

A definition of the chemical industry

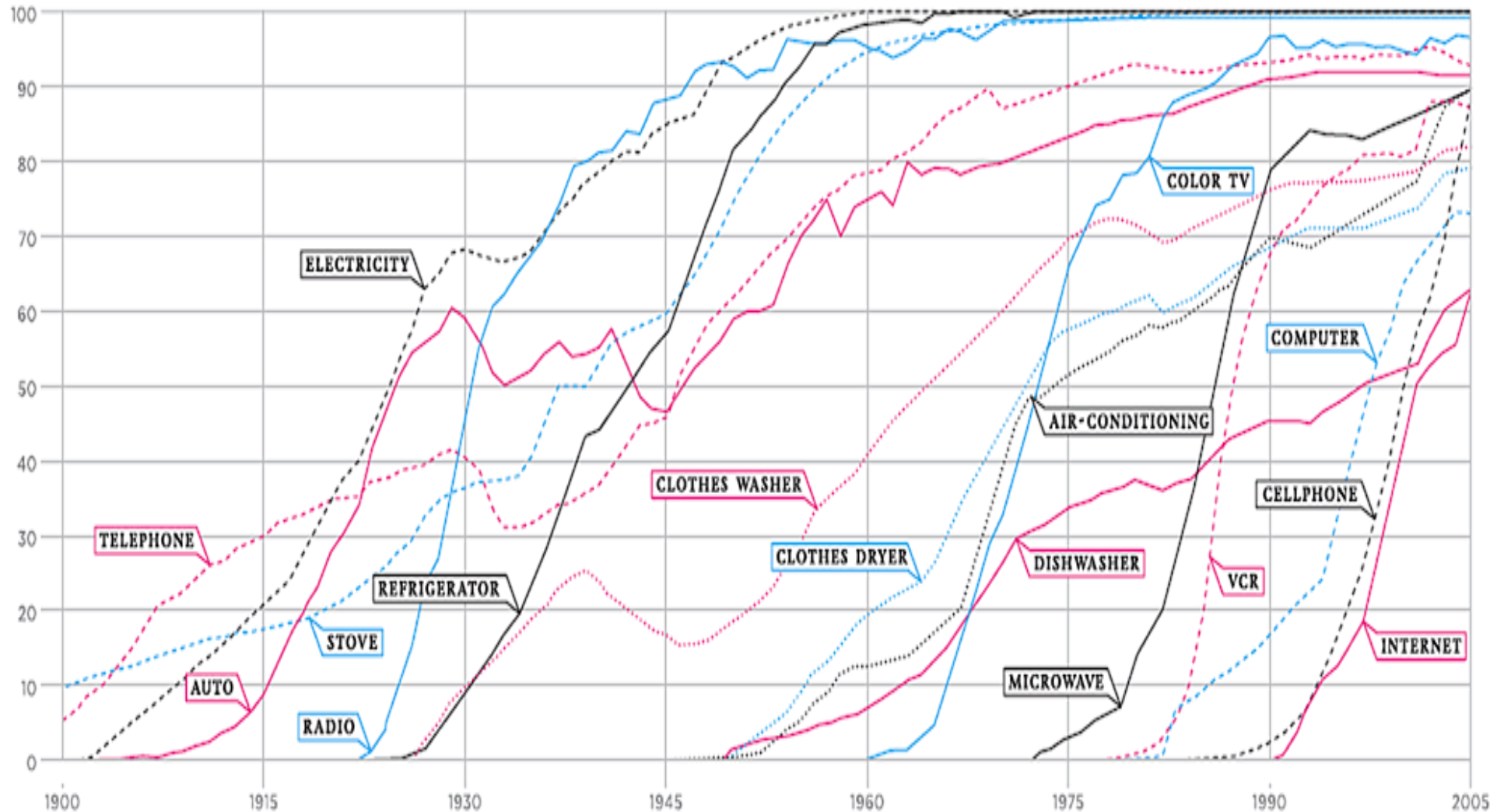
The chemical industry is an industry where its raw materials are distinguished more for their chemical properties than for their physical or mechanical properties. It processes these raw material into higher added value chemical products. The processing may be by increased purity, increased concentration, chemical reactions or a combination of the above.

The chemical industry is characterized by the high sophistication of its processes, by advanced automatic controls of plant operations and of products quality, by a high investment per employee, and by high productivity per employee. This is the reason for the requirement of high professional education and ability in the chemical industry.

The fast growing consumers markets

PERCENT OF
U.S. HOUSEHOLDS

CONSUMPTION SPREADS FASTER TODAY



The global chemical industry

**Changing
And changing**

The global chemical industry in 2015

- In the past decade the map of the global industry has changed considerably.

