polymers, sodium hydroxide, soda ash, and TiO<sub>2</sub>; Other Americas is a key source of ammonia and methanol (Surplus improves from \$2.3 billion to \$10.9 billion by 2030, *growth of \$8.6 billion*)
- **Europe** is an important destination for TiO<sub>2</sub>, PVC, butadiene rubber, styrene, ethylene copolymers, acrylic polymers and polyether polyols; Europe is a key source of ammonia, urea, butadiene, benzene and para-xylene (Surplus improves from \$2.8 billion to \$5.4 billion by 2030)
- **China** is an important destination for polycarbonates, PVC, para-xylene, styrene, caprolactam, MEG, polypropylene, PE and polyether polyols (Surplus improves by \$3.0 billion to \$11.7 billion by 2030, *growth of \$8.7 billion*)
- **India** is an important destination for DAP, phenol and acrylonitrile (Surplus improves by \$0.4 billion to \$2.1 billion by 2030)
- **Other Asia** is an important destination for acrylonitrile, TiO<sub>2</sub>, ethylene copolymers, xylenes, polyether polyols, polycarbonates and phenol and an important source of benzene, ABS, toluene, and urea (Surplus improves by \$1.9 billion to \$2.5 billion by 2030)
- **Rest of World (ROW)** is a important source of urea and ethylene glycol and is an important destination for PVC (\$1.0 surplus becomes a deficit of \$0.9 billion by 2030)

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**Section 5**  
**Conclusions: Trade Trends and Policy Impacts**

**Trade Trends by Category: On a weight basis, U.S. trade for the selected chemicals is projected to increase from a small deficit in 2014 to a surplus of 17 billion tons by 2030**



The deficit in C1 chemicals will shrink by 35%, as additional methanol, ammonia and urea capacity based on natural gas feedstocks are constructed

Net exports of C2 chemicals, which includes polyethylene and PVC, will nearly double to 14.6 billion tons

Trade surplus for C3 chemicals will expand by 25% to 3 billion tons

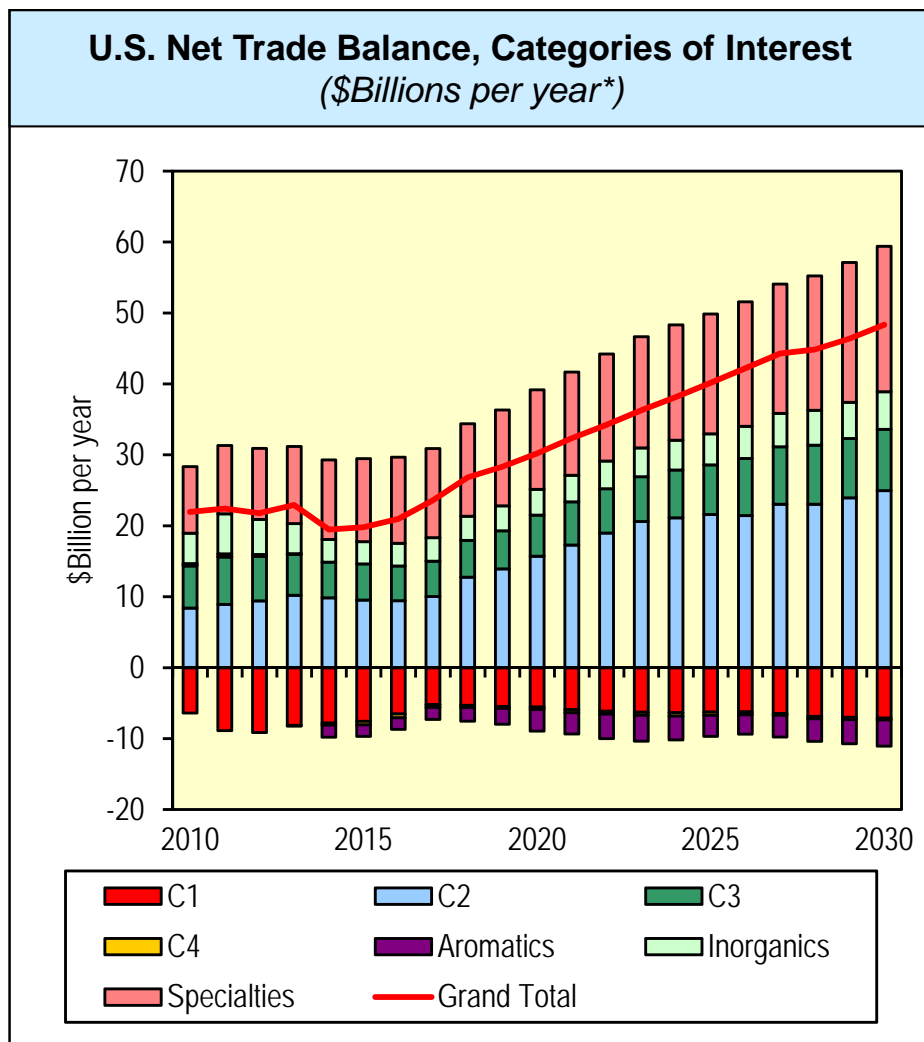
Due to the lightening of cracker feedstocks and continued importation of benzene and butadiene, the small trade deficit for C4s and aromatics will continue

The trade surplus for inorganics, which have lower average prices than the other materials, will increase from 10 billion tons to 13 billion tons

Due to relatively high prices, the trade surplus for specialties has a relatively small impact on a weight basis

**On a weight basis, the largest impact is reduced C1 net imports and increased C2 net exports**

**Trade Trends by Category: Due to higher “value-added” of exports compared to imports, the U.S. trade surplus for the selected chemicals is projected to increase from \$19.5 billion in 2014 to \$48.3 billion by 2030**



Although balanced on a weight basis, the U.S. is in surplus by \$19.5 billion on a value basis

The trade deficit in C1 chemicals will shrink as new natural gas based ammonia and methanol plants are built

Most importantly, driven by competitive advantage based on low cost ethane and a massive investment in new crackers to make ethylene, net exports of C2 chemicals will increase by \$15 billion

C3 chemical exports will recover after on-purpose sources of propylene are built

The trade deficit in aromatics and C4s will continue as the U.S. continues to import large quantities of benzene and butadiene

Note that net exports of specialties will increase from \$11.2 billion in 2014 to \$20.5 billion by 2030, based on intellectual property and competitive advantage

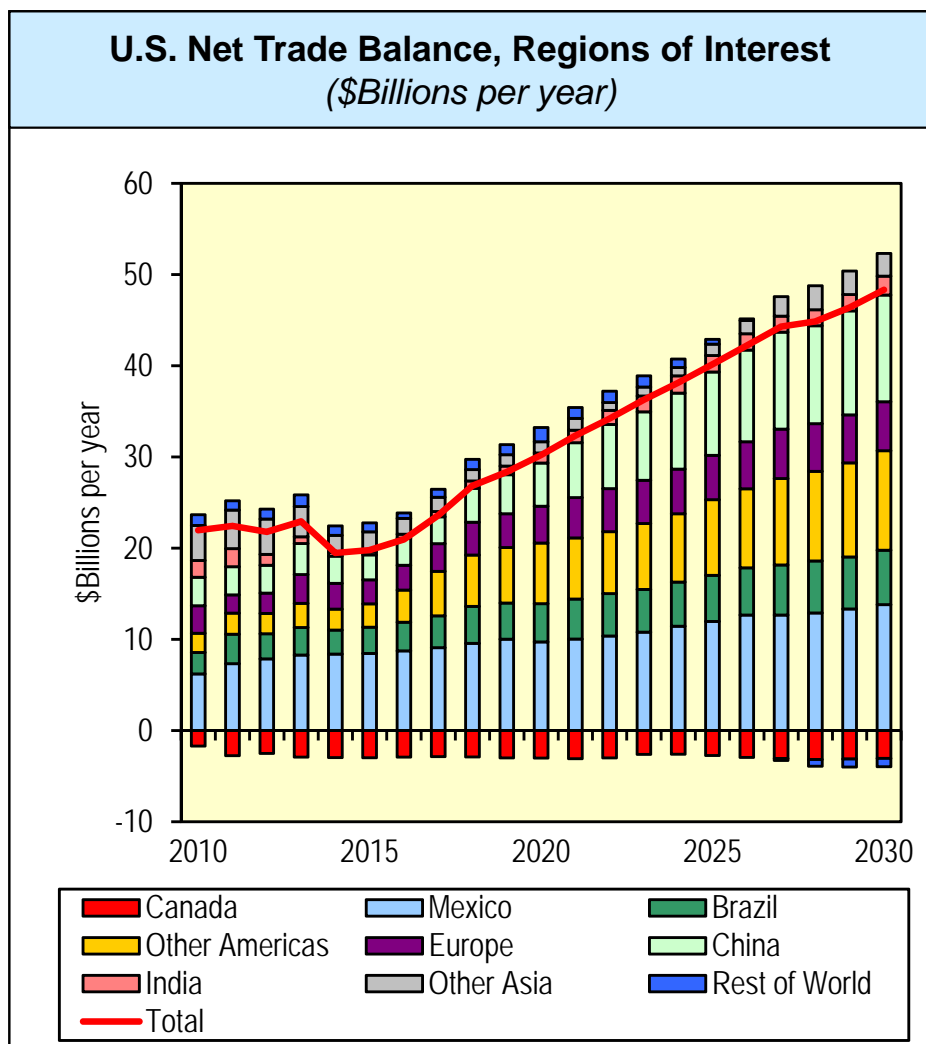
As a comparison, for 2013, total U.S. exports of goods were \$1,590.4 billion and imports were \$2,293.5 billion, resulting in a goods deficit of \$703 billion

**The 2014 trade surplus of \$19.5 billion for the selected chemicals represents 2.8% of the absolute value of the \$703 billion 2013 U.S. trade deficit in “goods”**

\* Current dollars, assuming 2% inflation



**Trade Trends by Region:** The value of chemical net exports reviewed herein will increase from \$19.5 billion in 2014 to \$48 billion per year by 2030, with the Americas (Canada, Mexico, Brazil, Other Americas) expected to remain the leading net export destination

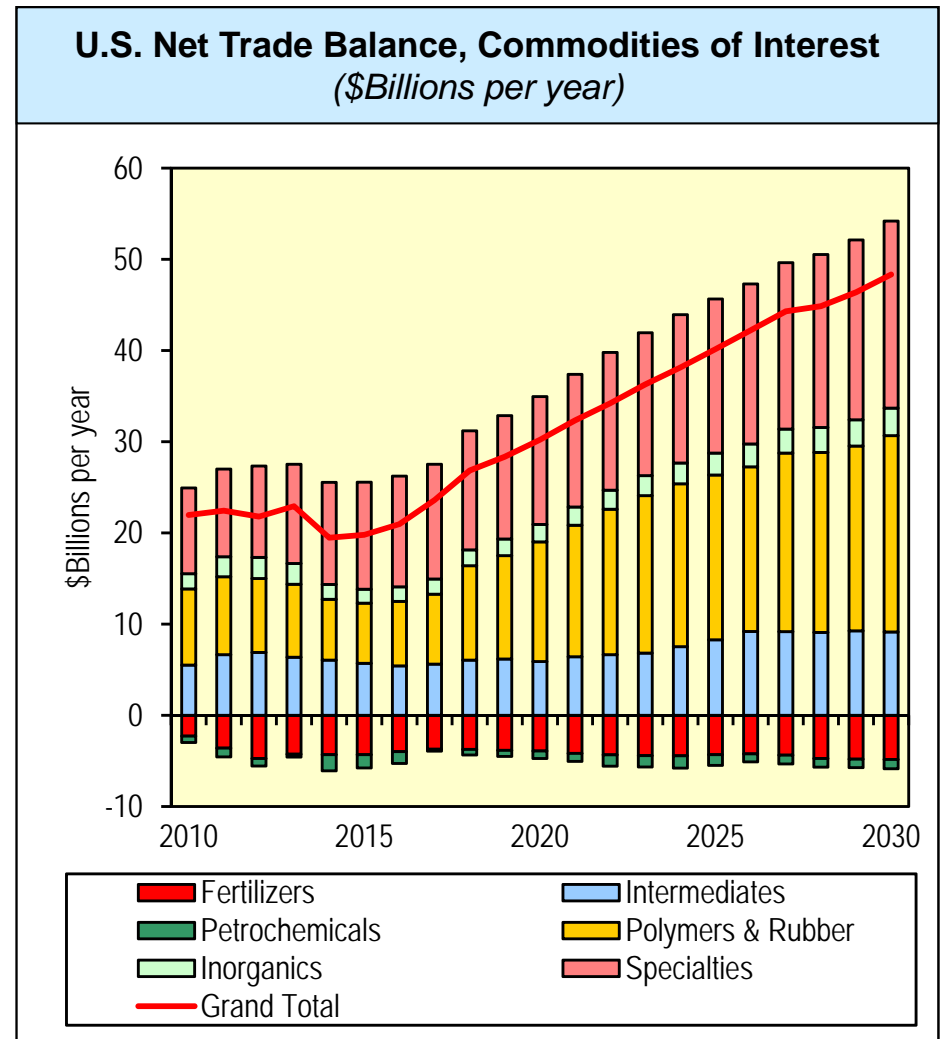
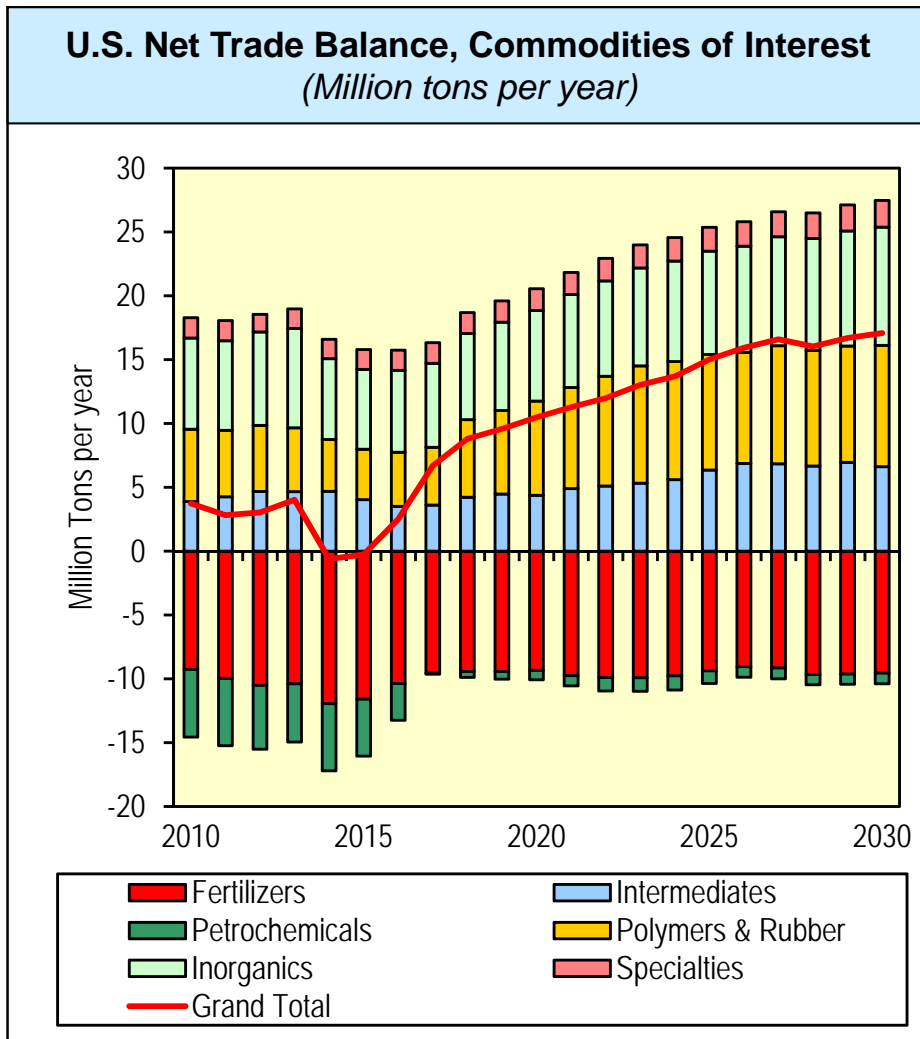


- **Canada:** Deficit remains at \$3 billion by 2030
- **Mexico:** Surplus improves by \$8.4 billion to \$13.8 billion by 2030 (*growth of \$5.4 billion*), but is not growing as fast as the overall net trade surplus
- **Brazil:** Surplus more than doubles to \$6.0 billion by 2030
- **Other Americas:** Surplus improves from \$2.3 billion to \$10.9 billion by 2030 (*growth of \$8.6 billion*)
- **Europe** Surplus improves from \$2.8 billion to \$5.4 billion by 2030
- **China:** Surplus improves by \$3.0 billion to \$11.7 billion by 2030 (*growth of \$8.7 billion*)
- **India:** Surplus improves by \$0.4 billion to \$2.1 billion by 2030
- **Other Asia:** Surplus improves by \$1.9 billion to \$2.5 billion by 2030
- **Rest of World:** \$1.0 surplus becomes a deficit of \$0.9 billion by 2030

**Net exports to China, Mexico, and Other Americas and are forecast to account for \$22.7 billion of the \$28.5 billion in regional net export growth**

Conclusions: Trade Trends

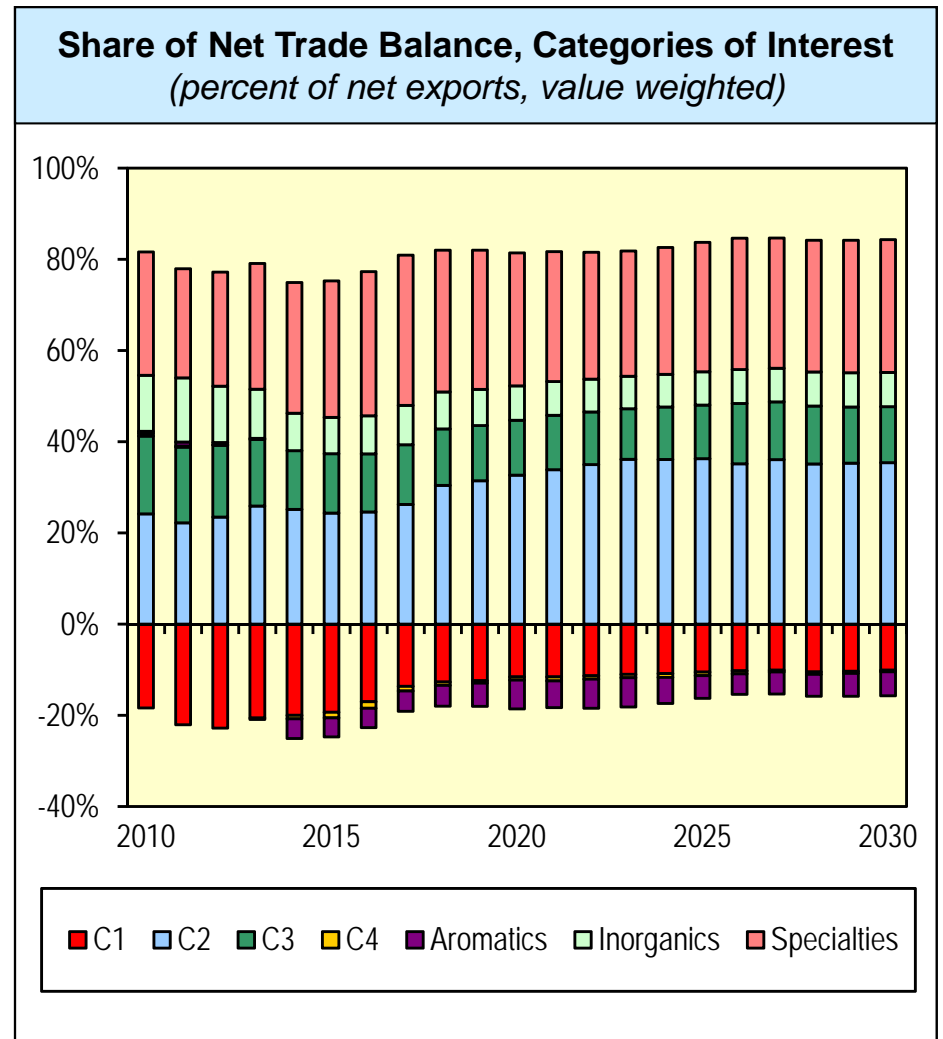
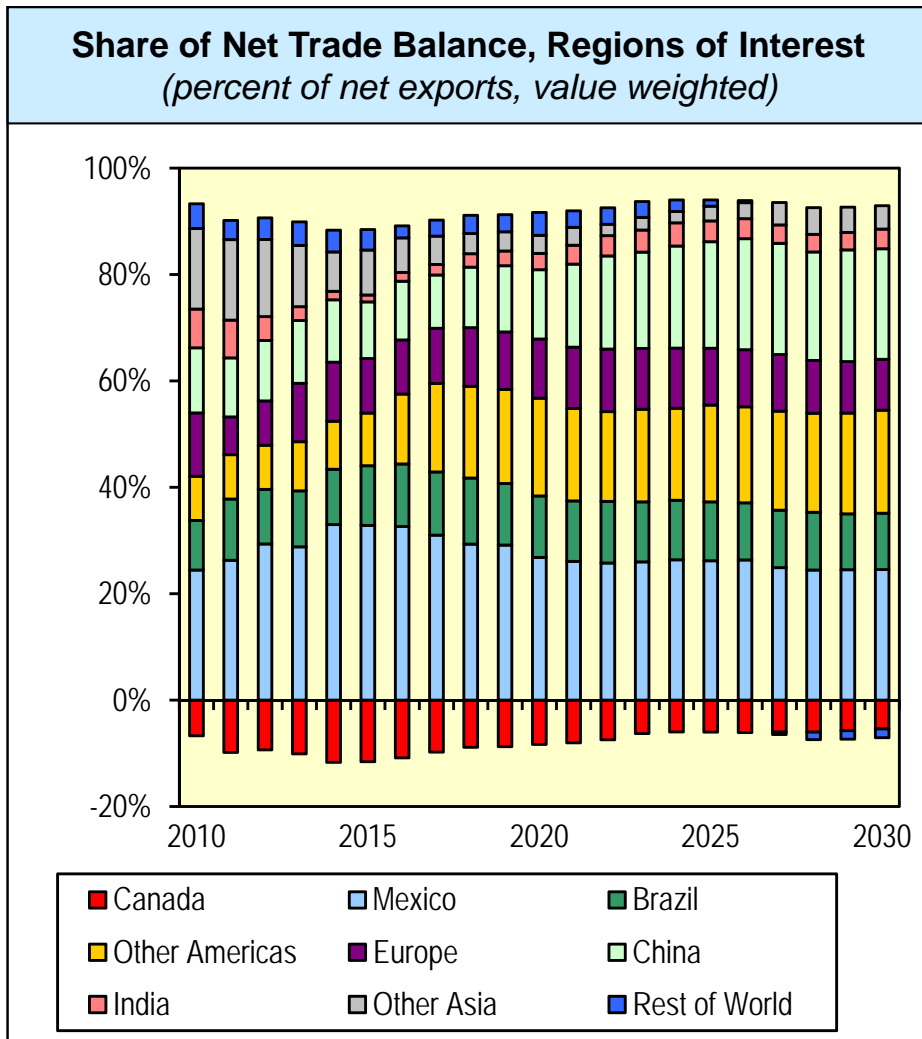
The biggest driver of the improving U.S. trade surplus will be polymers (with growth to \$21.5 billion net exports by 2030), specialties (to \$20.5 billion), and intermediates (to \$9.15 billion of net exports)



