Fuels Workshop on Regulatory and Non-Regulatory Fuels Activities for 2006

August 11, 2006

California Environmental Protection Agency

Air Resources Board

Agenda

- Introductions and Schedule
- California Predictive Model
- Presentations by Others
- Open Discussions
- Closing Remarks

Future 2006 Workshops

- Aug. 25 9:00-12:30 Byron Sher Auditorium
  - This workshop will be webcast; conference call phone number and pass code will be the same as today.
  - Next set of workshop being scheduled

Discussion Topic: Predictive Model

New Website

- To facilitate communications with stakeholders, the ARB staff has created a new webpage for Predictive Model development activities
  - The new webpage may be found at: www.arb.ca.gov/fuels/gasoline/premodel/pmdevelop.htm

Predictive Model

- Committed to the Board to review need for update about every 5 years – last updated 1999
- Currently slated to go to the Board on December 7-8, 2006
  - Hearing notice package filed with OAL on 10/10
  - Staff Report release no later than 10/20

Predictive Model - Hydrocarbons

- Four Parts
  - Exhaust HC% * IWF * RF +
  - Evap HC% * IWF * RF +
  - CO% * IWF *RF +
  - Permeation% * IWF * RF
- Evap HC - Hot Soak, Diurnal, Resting Loss, and Running Loss

Predictive Model – Weighting Factors

- Staff will change how the emission categories are weighted.
- Each hydrocarbon emissions category will be weighted based on the entire fleet rather than just Tech 3,4, and 5.

Statistics Subgroup

- Group proposed that Auto/Oil #17 and #18 vehicles in Tech 5 be moved back to Tech 4
- Averaging repeats question been posed to David Rocke
- Group is now evaluate alternative methods to construct the Tech 5 offset model.
- Evaluating a set of CO equations to be used in the hydrocarbon model
  - Methodologies will be the same as HC model

Reactivity
2003 Update to MIR Values

- 23 existing VOCs for which new MIR values differed by 5% or greater
- 102 new VOCs added to the list
- While average reactivity is changing, the relative difference is still close
- New reactivities are available through Predictive Model webpage.
- Average reactivity calculations based on Total Organic Gases (TOG)

Relative Reactivity

- Staff is working with MSOD to gain access to speciated data from in-use testing program database and special studies
- Database contains information on species for exhaust, diurnal, and hot soak tests
- Running loss could be modeled similar to the ethanol multimedia assessment
  - Running loss could be modeled as liquid leaks and headspace vapors

Preliminary Draft Starting Place Model

Predictive Model Fuel Property Response

2010 Statewide, Ozone Forming Potential

All Gasoline Vehicles

	On-Road				Offroad
	TOG			CO	TOG
CY	Exh	Evap	Perm Incr.	Exh	Perm Incr.
Emissions (tpd)	388	365	28	5942	34
MIR	3.35	2.21	3.47	0.07	3.47
Ozone (tpd)	1301	806	99	416	118
Ozone (% Tot)	47.5	29.4	3.6	15.2	4.3

EMFAC 2007 Working Draft, CA 8-Hr O3 Temp. Profile and Rel. Humidity

Statewide, Ozone Forming Potential

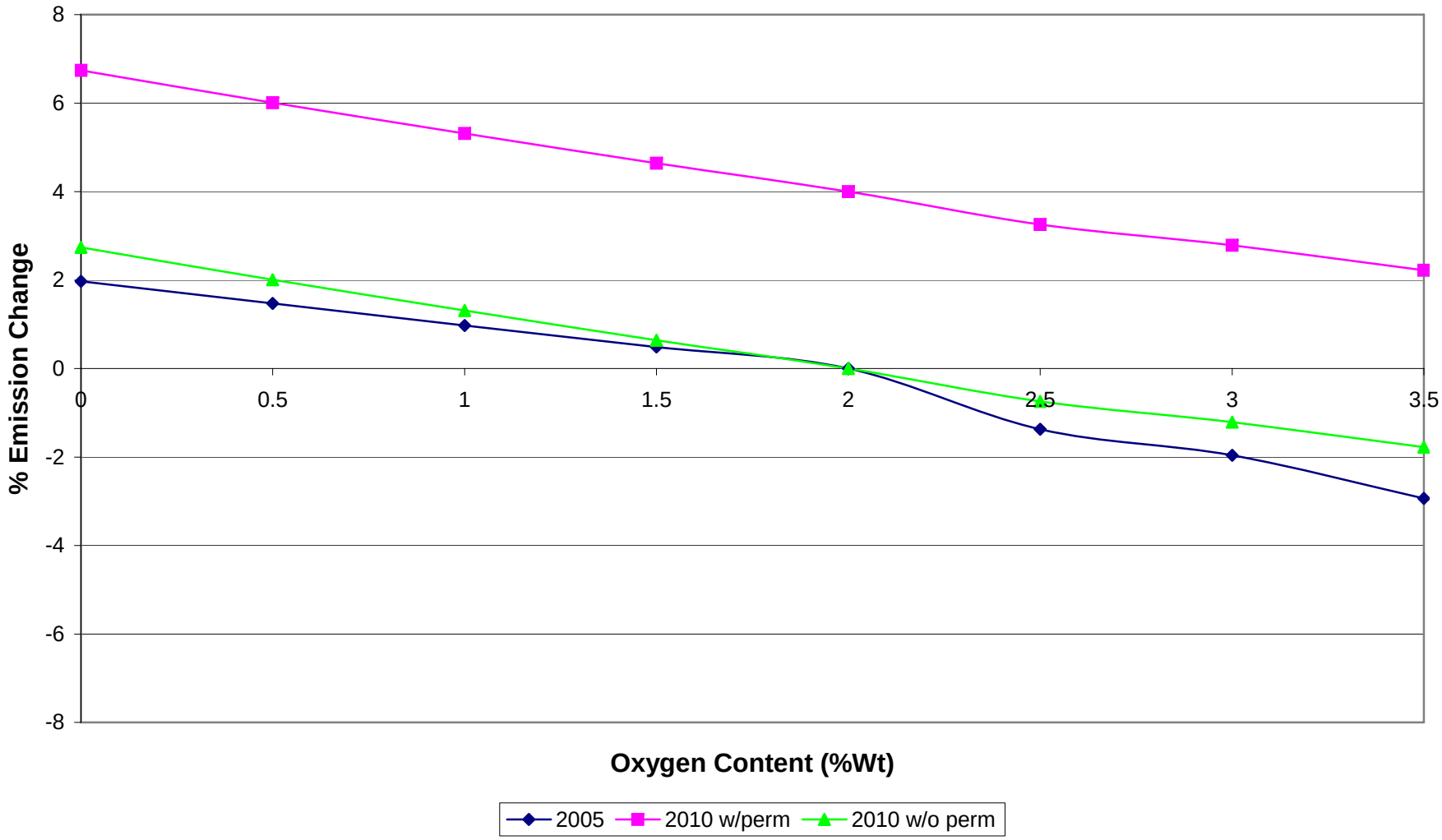
All Gasoline Vehicles (tpd)

	On-Road					Offroad	Total
	TOG			CO		TOG	
CY	Exh	Evap	Perm Incr.	Exh	% Perm of Total On-Road	Perm Incr.	% Perm of Total
2010	1301	806	99	416	3.8%	118	7.9%
2015	729	679	67	288	3.8%	109	9.4%
2020	495	583	48	204	3.6%	110	11.0%

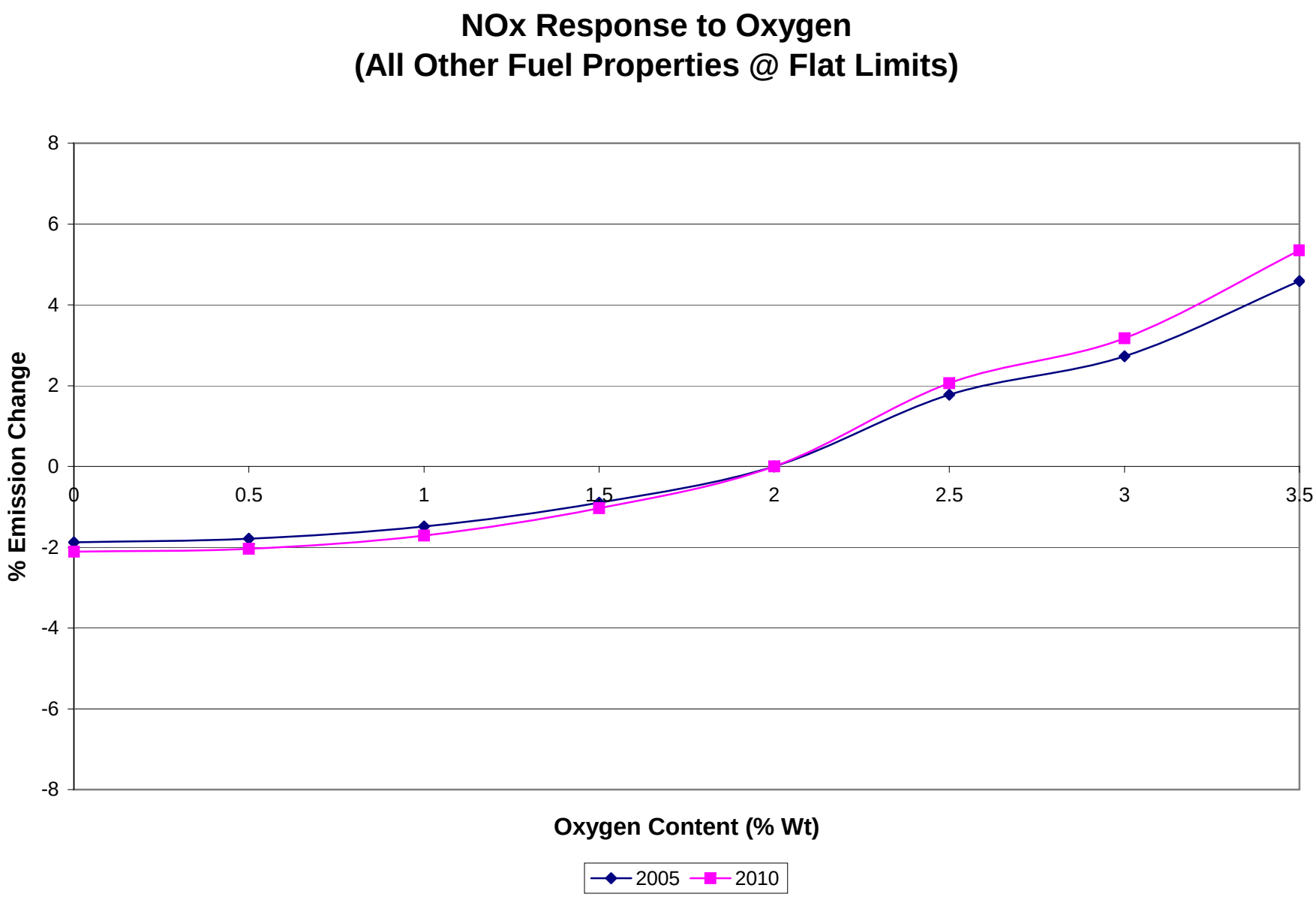
Preliminary Draft Starting Place Model

- Use new data
- Auto/Oil 17 and 18 in Tech 4
- Averaged Repeats
- Forward stepwise based on significance level
- Unsupported first order terms removed
- No RVP interaction terms
- Reactivities are same as with current Predictive Model, except permeation
- Use new inventory weights

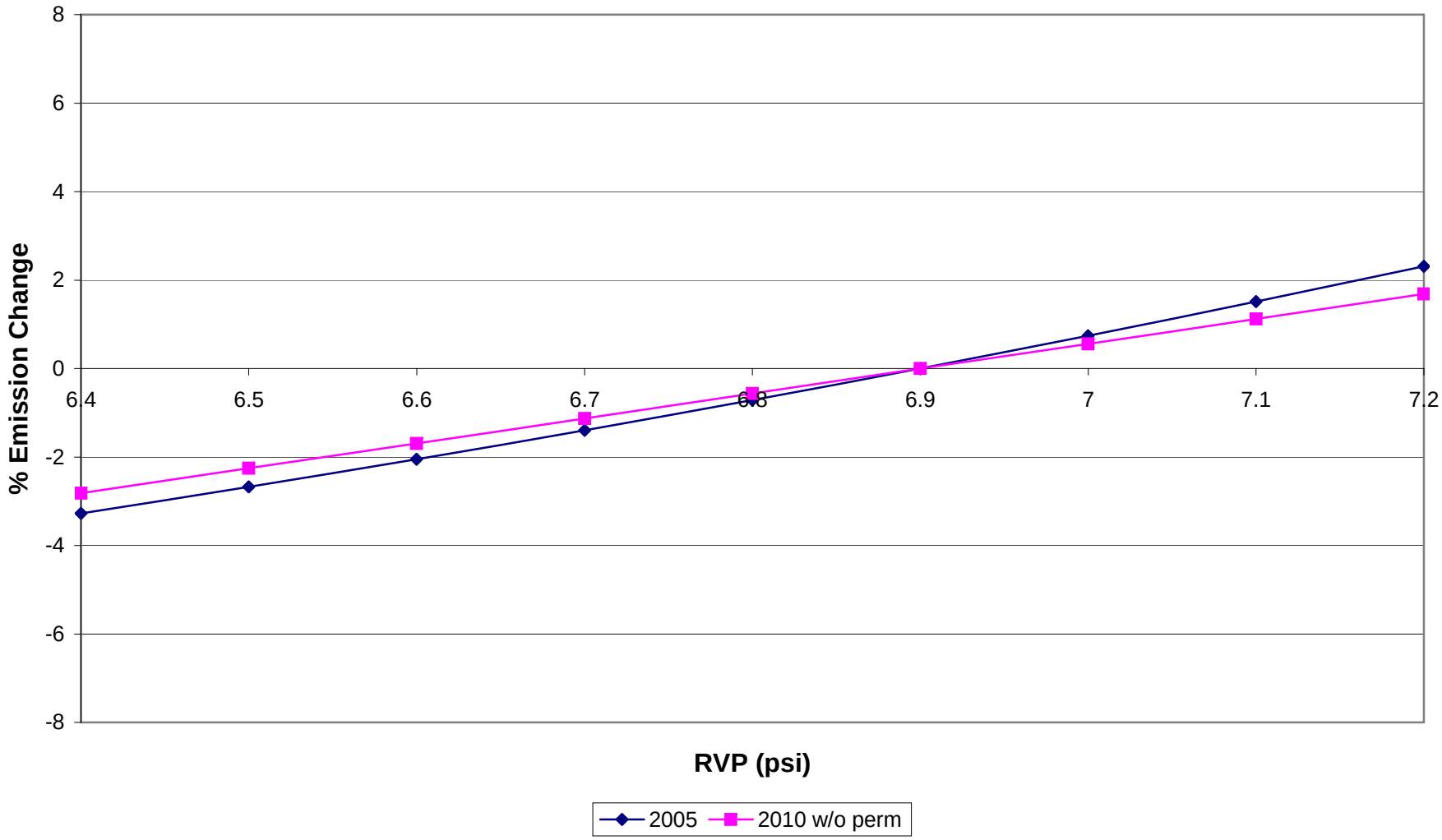
Ozone Forming Potential Response to Oxygen
(All Other Fuel Properties @ Flat Limits)