Old company names: Rhone Poulenc, Elf, Nobel, Union Carbide, Huls, Hoechst, **Stauffer, Diamond Shamrock, Texas Gulf, Big Three Industries, National Distillers, Pennwalt** have disappeared and were replaced by names picked by public relations managers: Novartis, Clariant, Aventis, ChemFirst, Astra Zeneca, Wyeth, Syngenta, Hexion, Noveon, Senomix, Lanxess, Yara.

- Only two of the many large companies whose main business were chemicals remain: BASF & Dow.

RANK		COMPANY	CHEMICAL SALES	CHANGE	CHEMICAL SALES AS	HEADQUARTERS	CHEMICAL OPERATING PROFITS ^a	CHANGE	CHEMICAL OPERATING PROFITS AS	OPERATING PROFIT MARGIN ^b	IDENTIFIABLE CHEMICAL ASSETS	CHEMICAL ASSETS AS % OF	CHEMICAL OPERATING RETURN ON
2012	2011		(\$ MILLIONS) 2012	FROM 2011	% OF TOTAL SALES		(\$ MILLIONS)	FROM 2011	% OF TOTAL OPERATING PROFITS		(\$ MILLIONS)	TOTAL ASSETS	ASSETS
1	1	Dow Chemical	\$56,786	-5.3%	100.0%	Midland, Mich.	\$4,425	-2.1%	100.0%	7.8%	\$69,605	100.0%	6.4%
2	2	ExxonMobil	38,726	-7.7	8.5	Irving, Texas	4,885	-16.9	6.4	12.6	26,124	7.8	18.7
3	3	DuPont ^d	30,216	-13.1	86.8	Wilmington, Del.	4,688	-15.5	97.0	15.5	16,243	64.0	28.9
4	5	PPG Industries	14,168	2.5	93.2	Pittsburgh	2,199	13.9	97.2	15.5	10,990	69.2	20.0
5	4	Chevron Phillips	13,307	-4.5	100.0	The Woodlands, Texas	na	na	na	na	9,409	100.0	na
6	6	Praxair ^d	11,224	-0.2	100.0	Danbury, Conn.	3,460	-0.1	100.0	30.8	18,090	100.0	19.1
7	7	Huntsman Corp.	11,187	-0.3	100.0	Salt Lake City	931	23.6	100.0	8.3	8,884	100.0	10.5
8	8	Mosaic ^e	11,108	11.8	100.0	Plymouth, Minn.	2,675	-2.7	100.0	24.1	16,690	100.0	16.0
9	9	Air Products ^f	9,192	-5.1	95.6	Allentown, Pa.	1,582	-2.6	97.3	17.2	15,574	91.9	10.2
10	11	Eastman Chemical	8,102	12.9	100.0	Kingsport, Tenn.	920	-9.2	100.0	11.4	11,619	100.0	7.9
11	10	Momentive	7,113	-9.3	100.0	Columbus, Ohio	465	-39.7	100.0	6.5	6,229	100.0	7.5
12	12	Celanese	6,418	-5.1	100.0	Dallas	583	-27.3	100.0	9.1	9,000	100.0	6.5
13	17	Honeywell ^d	6,184	9.3	16.4	Morristown, N.J.	1,154	10.7	19.6	18.7	6,396	15.3	18.0
14	20	Ashland ^f	6,172	36.2	75.2	Covington, Ky.	628	108.6	72.7	10.2	9,665	90.5	6.5
15	13	Dow Corning	6,119	-4.8	100.0	Midland, Mich.	na	na	na	na	13,301	100.0	na
16	15	CF Industries	6,104	0.1	100.0	Long Grove, Ill.	2,962	7.1	100.0	48.5	10,167	100.0	29.1
17	14	Lubrizol	6,100	0.0	100.0	Wickliffe, Ohio	na	na	na	na	na	na	na
18	16	Styron	5,500	-8.3	100.0	Berwyn, Pa.	na	na	na	na	na	na	na
19	19	Ecolab	5,161	11.0	43.6	St. Paul	682	27.2	53.1	13.2	11,215	63.8	6.1
20	18	Occidental Petroleum	4,580	-4.9	18.9	Los Angeles	720	-16.4	9.3	15.7	3,854	6.0	18.7
21	22	FMC Corp.	3,748	11.0	100.0	Philadelphia	696	12.4	100.0	18.6	4,374	100.0	15.9
22	23	Monsanto ^g	3,715	14.7	27.5	St. Louis	477	69.8	15.7	12.8	4,280	21.2	11.1
23	21	Westlake Chemical	3,571	-1.3	100.0	Houston	615	37.7	100.0	17.2	3,412	100.0	18.0
24	25	Cabot Corp. ^f	3,300	6.4	100.0	Boston	290	19.3	100.0	8.8	4,399	100.0	6.6
25	24	W.R. Grace	3,156	-1.8	100.0	Columbia, Md.	564	7.5	100.0	17.9	5,090	100.0	11.1

GLOBAL TOP 50

BASF retained the lead, but Sinopec overtook Dow Chemical to claim the number two spot