**The U.S. will remain in deficit for petrochemicals and fertilizers, and realize a modest improvement for inorganics, with the value of net exports growing at 4.0% CAGR**

Conclusions: Trade Trends

**On a share basis, net exports of chemicals and plastics to China and Other Americas will account for an increasing share of U.S. exports; while exports to Canada, Mexico, Europe and Other Asia will account for a declining share**



**Net exports of C2 chemicals will show the largest share gain, while C1 chemical net imports will decrease markedly**

**The value of U.S. net exports will increase to \$48.3 billion by 2030, representing 5.8% compounded value growth, with important improvements in the trade surplus for C1 chemicals, C2 chemicals and specialties**

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**On a category basis:** Shale gas and NGLs will have a positive impact on U.S. petrochemical investment and net exports for C<sub>1</sub>-C<sub>3</sub> petrochemicals, and a negative impact on supply of aromatics, with relatively little impact on C4 chemicals as follows:

- **C1** – much fewer imports of methanol, ammonia and urea as new domestic capacity is added
  - Trade deficit shrinks from \$20.5 billion to \$13.2 billion in 2030
- **C2** – much greater exports of ethylene derivatives based on feedstocks from new ethane steam crackers
  - Surplus more than doubles from \$9.8 billion to \$25 billion in 2030
- **C3** – C3 derivative exports will recover after on-purpose sources of propylene are built
  - Net exports grow from \$5.0 billion to \$8.6 billion by 2030
- **C4** – minor impact on net imports and exports of butadiene and derivatives
  - Deficit stays at approximately -\$0.3 billion
- **Aromatics** – a minor change, with fewer net exports (or greater net imports) of most aromatics and derivatives
  - Net imports increase from \$1.7 billion to \$3.7 billion
- **Inorganics** – driven by lower energy costs, U.S. surplus will increase
  - Net exports increase from \$3.2 billion to \$5.3 billion
- **Specialties** – driven by technology and lower energy costs, will significantly improve the U.S. net export position
  - Net exports grow from \$11.2 billion in 2014 to \$20.5 billion

## **Driven by increased exports of polymers and specialties to China, Mexico and Other Americas, the U.S. trade surplus for the commodities of interest will grow by \$28.8 billion**

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**On a regional basis**, there will be a significant increase in exports of chemicals and plastics to China (growing from \$3 billion to \$11.7 billion), as well as to Other Americas (growing from \$2.3 billion to \$10.9 billion), Mexico (growing from \$8.4 billion to \$13.8 billion), and Europe (growing from \$2.8 billion to \$5.4 billion)

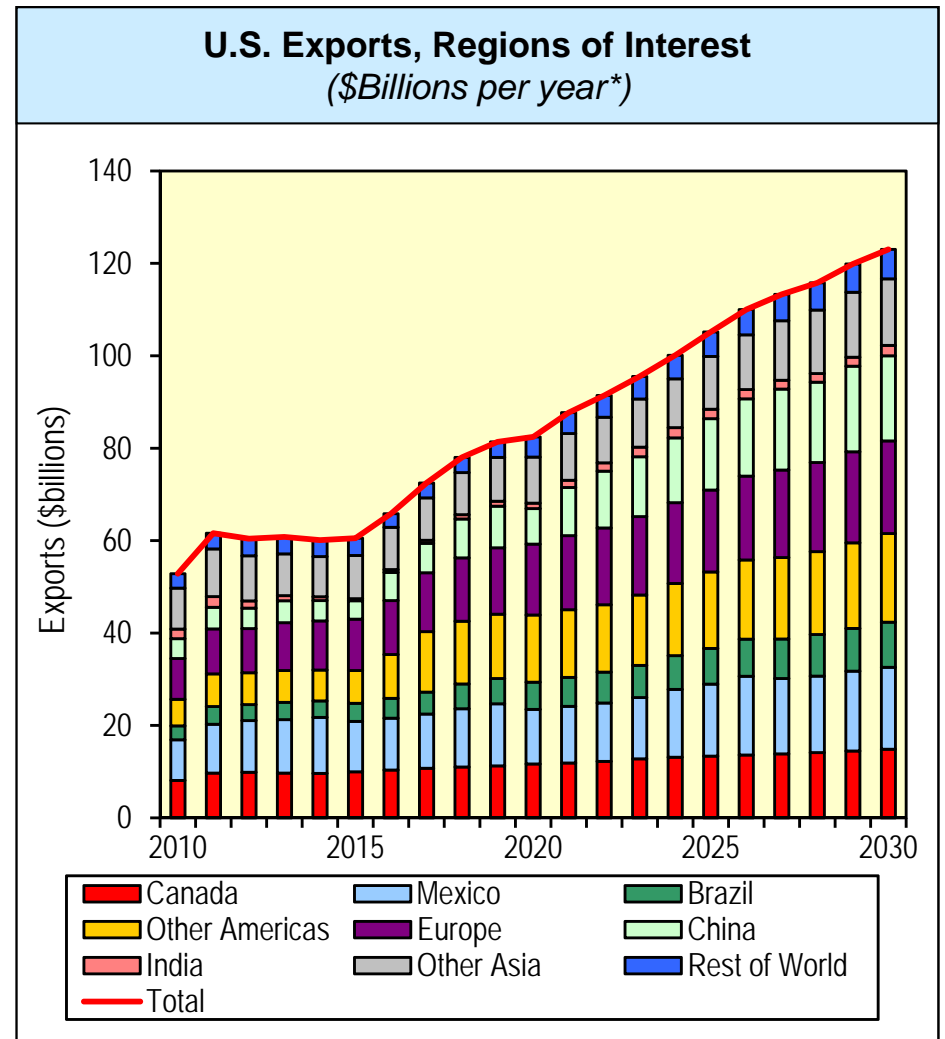
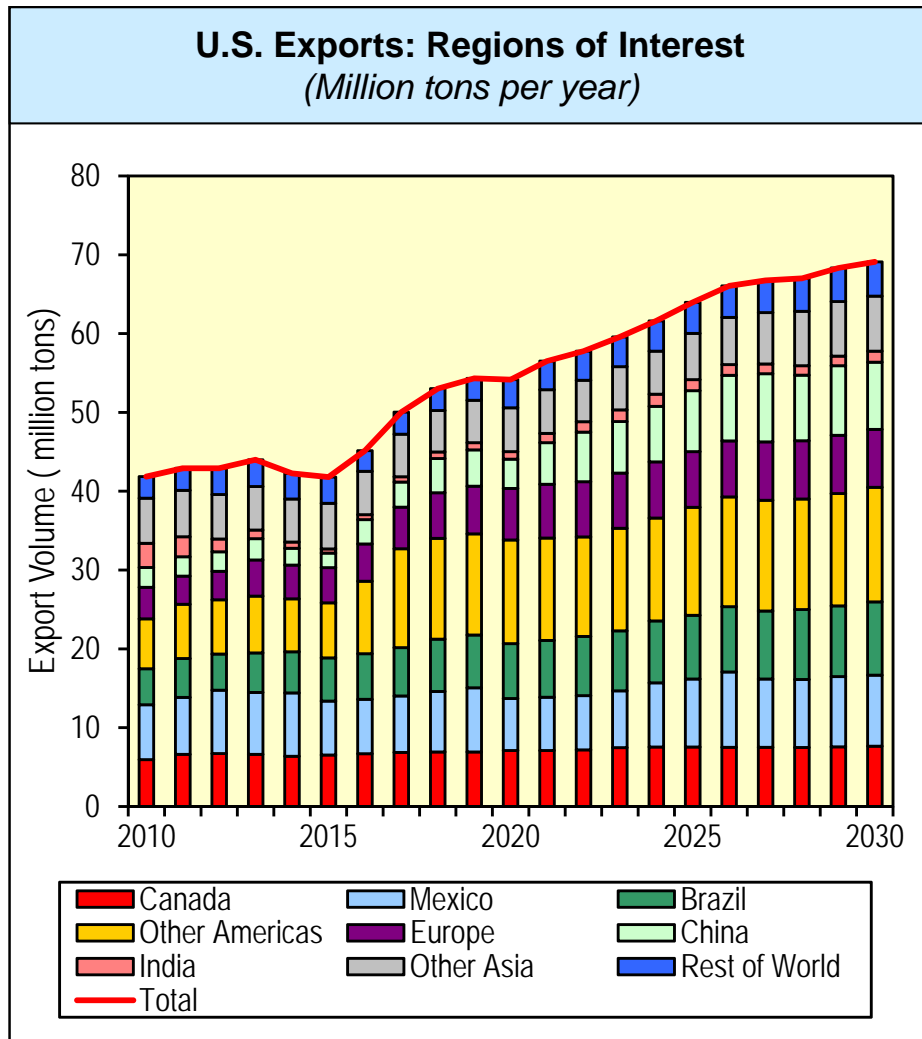
- Exports to Brazil will remain relatively flat on a weight basis as domestic capacity is added during the next decade
- Canada and Rest of World will be a source of net imports

**On a commodity basis**, the biggest driver of the improving U.S. trade surplus will be polymers (with almost \$15 billion in net export growth) and specialties (\$9.3 billion of increased net exports), with moderate growth in intermediates (\$3.1 billion in net export growth)

- Although the overall position will improve, the U.S. will remain in deficit for petrochemicals (\$0.7 billion improvement – fewer imports)
- The U.S. will import less fertilizers (deficit shrinks by 2.4 million tons), but due to higher prices, net imports increases by \$0.5 billion

***Polymers and specialties will be the commodities that gain the most net export value***

**Although not part of the scope of this report, Nexant estimates that exports of “commodities of interest” will more than double from \$60 billion in 2014 to \$123 billion by 2030, with exports to the Americas expected to account for approximately half of total export value**



**Of the \$63 billion increase in exports, net exports are forecast to increase by \$29 billion**

\* Current dollars, assuming 2% inflation

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**Section 5**  
**Conclusions: Policy Implications**

**Regulatory Environment: U.S. Government policies play an important supporting role for future chemicals investment based on how it regulates key feedstocks like oil, gas and NGLs**

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U.S. government currently limits its role relative to fossil fuels to the following:

- Ensuring energy security
- Controlling energy imports and exports (especially crude oil)
- Supporting advanced research and development

Although “crude oil” exports are prohibited except as exempted by regulation, the regime is gentler for other fuels. Exports of coal, petroleum products, natural gas and petrochemical feedstocks may be restricted at the discretion of the executive branch, but they are not blocked by EPCA

Hence, refined products and petrochemicals are internationally traded at will based on market supply and demand, and the shale revolution has created a multi-decade opportunity for increased petrochemical production and exports

*However, the uncertainty around the future of gas and condensate exports could be a critical factor in determining future feedstock costs*

***U.S. government control of energy exports plays an indirect role in supporting petrochemical investment***



**Shale Gas and NGLs: The success of U.S. E&P firms in shale gas and oil exploitation are unique to the U.S. in most cases and unlikely to be soon matched anywhere else in the world**

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**Factors and Policies supporting U.S. Shale Gas and Tight Oil Development:**

- Liberalized natural gas market
- Competitive industry with many entrepreneurial companies
- Industry's focus on technological innovation
- Vast, independent oil field service sector
- Extensive natural gas processing and pipeline infrastructure
- Financial markets offering many funding options
- Incentives for private landowners to provide land access
- Favorable fiscal and regulatory structure

***...However, eventually one or more other regions will find ways to profitably exploit their local shale resource***

**Foreign Direct Investment: In addition to low-cost gas and NGL feedstocks, one of the attractive features of investing in U.S. petrochemical production is access to the U.S. free market economy**

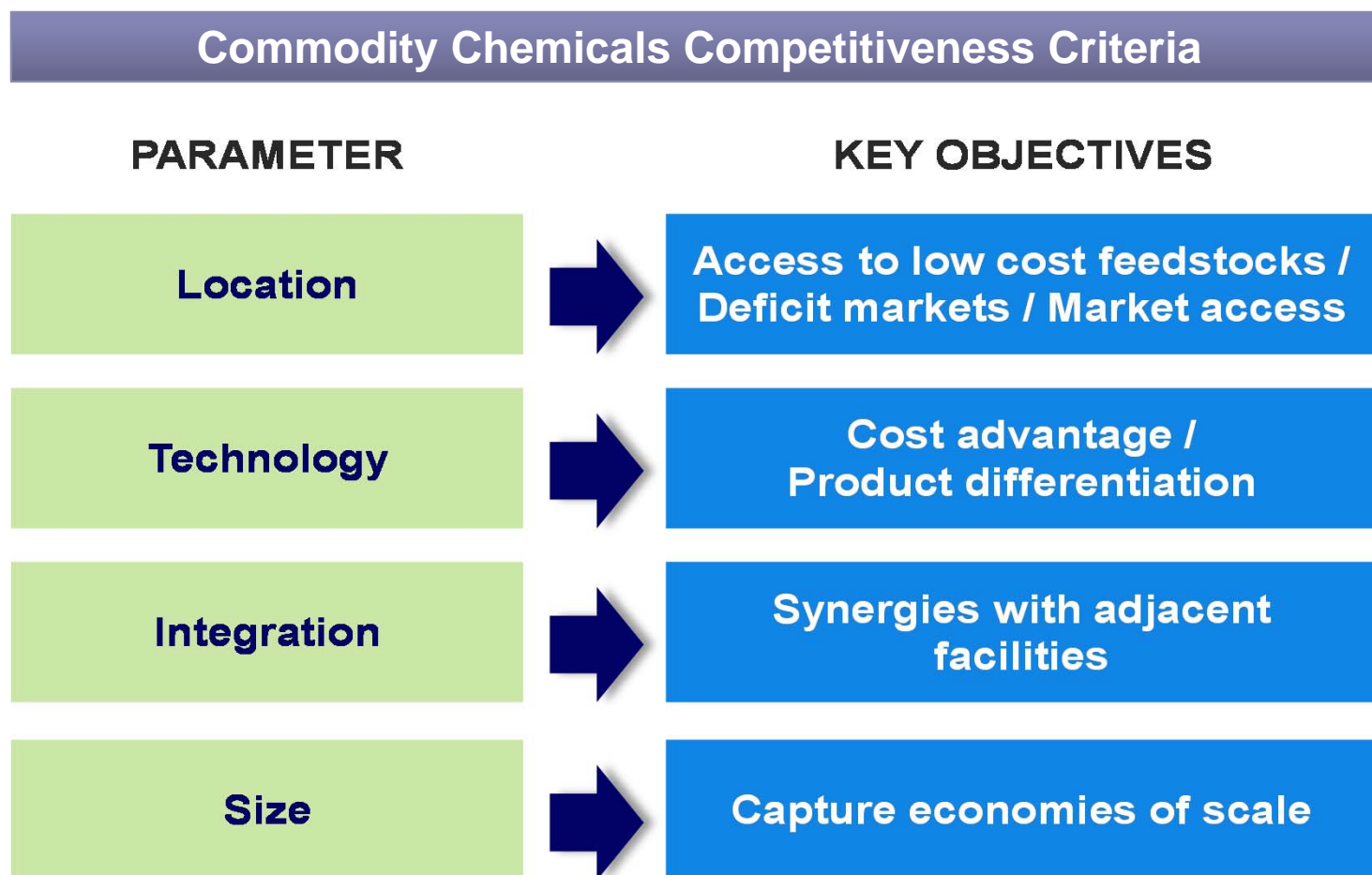
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- As a free market, most foreign companies are welcome to make an investment in the U.S.
- Investment can be with a local partner or independently, but the advantages of access to inexpensive feedstocks, land, labor, infrastructure, and shipping apply to everyone
- In addition, an investment in the U.S. can be made with confidence about the future of the country — the rule of law, the availability of gas and NGLs, and the well-balanced regulatory environment

***Access to advantaged feedstocks and U.S. infrastructure are key reasons for continuing local and foreign direct investment in the U.S.***

**Investment Drivers: Access to low-cost feedstocks and technology will drive investment in U.S. petrochemicals, fertilizers, polymers and specialty chemicals**

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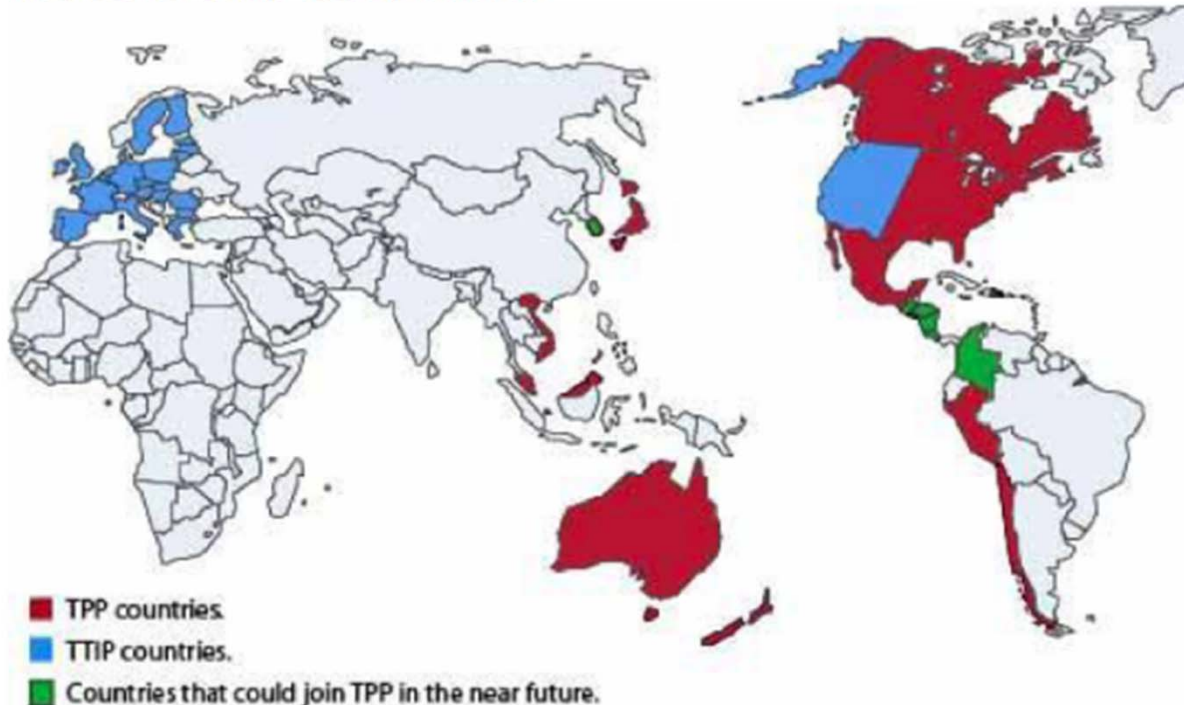


*There are very few places in the world where all of the factors necessary for competitive success in chemicals are available to domestic and outside investors*

**Tariffs and Global Trade Barriers: Historic movement towards greater free trade is expected to continue for leading export destinations, which will enable the U.S. to share its shale gas bounty with the world**

**TPP\* and TTIP\*\* Countries  
and potential new countries**

**TPP AND TTIP COUNTRIES**



**Example: For LLDPE**

- Assuming that TTIP is completed between the U.S. and the EU, Nexant assumes that 6.5% duties on LLDPE to Europe could be eliminated by 2017
- Furthermore, in the Pacific Region, the TPP would eliminate duties on polyethylene with Japan (6.5%) and Malaysia (15%). Korea's 4.5% tariff on LLDPE may also be eliminated as the FTA with Korea reaches maturity
- Chinese polyethylene tariffs of 6.5% could also decline if they eventually negotiate a FTA with the U.S. or join TPP

***Reducing or eliminating protective tariffs on polymers in particular could have a large impact on the growth of U.S. net exports***

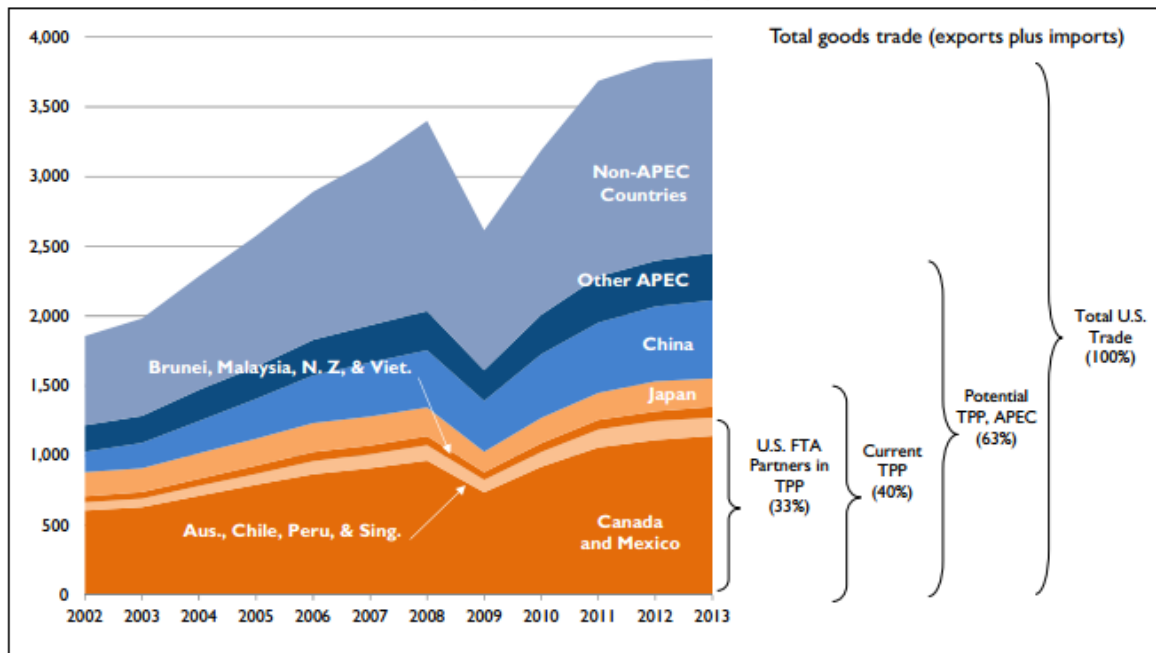
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\* (TPP) – Trans Pacific Partnership

\*\* (TTIP) - US-EU Transatlantic Trade and Investment Partnership

**Tariffs and Global Trade Barriers: The current TPP countries would provide an incremental change in free trade for the U.S.**

**U.S.-World, APEC, and TPP Goods Trade**  
(in billions of U.S. dollars)



Source: Analysis by CRS. Data from the International Trade Commission.