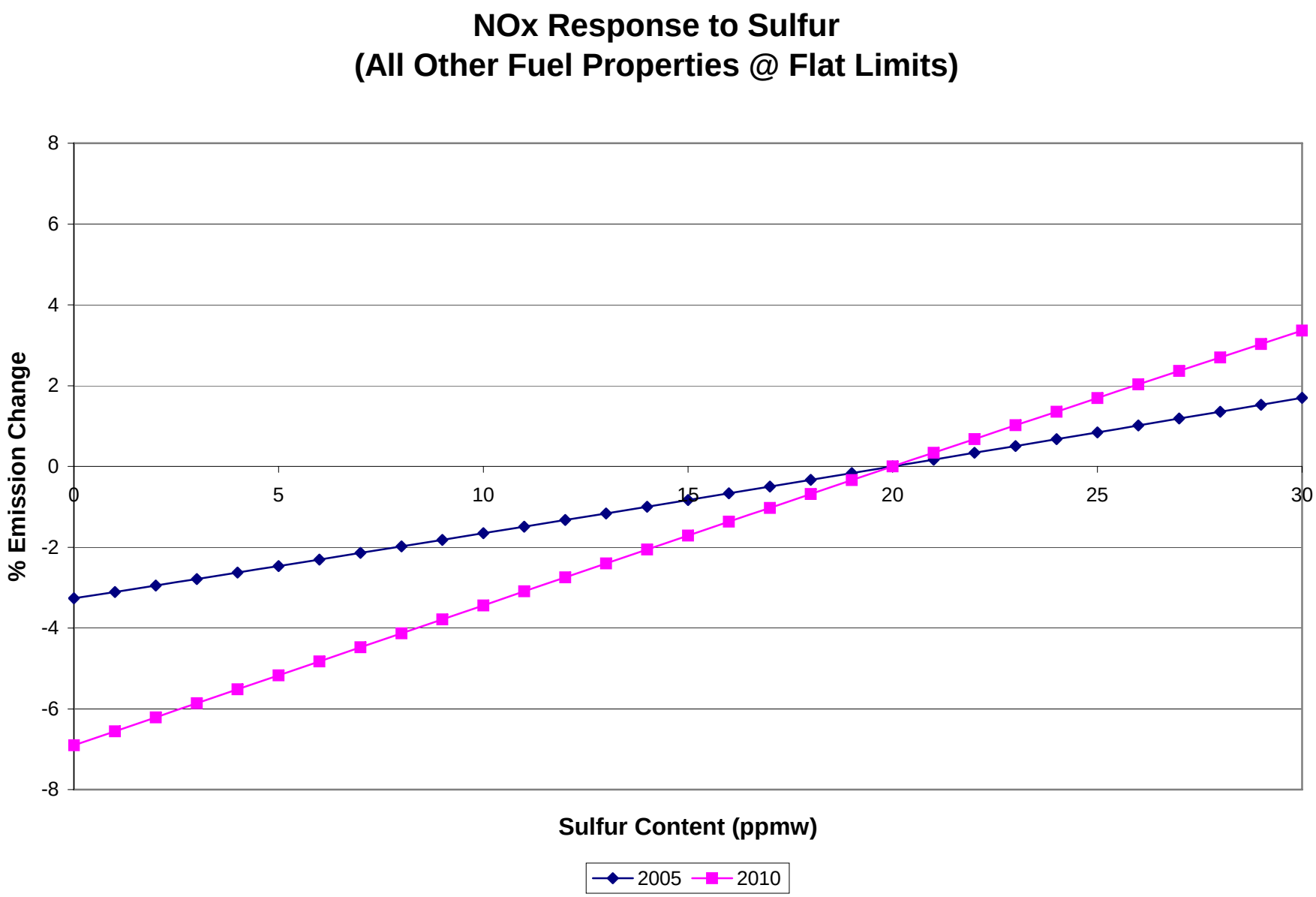


Gasoline

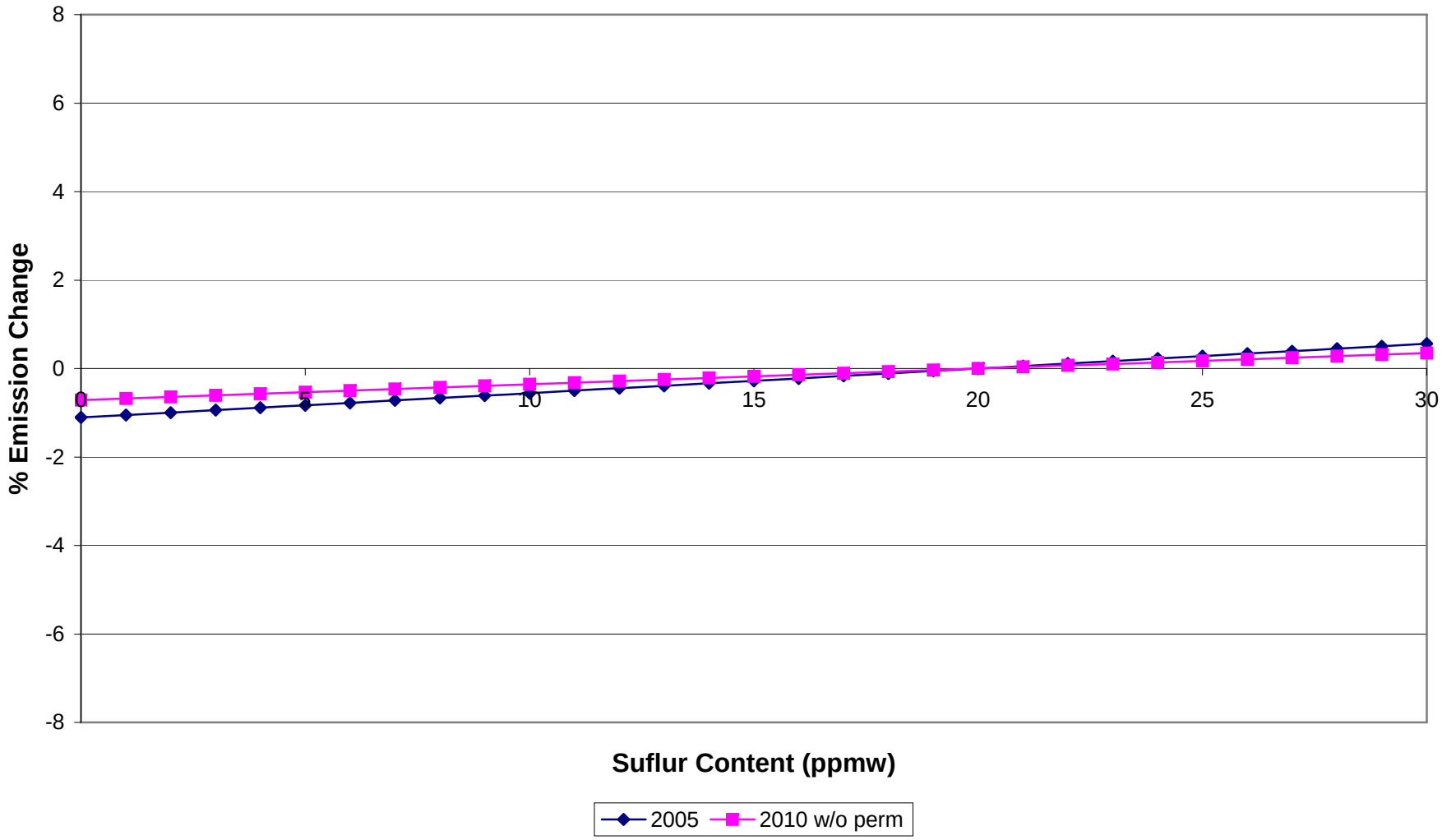

NOx Response to Oxygen
(All Other Fuel Properties @ Flat Limits)
% Emission Change
8
6
4
2
0
-2
-4
-6
-8
0
0.5
1
1.5
2
2.5
3
3.5
Oxygen Content (% Wt)
2005
2010

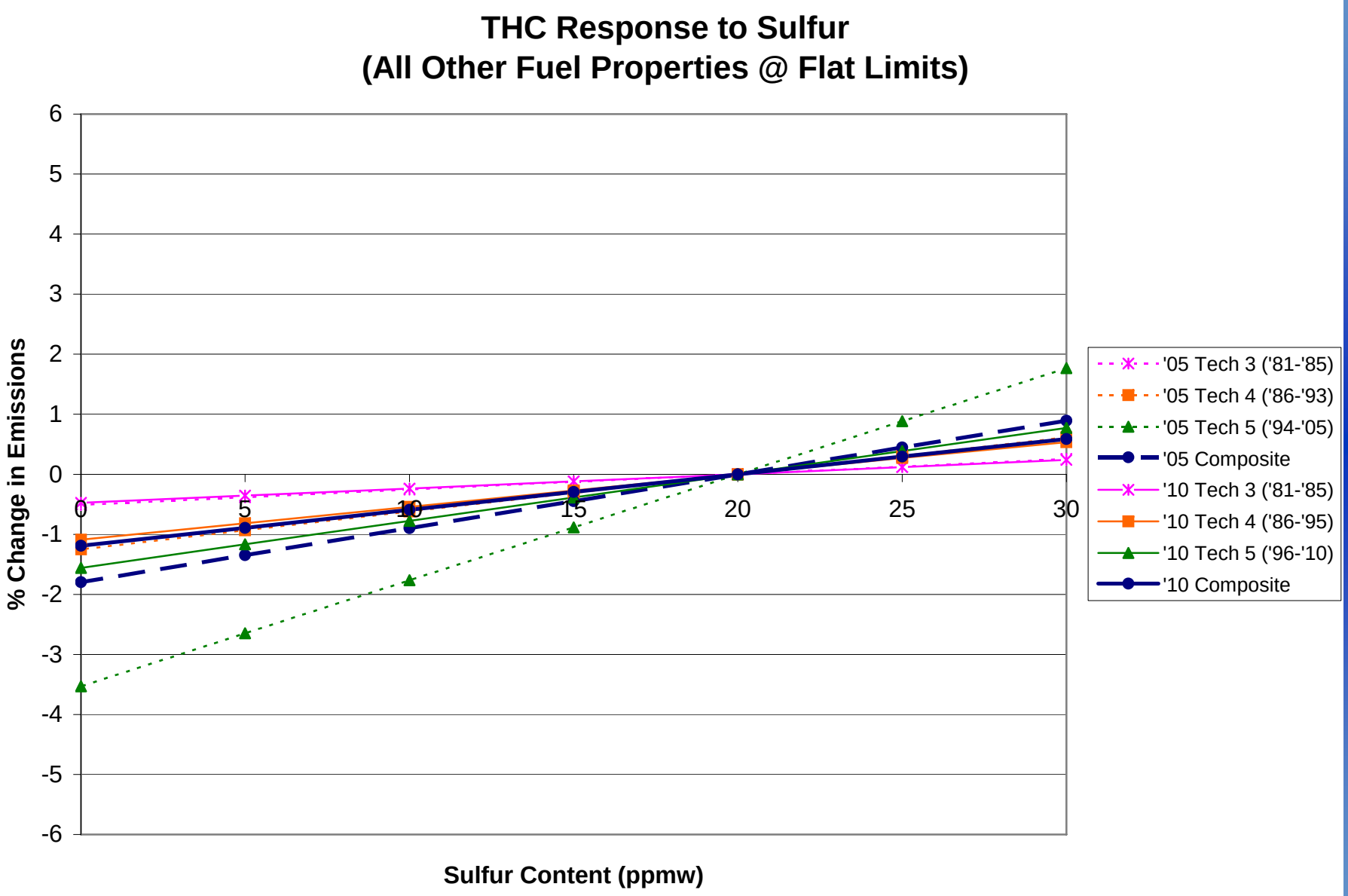
Ozone Forming Potential Response to RVP
(All Other Fuel Properties @ Flat Limits)

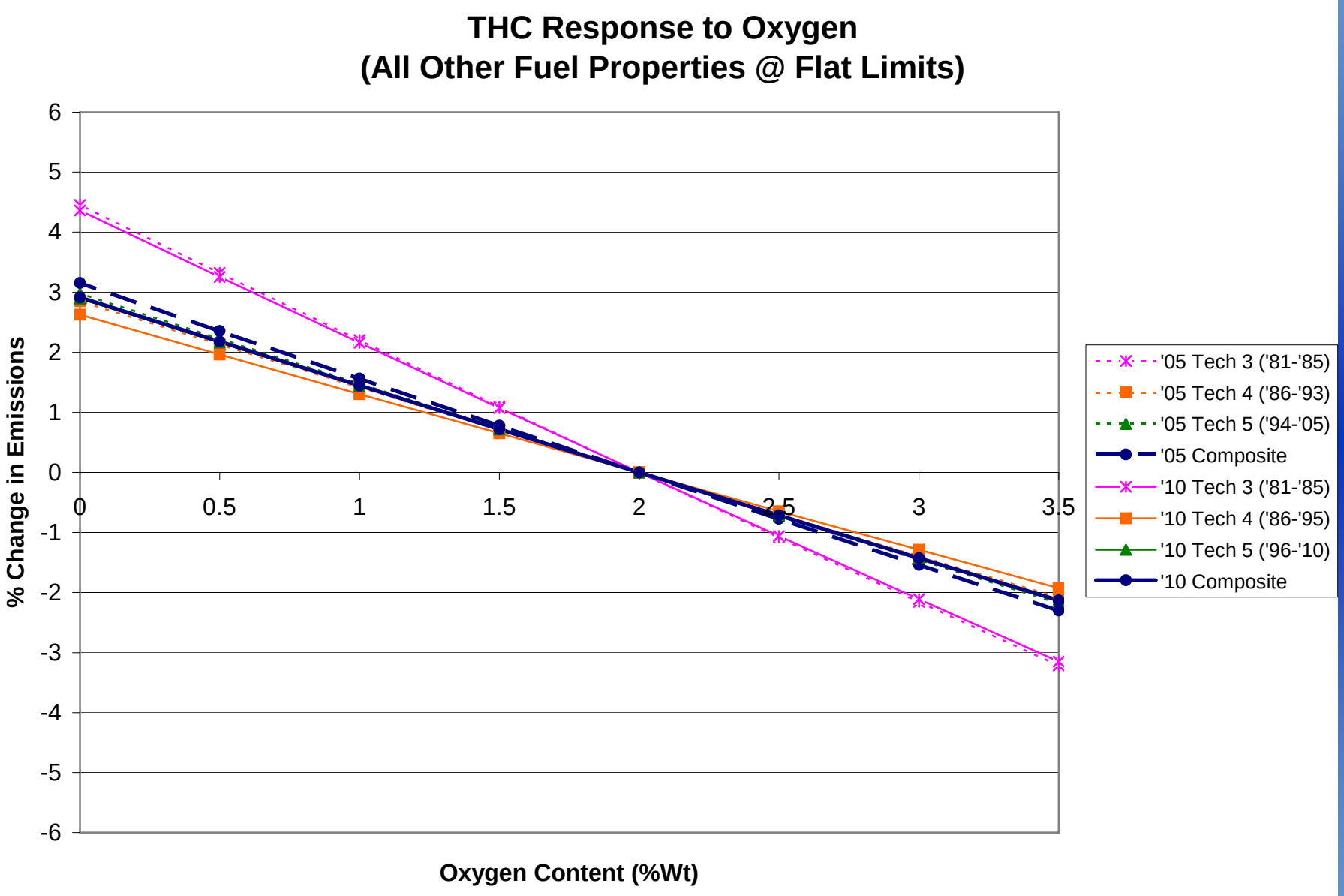



NOx Response to Sulfur
(All Other Fuel Properties @ Flat Limits)
% Emission Change
8
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20
25
30
Sulfur Content (ppmw)
2005
2010

Ozone Forming Potential Response to Sulfur
(All Other Fuel Properties @ Flat Limits)




THC Response to Sulfur
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
5
10
15
20
25
30
Sulfur Content (ppmw)
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


THC Response to Oxygen
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
0.5
1
1.5
2
2.5
3
3.5
Oxygen Content (%Wt)
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite

Emissions Inventory

Emissions Inventory Update

- Documentation available through Reformulated Gasoline Predictive Model webpage at: www.arb.ca.gov/fuels/gasoline/premodel/pmdevelop.htm
- Temperature profile document posted

Permeation - What's Next

- The Permeation Report – Part 2

- Report will be available through Predictive Model webpage and stakeholders will be notified through fuels e-mail list server

New Working SubGroups

- Reactivity SubGroup
  - Dr. Anil Prahbu
  - Dr. Dongmin Lou
  - Dr. Gary Whitten
  - Cynthia Williams
  - Rory Macarther
  - Paul Wuebben
  - Steve Brisby
- First conference call being set

New Working SubGroups

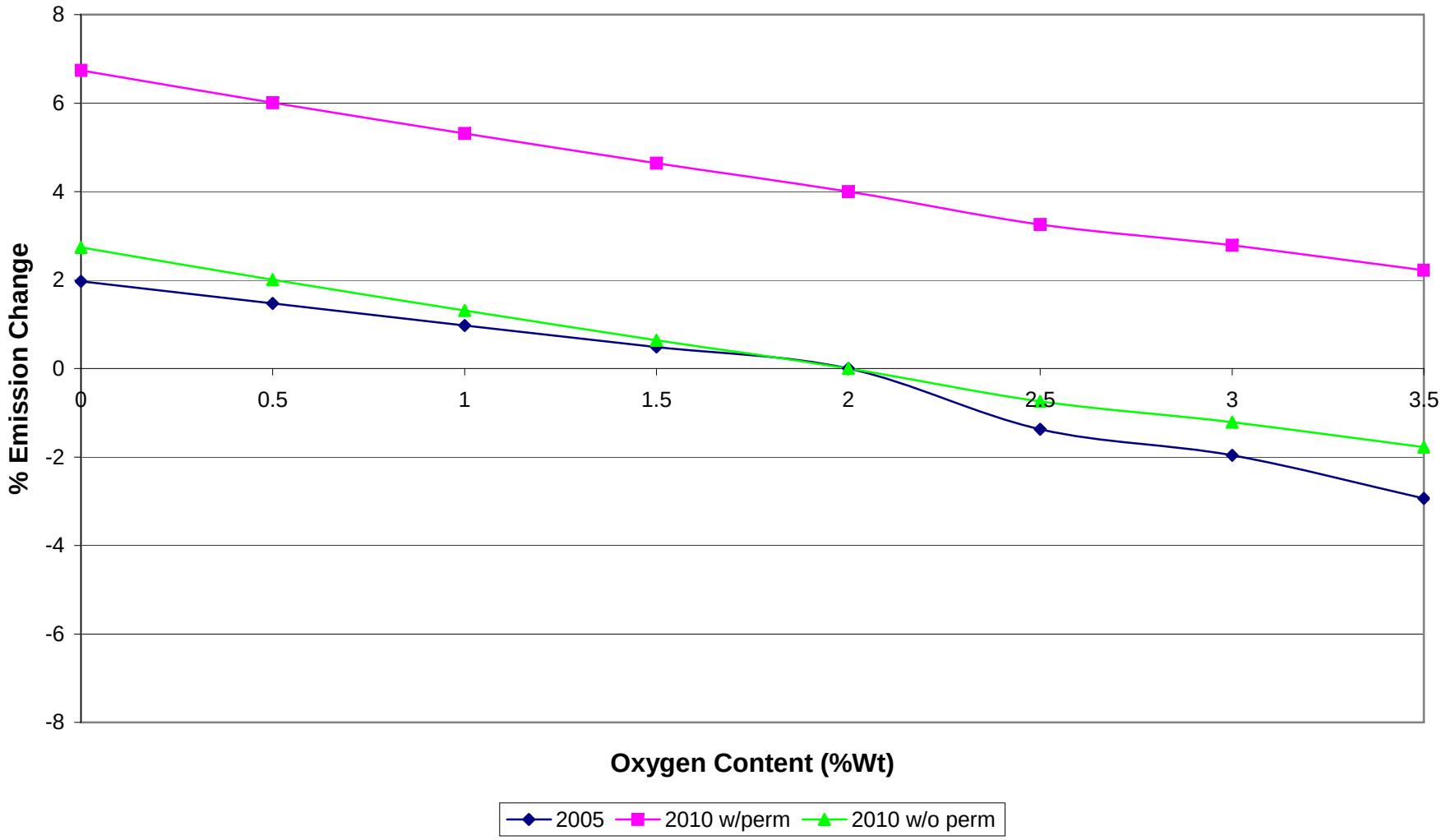
- Inventory SubGroup
  - Ben Handcock
  - Tom Darlington
  - James Uihlein
  - Gary Herwick
  - Steve Brisby
  - Paul Wuebben
- First conference call being set