RANK		COMPANY	CHEMICAL SALES	CHANGE	CHEMICAL SALES AS	HEAD-QUARTERS COUNTRY	CHEMICAL OPERATING PROFITS ^a	CHANGE	CHEMICAL PROFITS AS	OPERAT-	IDENTIFIABLE	CHEMICAL	OPERATING
2013	2012		(\$ MILLIONS) 2013	FROM 2012	% OF TOTAL SALES		(\$ MILLIONS)	FROM 2012	% OF TOTAL OPERATING PROFITS	ING PROFIT MARGIN ^b	CHEMICAL ASSETS (\$ MILLIONS)	AS % OF TOTAL ASSETS	RETURN ON CHEMICAL ASSETS
1	1	BASF	\$78,615	-4.6%	80.0%	Germany	\$6,317	-6.2%	65.4%	8.0%	\$69,676	81.5%	9.1%
2	3	Sinopec	60,829	5.0	13.0	China	103	71.9	0.6	0.2	25,427	12.3	0.4
3	2	Dow Chemical	57,080	0.5	100.0	U.S.	4,715	6.6	100.0	8.3	69,501	100.0	6.8
4	5	SABIC	43,589	3.1	86.5	Saudi Arabia	12,795	1.7	86.7	29.4	84,207	93.1	15.2
5	4	Shell ^d	42,279	-7.6	9.4	Netherlands	na	na	na	na	na	na	na
6	6	ExxonMobil	39,048	0.8	9.3	U.S.	5,180	6.0	9.1	13.3	27,475	7.9	18.9
7	7	Formosa Plastics ^e	37,671	5.9	60.2	Taiwan	2,352	67.2	62.8	6.2	43,060	66.6	5.5
8	8	LyondellBasell Industries	33,405	1.7	75.8	Netherlands	5,087	17.5	99.7	15.2	na	na	na
9	9	DuPont ^d	31,044	2.7	86.9	U.S.	5,234	11.6	97.5	16.9	18,113	66.2	28.9
10	12	Ineos	26,861	-10.8	100.0	Switzerland	2,137	-6.3	100.0	8.0	na	na	na
11	10	Mitsubishi Chemical	26,685	14.8	74.4	Japan	507	121.1	44.8	1.9	23,411	65.7	2.2
12	11	Bayer	26,636	0.9	49.9	Germany	4,409	1.0	39.5	16.6	25,571	37.5	17.2
13	13	LG Chem	21,142	-0.5	100.0	South Korea	1,592	-8.8	100.0	7.5	15,938	100.0	10.0
14	14	AkzoNobel	19,376	-5.2	100.0	Netherlands	1,193	-3.5	100.0	6.2	21,332	100.0	5.6
15	16	Air Liquide	19,153	-0.8	94.7	France	3,569	1.1	96.9	18.6	29,595	95.2	12.1
16	17	Braskem	18,994	15.4	100.0	Brazil	1,370	140.1	100.0	7.2	22,414	100.0	6.1
17	19	Mitsui Chemicals	18,916	11.5	100.0	Japan	306	597.1	100.0	1.6	13,634	100.0	2.2
18	23	Linde	18,554	11.0	83.9	Germany	5,108	13.0	97.0	27.5	na	na	na
19	15	Sumitomo Chemical	18,116	16.3	78.8	Japan	688	136.9	66.6	3.8	18,163	63.6	3.8
20	18	Reliance Industries	17,778	10.4	23.3	India	1,436	17.4	35.2	8.1	9,844	13.4	14.6

GLOBAL TOP 50

BASF maintained the top spot for the ninth year, Dow regained the number two spot