**Impact of TPP**

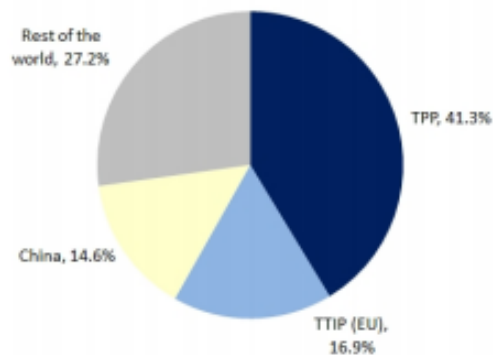
- For the U.S., the most important element of the current TPP is the addition of Japan as a free trade partner, which represented over \$200 billion in “total goods trade” in 2013
- All 12 TPP partners shown in orange on the chart are also members of the Asia-Pacific Economic Cooperation (APEC) forum
- China, which represented over \$500 billion in “total goods trade”, has expressed moderate interest in joining TPP, but this is clearly well down the road
- Several other APEC nations have also expressed varying levels of interest

***The eventual inclusion of China and other non-TPP nations in APEC would have a more significant and positive impact on chemicals trade***

**Tariffs and Global Trade Barriers: The current TPP, which includes Canada, Mexico, Korea, and other countries with U.S. FTAs, would represent 41.3% of U.S. goods trade in 2013**

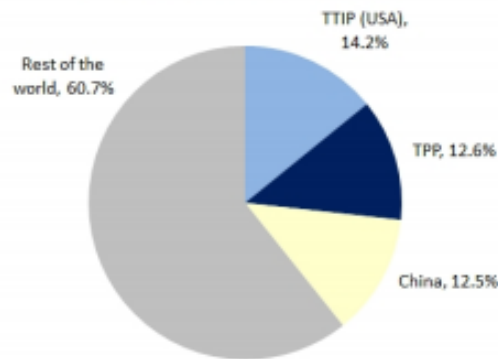
**U.S. and EU Goods Trade**  
(in billions of U.S. dollars)

USA TRADE IN GOODS 2013



Source: own calculations based on US Census Bureau data

EU TRADE IN GOODS 2013



Source: own calculations based on DG TRADE, European Commission data

**Impact of TTIP**

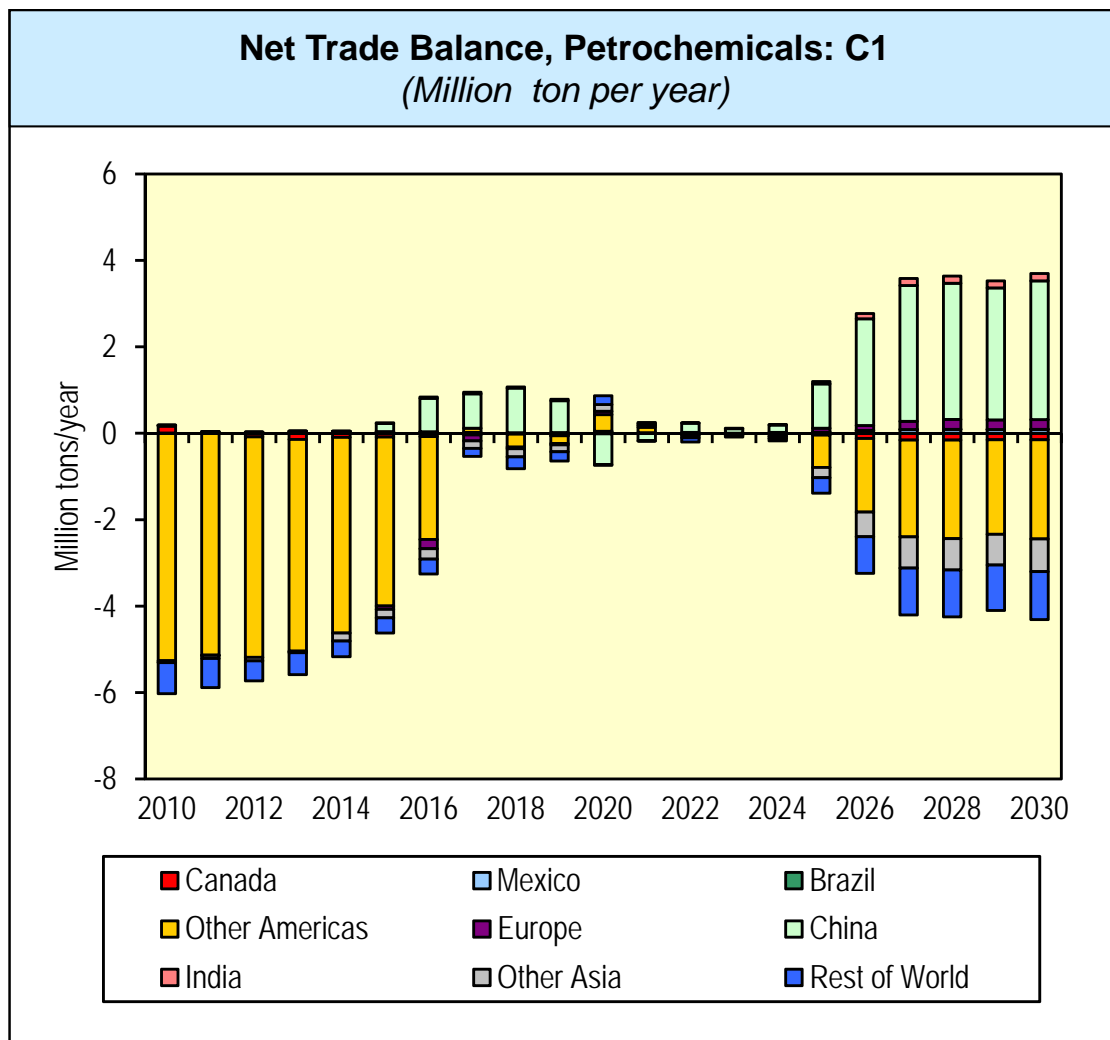
- The TTIP, would represent 16.9% of “total goods trade” across the U.S. border and 14.2% across the EU’s border
- As a significant portion of C2 chemicals and specialties trade is expected to target Europe, the TTIP could have a significant impact on trade flows of chemicals
- Overall trade with Europe is greater than trade with new FTA partners in the TPP (Japan, Brunei, Malaysia, New Zealand, and Vietnam); therefore, Nexant expects that, compared to TPP, completion of the TTIP would likely have a larger impact on chemicals trade

***Relative to net exports of chemicals, the TTIP is probably the most important FTA under negotiation by the U.S. government***

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**Appendix A**  
**Forecast, Net Exports by Subsector**

## Petrochemicals: C1: The methanol net trade deficit will disappear



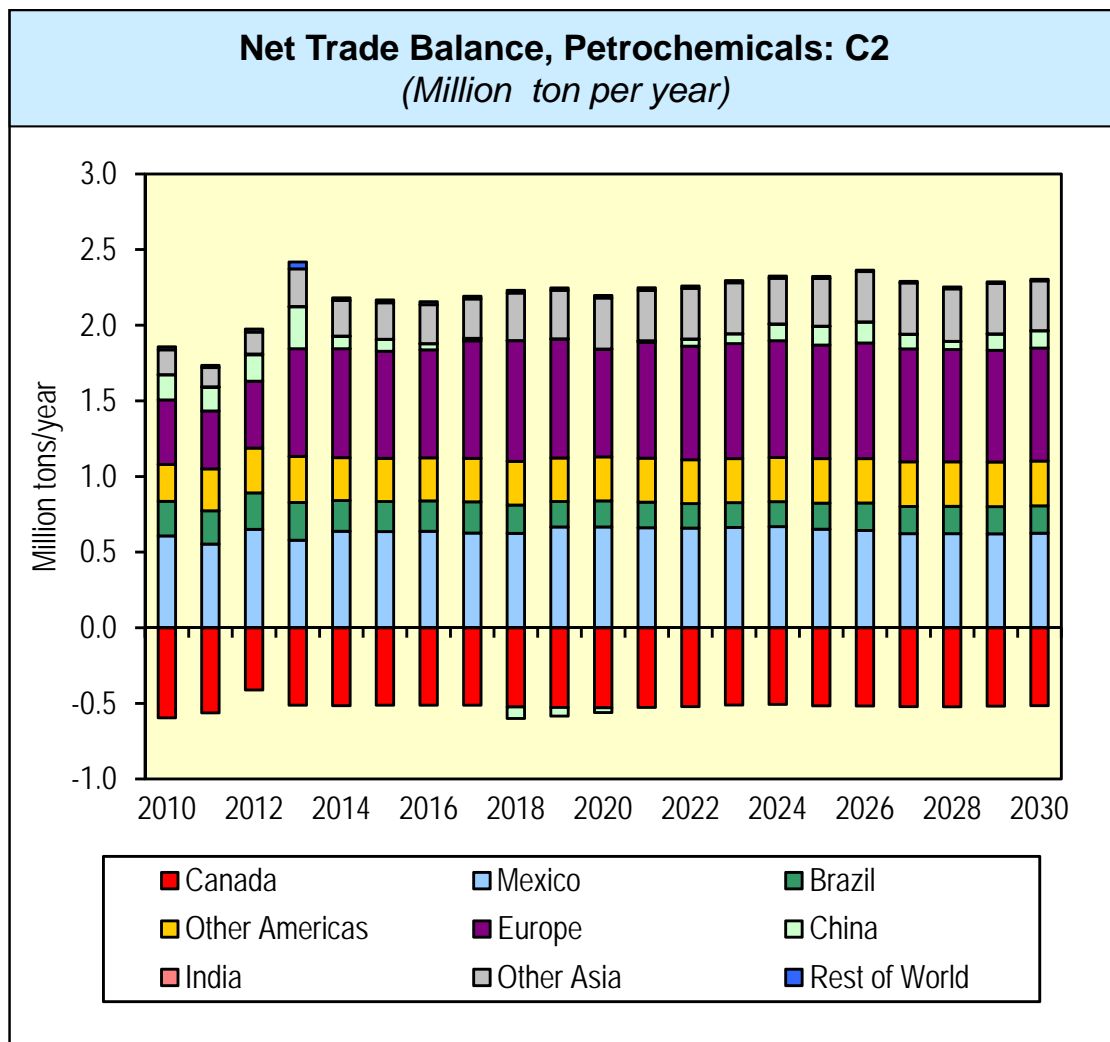
The methanol trade balance is expected to improve in the short term.

China is expected to become a large net importer of methanol from the U.S. as they execute their methanol to olefins (MTO) self-sufficiency plan

Depending on the restrictions on the export of natural gas, and the resulting price, methanol net exports from “Other Americas” and ROW could resume later in the 2020s

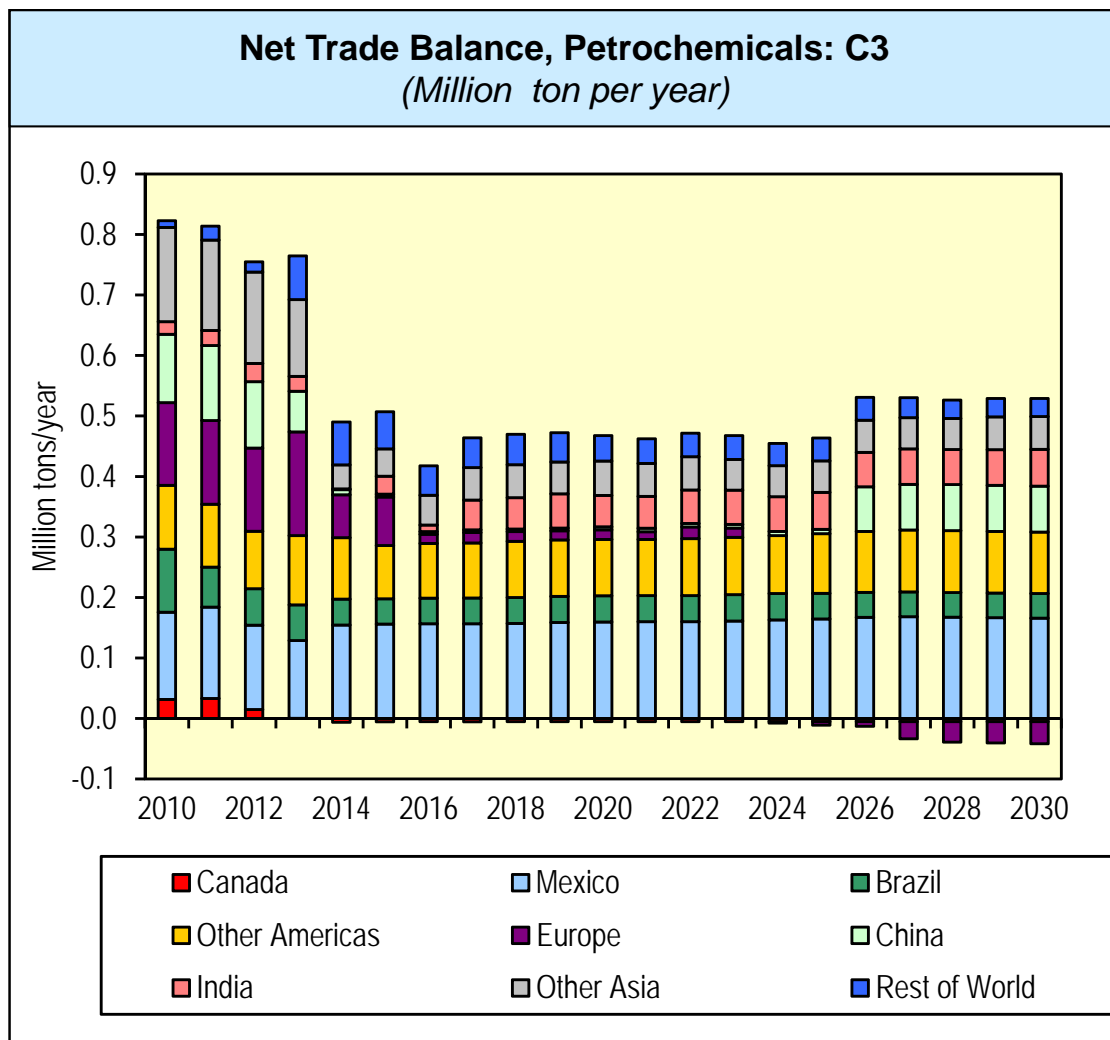


## Petrochemicals: C2: Styrene, VAM



Styrene and VAM should remain advantaged exports due to low cost ethylene and conversion energy (natural gas)

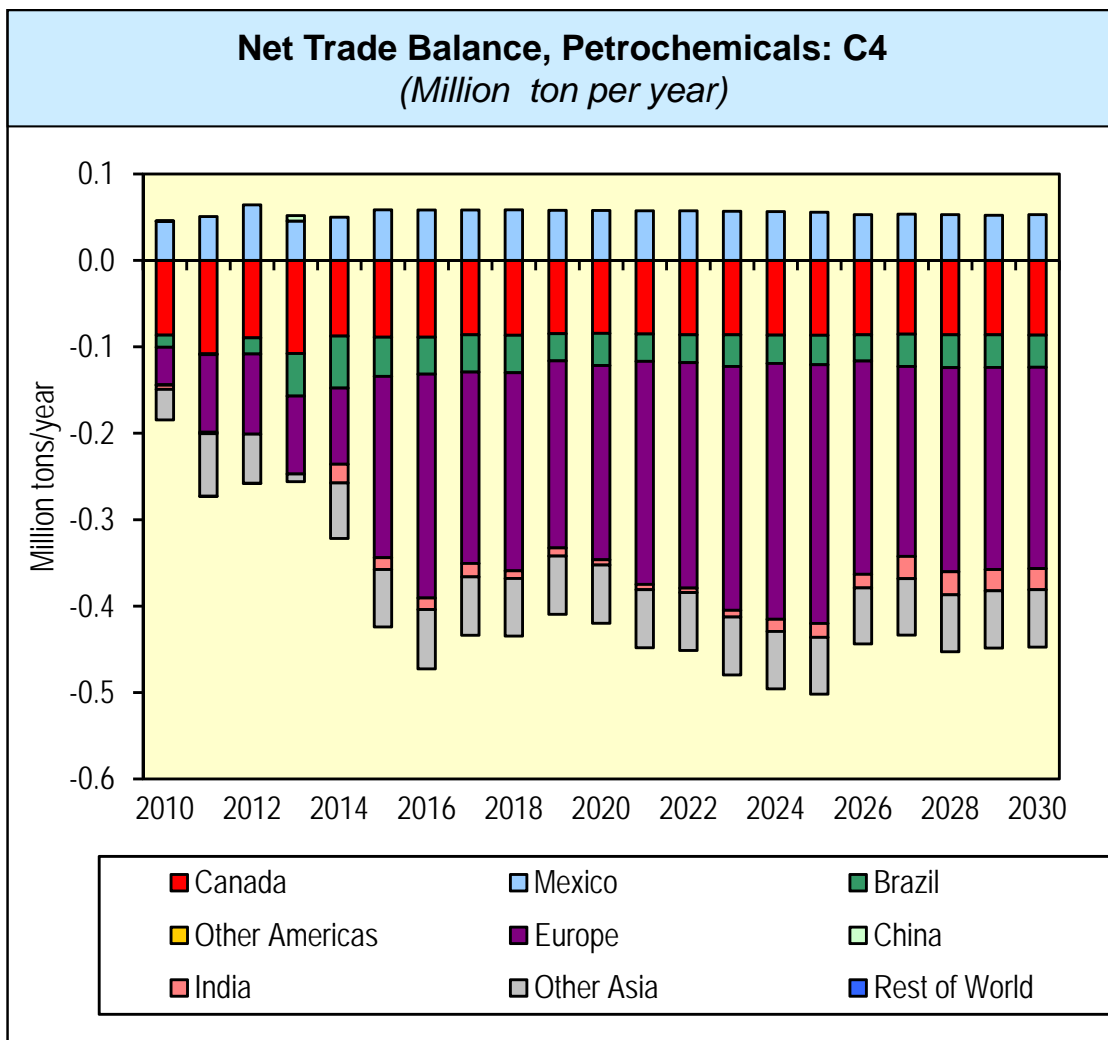
## Petrochemicals: C3: 2EH, iPropanol, n-butanol, 2EH Acrylate, butyl acrylate, propylene glycol



C3 petrochemical net exports have declined with the availability of propylene

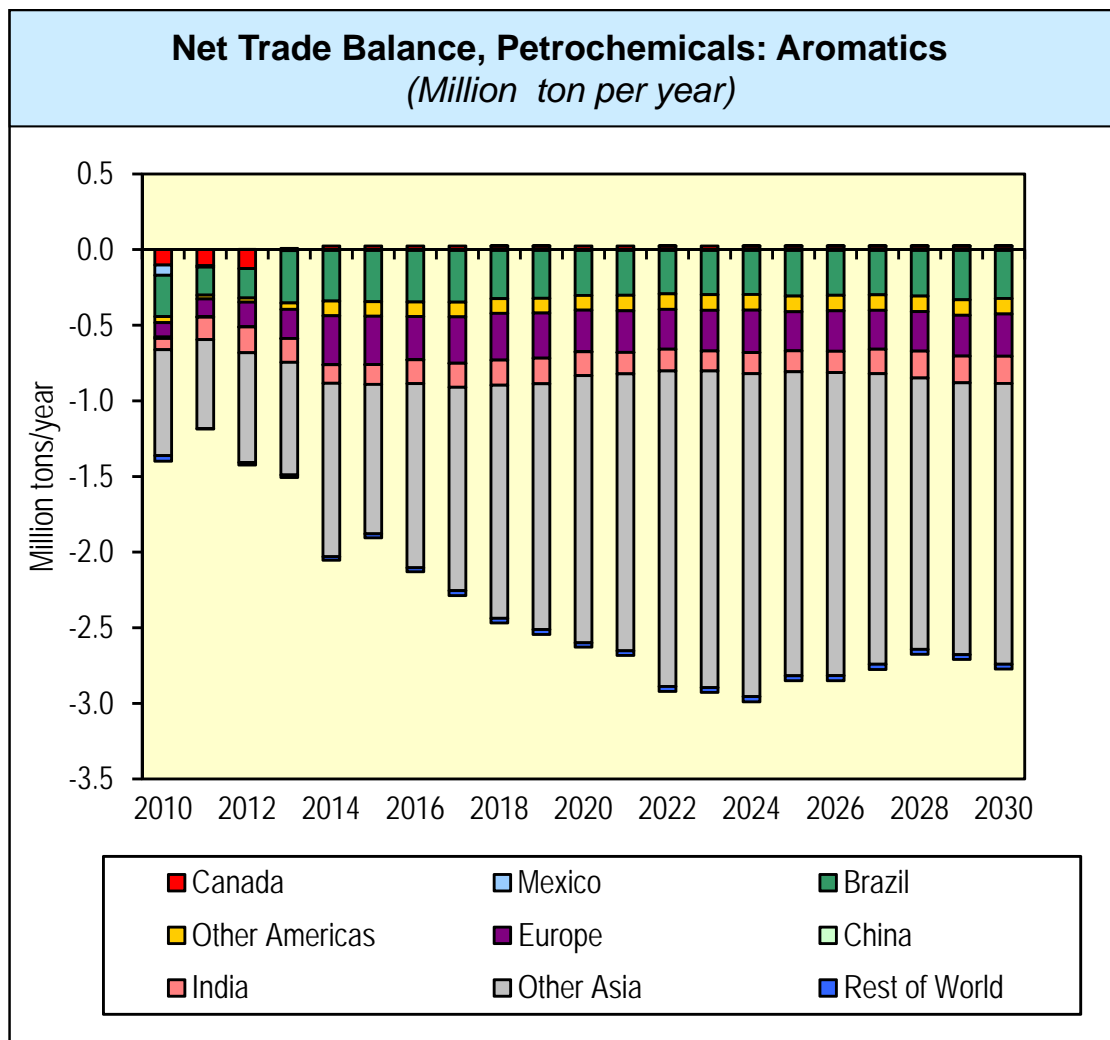
With the installation of new on-purpose propylene via PDH and MTO, the U.S. should be able to resume at least a portion of its previous position