Presentations by Others

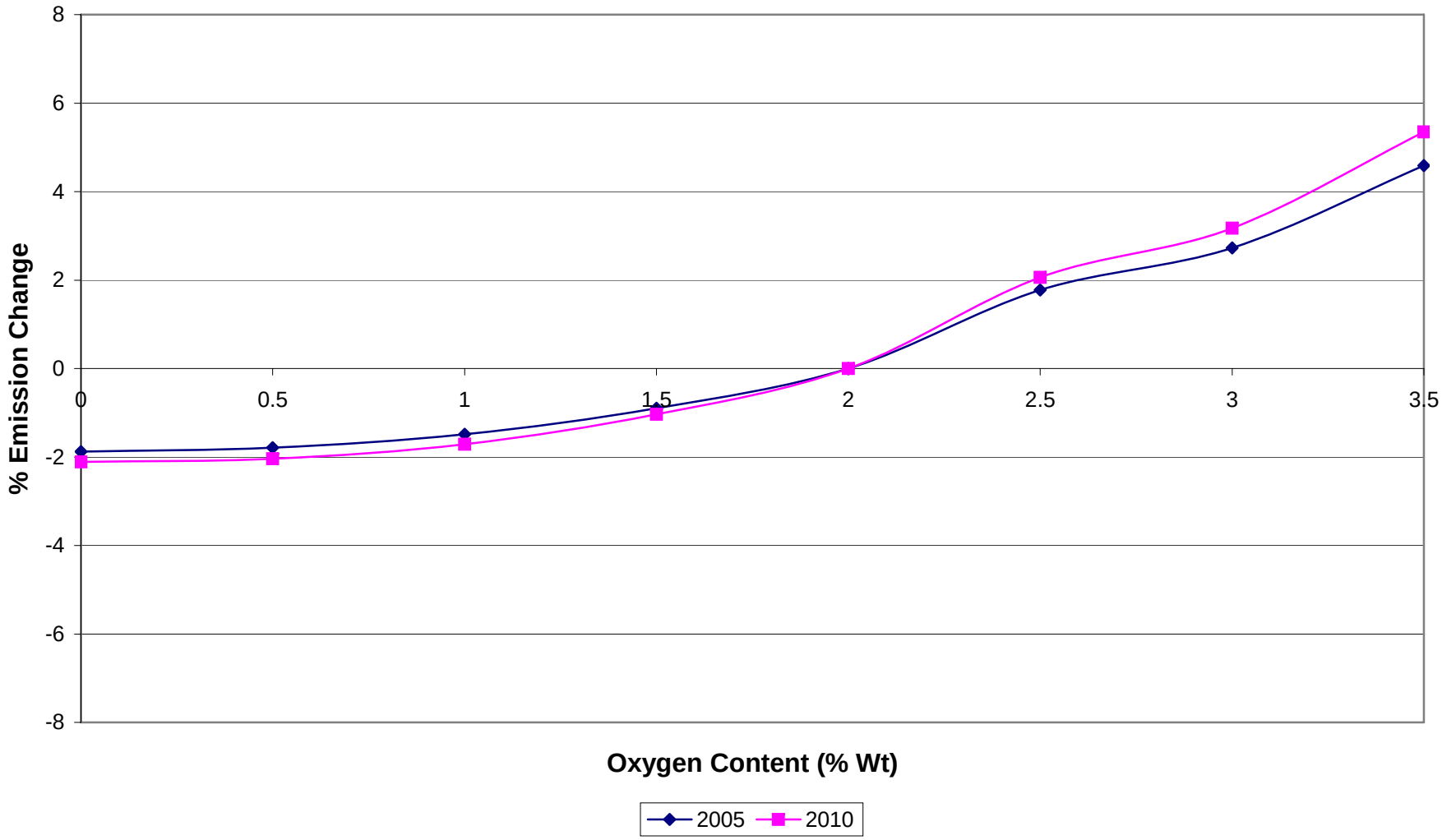
Open Discussions

Closing Remarks

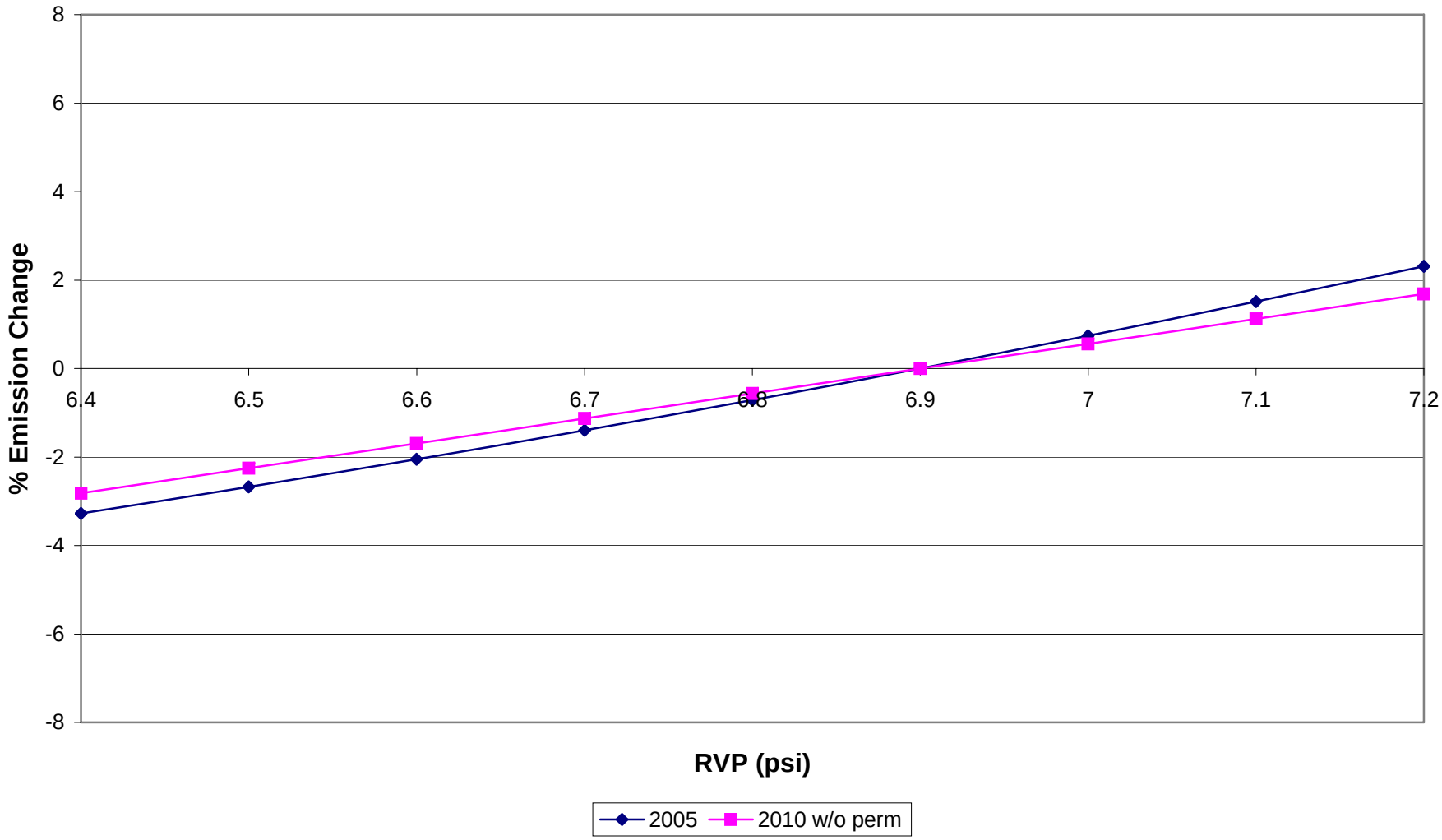
Ozone Forming Potential Response to Oxygen
(All Other Fuel Properties @ Flat Limits)



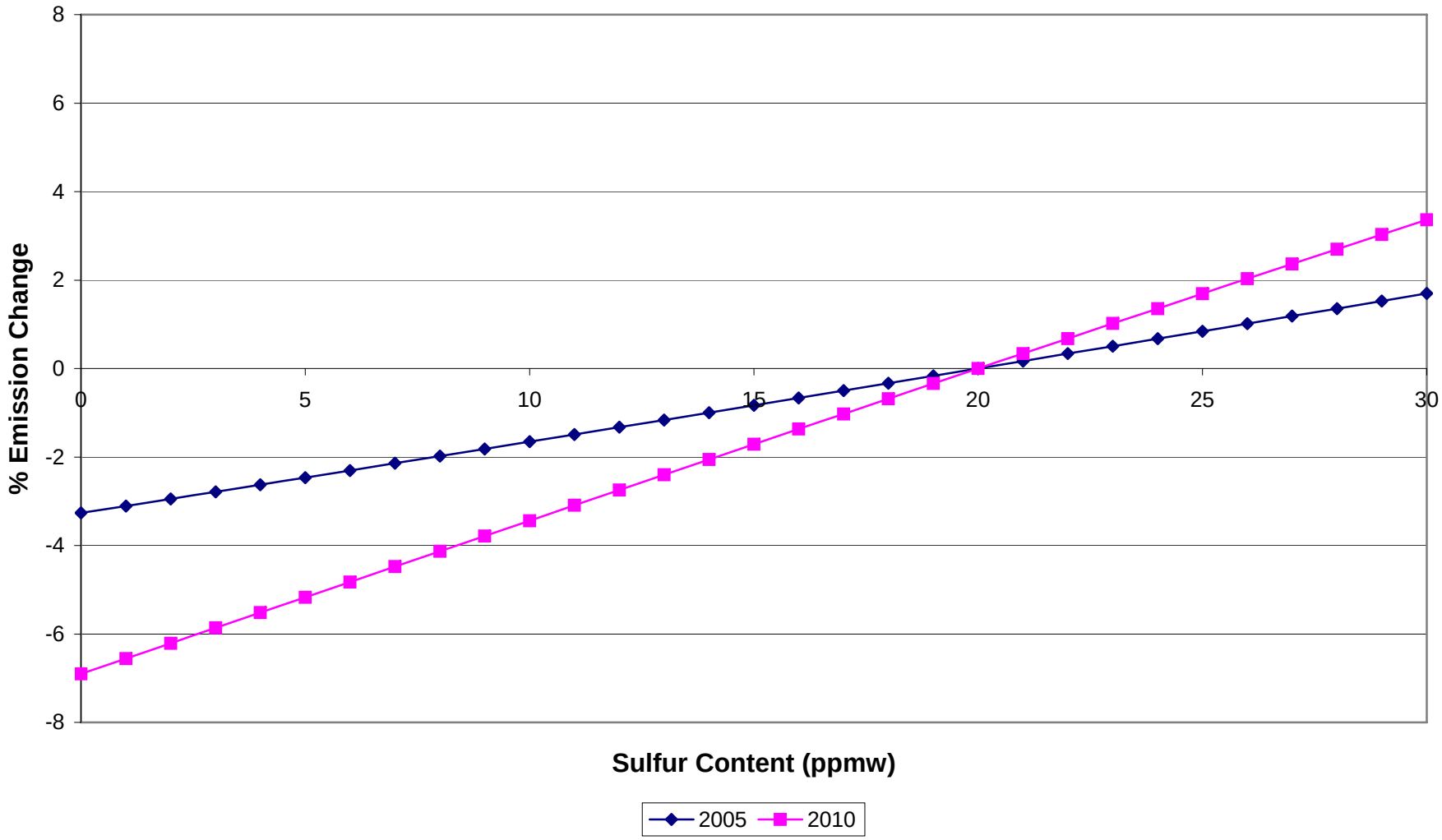
NOx Response to Oxygen
(All Other Fuel Properties @ Flat Limits)



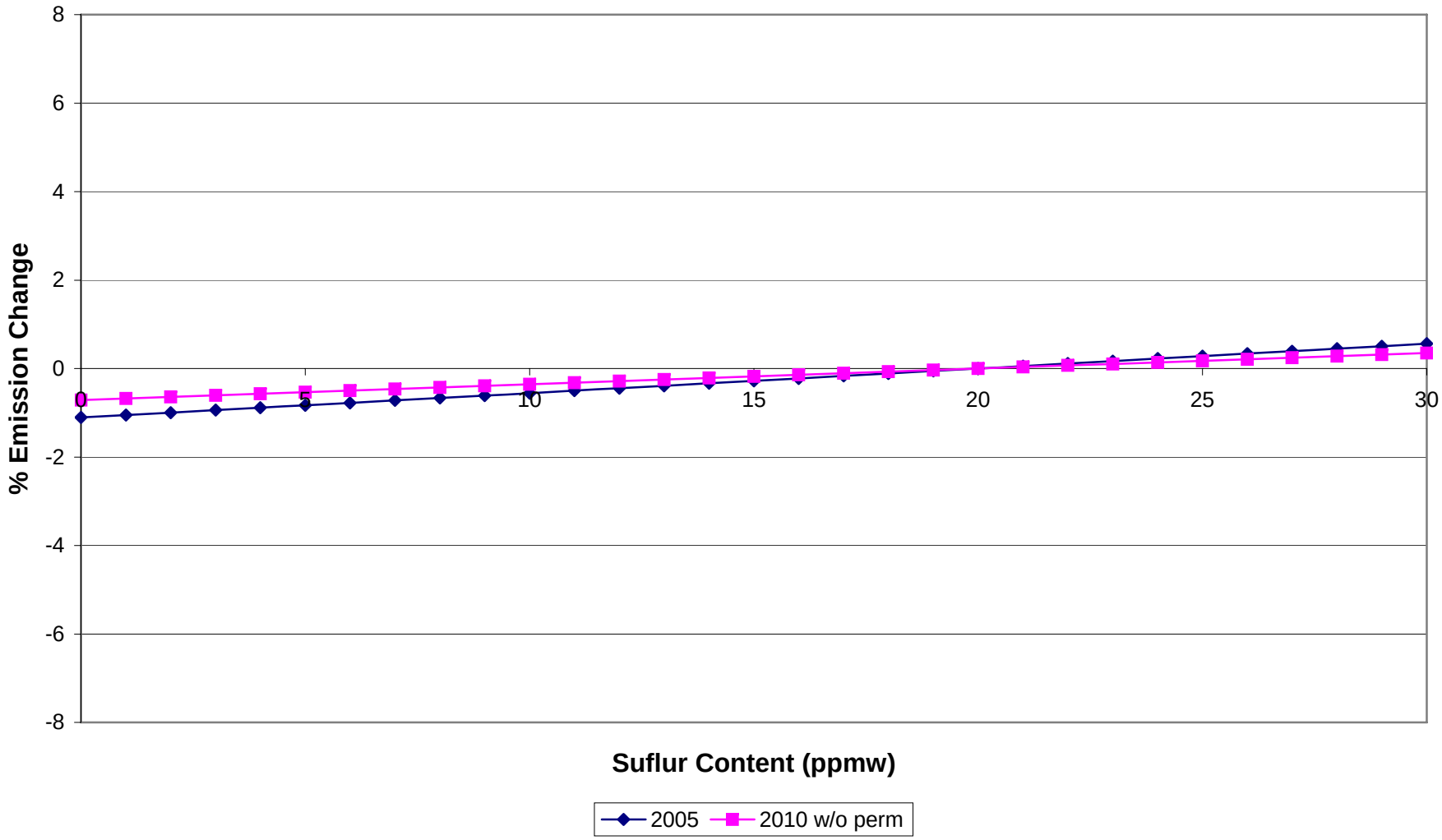
Ozone Forming Potential Response to RVP
(All Other Fuel Properties @ Flat Limits)



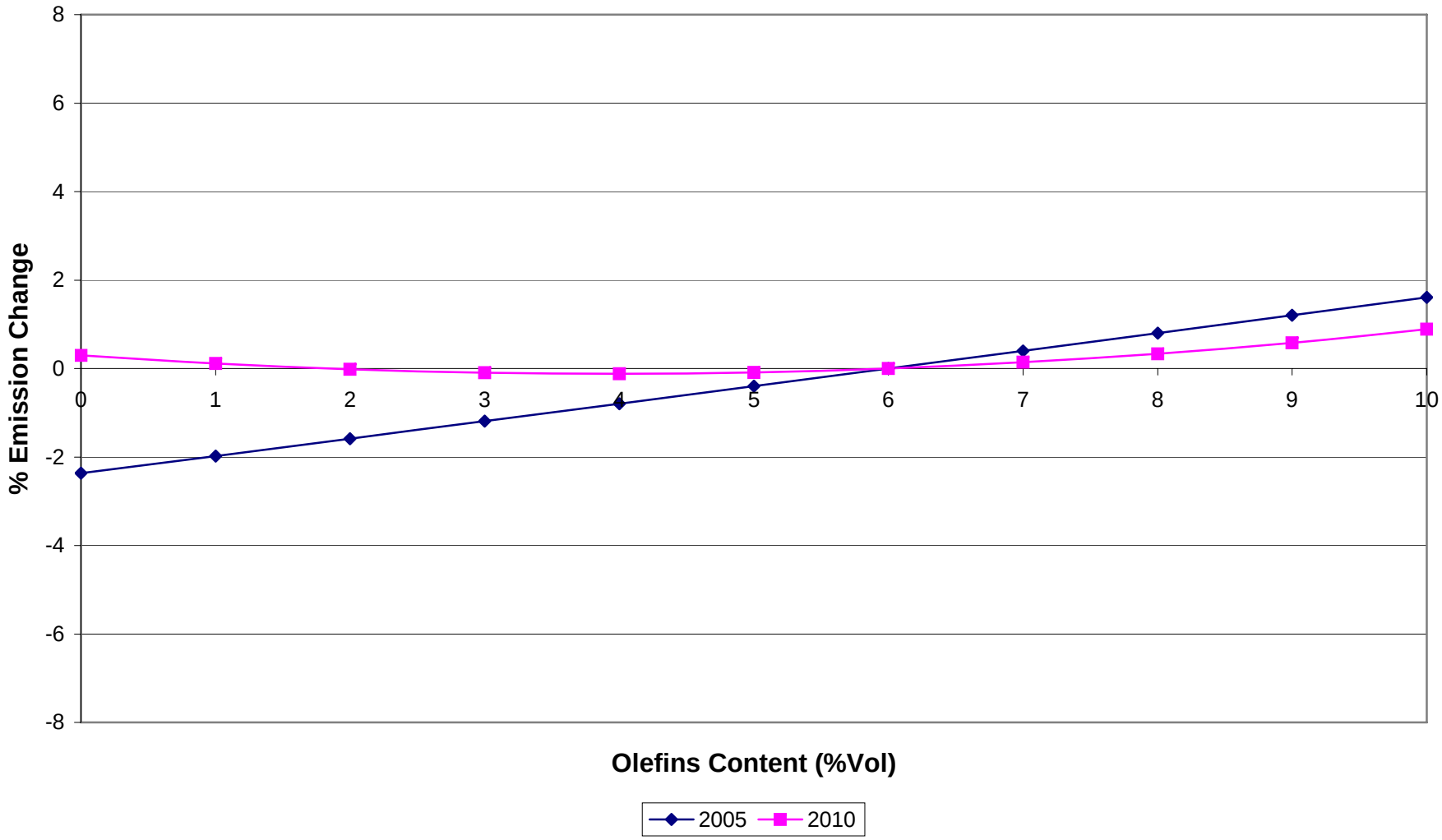
NOx Response to Sulfur
(All Other Fuel Properties @ Flat Limits)