RANK		COMPANY	CHEMICAL SALES	CHANGE	CHEMICAL SALES AS	HEAD-QUARTERS COUNTRY	CHEMICAL OPERATING PROFITS ^b	CHANGE	CHEMICAL PROFITS AS % OF TOTAL OPERATING PROFITS	OPERATING PROFIT MARGIN ^c	IDENTIFIABLE CHEMICAL ASSETS	CHEMICAL ASSETS AS % OF TOTAL ASSETS	OPERATING RETURN ON CHEMICAL ASSETS ^d
2014	2013 ^a		(\$ MILLIONS) 2014	FROM 2013	% OF TOTAL SALES		(\$ MILLIONS)	FROM 2013	% OF TOTAL OPERATING PROFITS	OPERATING PROFIT MARGIN ^c	(\$ MILLIONS)	ASSETS	ASSETS
1	1	BASF	\$78,698	0.0%	79.6%	Germany	\$7,896	24.8%	77.9%	10.0%	\$76,693	80.8%	10.3%
2	3	Dow Chemical	58,167	1.9	100.0	U.S.	5,950	26.2	100.0	10.2	68,796	100.0	8.6
3	2	Sinopec	57,953	-4.6	12.8	China	-351	nm	def	def	26,410	11.2	def
4	4	SABIC	43,341	-0.6	86.4	Saudi Arabia	12,033	-6.0	87.4	27.8	84,128	92.8	14.3
5	5	ExxonMobil	38,178	-2.2	9.7	U.S.	5,705	10.1	11.3	14.9	27,247	7.8	20.9
6	7	Formosa Plastics ^e	37,059	-2.2	60.4	Taiwan	1,592	-36.8	60.4	4.3	43,449	66.9	3.7
7	8	LyondellBasell Industries	34,839	4.3	76.4	Netherlands	na	na	na	na	na	na	na
8	9	DuPont ^f	29,945	-3.5	86.2	U.S.	6,184	18.2	97.3	20.7	18,932	68.2	32.7
9	10	Ineos	29,652	10.2	100.0	Switzerland	2,768	29.4	100.0	9.3	na	na	na
10	12	Bayer	28,120	5.4	50.1	Germany	4,717	6.8	40.3	16.8	29,286	31.4	16.1
11	11	Mitsubishi Chemical	26,342	6.9	76.2	Japan	870	85.8	55.5	3.3	29,077	71.1	3.0
12	5	Shell ^f	24,607	-41.8	5.8	Netherlands	na	na	na	na	na	na	na
13	13	LG Chem	21,456	-2.4	100.0	South Korea	1,656	0.0	100.0	7.7	17,227	100.0	9.6
14	16	Braskem	19,578	12.4	100.0	Brazil	1,475	17.4	100.0	7.5	21,020	100.0	7.0
15	15	Air Liquide	19,210	0.2	94.1	France	3,688	3.2	97.3	19.2	31,852	94.9	11.6
16	14	AkzoNobel	19,011	-2.0	100.0	Netherlands	1,426	19.4	100.0	7.5	21,674	100.0	6.6
17	18	Linde	18,593	0.1	82.0	Germany	5,100	-0.3	97.8	27.4	na	na	na
18	19	Sumitomo Chemical	17,833	6.6	79.3	Japan	1,041	64.0	86.5	5.8	17,420	63.9	6.0
19	17	Mitsui Chemicals	17,201	-1.5	100.0	Japan	454	60.5	100.0	2.6	12,636	100.0	3.6
20	21	Evonik Industries	17,177	0.3	100.0	Germany	1,737	4.9	100.0	10.1	20,854	100.0	8.3
21	22	Toray Industries	17,006	10.6	89.4	Japan	1,231	15.8	105.4	7.2	19,527	87.6	6.3
22	20	Reliance Industries	15,870	-6.9	25.8	India	1,359	-1.3	31.1	8.6	9,703	11.7	14.0
23	24	Yara	15,141	12.1	100.0	Norway	2,217	21.0	100.0	14.6	17,728	100.0	12.5
24	25	PPG Industries	14,250	8.0	92.8	U.S.	2,156	15.5	96.4	15.1	14,330	81.5	15.0
25	26	Solvay	14,134	2.5	100.0	Belgium	1,445	22.4	100.0	10.2	23,795	100.0	6.1
26	23	Lotte Chemical	14,121	-9.6	100.0	South Korea	333	-28.0	100.0	2.4	9,810	100.0	3.4
27	27	Chevron Phillips Chemical	13,416	2.0	100.0	U.S.	na	na	na	na	12,311	100.0	na
28	28	DSM	12,344	-3.5	100.0	Netherlands	339	-41.6	100.0	2.7	16,125	100.0	2.1
29	30	Praxair	12,273	2.9	100.0	U.S.	3,907	4.6	100.0	31.8	19,802	100.0	19.7
30	31	SK Innovation	12,011	1.7	19.2	South Korea	341	-57.5	nm	2.8	na	na	na
31	29	Shin-Etsu Chemical ^f	11,874	7.7	100.0	Japan	1,753	6.6	100.0	14.8	23,192	100.0	7.6
32	33	Huntsman Corp.	11,578	4.5	100.0	U.S.	787	17.3	100.0	6.8	11,002	100.0	7.2
33	36	Syngenta	11,286	4.6	74.6	Switzerland	na	na	na	na	na	na	na
34	35	Borealis	11,076	2.7	100.0	Austria	326	55.9	100.0	2.9	11,107	100.0	2.9
35	34	Lanxess	10,646	-3.5	100.0	Germany	543	33.3	100.0	5.1	9,641	100.0	5.6
36	32	Asahi Kasei	10,628	2.8	55.4	Japan	746	28.0	45.4	7.0	9,362	50.3	8.0
37	37	Sasol	10,299	20.9	55.1	South Africa	775	178.2	20.2	7.5	9,466	37.2	8.2