### Petrochemicals: C4: 1,3-Butadiene



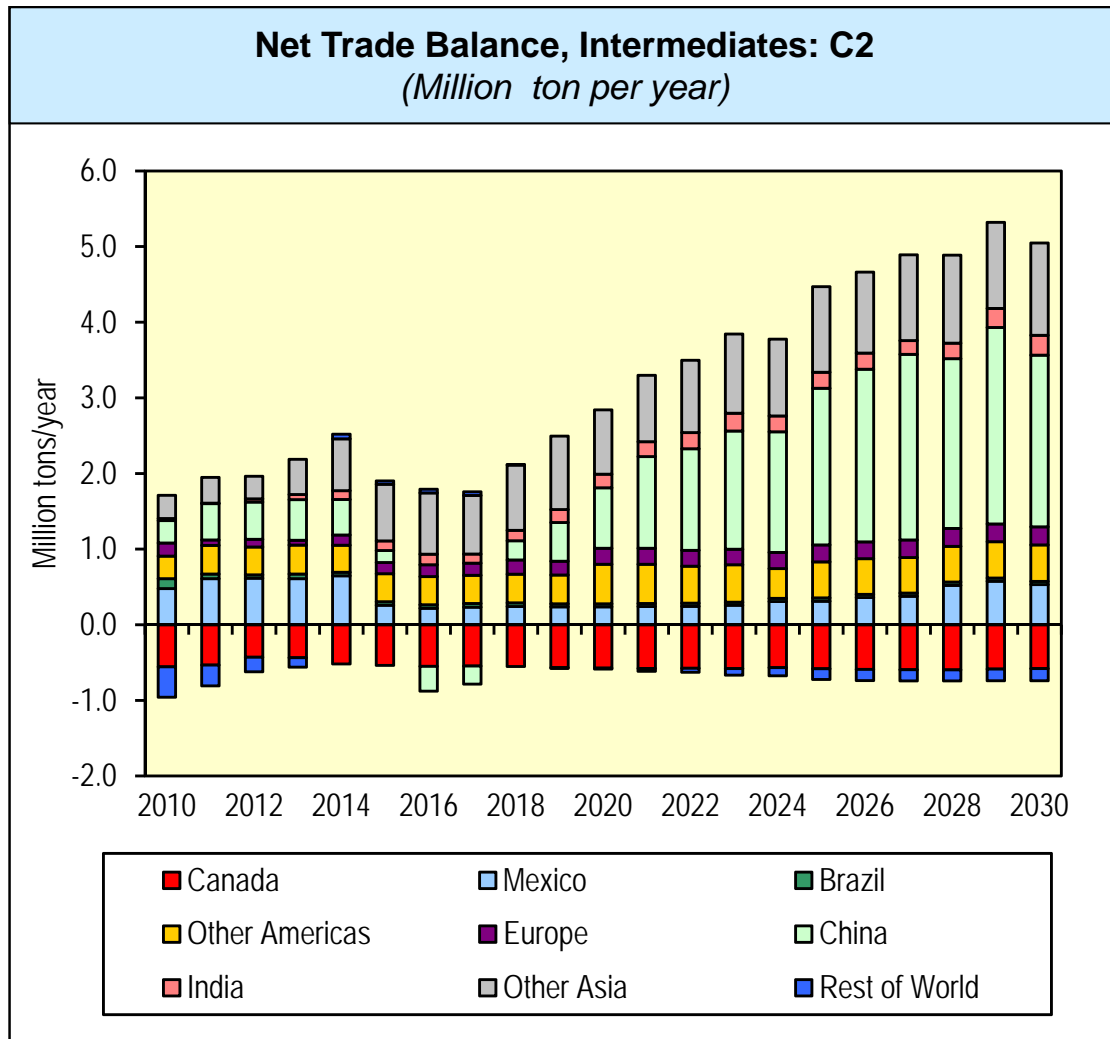
Butadiene will increasingly be imported as domestic sources have declined with the lightening of cracker feedstocks

## Petrochemicals: Aromatics: Benzene, xylene, toluene, Phthalic Anhydride



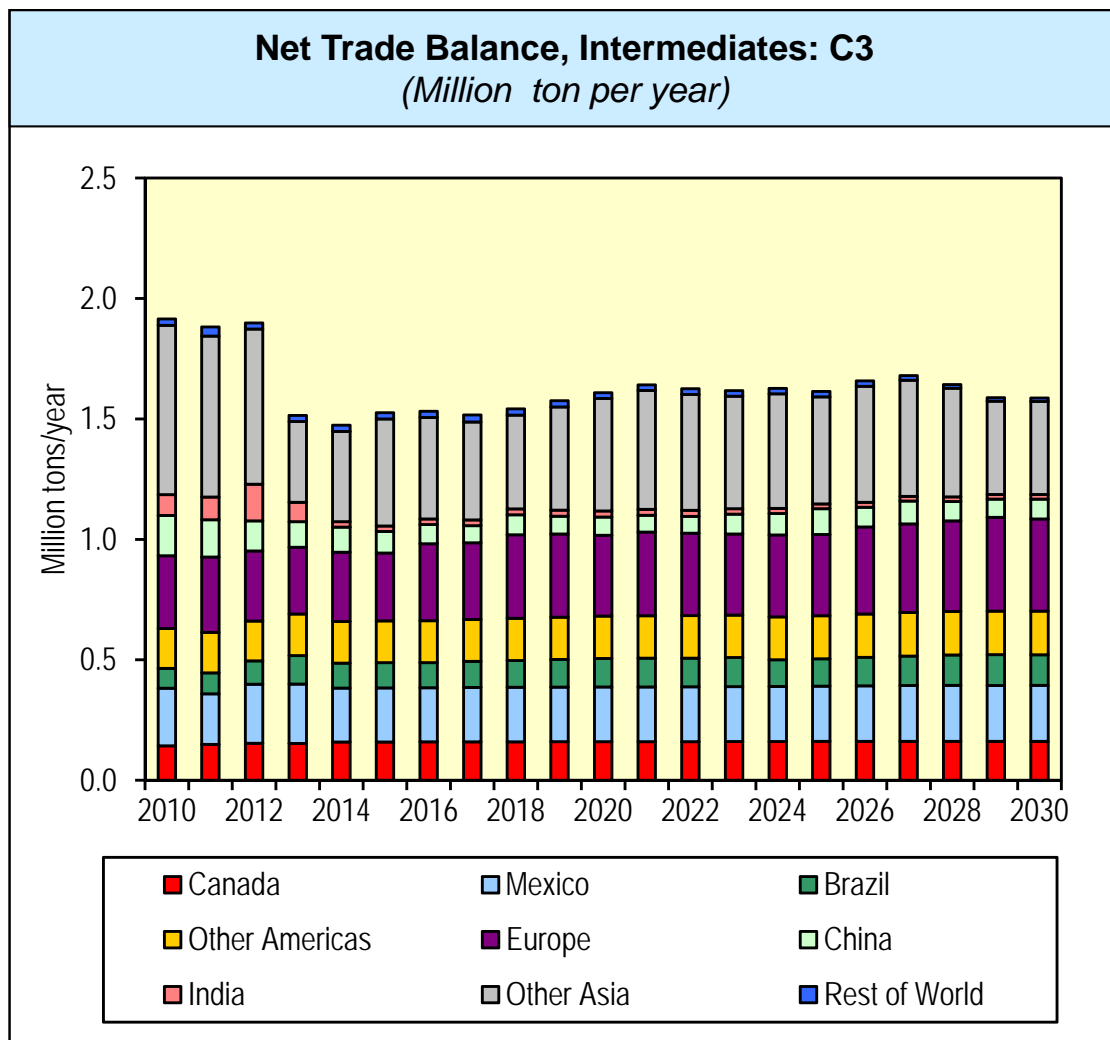
Aromatic petrochemicals, especially benzene will be increasingly imported as domestic sources have declined with the lightening of cracker feedstocks

### Intermediates: C2: EDC, MEG, VCM



Shale gas NGLs provides a huge advantage to the USA for exports of EDC, VCM and MEG to China for producing PVC and polyester

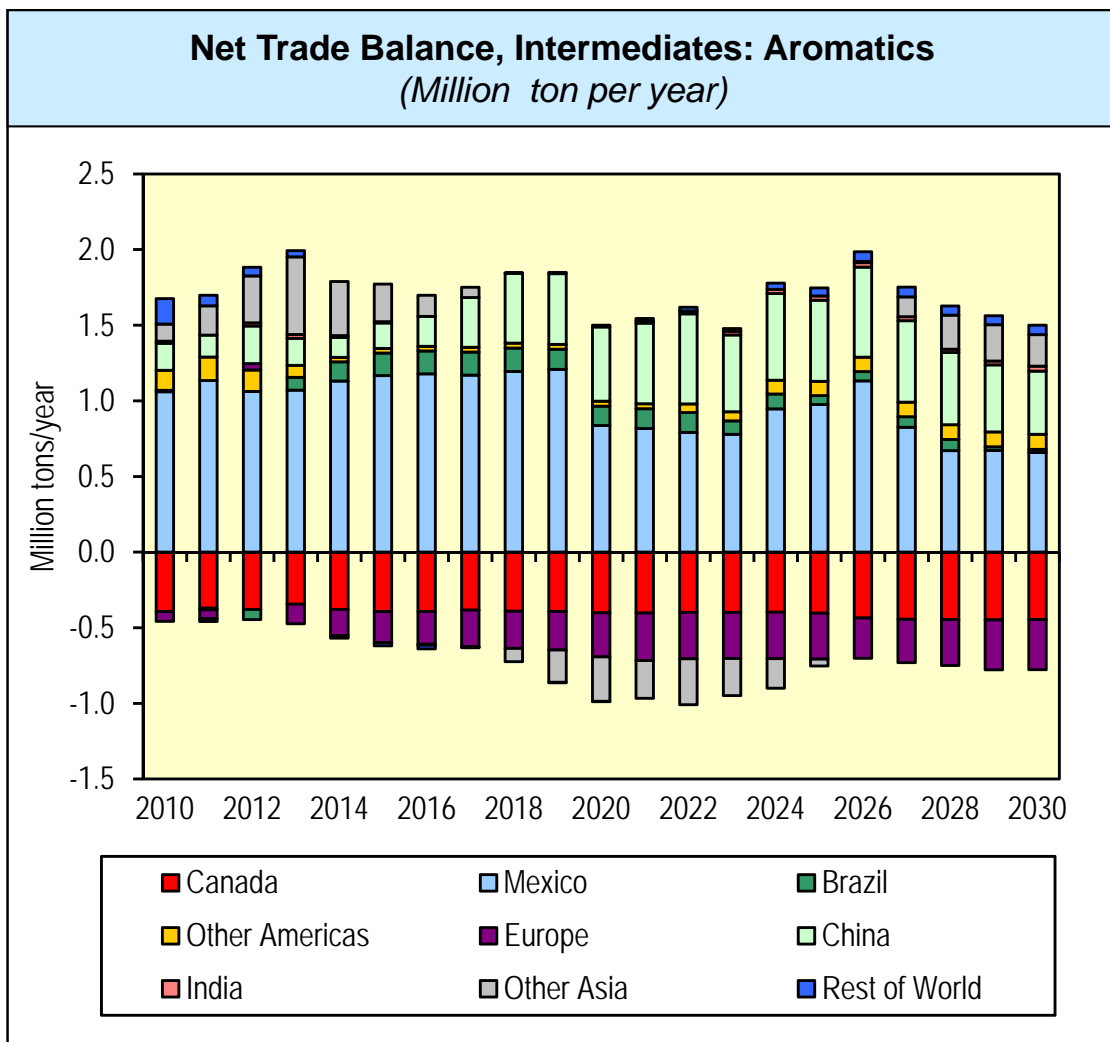
## Intermediates: C3: Acrylonitrile, Cumene, Phenol, PO, Polyether polyols



The large decrease in exports of phenol and acrylonitrile from 2012-2014 was driven by economics of reduced propylene supply

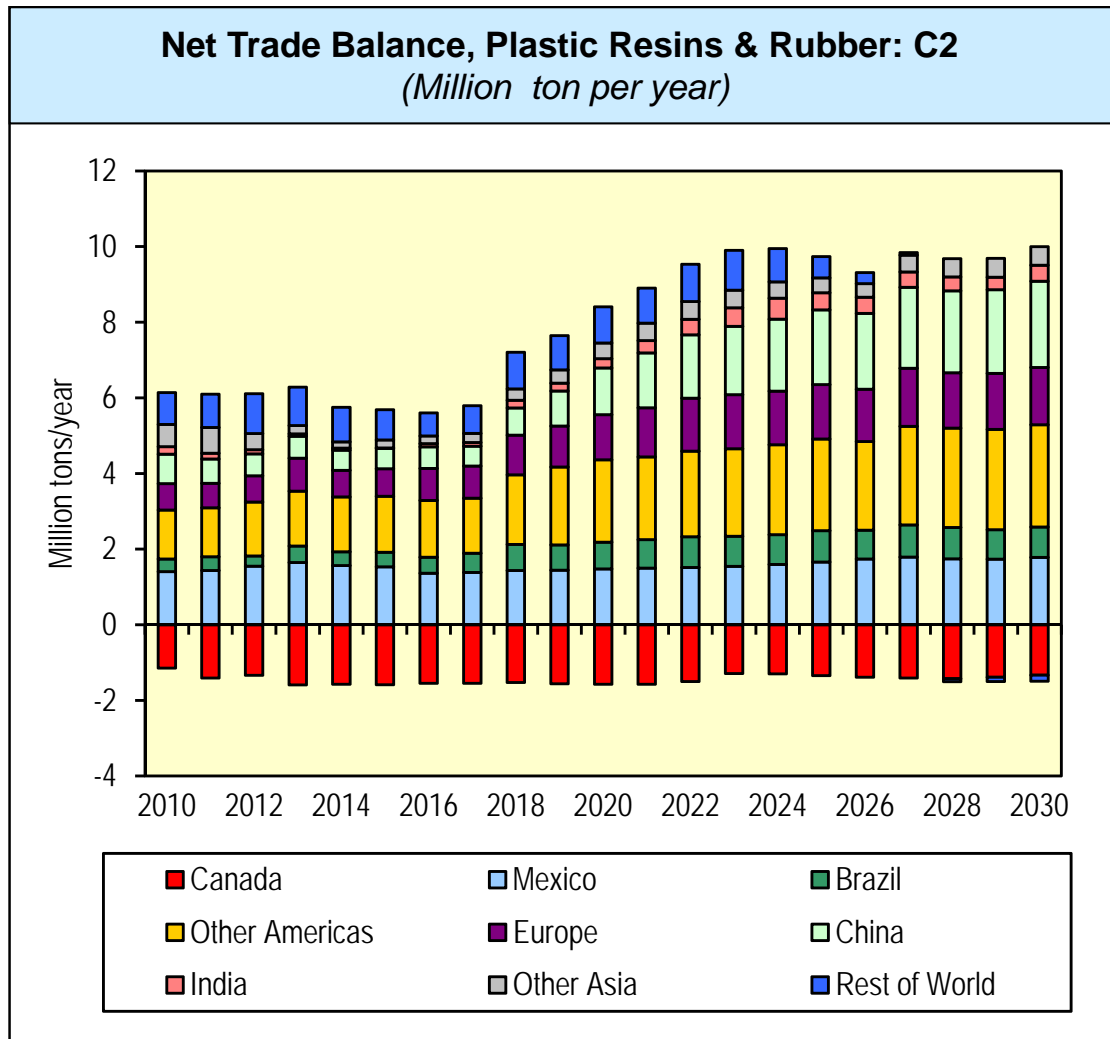
With the installation of new on-purpose propylene via PDH and MTO, the U.S. should be able to resume at least a portion of its previous position

**Intermediates: Aromatics: PX, PTA, Adipic, aniline, caprolactam, CX, MDI, TDI, Nitrobenzene**



In 2014, there was a large decline in para-xylene exports to Other Asia, and caprolactam to China as new domestic capacity came online in these regions

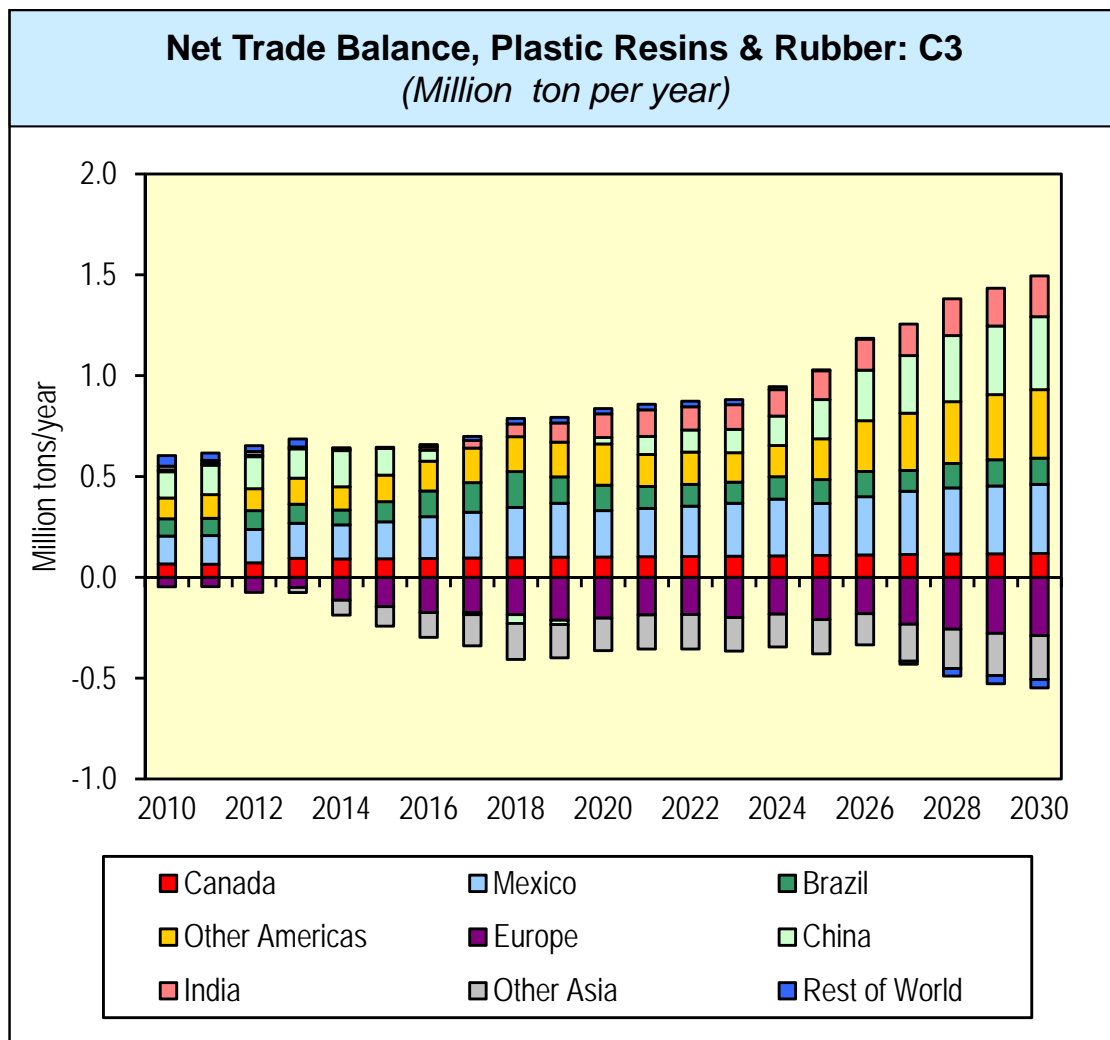
## Plastic Resins & Rubber: C2: Polyethylene and PVC are expected to drive the exports of C2 based polymers



There will be a large increase in polyethylene and PVC net exports to China, Europe and Other Americas as new ethane-based steam crackers and derivative capacity is installed in the U.S.



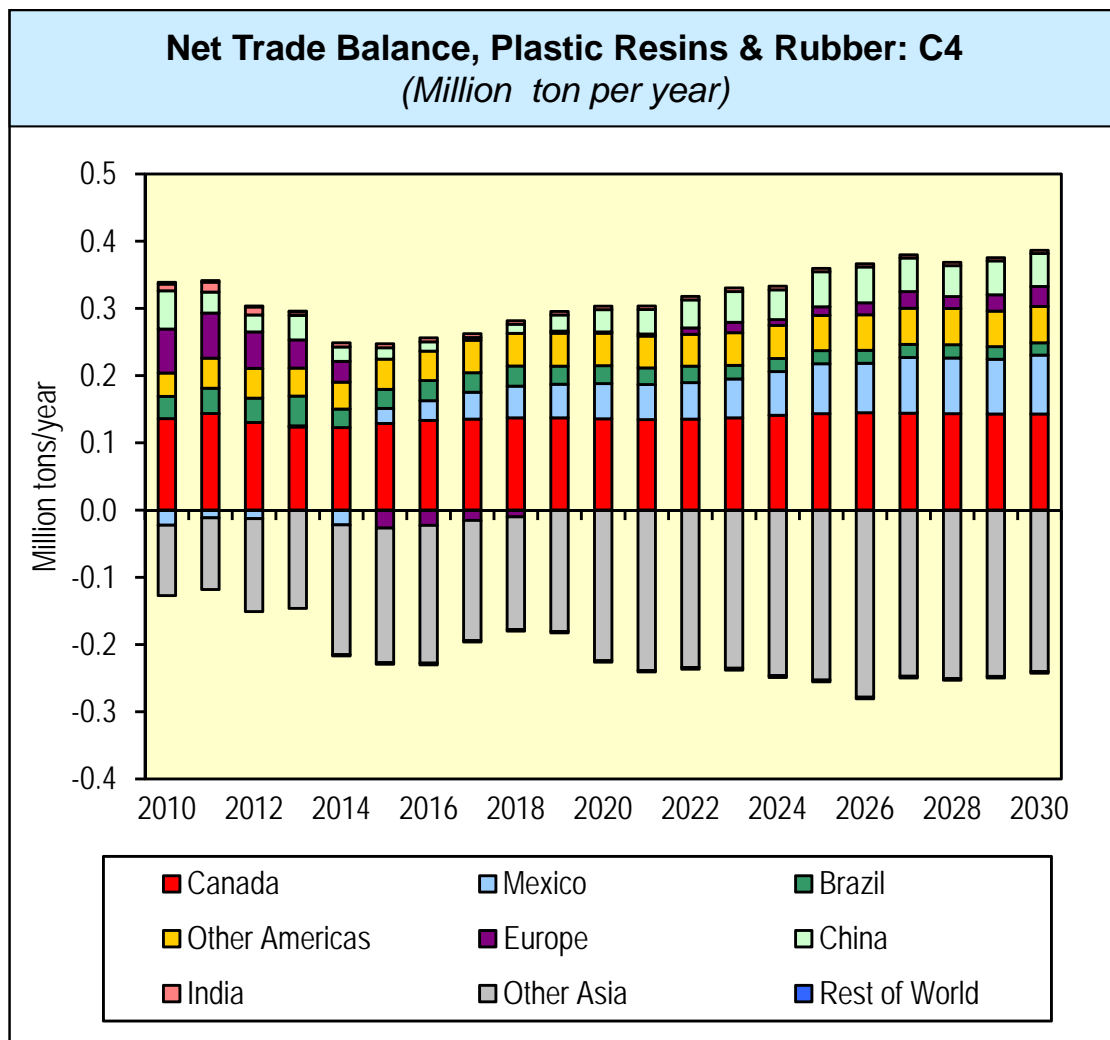
## Plastic Resins & Rubber: C3: Polypropylene, acrylic polymers, polycarbonate



C3 polymer net exports have declined with the availability of propylene

With the installation of new on-purpose propylene via PDH and MTO, the U.S. should be able to resume at least a portion of its previous position, as integrated suppliers of polypropylene gain competitive advantage for shipments to China, India, and Other Americas