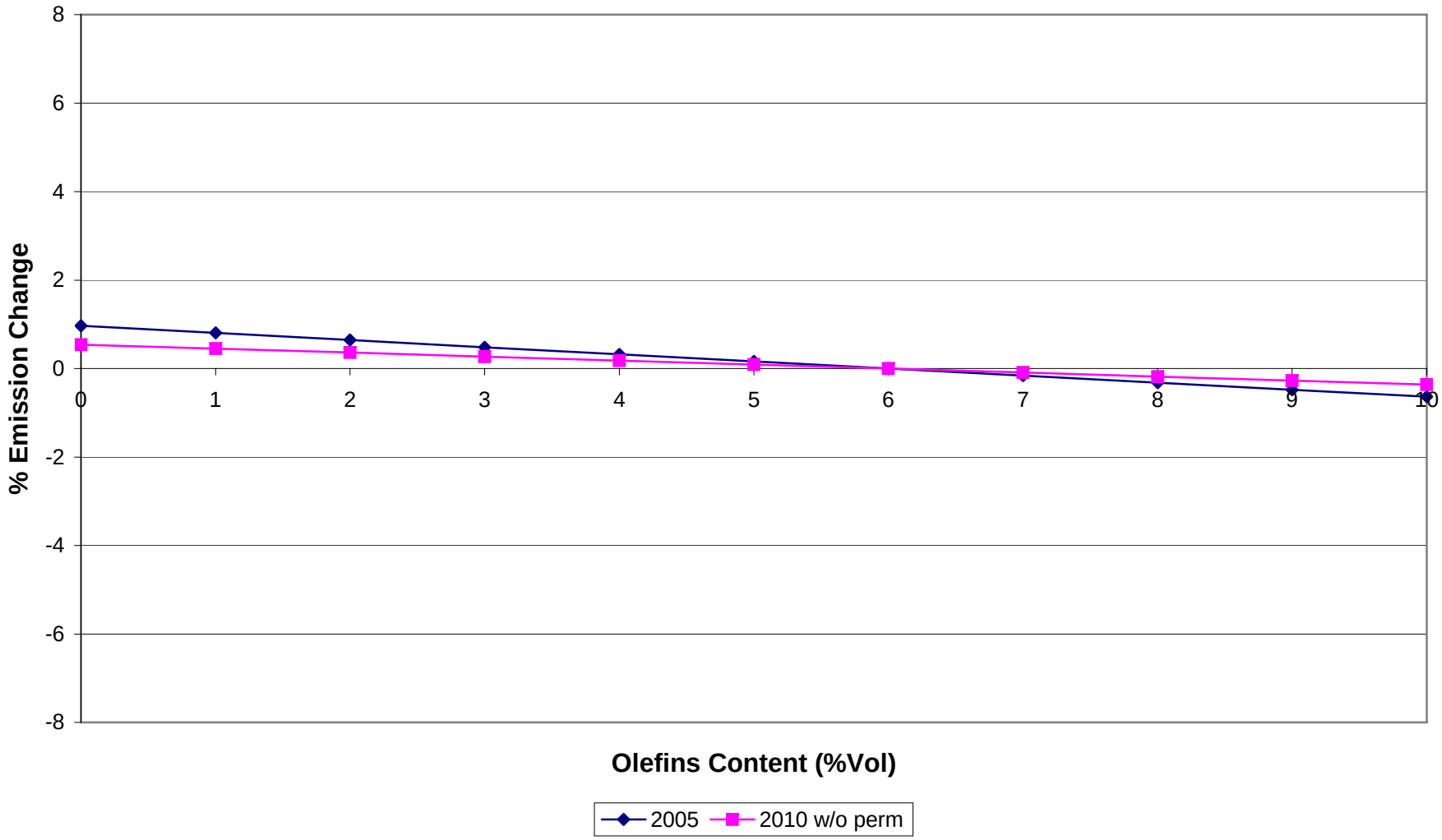
Ozone Forming Potential Response to Sulfur
(All Other Fuel Properties @ Flat Limits)



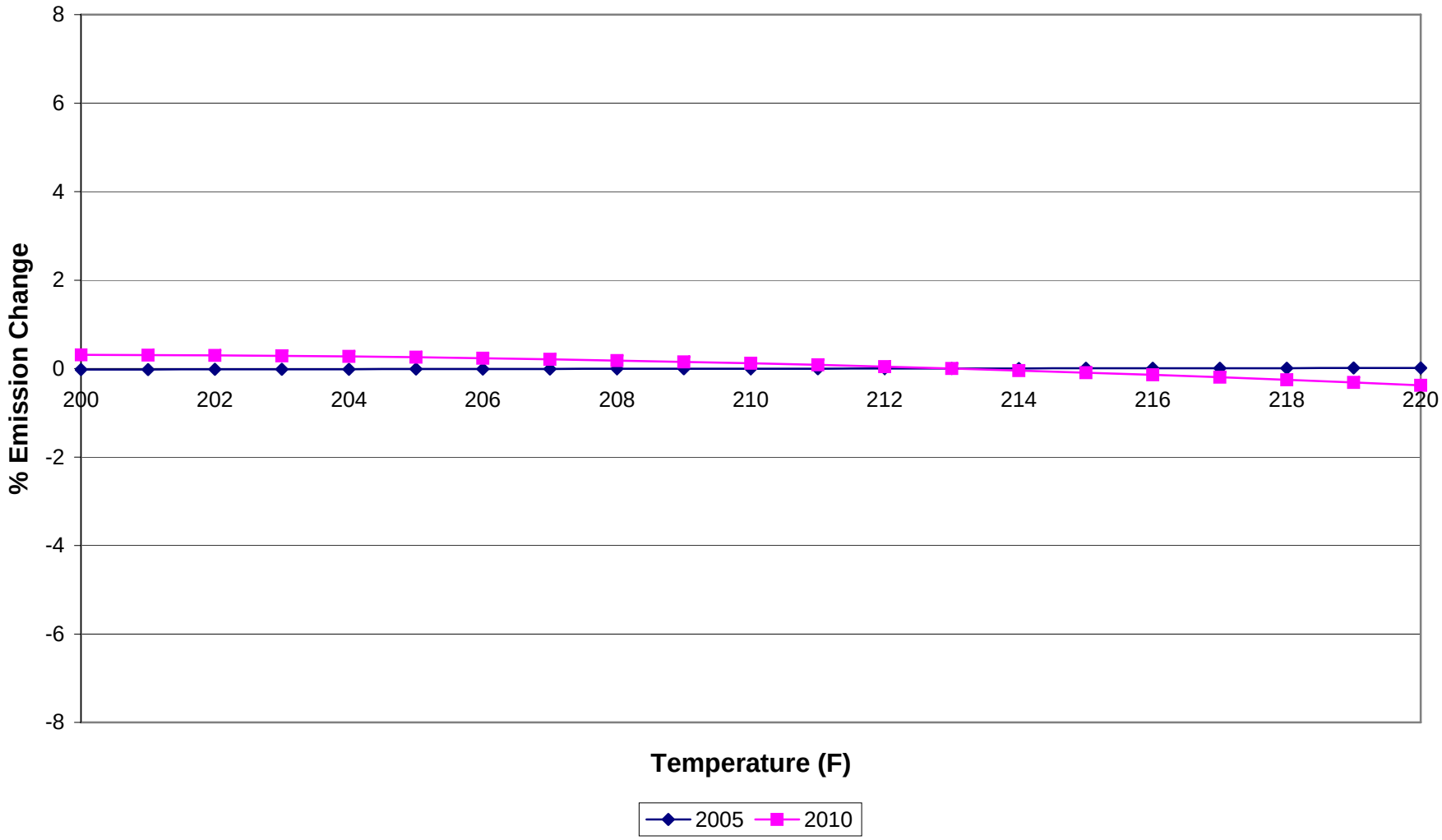
NOx Response to Olefins
(All Other Fuel Properties @ Flat Limits)



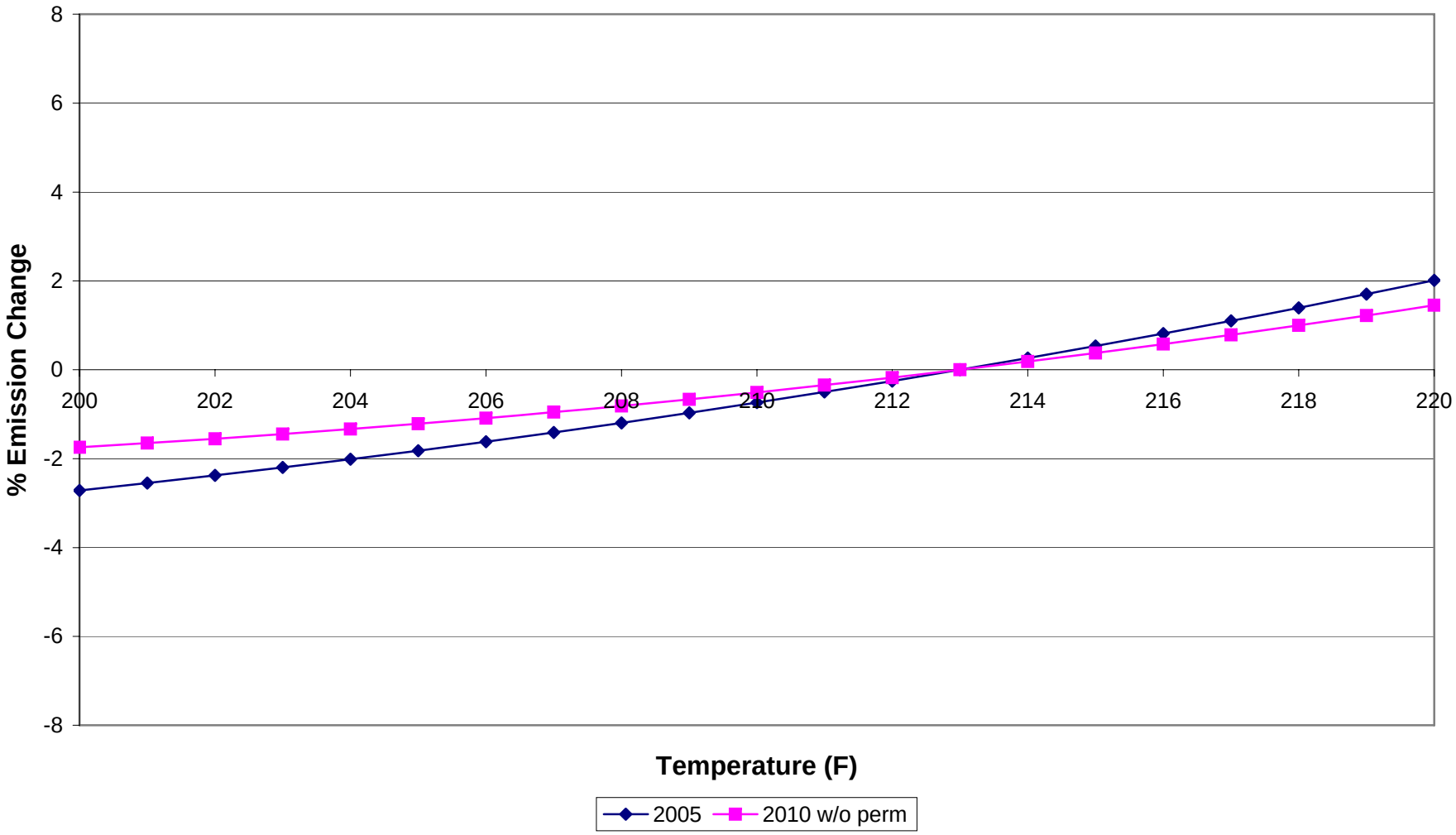
Ozone Forming Potential Response to Olefins
(All Other Fuel Properties @ Flat Limits)



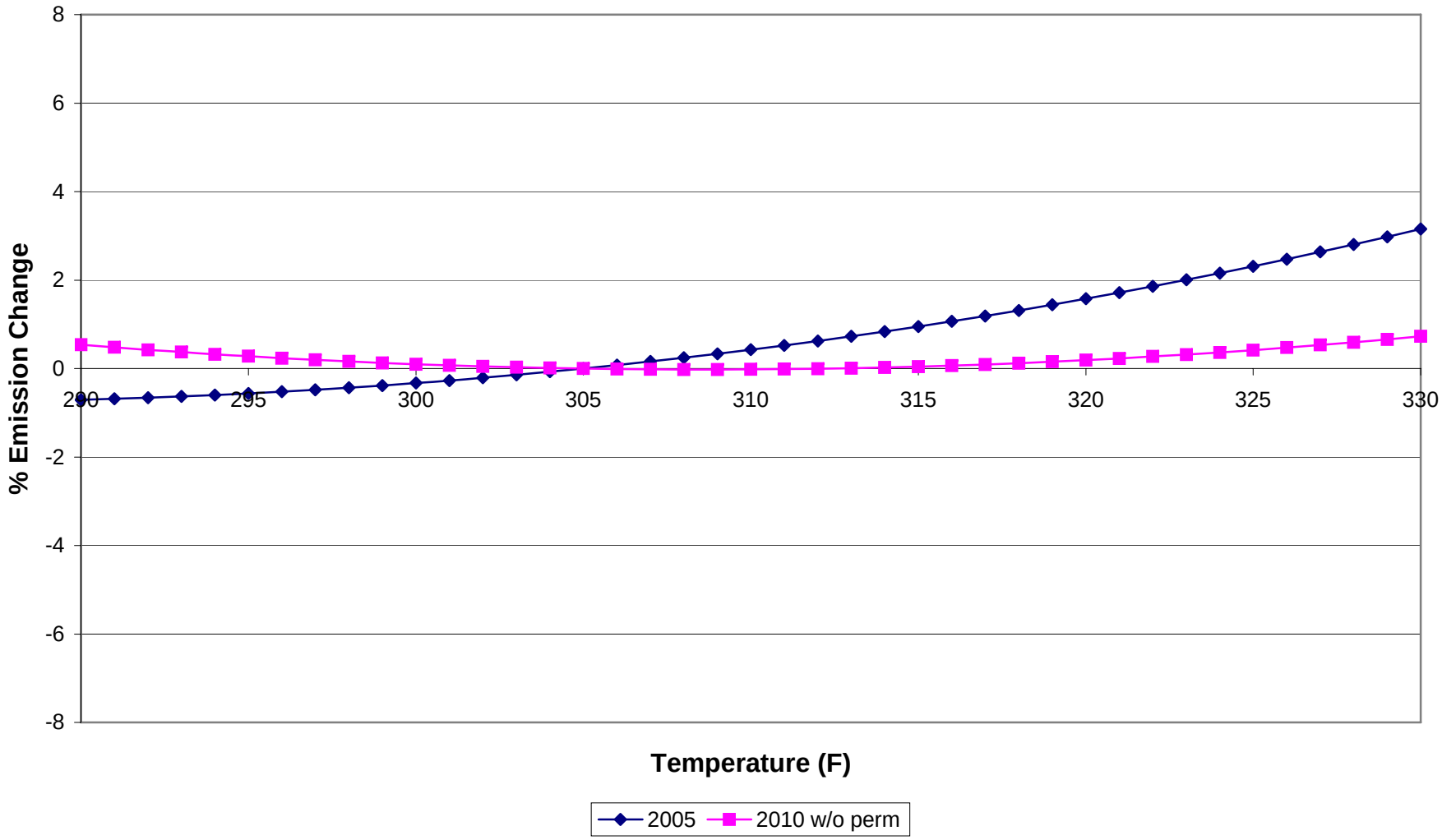
NOx Response to T50
(All Other Fuel Properties @ Flat Limits)



Ozone Forming Potential Resonse to T50
(All Other Fuel Properties @ Flat Limits)