A few disappearing companies

<u>Company</u>	<u>04</u>	<u>03</u>	<u>02</u>	<u>01</u>	<u>00</u>	<u>99</u>	<u>98</u>	<u>97</u>	<u>95</u>	<u>94</u>	<u>93</u>	<u>92</u>	<u>91</u>				
Celanese	50	44	44	44	44	40	-										
Hoechst							-7	5	2	1	1	2	3				
Rhone-Poulenc							-9	11	14	12	12	9	9				
Aventis				-43	33	17	-										
Novartis							-36	20	27	-							
Zeneca							-37	41	42	39	-						
Roche								-36	29	29	-						
Unilever									-37	37	38	40	40				
Monsanto				-47	49	33	40	-18	17	18	19	15					
Miles									-19	-							
Arco									-41	45	43	44	44				
UnionCarbide									-28	23	19	29	25	24	26	22	
Henkel				-17	21	16	18	22	27	20	22	22	28				
Nobel											-46	48					
Mobil											-25	36	37	36	33		
Amoco											-30	31	36	37	34		
Ashland											-39	43	50	-			
Occidental											-50	37	32	28	34	32	27

U.S. CHEMICAL TRADE BY PRODUCT

The shale gas revolution is fueling growth in U.S. chemical exports

EXPORTS (\$ MILLIONS)	1997	1998	1999	2010	2011	2012	2013	2014
PHARMACEUTICALS	\$10,368	\$11,944	\$13,537	\$46,580	\$45,164	\$48,449	\$48,125	\$51,576
CHEMICALS, EXCLUDING PHARMACEUTICALS	57,313	54,291	54,825	124,412	141,974	139,667	141,028	139,750
Agricultural chemicals	4,874	5,222	4,717	6,885	8,763	8,411	8,525	8,279
Consumer products	3,627	3,553	3,562	9,471	9,888	10,627	11,201	11,617
Basic chemicals	35,468	33,013	33,808	81,789	94,526	92,484	93,022	92,162
Inorganics	5,741	5,125	5,011	10,764	12,487	13,022	12,710	12,892
Bulk petrochemicals & intermediates	11,753	10,650	11,384	28,569	33,982	32,607	33,416	31,723
Petrochemical derivatives & other industrial chemicals	17,973	17,238	17,414	42,456	48,057	46,855	46,896	47,547
Plastic resins	10,859	10,275	10,438	28,396	31,358	30,524	31,165	31,616
Synthetic rubber	1,555	1,478	1,542	4,174	5,364	5,043	4,464	4,415
Synthetic fibers	2,146	1,961	1,775	2,354	2,666	2,659	2,777	2,720
Other basic chemicals	3,413	3,525	3,659	7,532	8,669	8,628	8,490	8,797
Specialties	13,345	12,503	12,737	26,267	28,797	28,144	28,280	27,692
Adhesives & sealants	608	618	670	1,751	1,891	1,998	1,996	2,040
Coatings	1,212	1,275	1,376	2,318	2,510	2,667	2,725	2,852
Other specialties	11,525	10,611	10,692	22,198	24,396	23,479	23,559	22,800
TOTAL	\$67,682	\$66,235	\$68,362	\$170,992	\$187,138	\$188,116	\$189,153	\$191,326

SOURCES: U.S. Department of Commerce, American Chemistry Council analysis

The Problems of the chemical industry

Low profitability in 8 out of 10 years in each •
decade.

Ownership of company stocks by pension •
groups, and short term view by boards.

Motivation of managers to get larger bonuses. •

The remedies tried - 1

- 1. Cutting costs, restructuring**
- 2. Staff reductions**
- 3. Strengthening existing production.**
Economy of scale. Operating and managerial efforts,
Technical innovations .
- 4. Reengineering**
Rethinking and radical redesign of business processes
- 5. Move into higher value products (specialties)**
- 6. Diversification**
Spreading the risks and balancing seasonally sensitive products.
- 7. Globalization - Foreign trade and production**

The remedies tried - 2

- 8. Divestitures,
Divisions from many companies were divested.**
- 9. Demerger.
Splitting the existing organization into separate entities.**
- 10. Leveraged Buy-outs
The buyers of plants under this scheme were employees and banks.**
- 11. Mergers and acquisitions, alliances and joint ventures.**

Selling and Buying

Some of the selling, buying and reorganizations were for the purpose of market share in specific businesses, or to get rid of businesses with a small market share. •

Many of the sales were in order to appease the stock market for poor performance of the companies. The stock market only looks at the quarterly reports or the gossip columns.. Each time a company is mentioned the value of its shares jumps in either direction.

Many of the sales were by managers who wanted the golden parachutes awarded by the shareholders for making an apparently good exit.

The remedies tried - 3

12. Manipulating stocks

Buying own companies shares.

13. Other managerial remedies:

A multitude of new 3 or 4 letter subjects, invented by business schools:

Examples of key gobbly terms popular in the chemical industry in the nineties:

SDP, PACE, ME, QFD, PS/MST, BPS, FE, SCM, HPWS, IWCT, CFM, TQM, PQM/PC.