## Plastic Resins & Rubber: C4: PBR, SBR, ABS

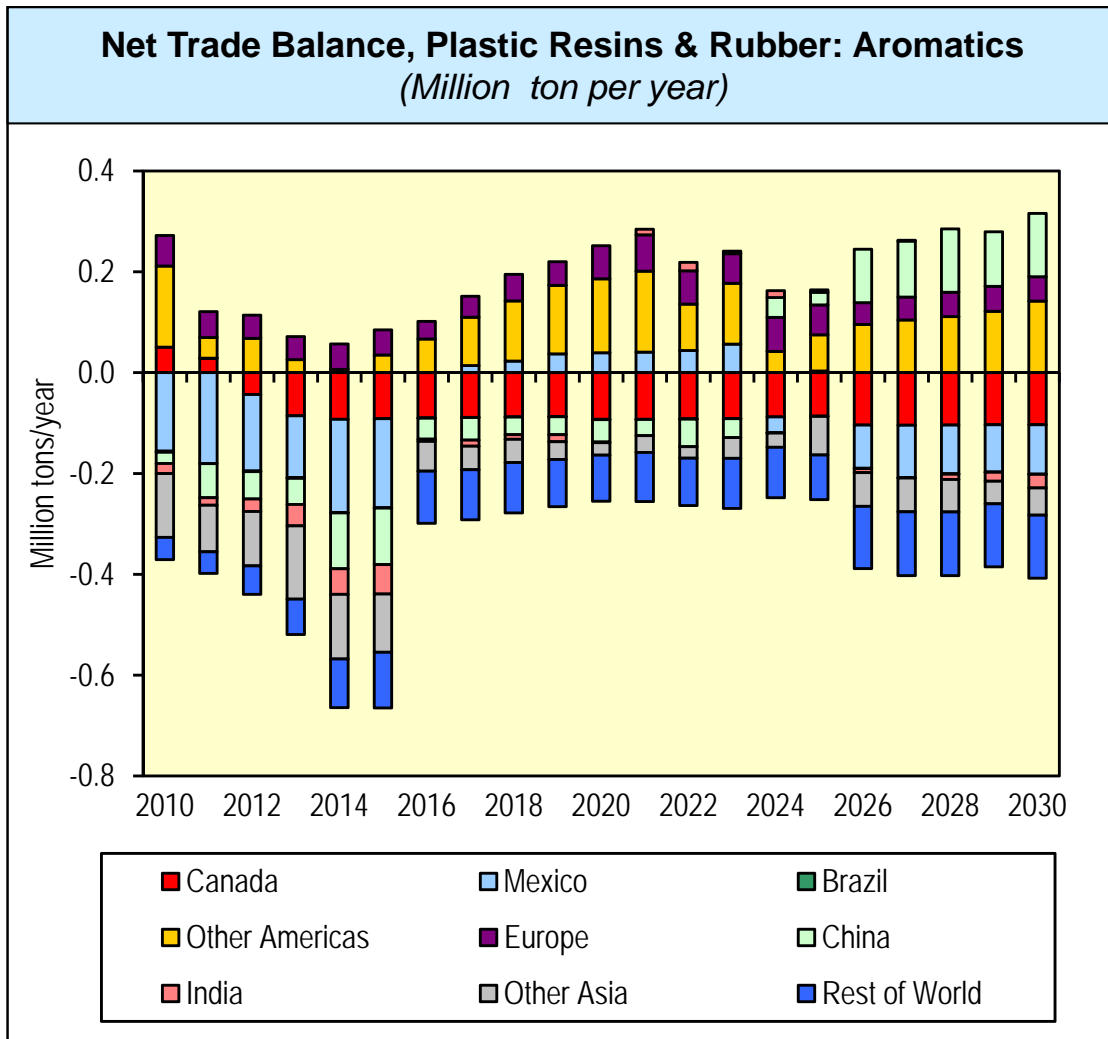


Mexico already imports butadiene (which is difficult/expensive to ship) and is adding tire capacity. Mexico is likely to import rubber and ABS rather than add butadiene capacity

Much of this category goes into tires and vehicles. As new tire factories are built in the U.S., rubber requirements will increase, and existing rubber capacity will refill.

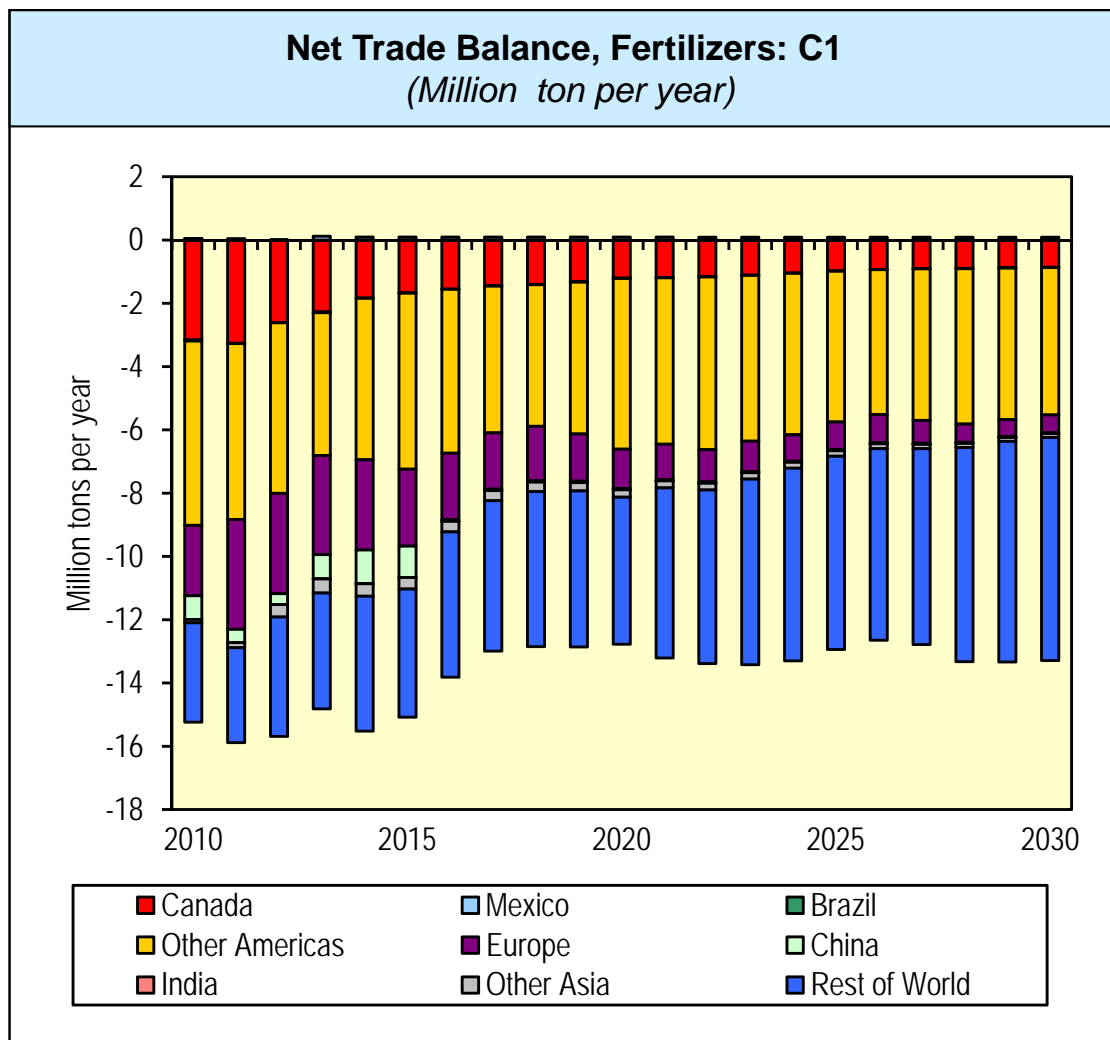
However, ABS, which is largely imported from Other Asia, will continue to be imported

## Plastic Resins & Rubber: Aromatics: PET



2 new PET units open in 2016 in USGC eliminating imports from Mexico, India and other Asia

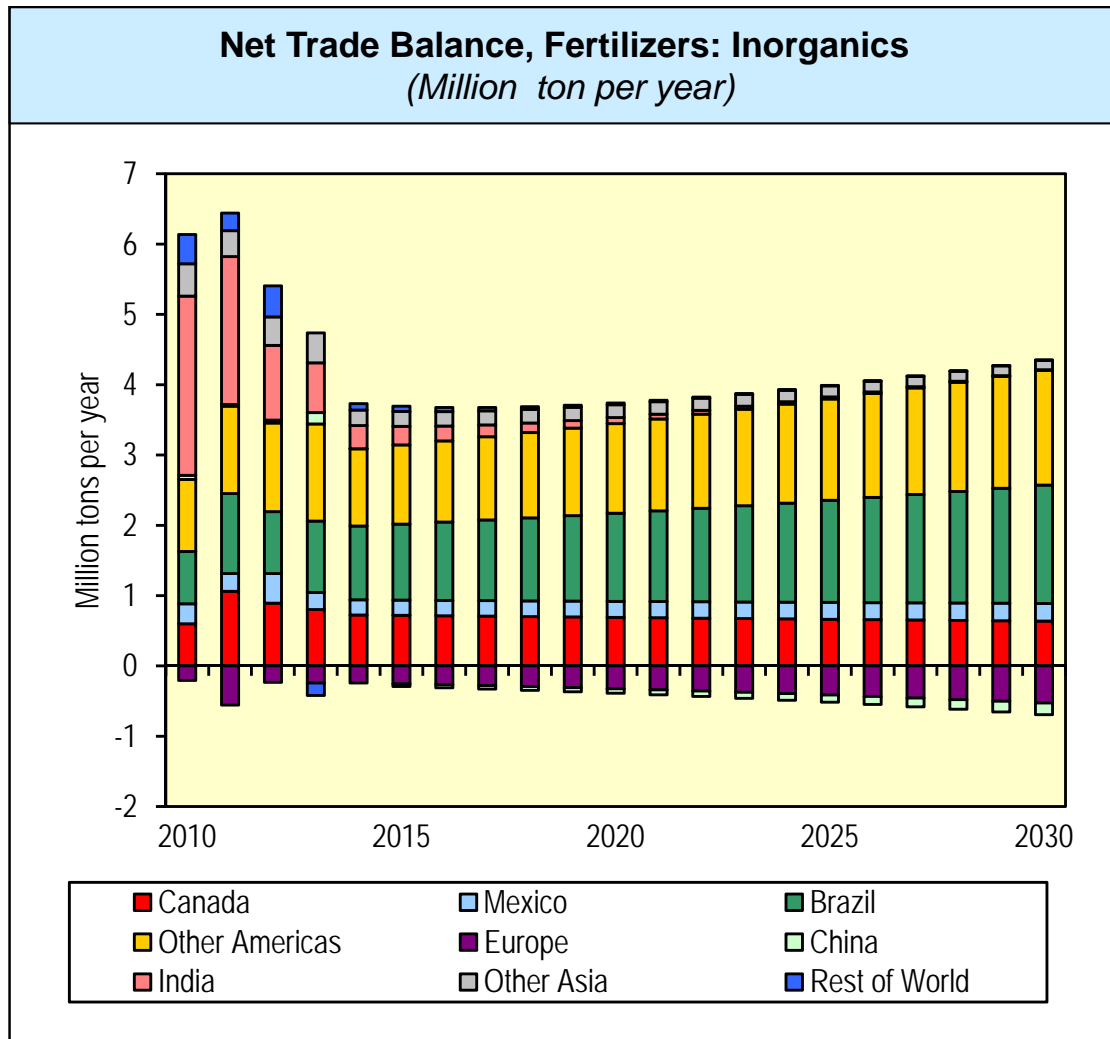
## Fertilizers: C1: Ammonia & Urea



The C1 Fertilizers (ammonia and urea) trade deficit should decrease as new capacity is installed

Depending on the restrictions on the export of natural gas, and the resulting price, C1 Fertilizers net imports could be even less than shown here, as additional capacity is installed

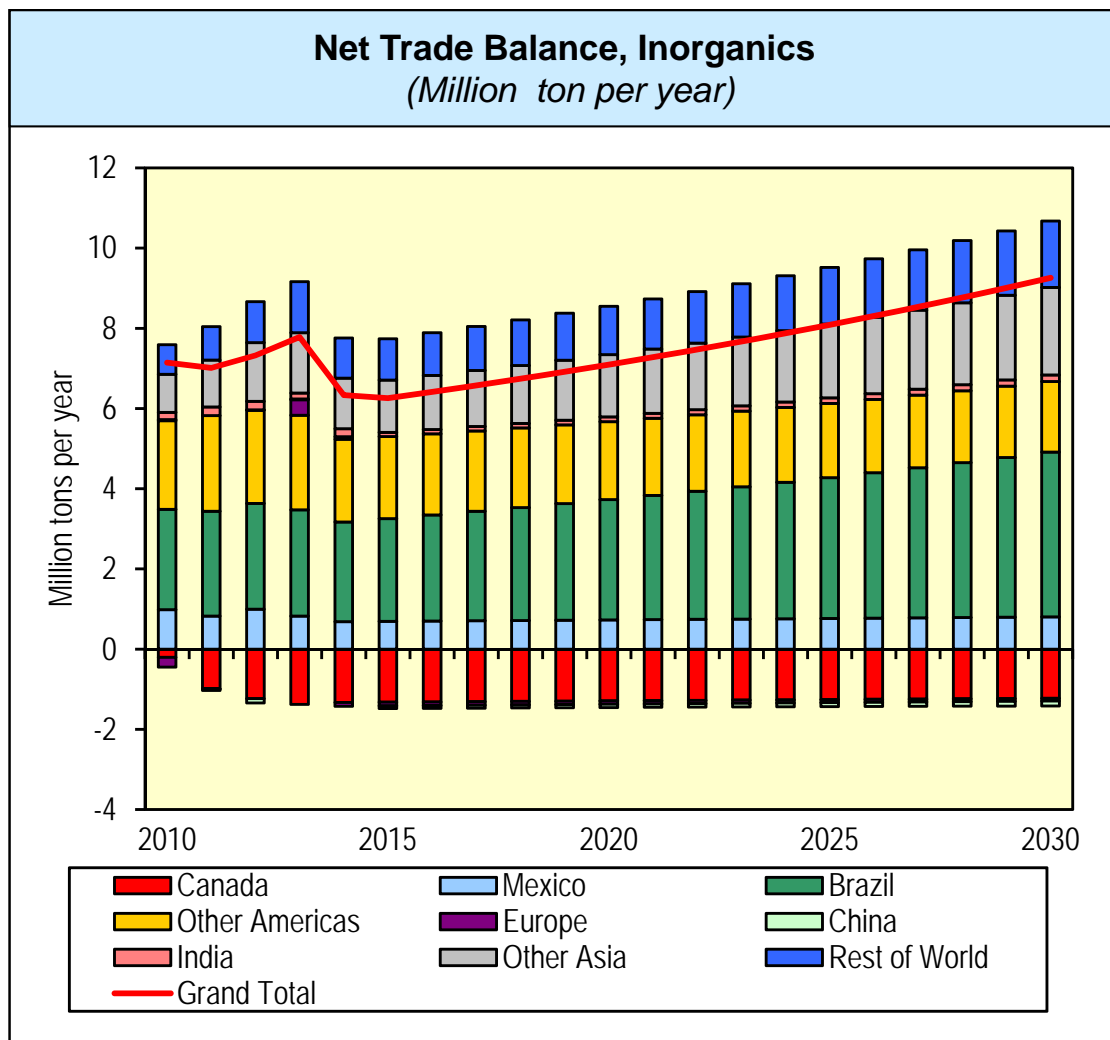
## Fertilizers: Inorganics: Monoammonium phosphate (MAP), diammonium phosphate (DAP)



New capacity and production in China now supports India's import needs, as the transportation cost is much lower for this regional destination

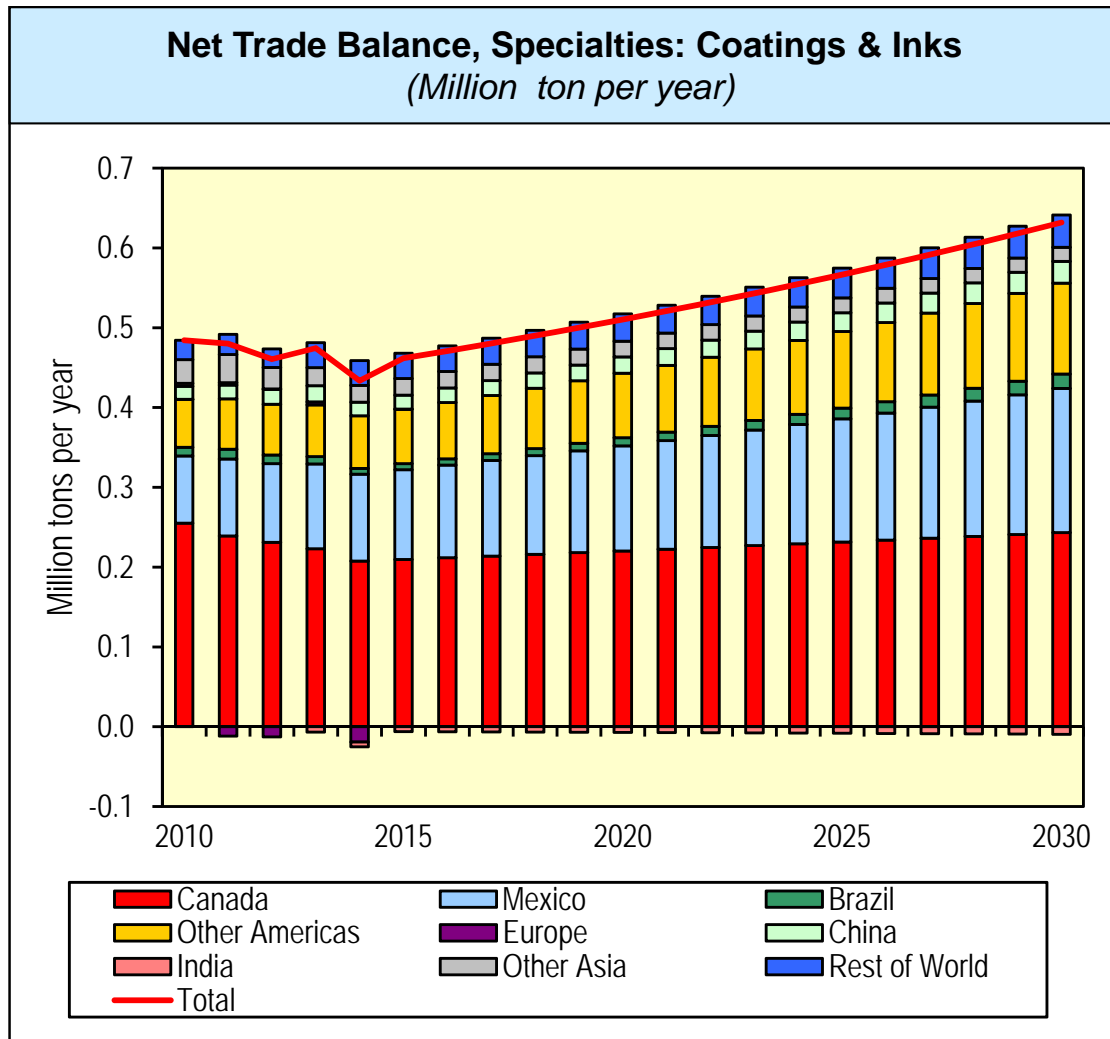
The U.S. can remain an exporter of these inorganic fertilizers to other nearby regions

## Inorganics: Caustic soda, soda ash, sulfuric acid, titanium dioxide are largely sold in the Americas



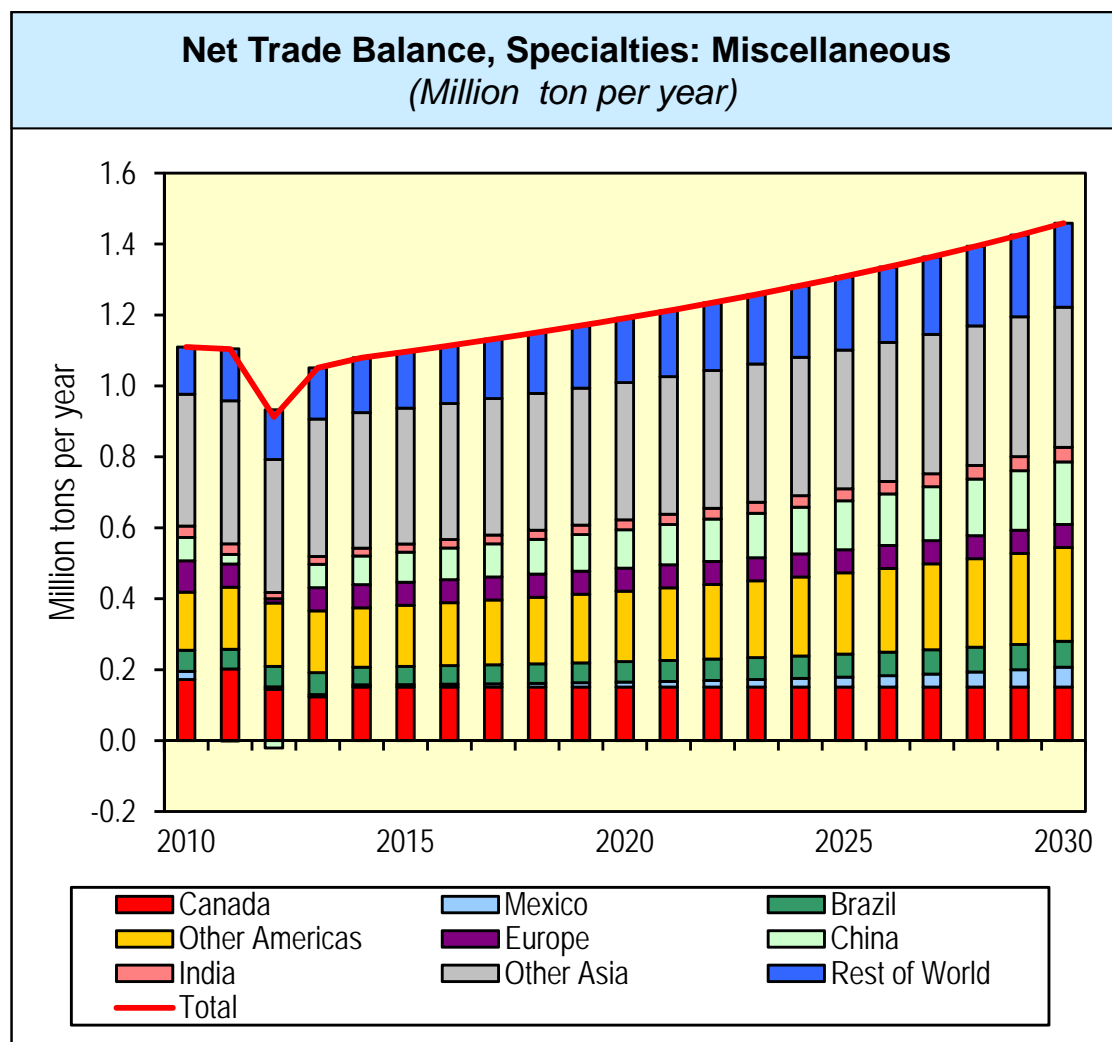
Other inorganics, of which a large portion is sold to Brazil and “Other Americas”, should resume its historic growth trend as world economies recover from the recent economic softening