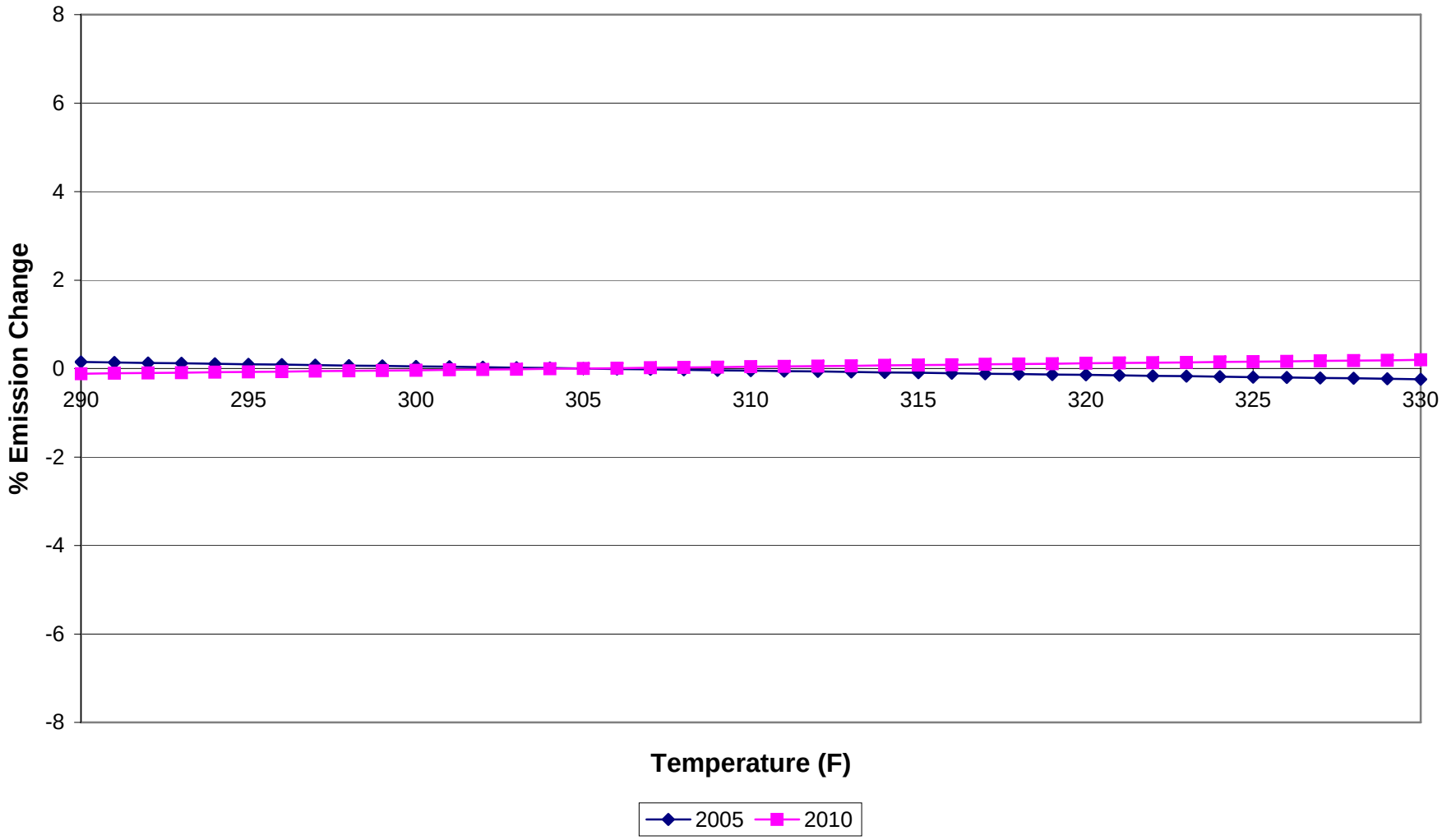


Ozone Forming Potential Response to T90
(All Other Fuel Properties @ Flat Limits)



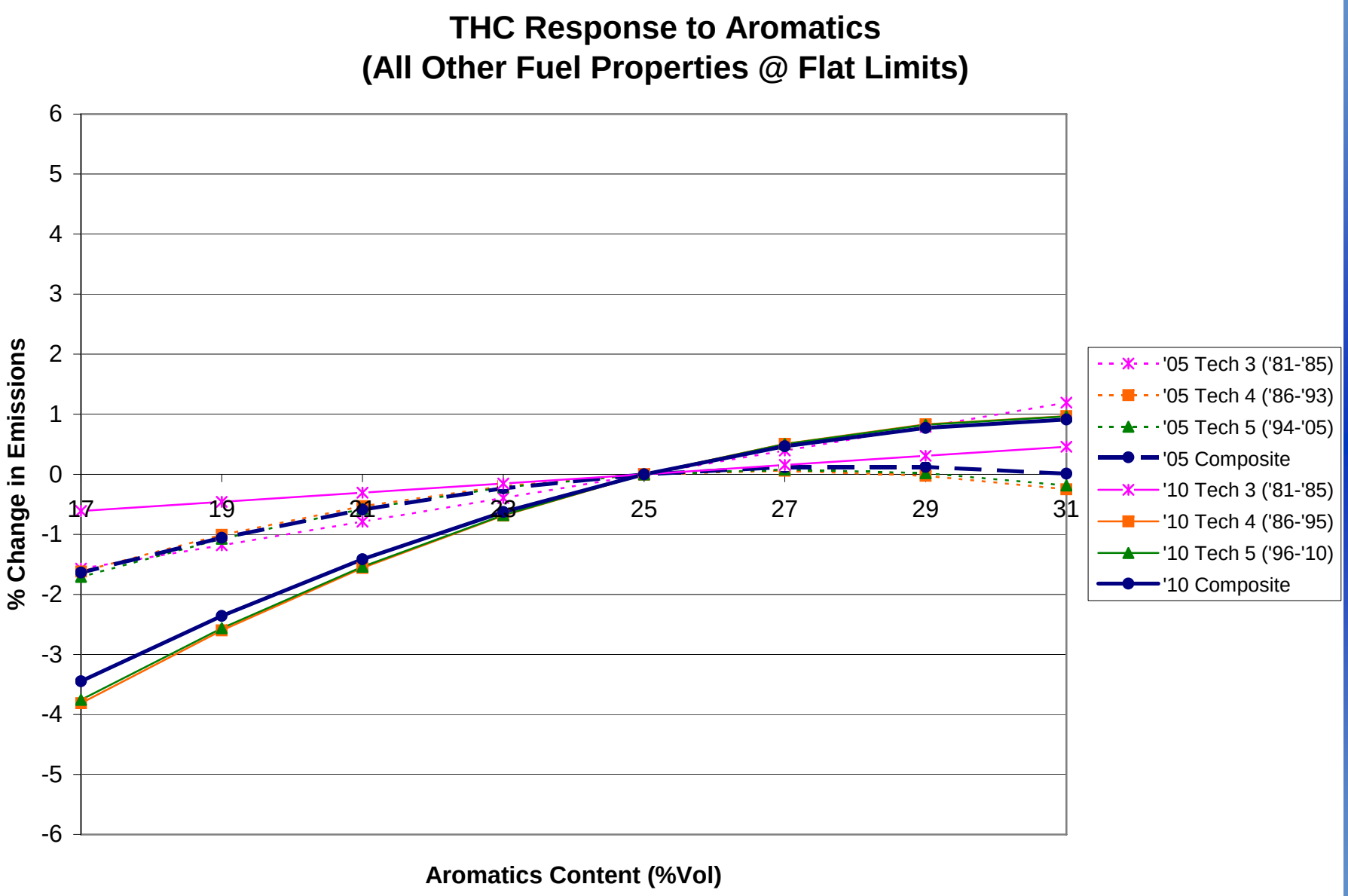
Temperat
ure (F)

NOx Response to T90
(All Other Fuel Properties @ Flat Limits)

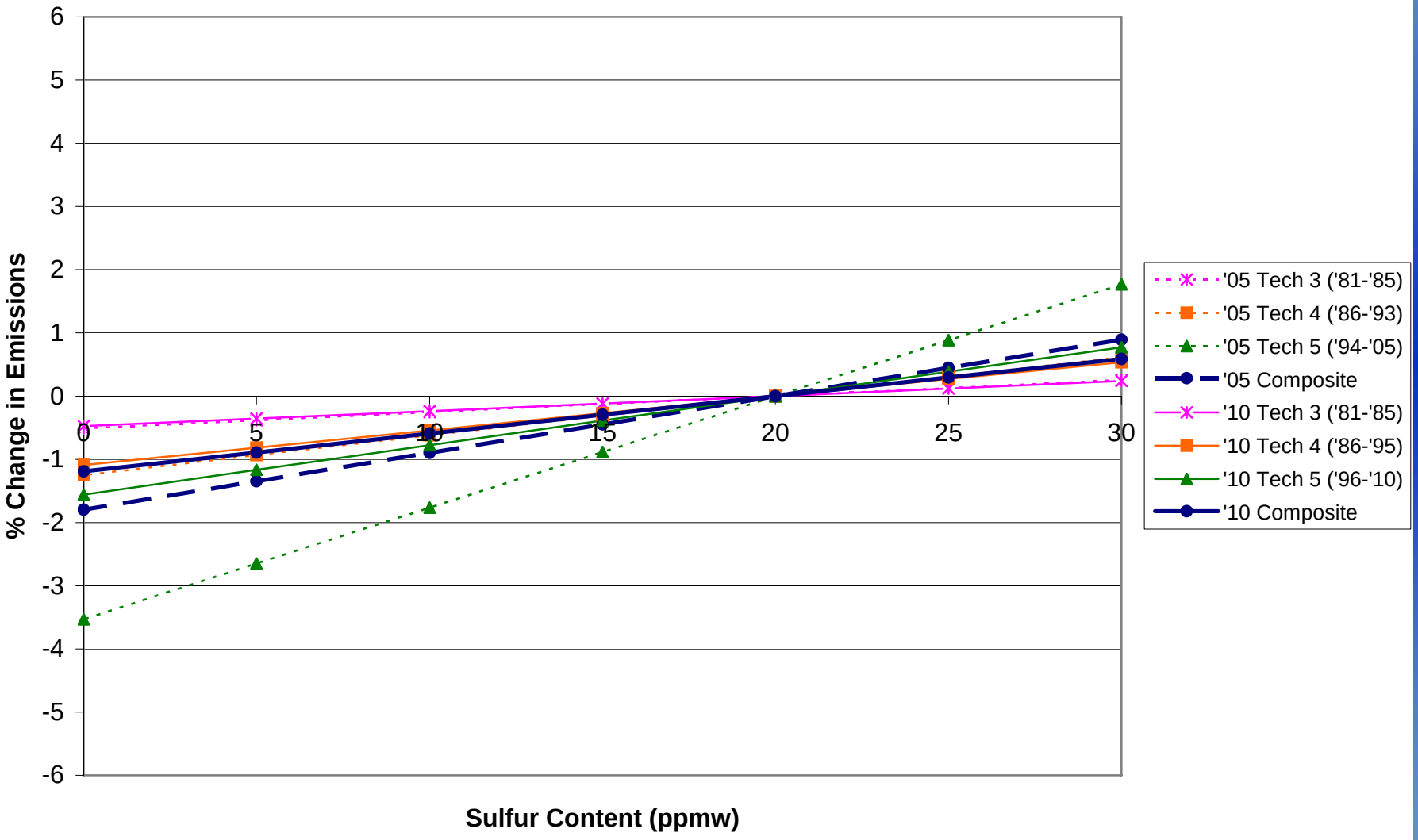


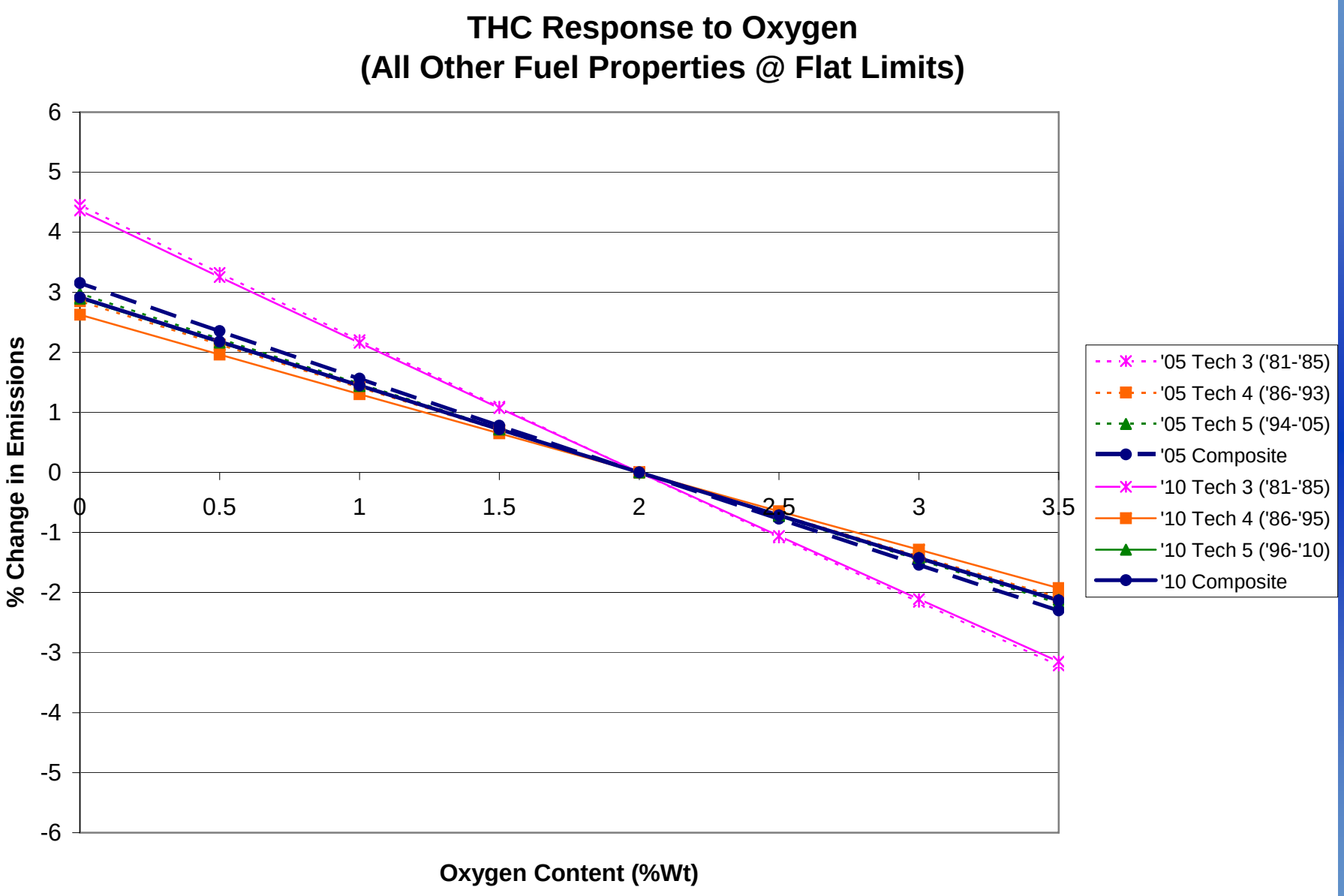
THC

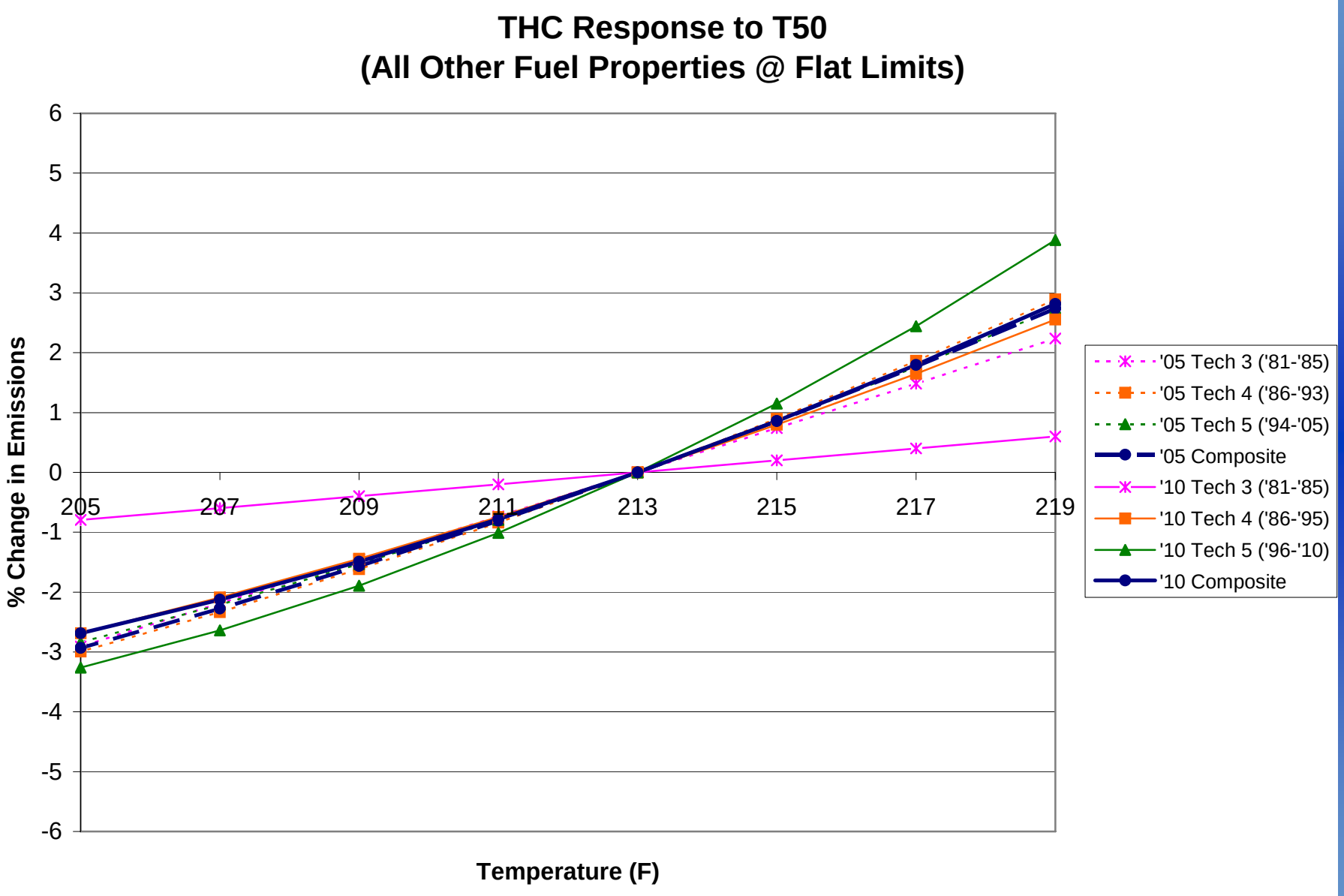
Response to Fuel Property Changes


THC Response to Aromatics
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
17
19
21
23
25
27
29
31
Aromatics Content (%Vol)
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite

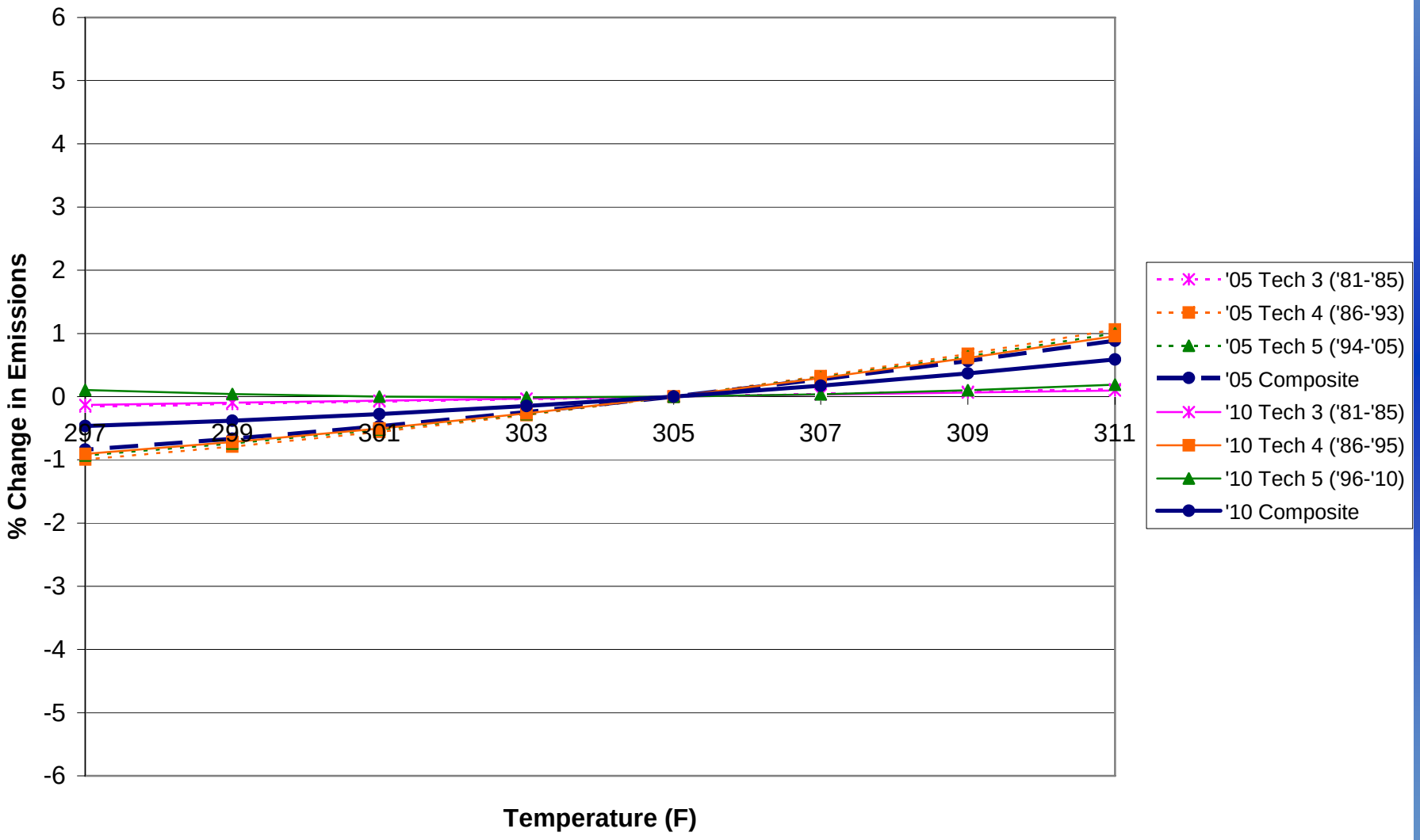
THC Response to Sulfur
(All Other Fuel Properties @ Flat Limits)



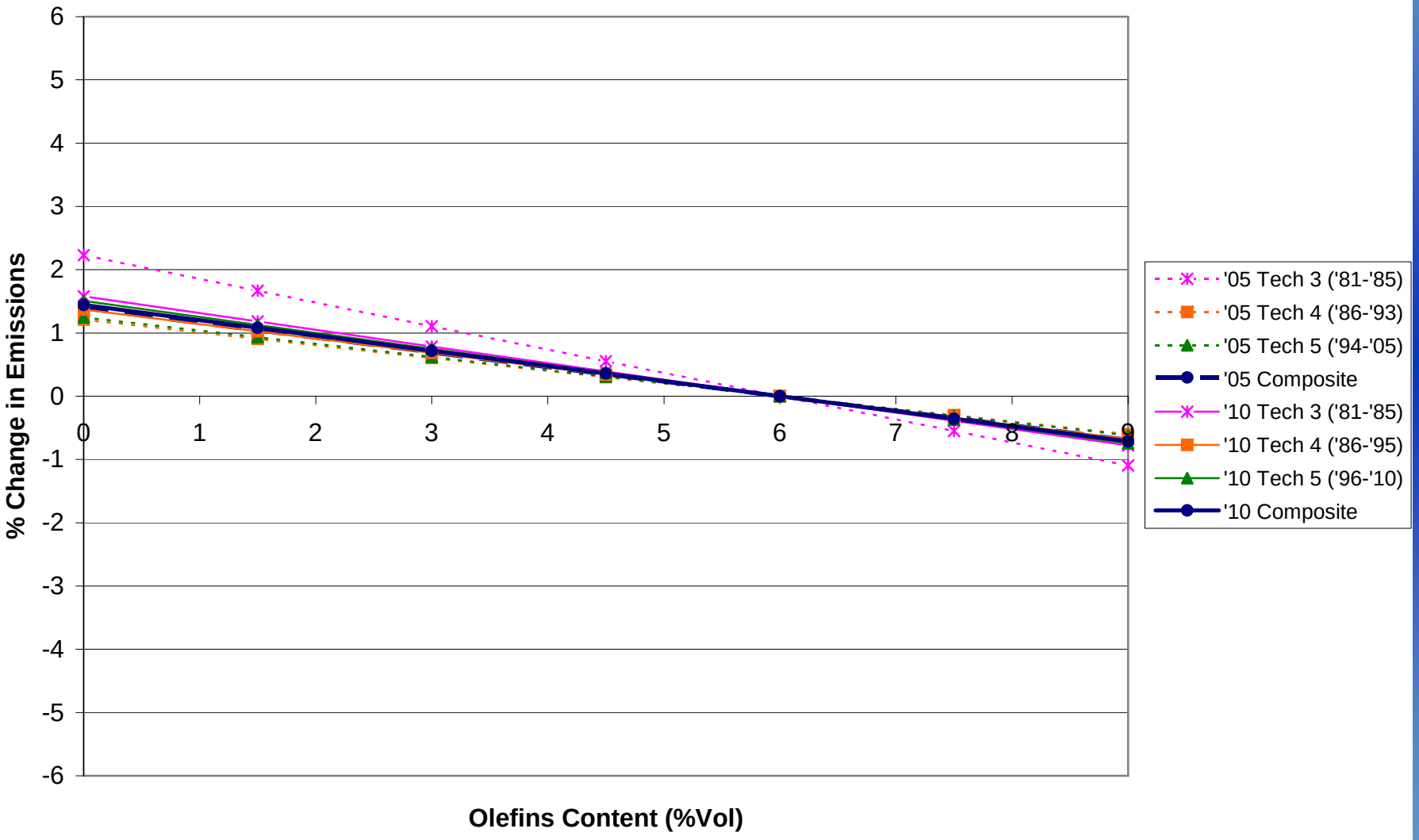

THC Response to Oxygen
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
Oxygen Content (%Wt)
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
0.5
1
1.5
2
2.5
3
3.5
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


THC Response to T50
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
205
207
209
211
213
215
217
219
Temperature (F)
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite

THC Response to T90
(All Other Fuel Properties @ Flat Limits)

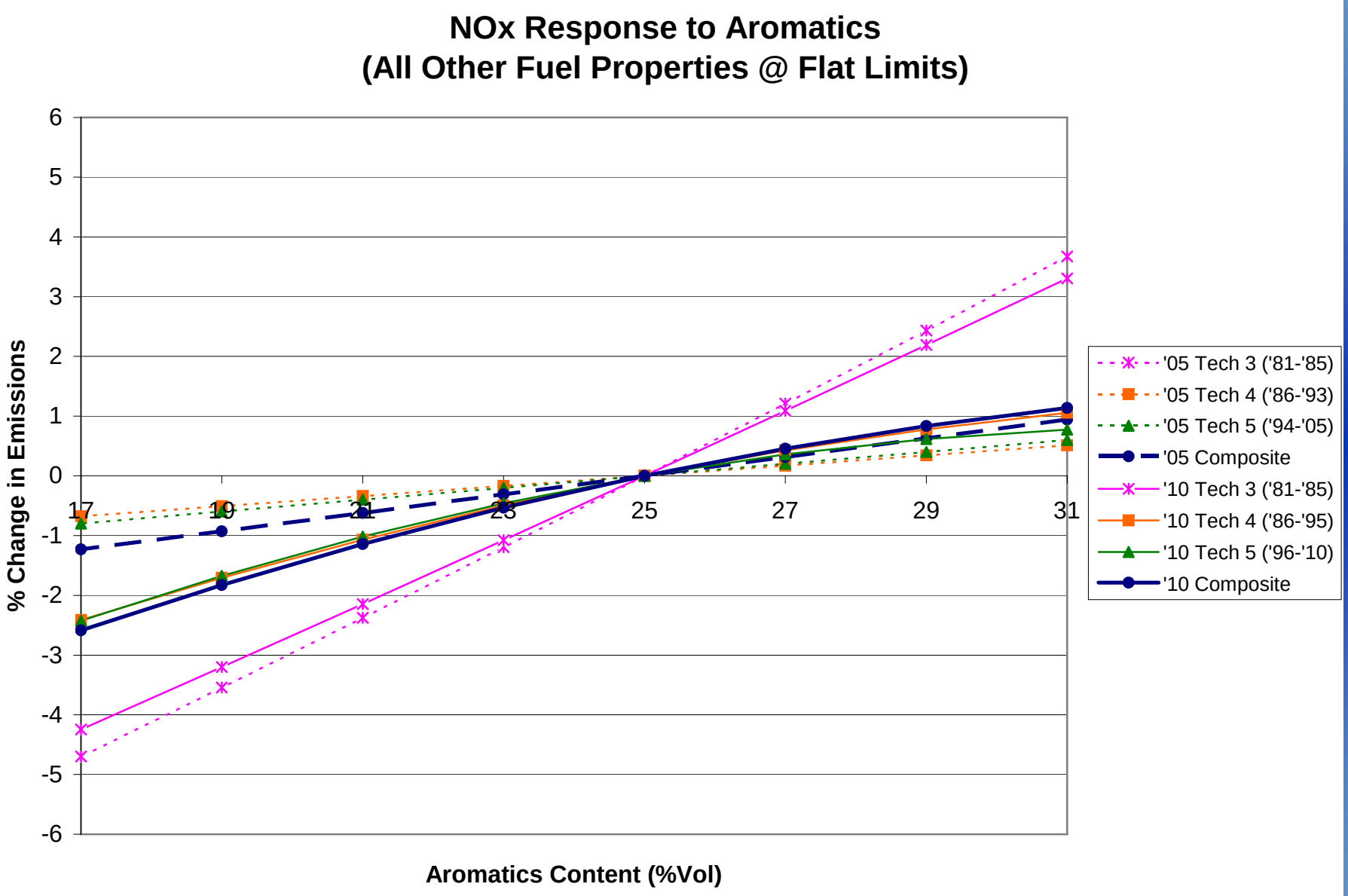


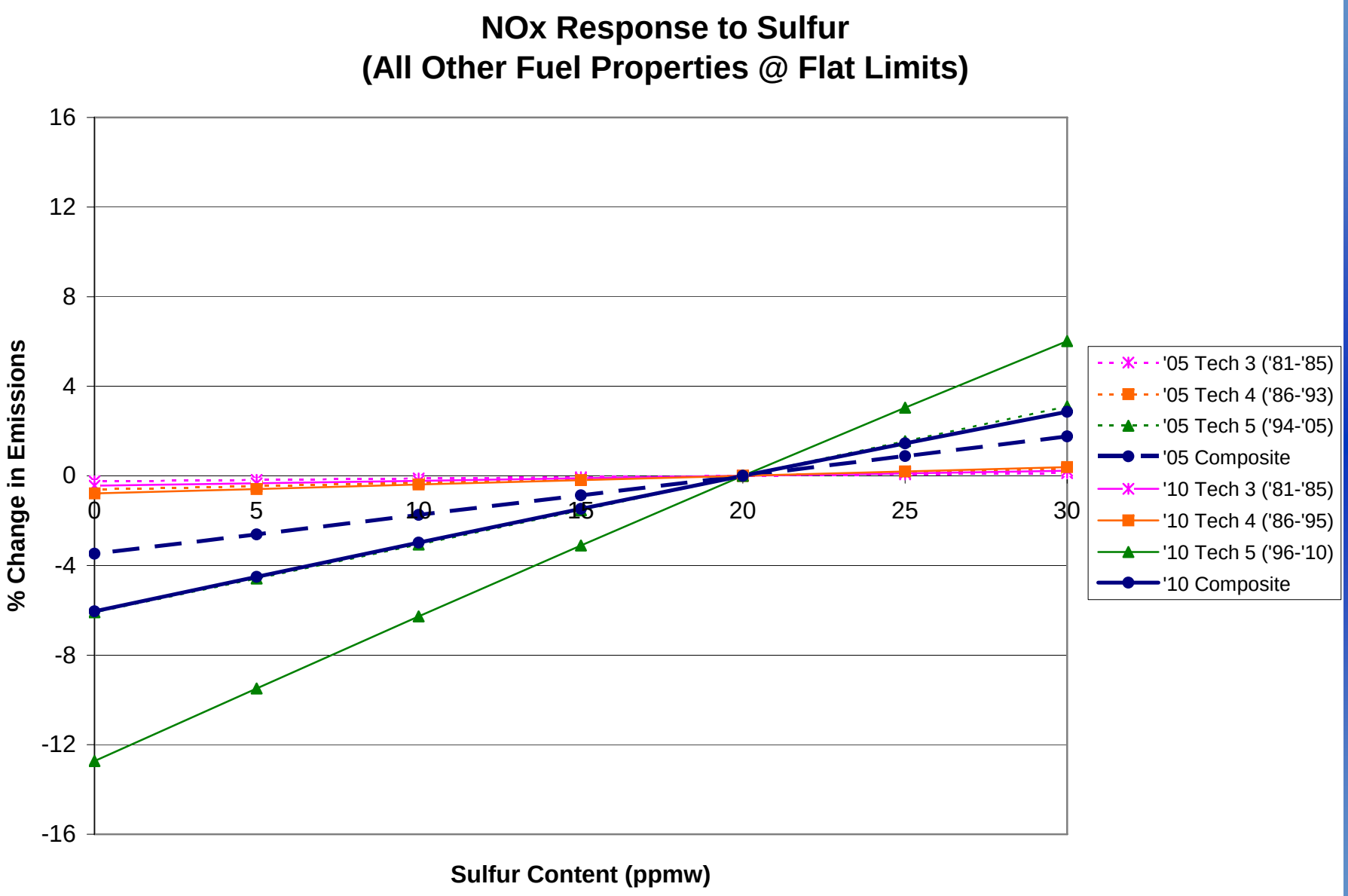
THC Response to Olefins
(All Other Fuel Properties @ Flat Limits)