13. Other managerial remedies, continued:

Examples of key gobbly terms popular in the chemical industry in this century:

**Sustainable Development, Sustainable growth,
Six Sigma,**

EPR = Extended Product responsibility,

DPR = Disaster Recovery Planning,

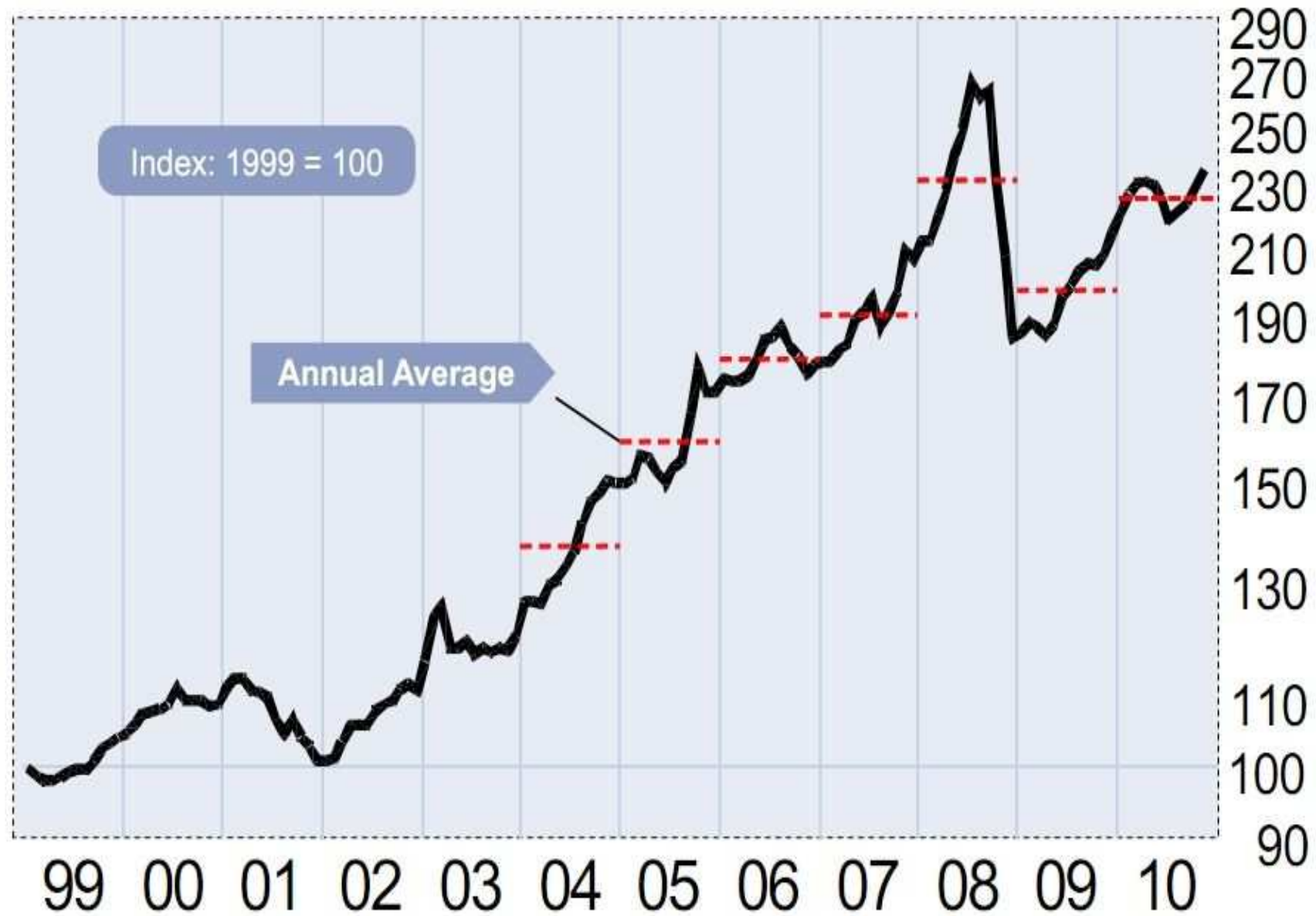
TRM - Time Based Management.