**Specialties: Coatings and Inks: HTS 3208, 3209, 3210, 3215 are largely sold in the Americas**



The U.S. has long been an important and growing source of coatings and inks to the Americas

## Specialties: Miscellaneous: HTS 38 (3809-3813, 3815, 3818, 3819, 3821, 3822)



The U.S. has a strong and growing position in miscellaneous specialty chemicals including:

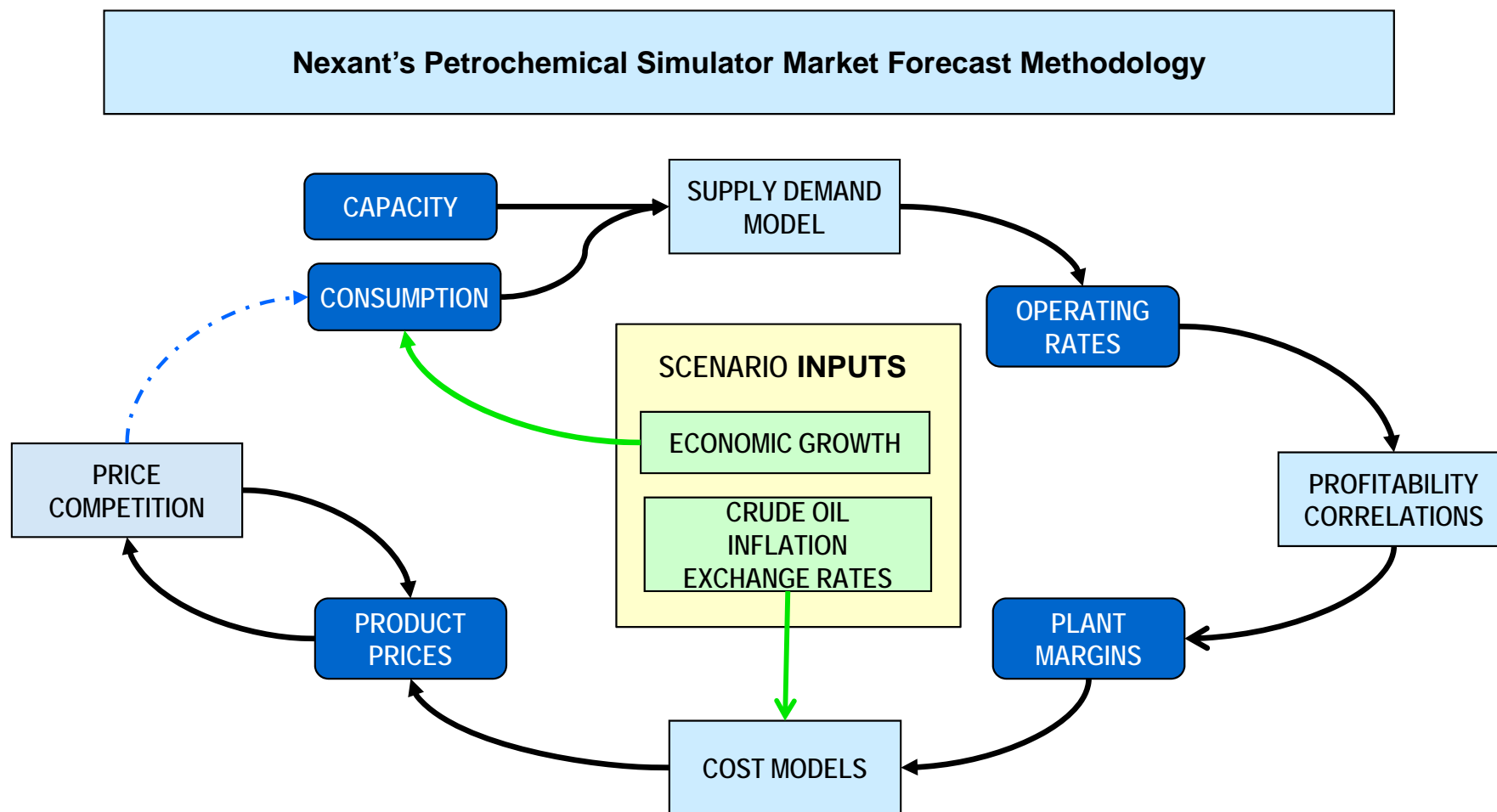
- 3801 Artificial Graphite; Collodial Graphite & Prep
- 3809 Finishing Agents Etc For Textiles, Paper
- 3810 Pickling Preps For Metal; Soldering
- 3811 Antiknock Preps & Other Additives For Mineral Oils
- 3812 Prepared Rubber Accelerators; Plasticizers Etc.
- 3813 Prep & Charges For Fire-extinguishers
- 3815 Reaction Initiators & Catalysts
- 3818 Chem Elem Doped, Used In Electron, Discs Wafers
- 3819 Hydraulic Brake & Transmission Fluids
- 3821 Prepared Culture Media For Devel't of Microorganisms
- 3822 Composite Diagnostic/lab Reagents, Exc Pharmaceutical



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**Appendix B**  
**Nexant's Simulator Methodology and Assumptions**

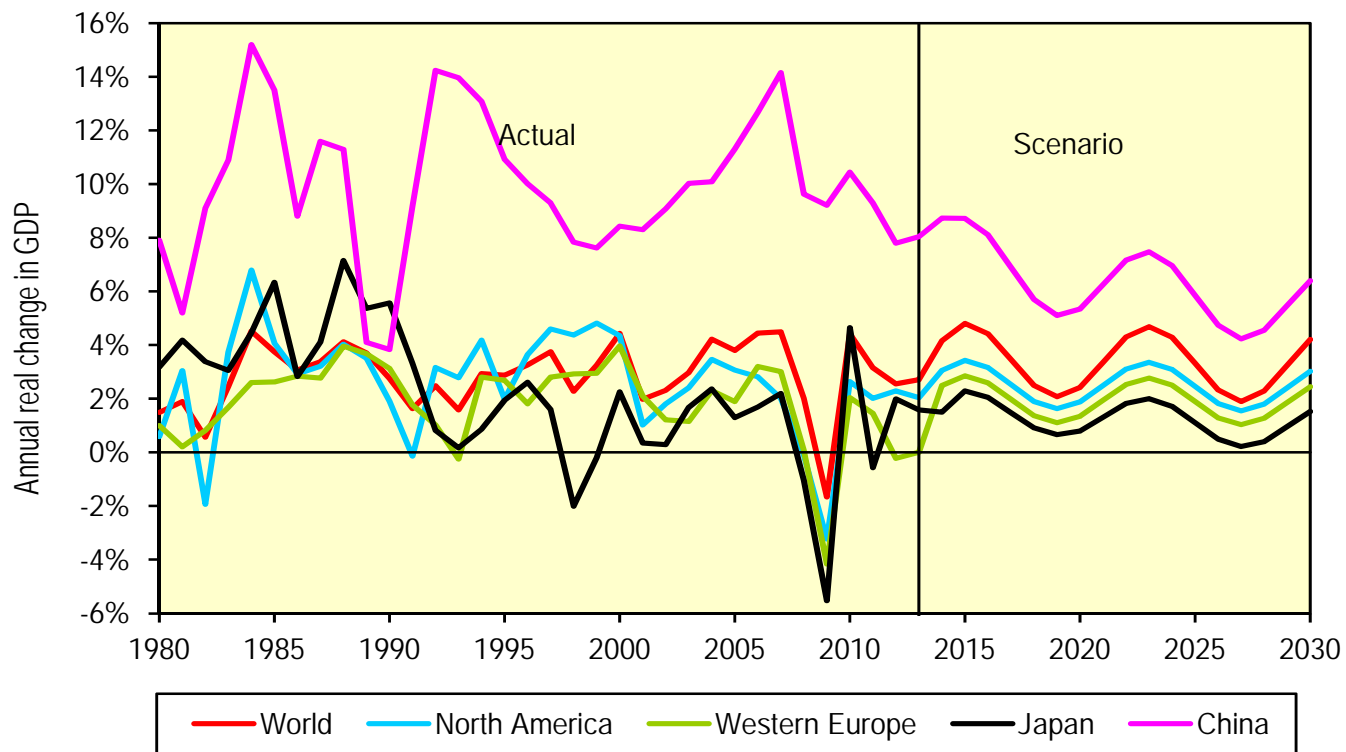
**Nexant's Petrochemical Simulator prepares forecasts of the global petro-chemical industry, with self consistent outlooks for markets and prices**



**Markets and prices are inherently linked. Crude oil and inflation scenarios influence costs. Economic growth scenarios directly influence markets**

## Economic Growth will slow in China

**World Economic Performance and Outlook  
(Real change in GDP)**

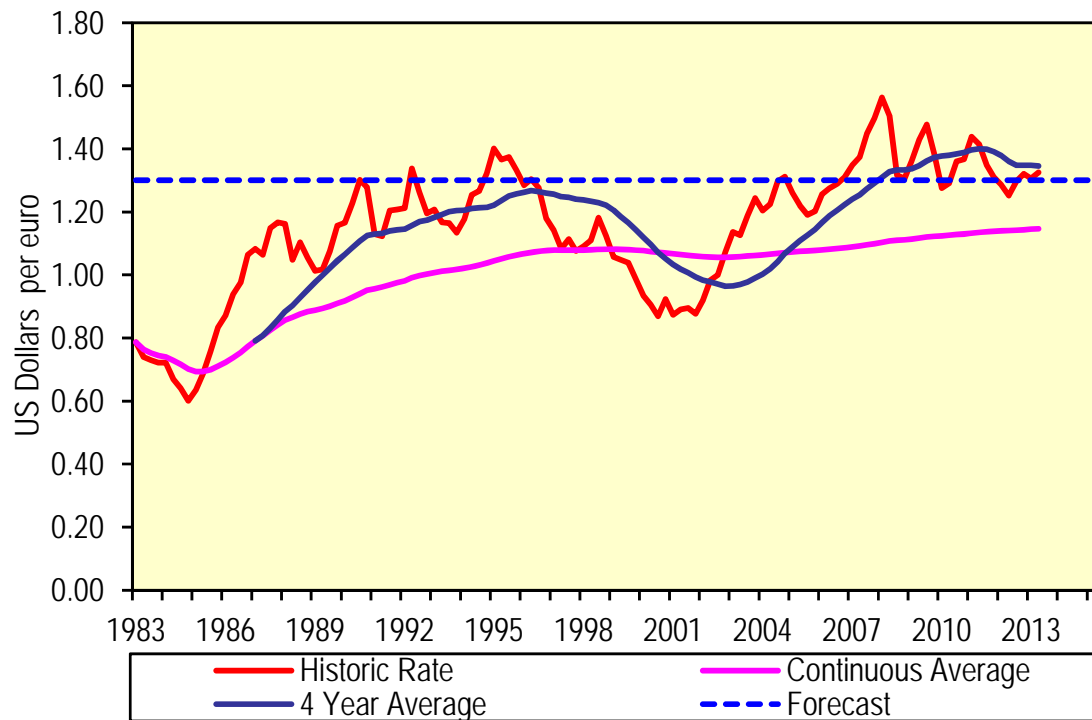


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***The outlook for economic growth scenario has been developed to follow an eight year cycle. 2007 marks the most recent peak of the world economic cycle, and the next peaks are nominally placed in 2015 and 2023.***

**Nexant's outlook assumes a stable \$1.30 = €1.00 long term trend, close to the average of the last decade**

**Euro Versus U.S. Dollar**

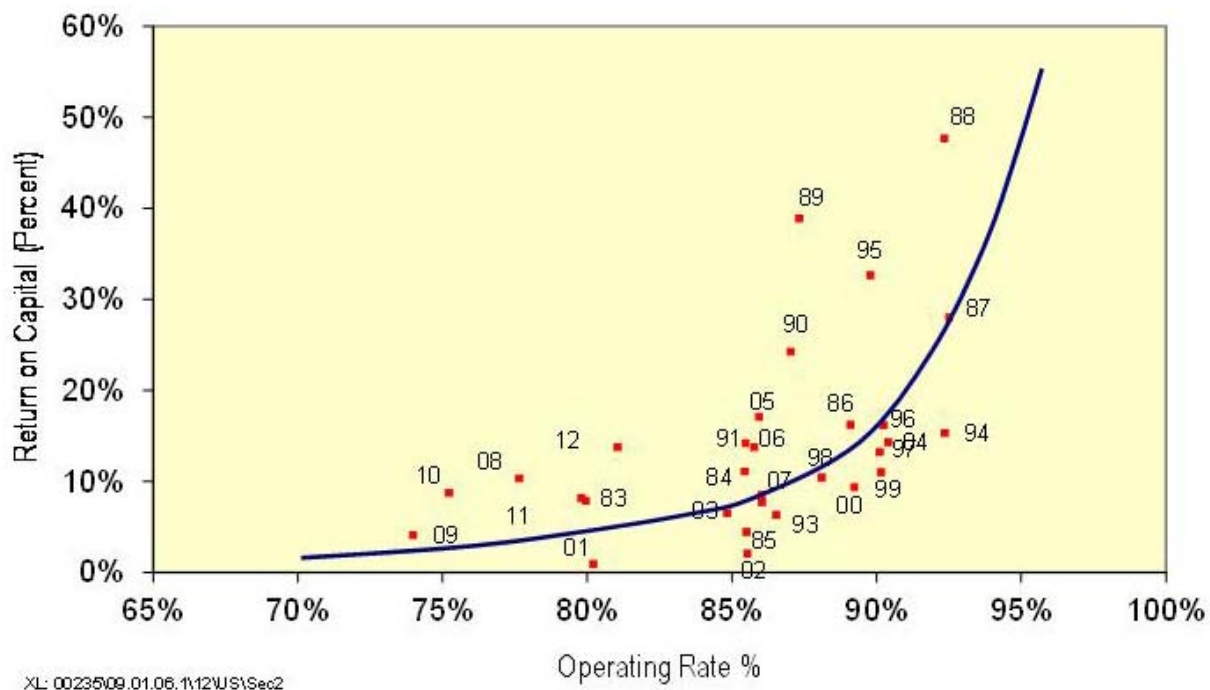


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***Nexant retains a flat trend line exchange rate forecast to reflect the view that inflation and growth rates will be similar in the U.S. and the EU***

**Margins are dependent upon the tightness of the market, typically measured by the average industry operating rate**

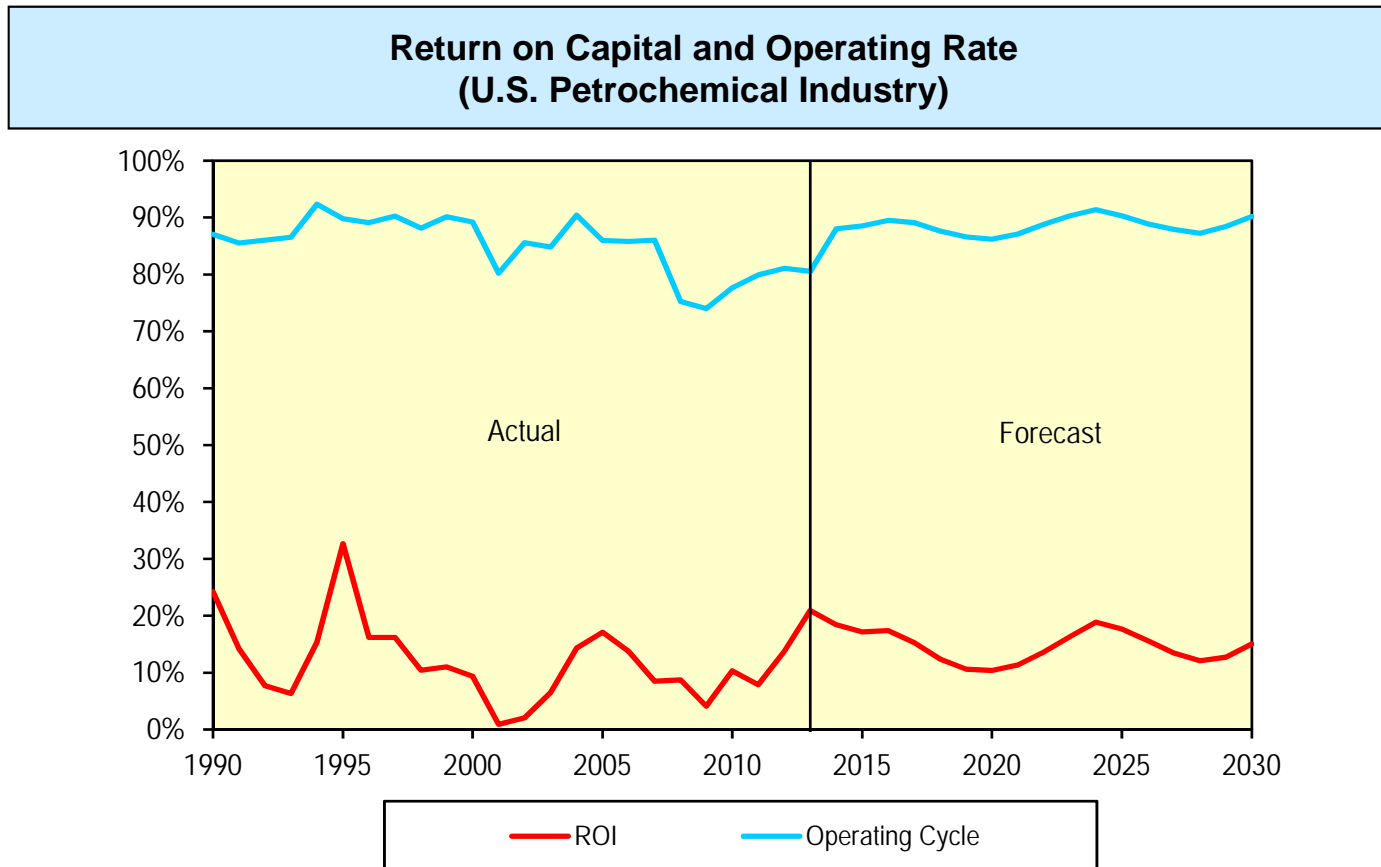
**Return on Capital and Operating Rate (U.S.)**



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***Even though recent operating rates have lagged in the USA, low cost feedstocks have lifted the profitability of many products well above the long-term trendline***

**The Petrochemical Simulator produces a price and profitability forecast that is inherently linked to the market dynamics scenario projected**



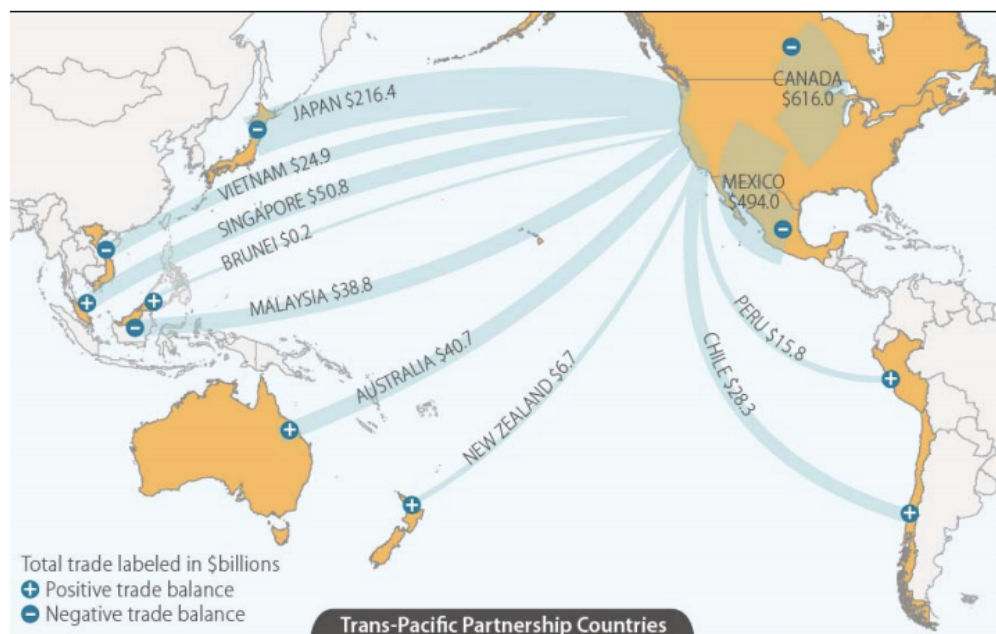
**Capacity expansions in the next two to three years are known and factored into the projections. Beyond the short term, the outcome of the cycle is speculative since it depends on unforeseen events as well as economic performance and the degree of over or under investment in the industry**

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**Appendix C**  
**Trade Agreements that could Impact Trade**

## Trans Pacific Partnership (TPP) Free Trade Agreement (FTA) is still being negotiated

### Trans Pacific Partnership



TPP is not finished yet, but is scheduled to begin in 2015

The countries currently party to the agreement — currently including Australia, Brunei, Chile, Malaysia, Mexico, New Zealand, Canada, Peru, Singapore, Vietnam, most critically Japan and potentially Korea — are some of the U.S.' biggest and fastest-growing commercial partners, accounting for \$1.5 trillion worth of trade in goods in 2012 and \$242 billion worth of services in 2011.

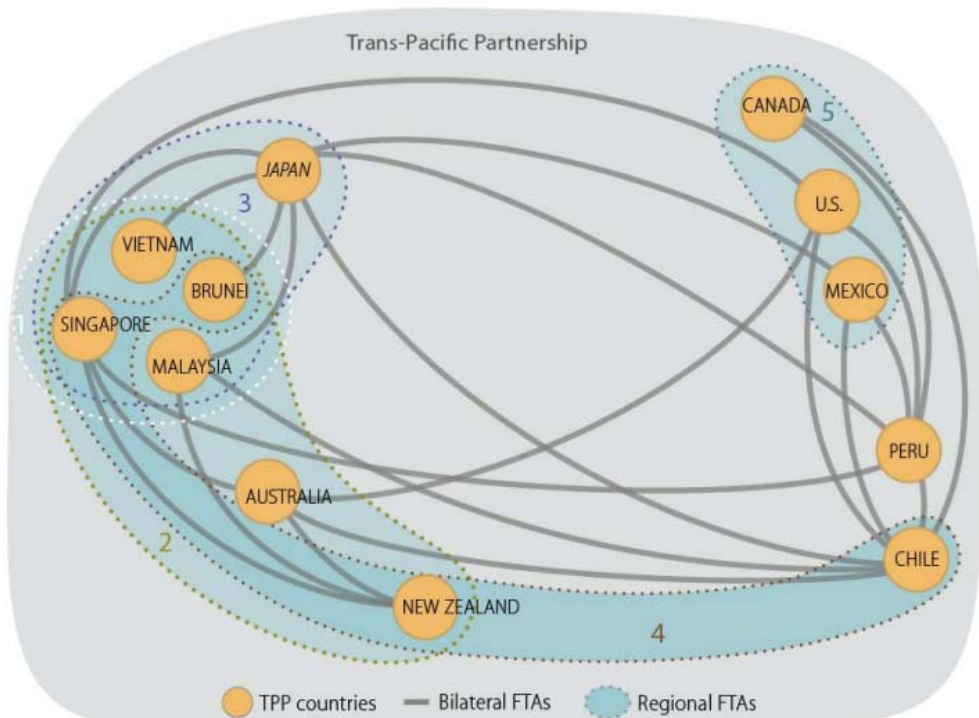
They're responsible for 40 percent of the world's GDP and 26 percent of the world's trade.