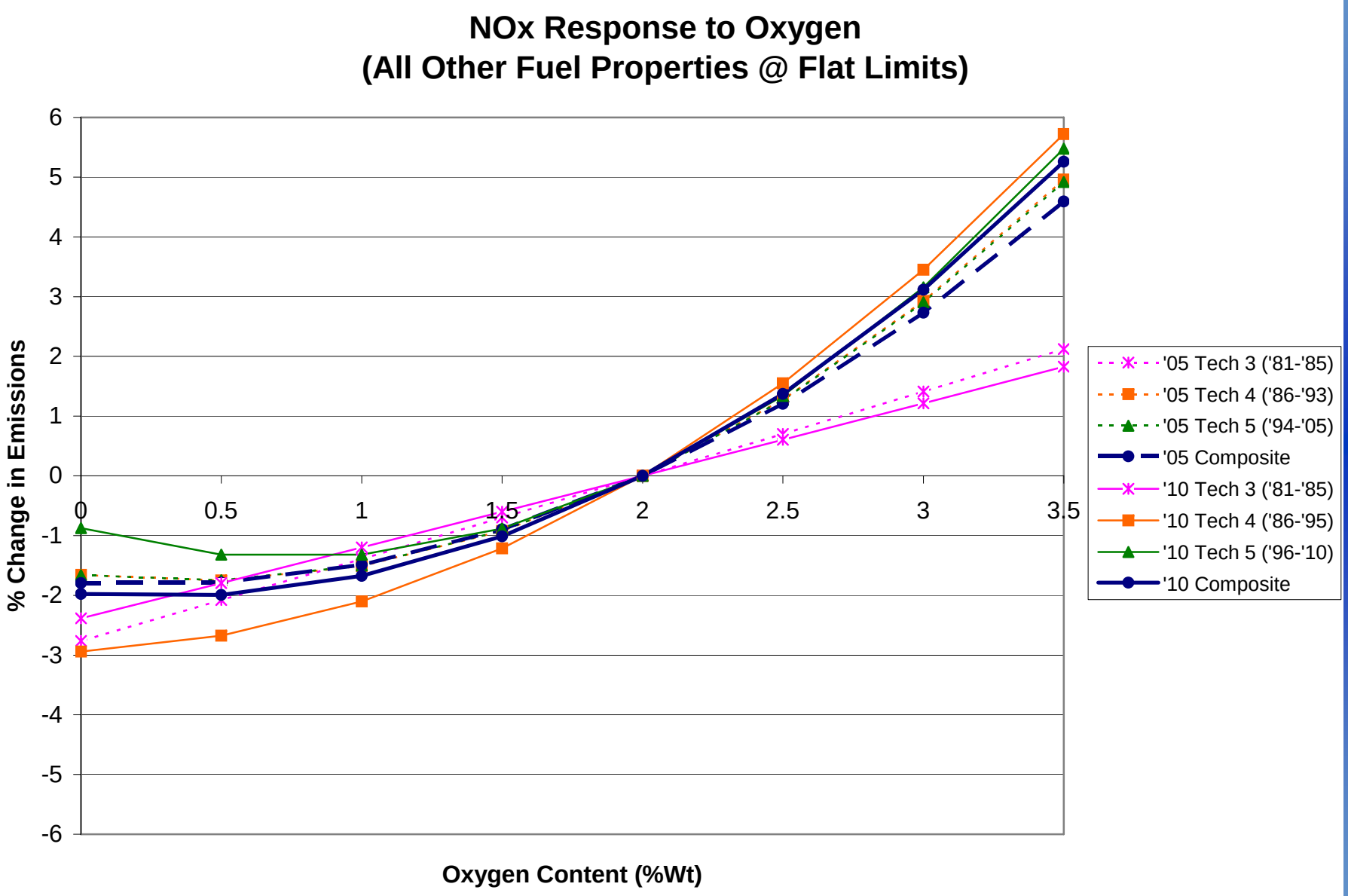


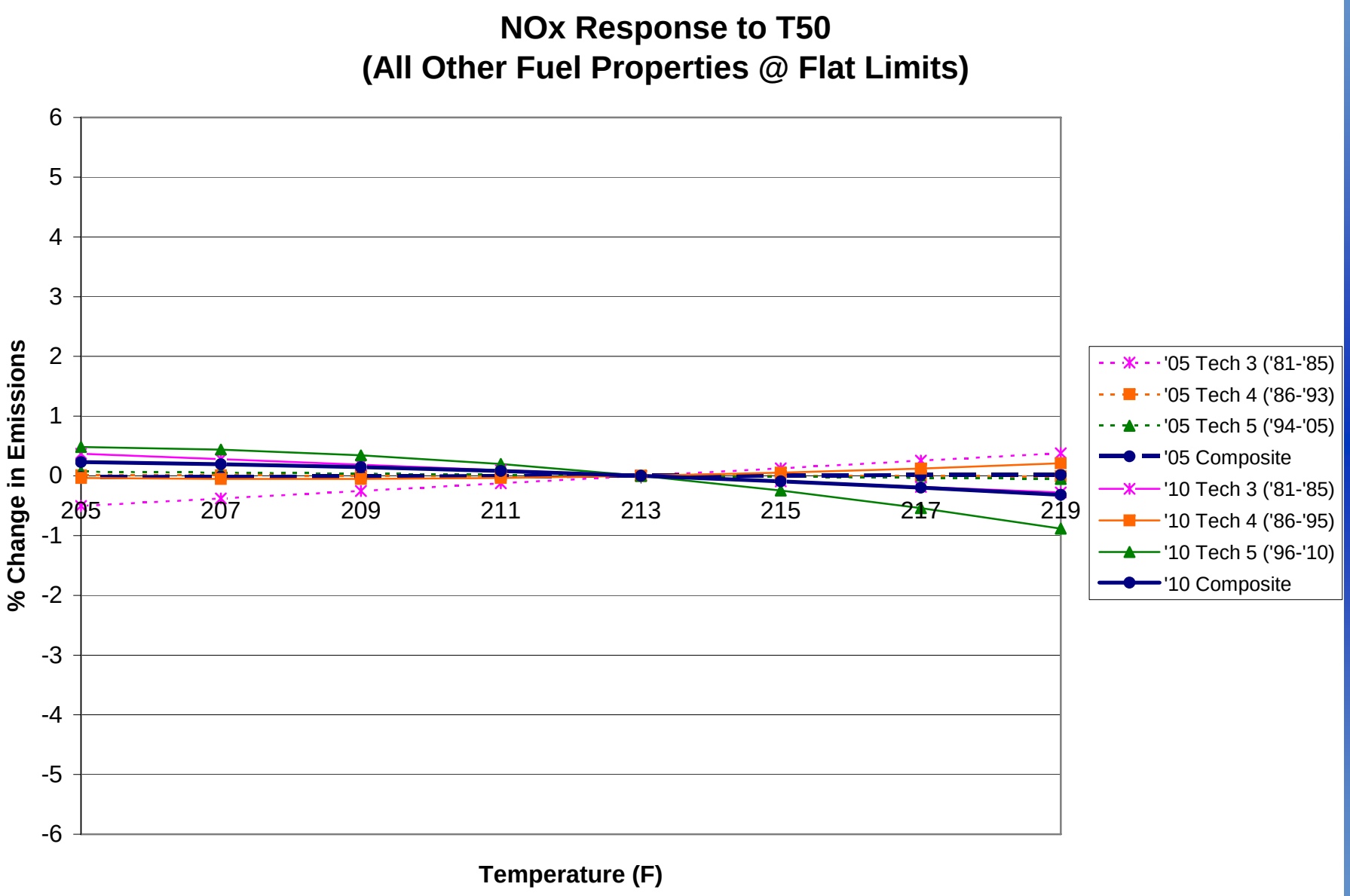
NOx

Response to Fuel Property Changes

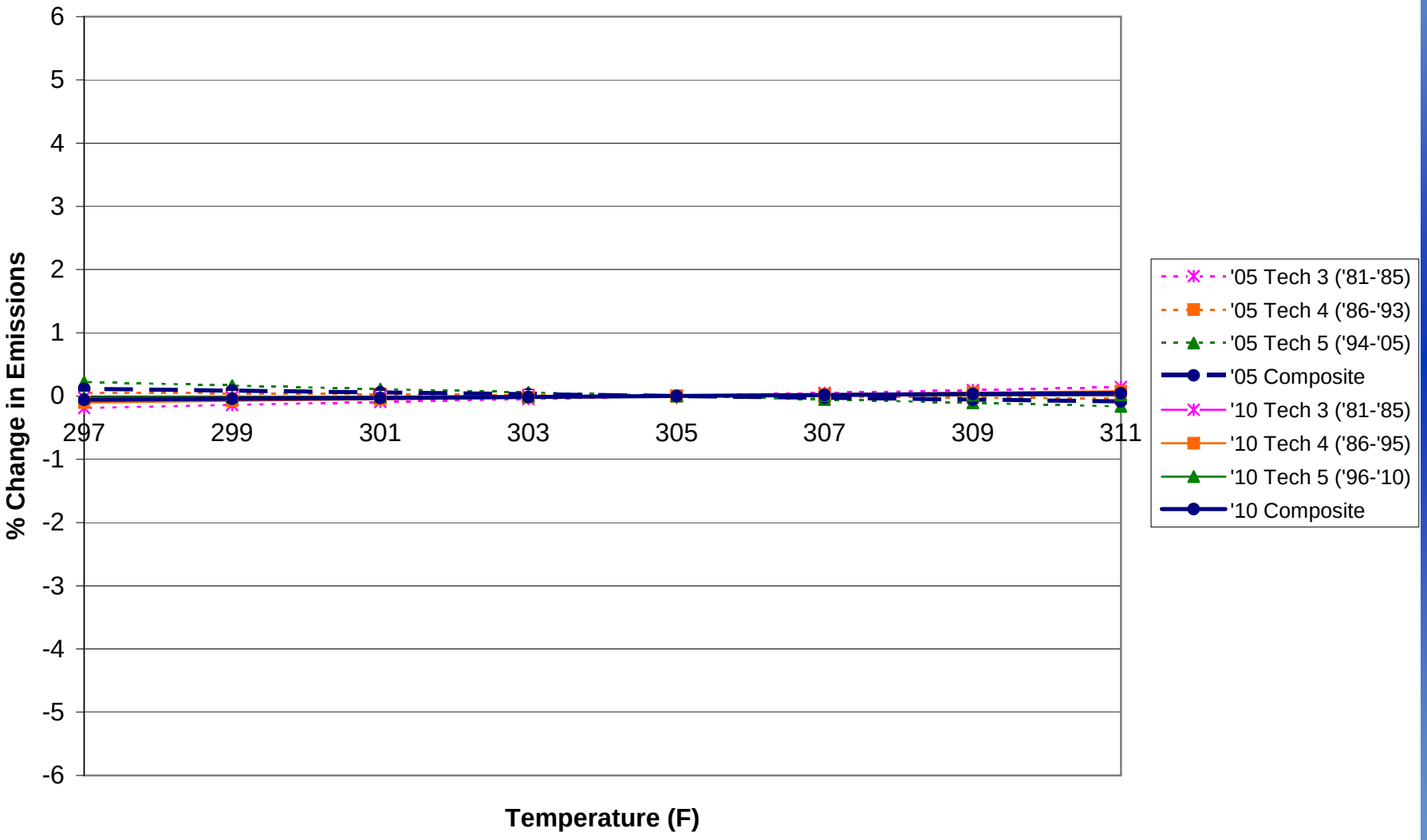

NOx Response to Aromatics
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
17
19
21
23
25
27
29
31
Aromatics Content (%Vol)
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite

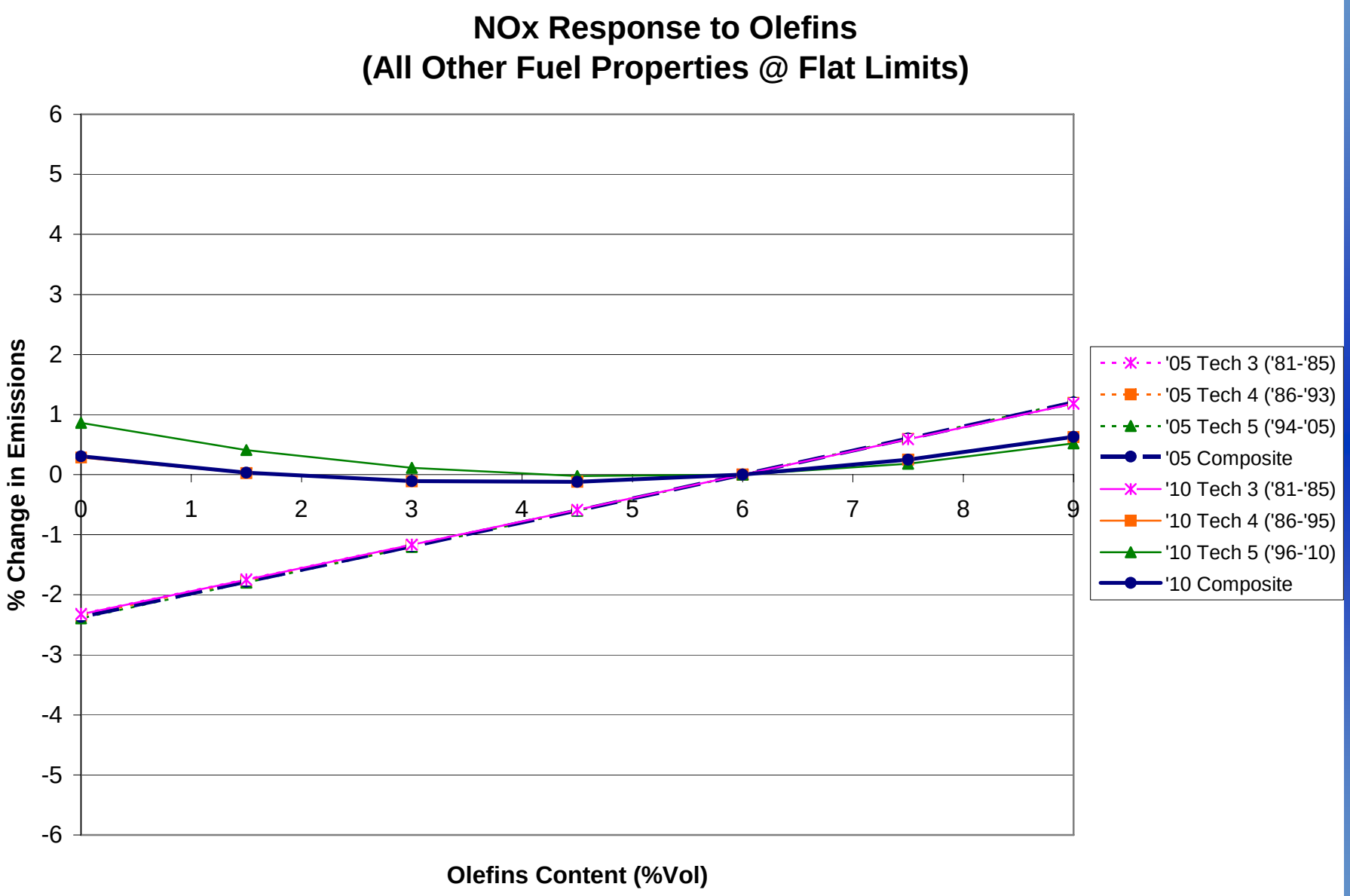

NOx Response to Sulfur
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
16
12
8
4
0
-4
-8
-12
-16
0
5
10
15
20
25
30
Sulfur Content (ppmw)
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


NOx Response to Oxygen
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
Oxygen Content (%Wt)
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
0.5
1
1.5
2
2.5
3
3.5
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


NOx Response to T50
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
205
207
209
211
213
215
217
219
Temperature (F)
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite

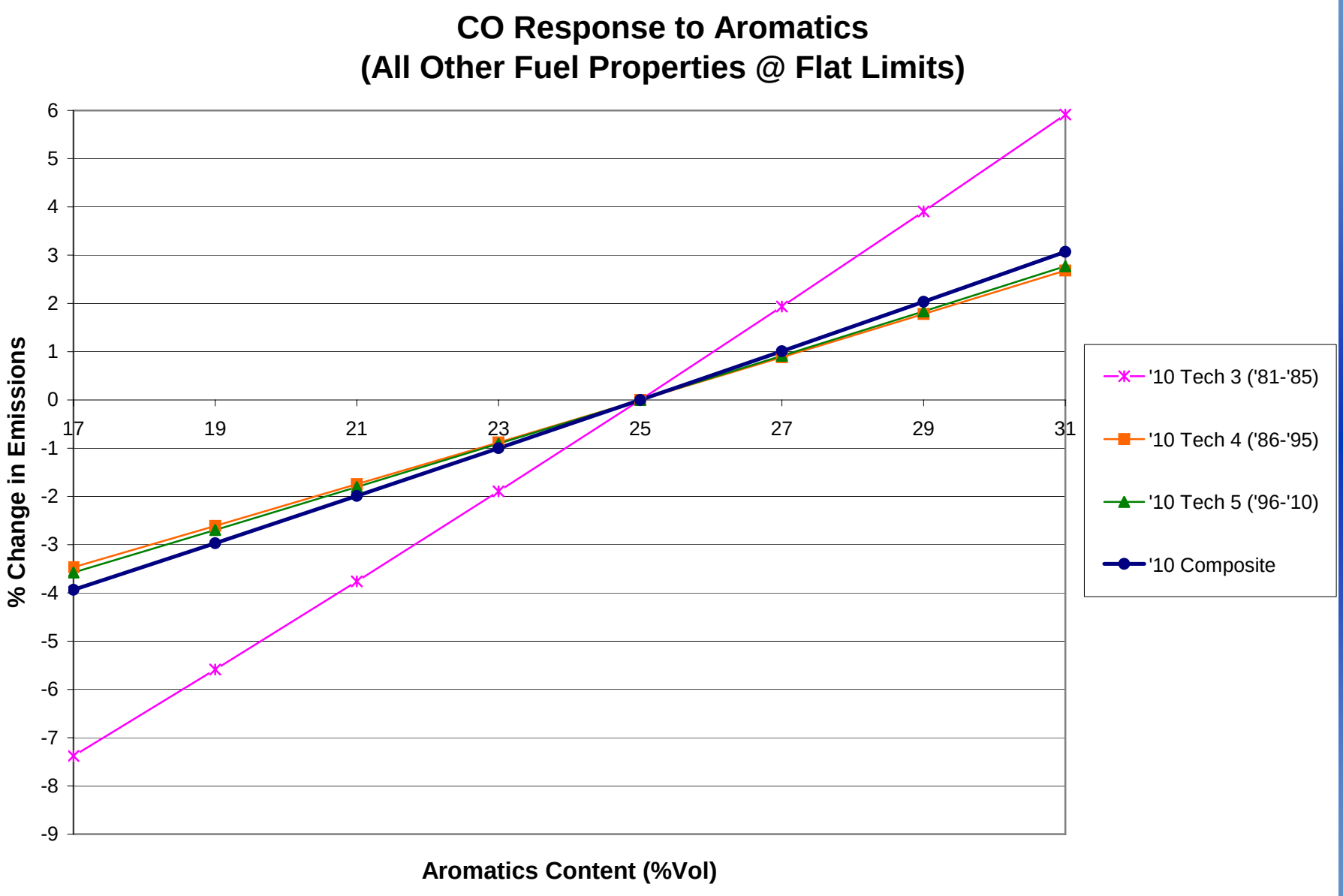
NOx Response to T90
(All Other Fuel Properties @ Flat Limits)