The major economic effects

Chemicals prices •

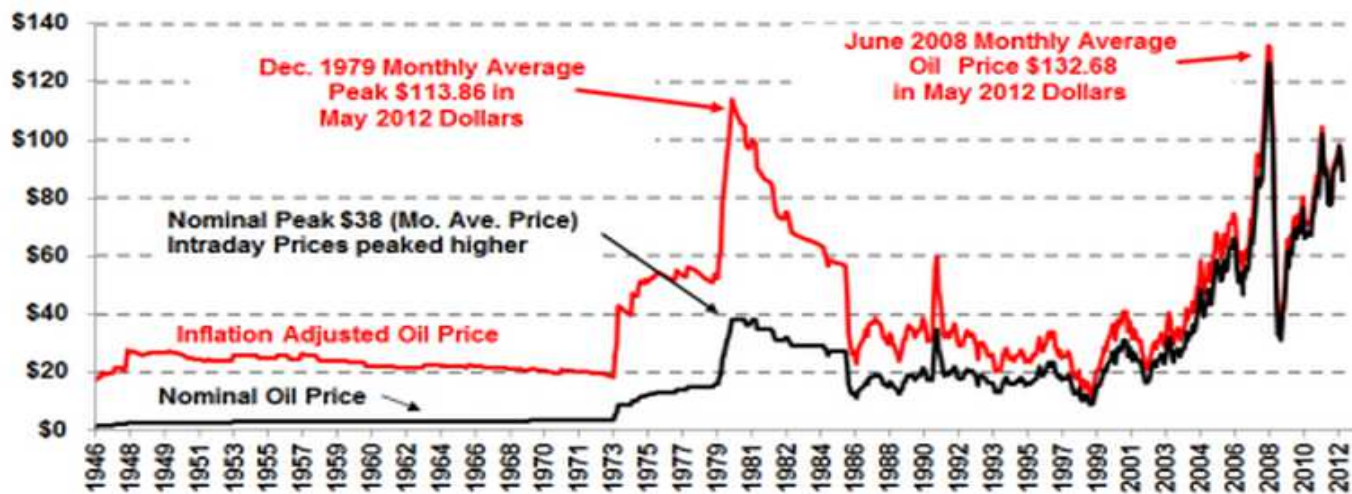
Crude Oil cost •

Industrial Chemicals Prices



Inflation Adjusted Monthly CRUDE OIL PRICES (1946-Present) In May 2012 Dollars

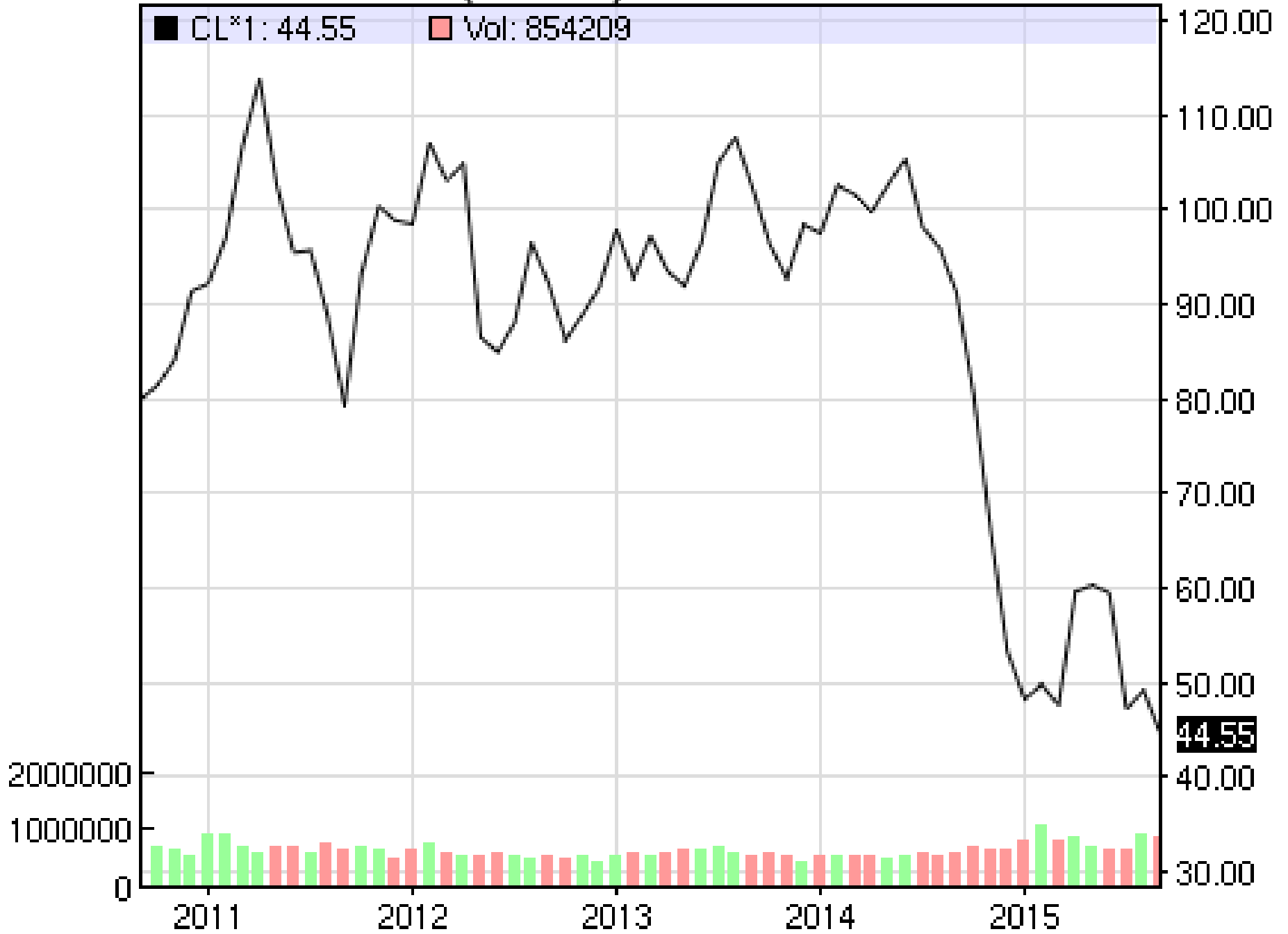
© www.InflationData.com
Updated 6/14/2012