<http://www.washingtonpost.com/blogs/wonkblog/wp/2013/12/11/everything-you-need-to-know-about-the-trans-pacific-partnership/>



## Trans Pacific Partnership

### Existing Free Trade Agreements Among TPP Countries



There are a number of existing FTA among the parties negotiating the TPP

In addition, there is a parallel effort to negotiate a FTA between U.S. and the E.U. called the Transatlantic Trade and Investment Partnership (TTIP)

<http://www.washingtonpost.com/blogs/wonkblog/wp/2013/12/11/everything-you-need-to-know-about-the-trans-pacific-partnership/>

## Transatlantic Trade and Investment Partnership (TTIP) is still at an early stage

### Largest U.S. Free Trade Agreements (FTAs): Economic Area, 2012

Actual	Scenario			
FTAs	GDP (billions of current U.S. dollars)	% World GDP	Population (millions)	% World Population
U.S.-South Korea FTA	\$16,841	23%	364	5%
North American Free Trade Agreement	\$18,681	26%	464	7%
Trans-Pacific Partnership*	\$27,558	36%	792	11%
Transatlantic Trade and Investment Partnership*	\$32,269	45%	817	12%

**Sources:** CRS analysis of data from International Monetary Fund, *World Economic Outlook*, April 2013; and European Commission, Eurostat.

**Notes:** \*Proposed FTAs.

TTIP is particularly significant as an opportunity for both sides to gain strategic market access to each other's economies

For instance, shortly after Japan announced plans to join the TPP negotiations, the EU and Japan stated their intent to negotiate a bilateral FTA

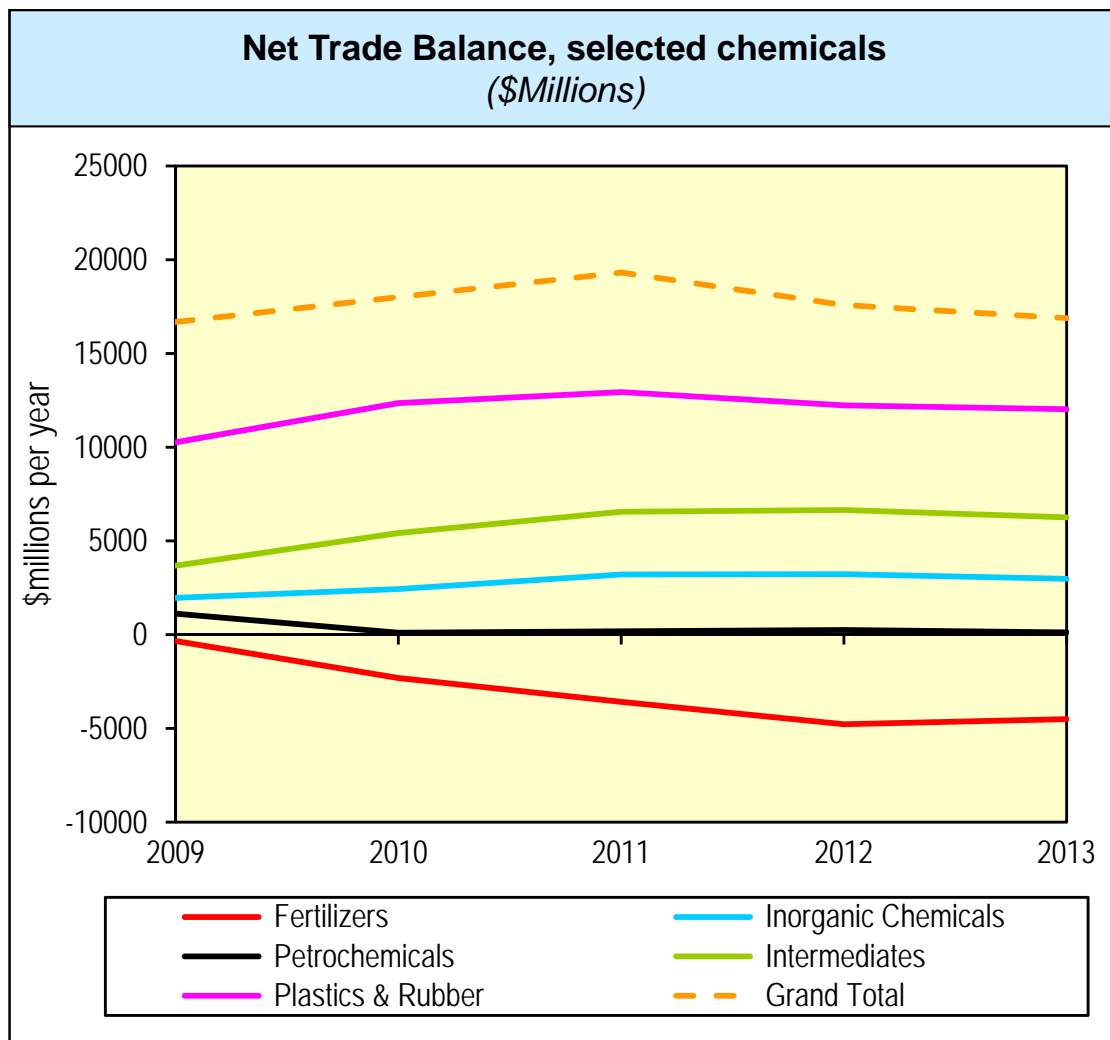
The EU-Canada Comprehensive Economic and Trade Agreement (CETA), reached in October 2013, makes the absence of a U.S.-EU FTA all the more notable, as now both the U.S. and EU separately have FTAs with Canada and Mexico

The two sides have had just three rounds compared to more than 30 in the negotiations towards TTIP's Asian cousin, the Trans-Pacific Partnership

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**Appendix D**  
**Historic Net Exports by Category**

**Since 2009, fertilizers have dragged down the net trade balance for chemicals**

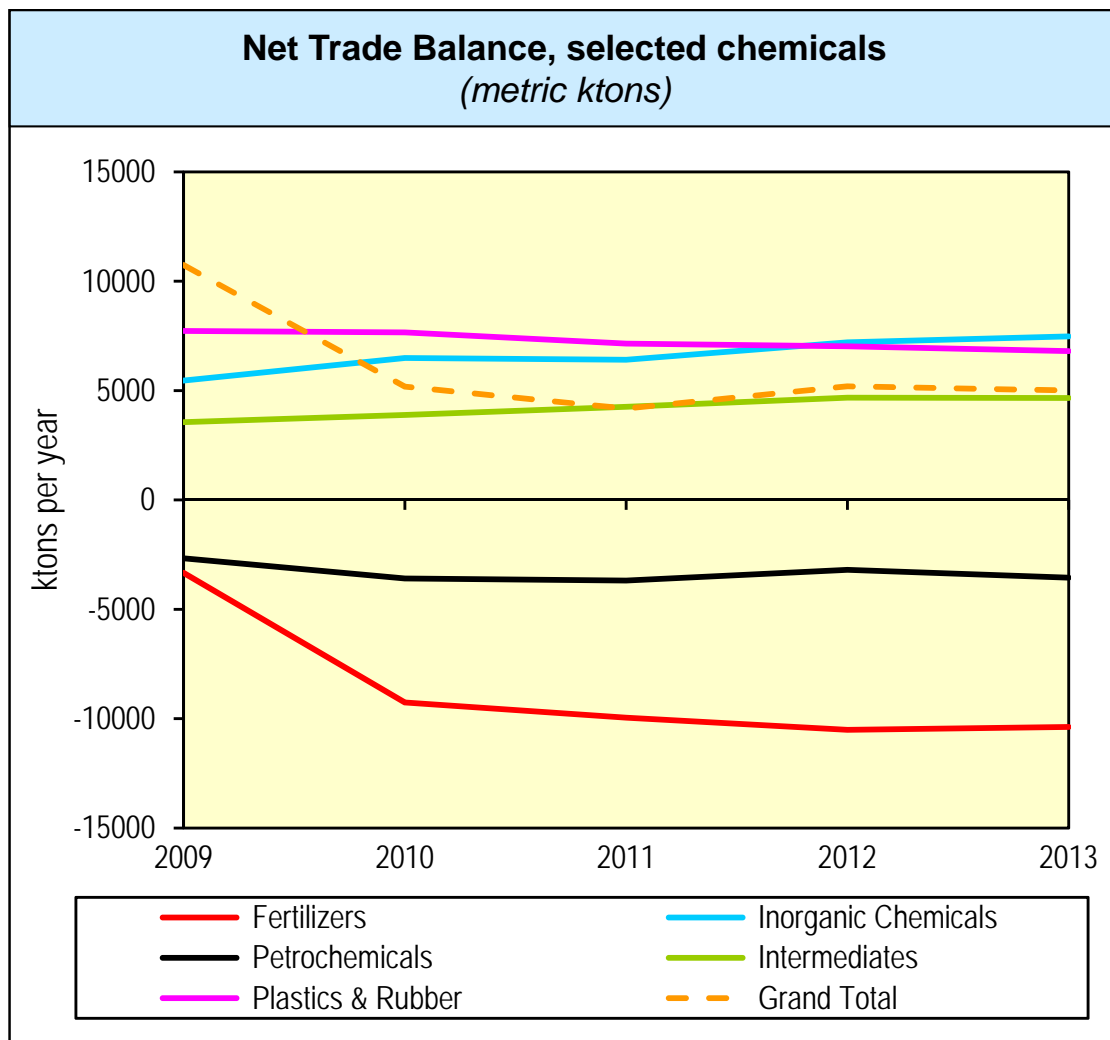


Using \$millions as the metric for net exports:

- Plastics and rubber have rebounded since the recession
- Intermediates and Inorganics (excluding DAP & MAP) have also shown growth
- Petrochemicals have become balanced
- Fertilizers have reached a net trade deficit

**However, the increase in oil prices since 2009 has had a significant impact on net exports**

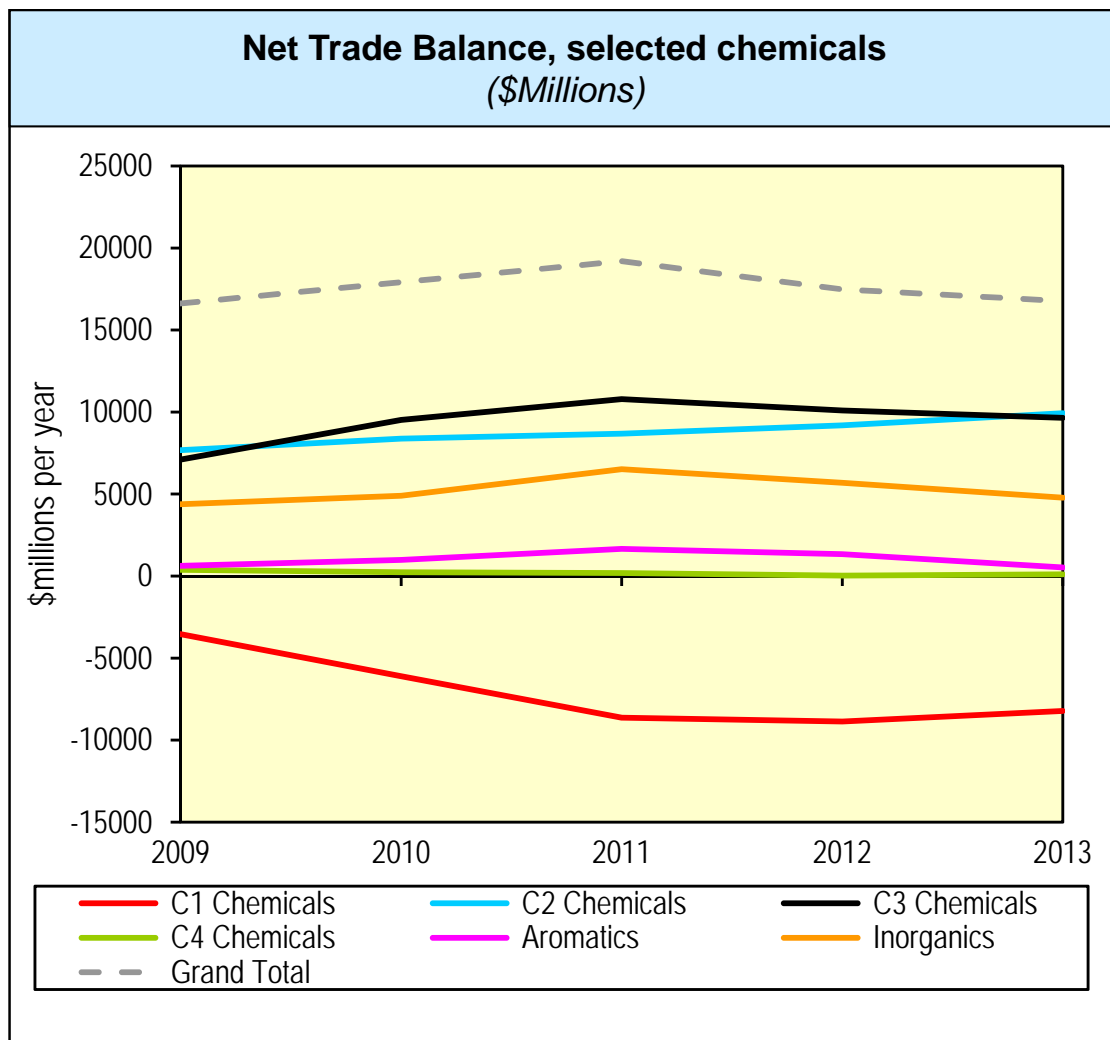
**Using ktons instead of \$millions shows that the trade balance for these chemicals has been flat to moderate growth for most chemicals other than fertilizers, which had a steep decline in 2010**



The overall net trade balance declined sharply in 2010, but has remained flat through 2013

- Inorganics (excluding DAP & MAP, which are included in fertilizers) and intermediates have shown moderate growth
- Petrochemicals have been flat and remained in deficit
- Plastics and rubber have also been flat

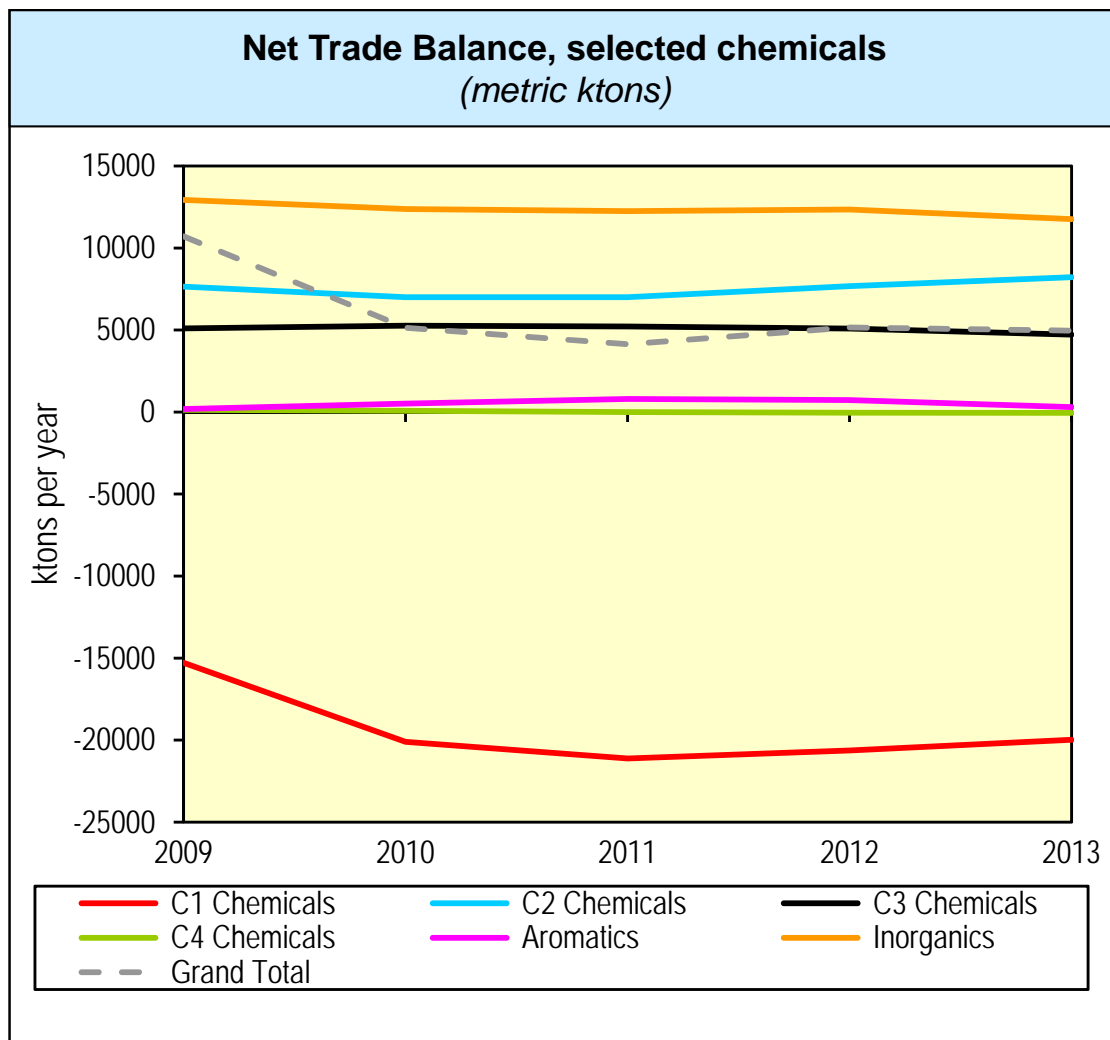
Since the 2009 recession , C2 and C3 chemicals have had solid net export growth



Using \$millions as the metric for net exports:

- C1 Chemicals have sunk further into deficit, as ammonia and urea imports have increased
- C2 and C3 have rebounded since the recession, though C3 has flattened
- C4 have remained balanced
- Aromatics increased and then declined
- Inorganics (including DAP & MAP fertilizers) rebounded and then declined

## C1 Chemicals have sunk further into deficit, while C2, C3 and inorganics have remained in surplus



Net trade in aromatics and C4 chemicals is relatively minor compared to the other categories

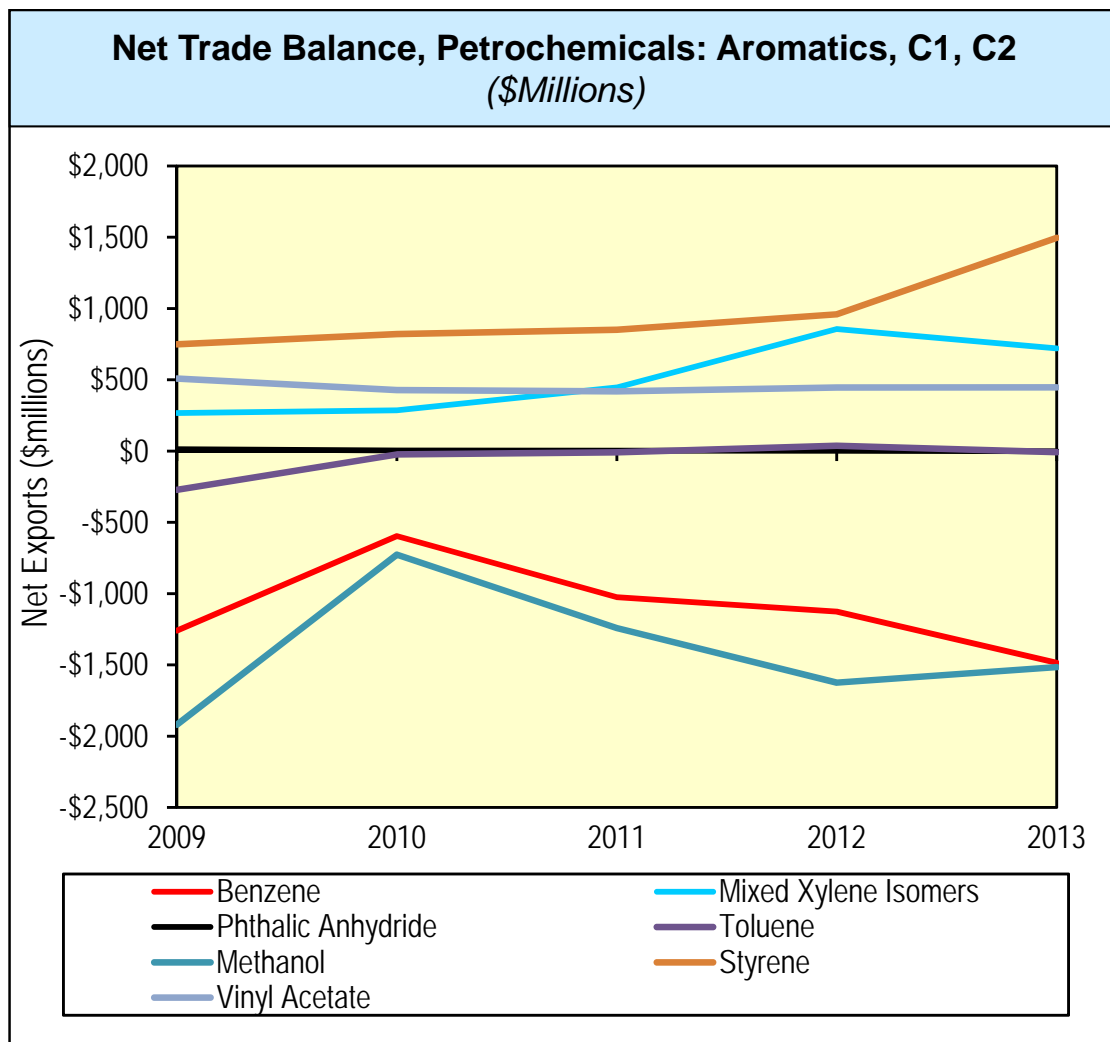
Note: Inorganics here includes DAP & MAP (fertilizers), as well as soda ash, sodium hydroxide, sulfuric acid, and titanium hydroxide

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**Appendix E**  
**Historic Net Exports by Chemical and Category**