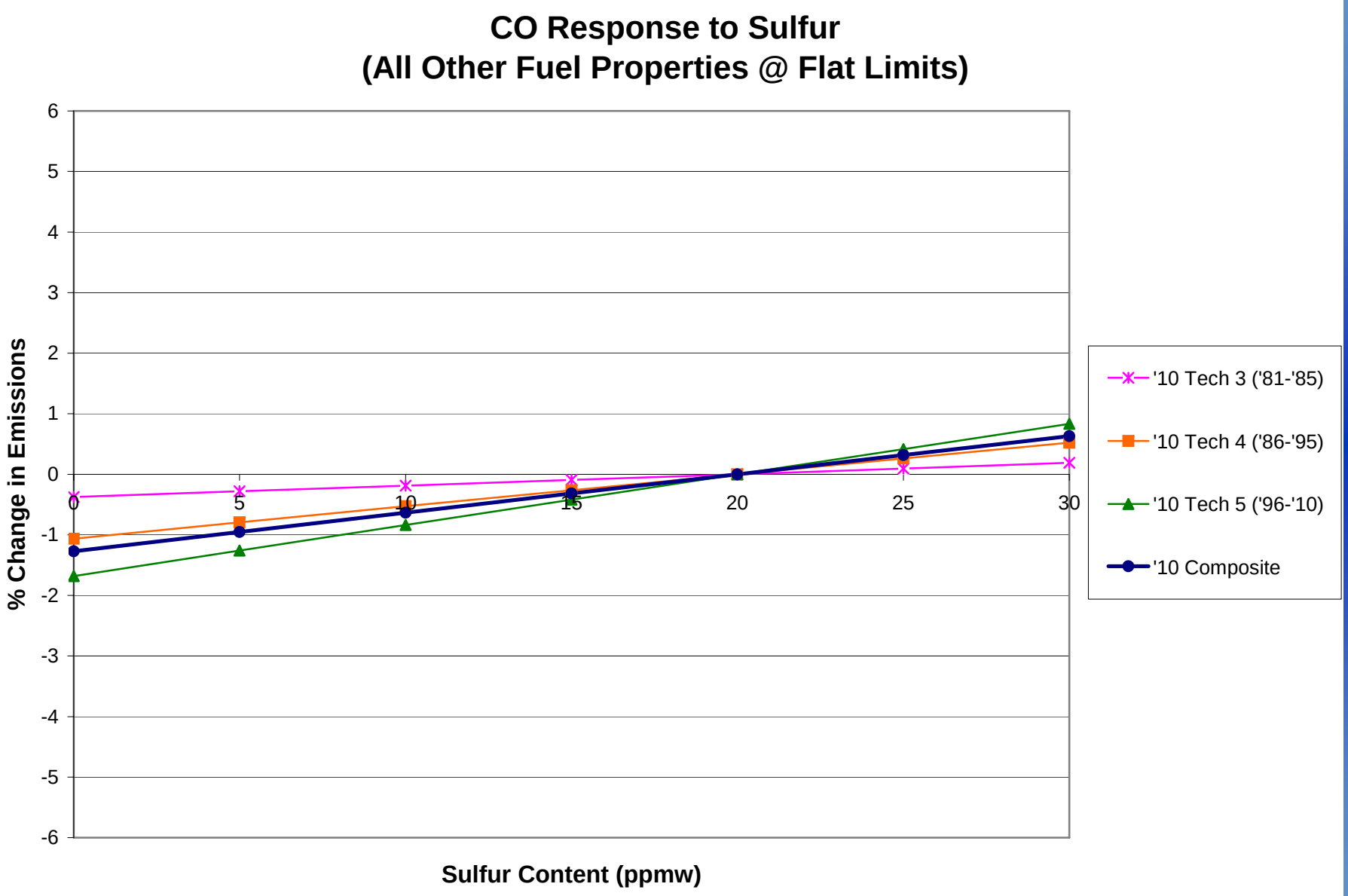


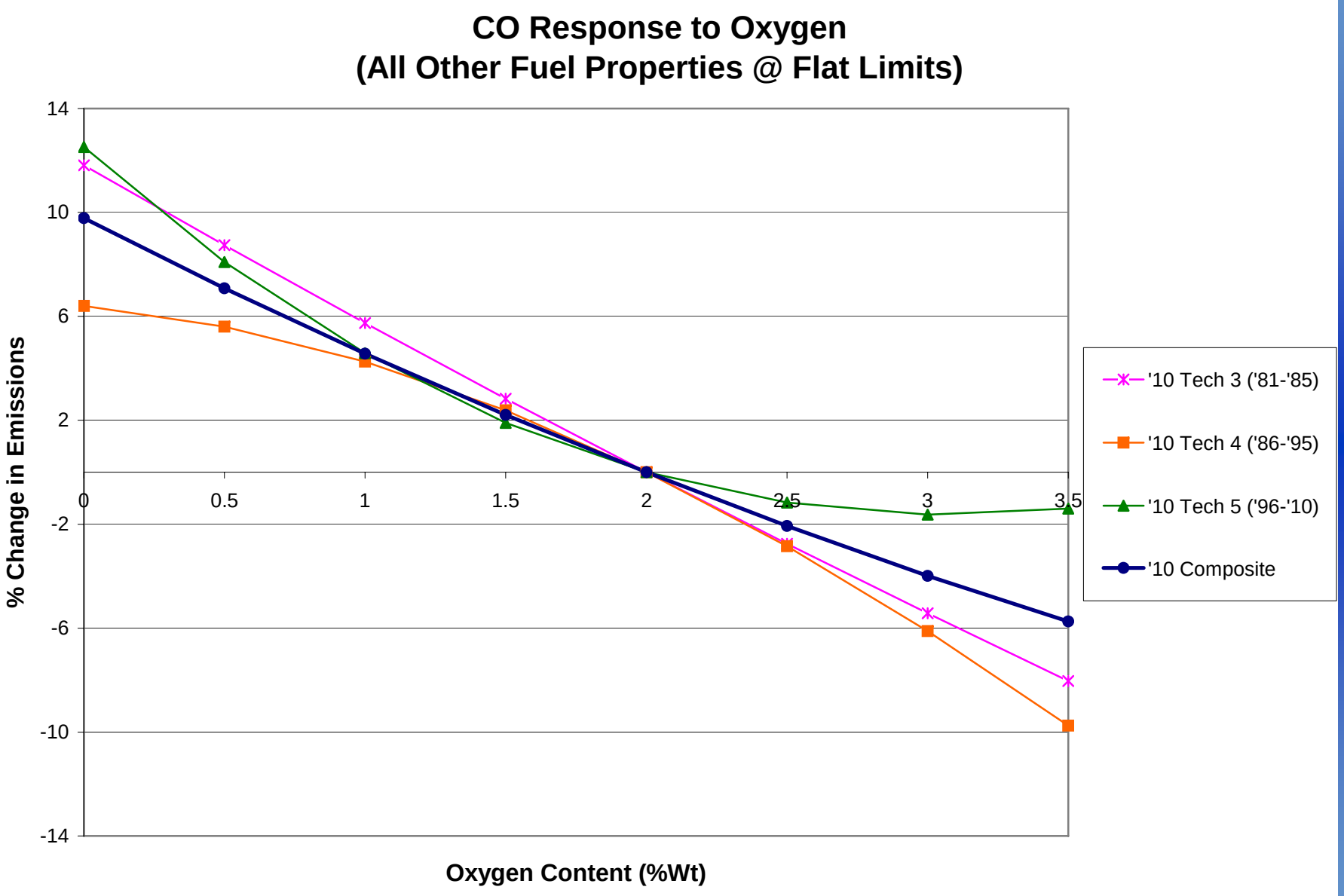

NOx Response to Olefins
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
1
2
3
4
5
6
7
8
9
Olefins Content (%Vol)
'05 Tech 3 ('81-'85)
'05 Tech 4 ('86-'93)
'05 Tech 5 ('94-'05)
'05 Composite
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite

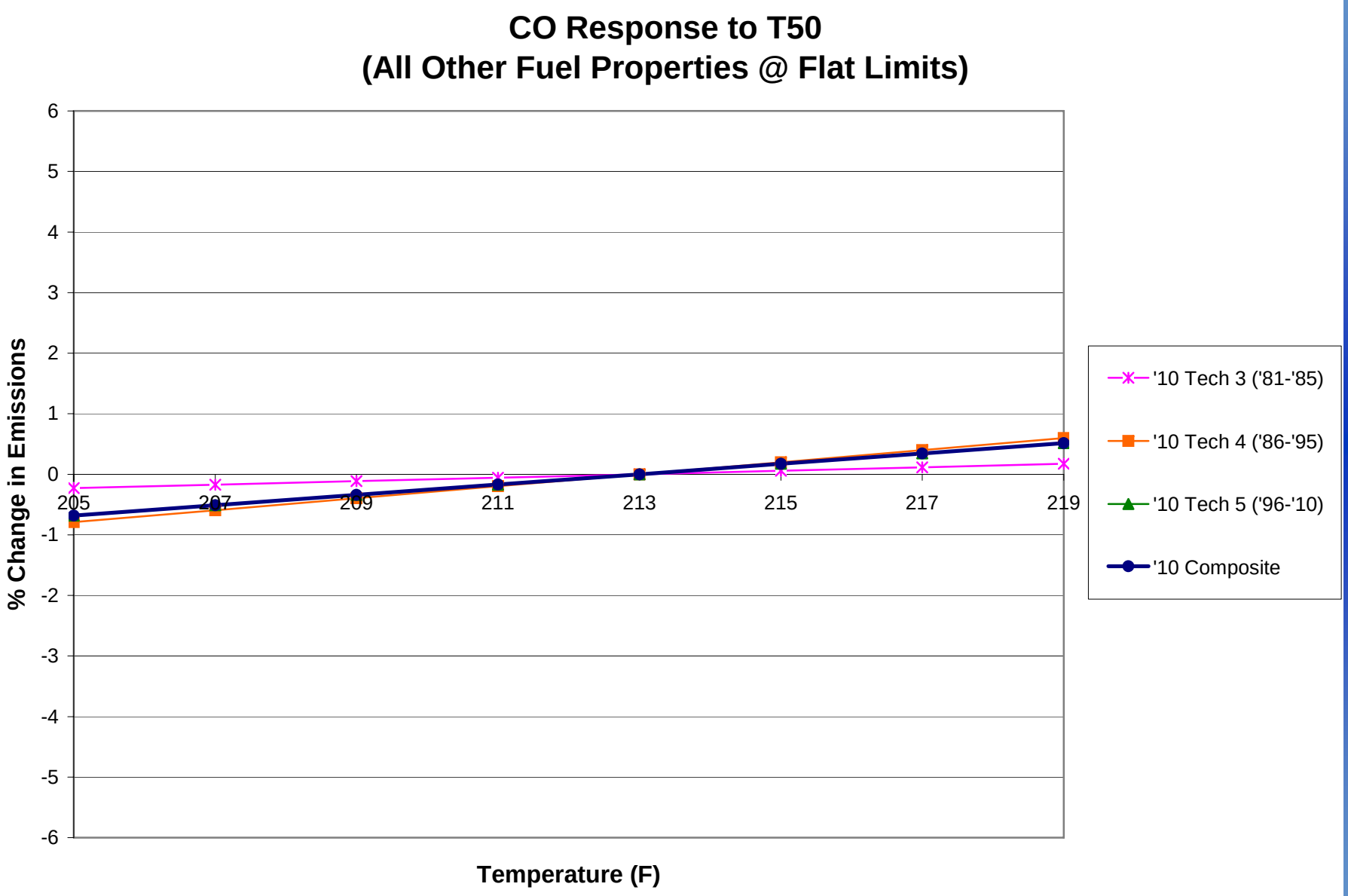
CO

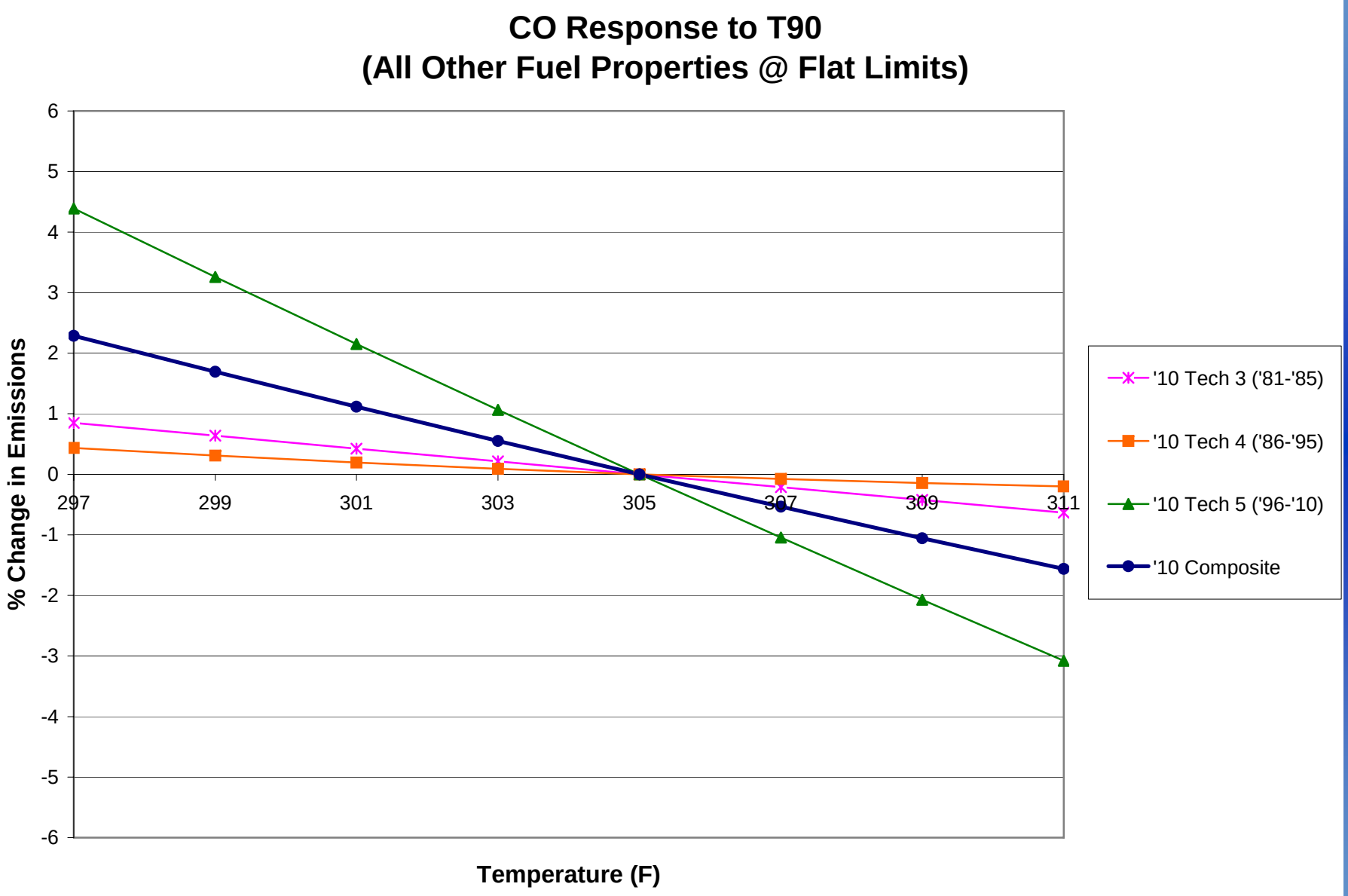
Response to Fuel Property Changes

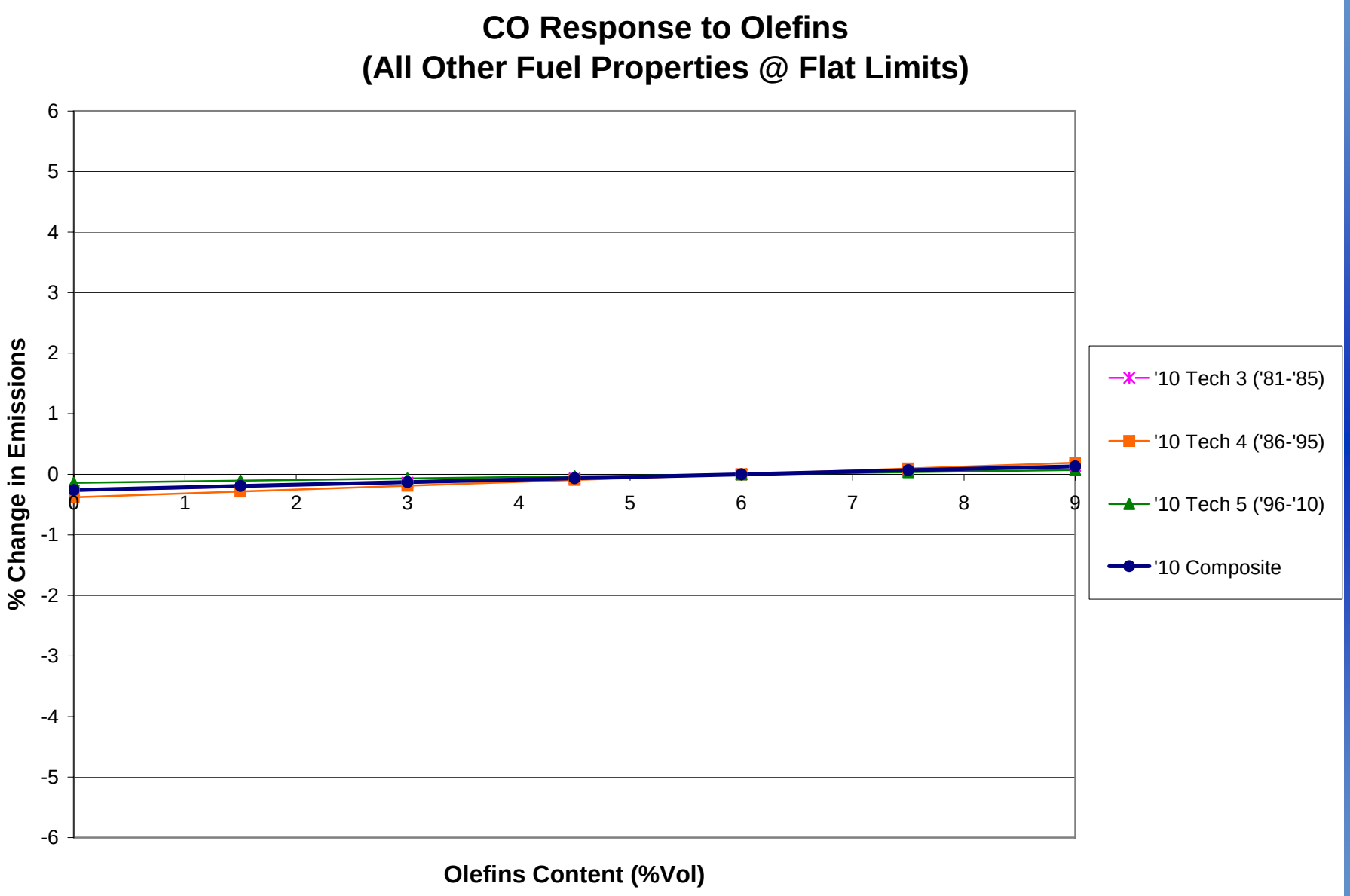

CO Response to Aromatics
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
17
19
21
23
25
27
29
31
Aromatics Content (%Vol)
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


CO Response to Sulfur
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
5
10
15
20
25
30
Sulfur Content (ppmw)
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


CO Response to Oxygen
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
14
10
6
2
-2
-6
-10
-14
0
0.5
1
1.5
2
2.5
3
3.5
Oxygen Content (%Wt)
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


CO Response to T50
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
205
207
209
211
213
215
217
219
Temperature (F)
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


CO Response to T90
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
297
299
301
303
305
307
309
311
Temperature (F)
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite


CO Response to Olefins
(All Other Fuel Properties @ Flat Limits)
% Change in Emissions
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
1
2
3
4
5
6
7
8
9
Olefins Content (%Vol)
'10 Tech 3 ('81-'85)
'10 Tech 4 ('86-'95)
'10 Tech 5 ('96-'10)
'10 Composite