Source of Data:

Oil Prices- www.PlainsAllAmerican.com -- Illinois Crude
CPI-U Inflation index- www.bls.gov

CLX10 - Crude Oil WTI (NYMEX)



Innovation

Identifying rising markets •

Identifying future technologies •

Entry Barriers to new products

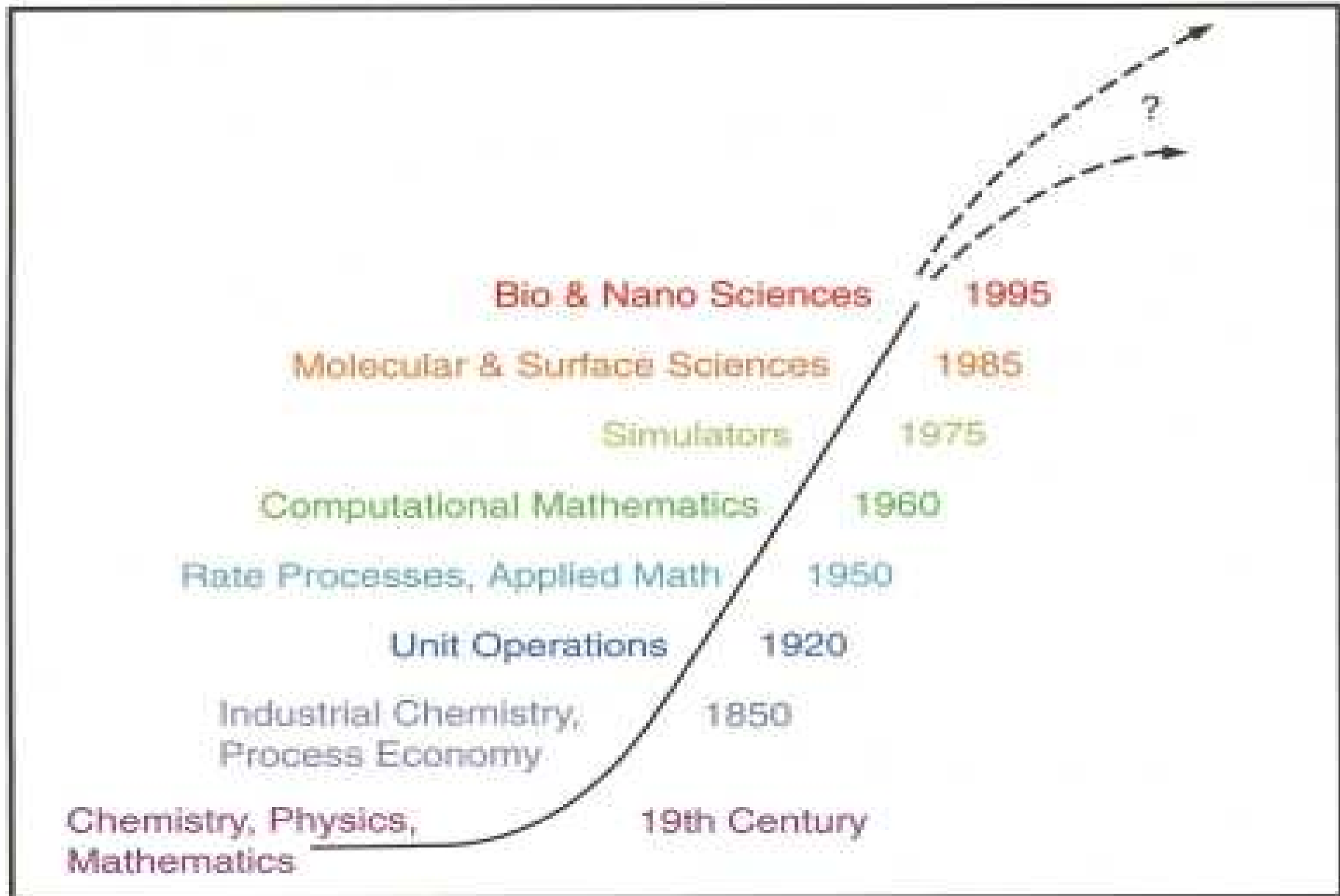
Technology maturation

Market saturation

Globalization

Environmental requirements

Short term view



■ Figure 5. Major developments in chemical engineering technology.