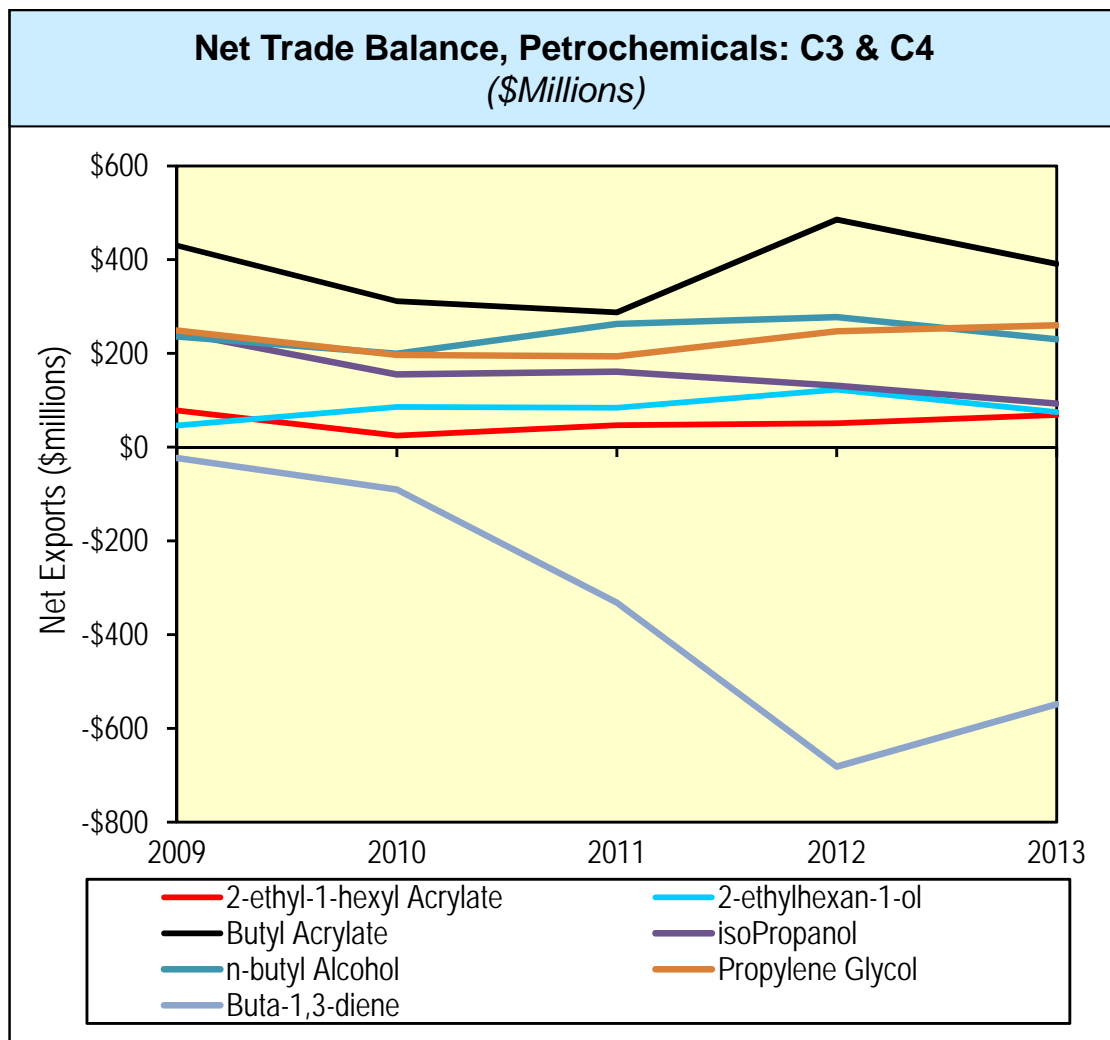


**Petrochemicals have been mixed, with Styrene improving . . .**



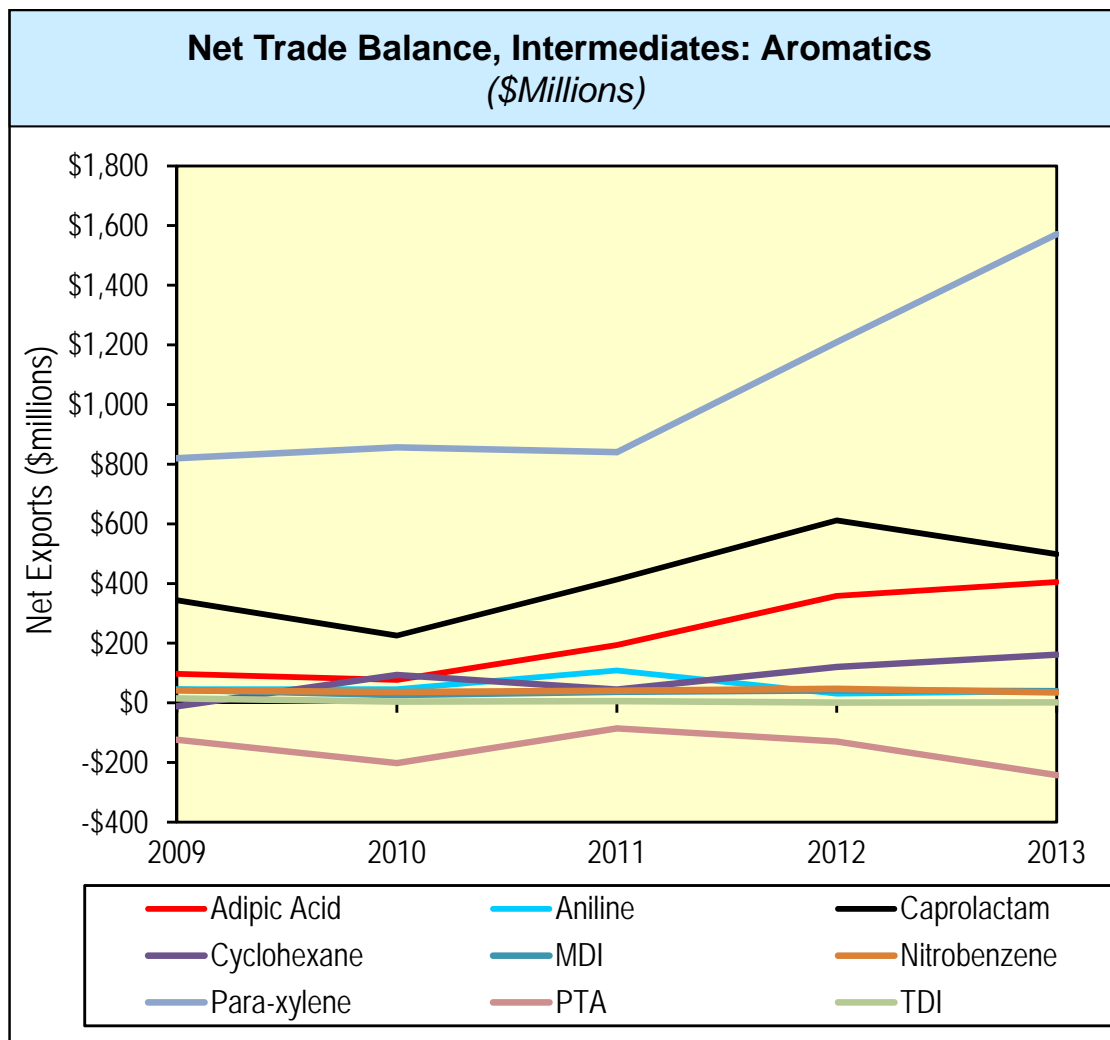
Methanol and benzene are key drivers of the petrochemicals trade deficit

**C3 Petrochemicals have a minor surplus driven by butyl acrylate . . .**



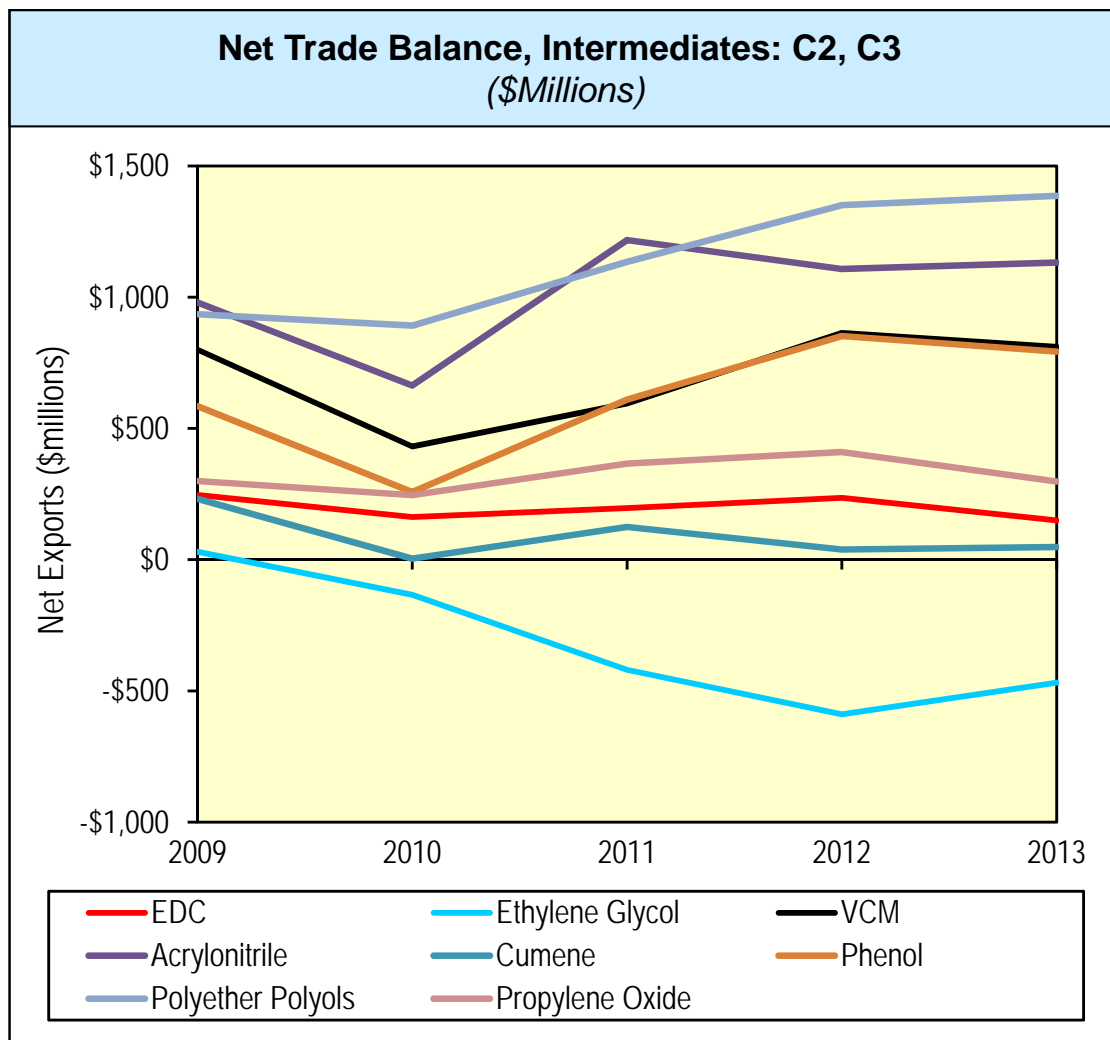
Butadiene imports result in in a significant deficit for C4s

### Among Intermediates, Aromatics are generally in surplus driven by Para-xylene



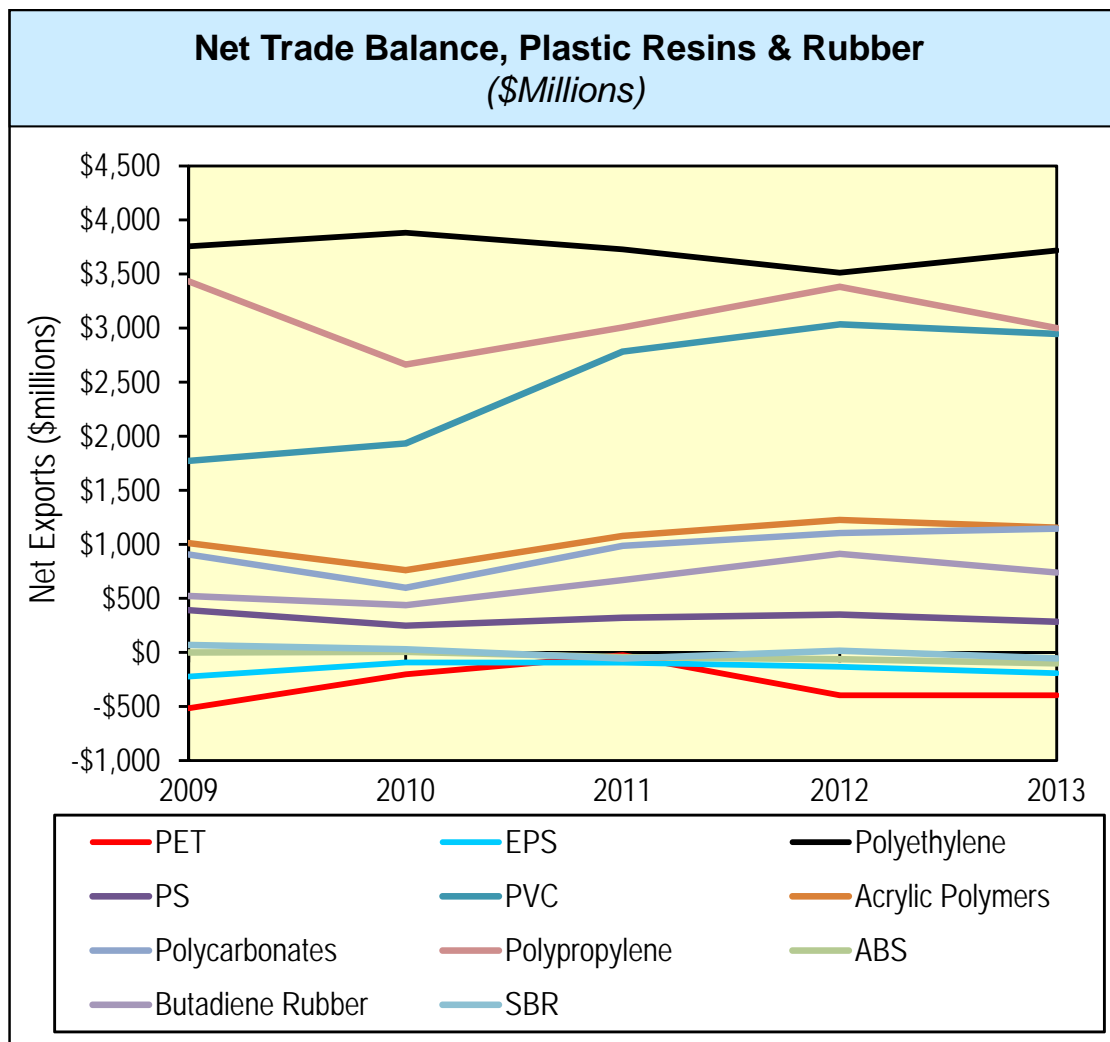
PTA is in deficit

**Intermediates are in surplus, largely driven by polyether polyols and acrylonitrile**



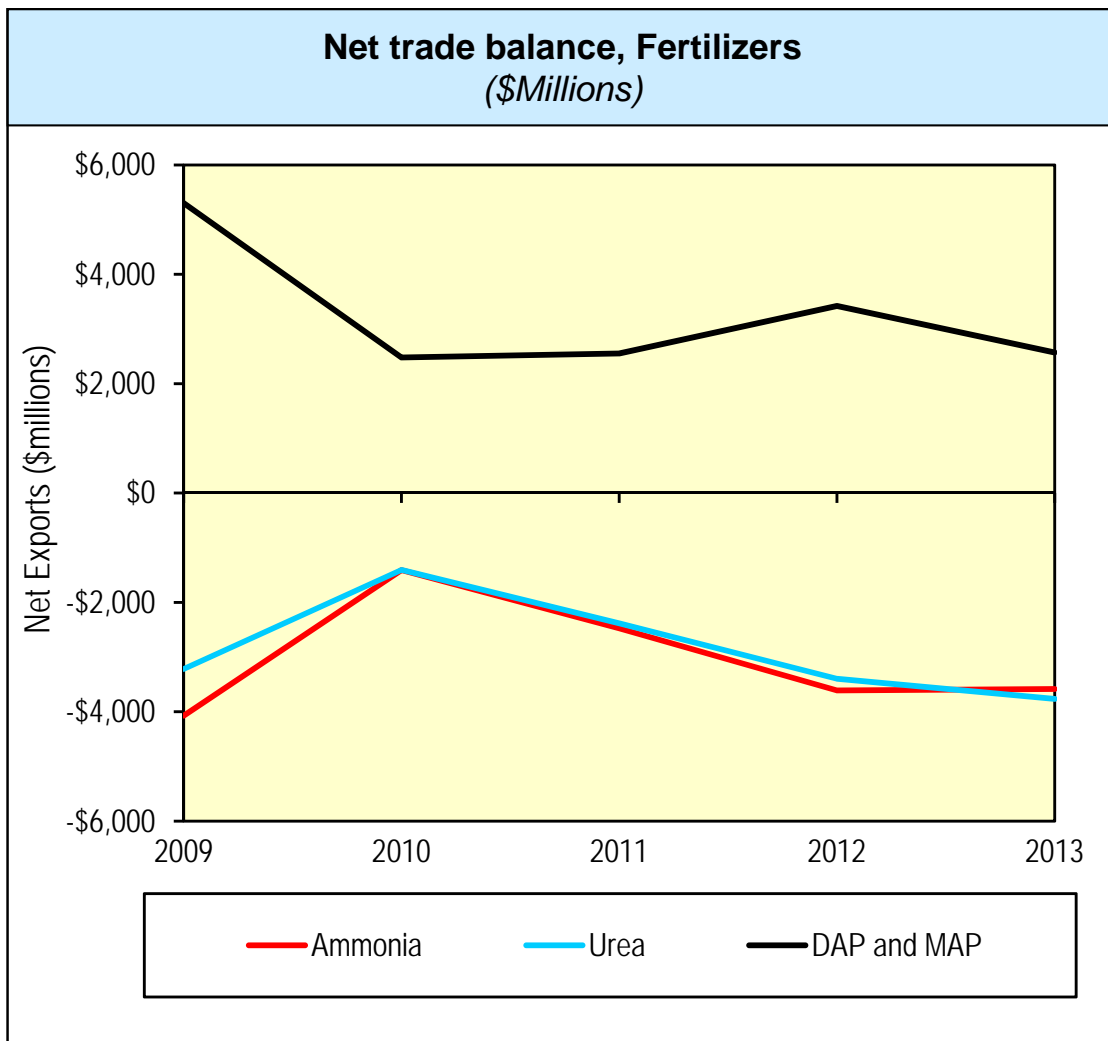
MEG is in deficit

**Plastics have yet to show a major impact from shale gas, but just wait . . .**



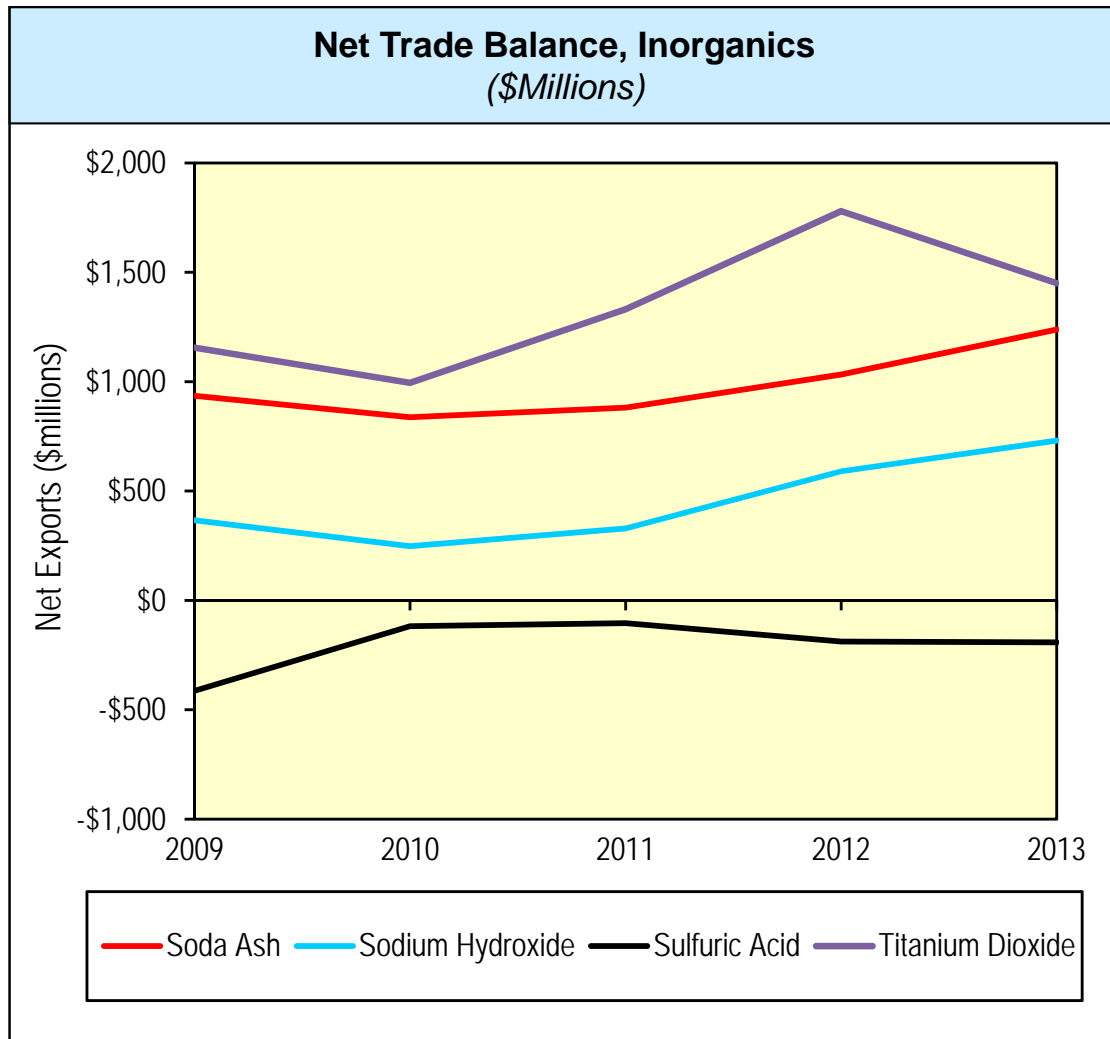
Polyethylene, Polypropylene and PVC are the key drivers of the polymer trade surplus

### Fertilizers of interest are running a \$5 billion trade deficit



Only DAP/MAP are running a trade surplus

## Inorganics have a positive trade balance, driven by TiO<sub>2</sub>, soda ash and NaOH



Sulfuric acid is in deficit

**Nexant, Inc.**

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