

The forecast is 'always' wrong

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The forecast is 'always' wrong

Objective:

**To present realistic assessment of
our ability to forecasting accurately**

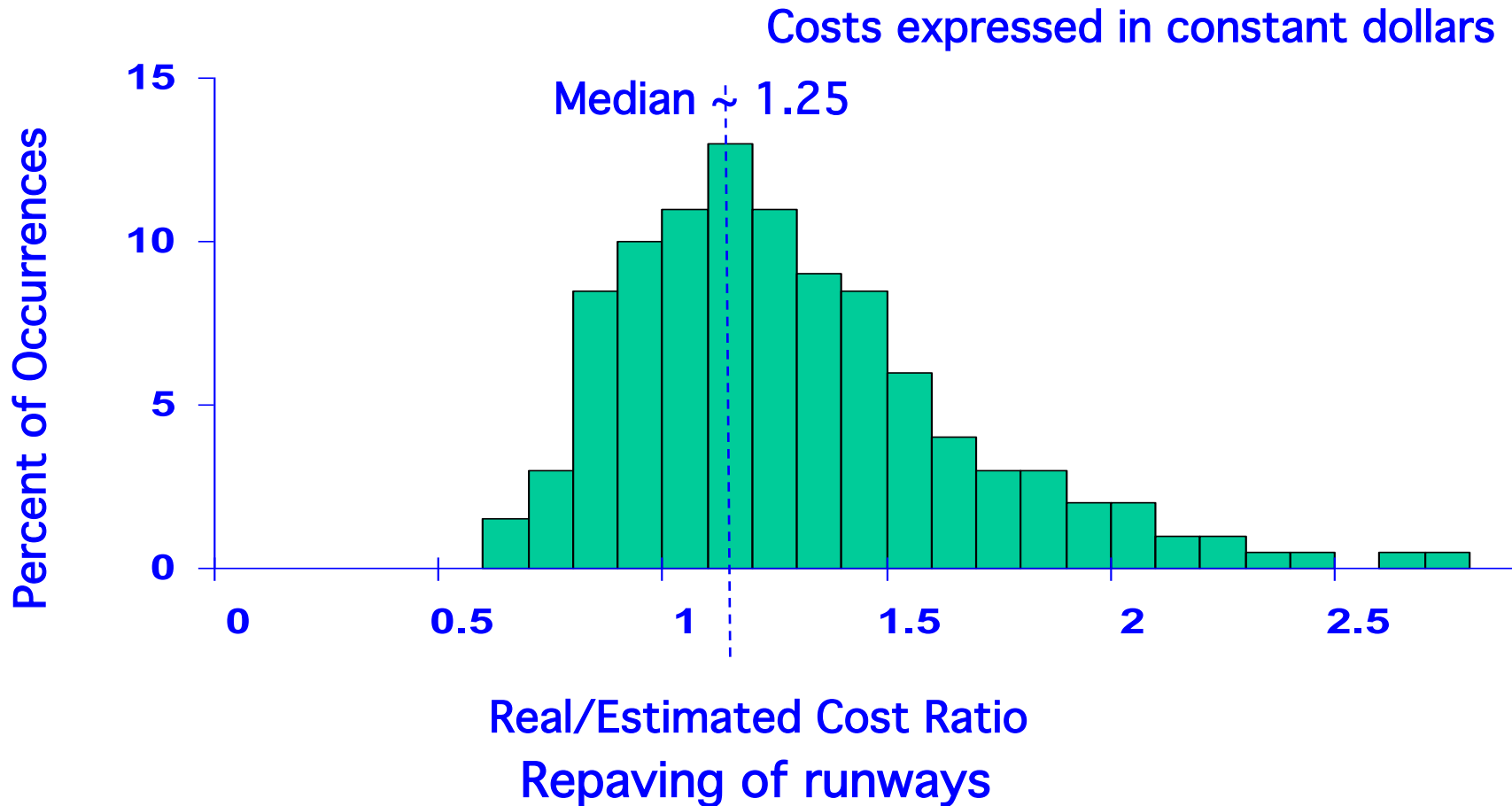
Causes of Uncertainty

- **Underlying variability of phenomenon**
- **Difficulties in measurement or estimation**
- **Unforeseen or “unpredictable” circumstances**
- **Limits to valid measurement**
 - for example: behavioral patterns

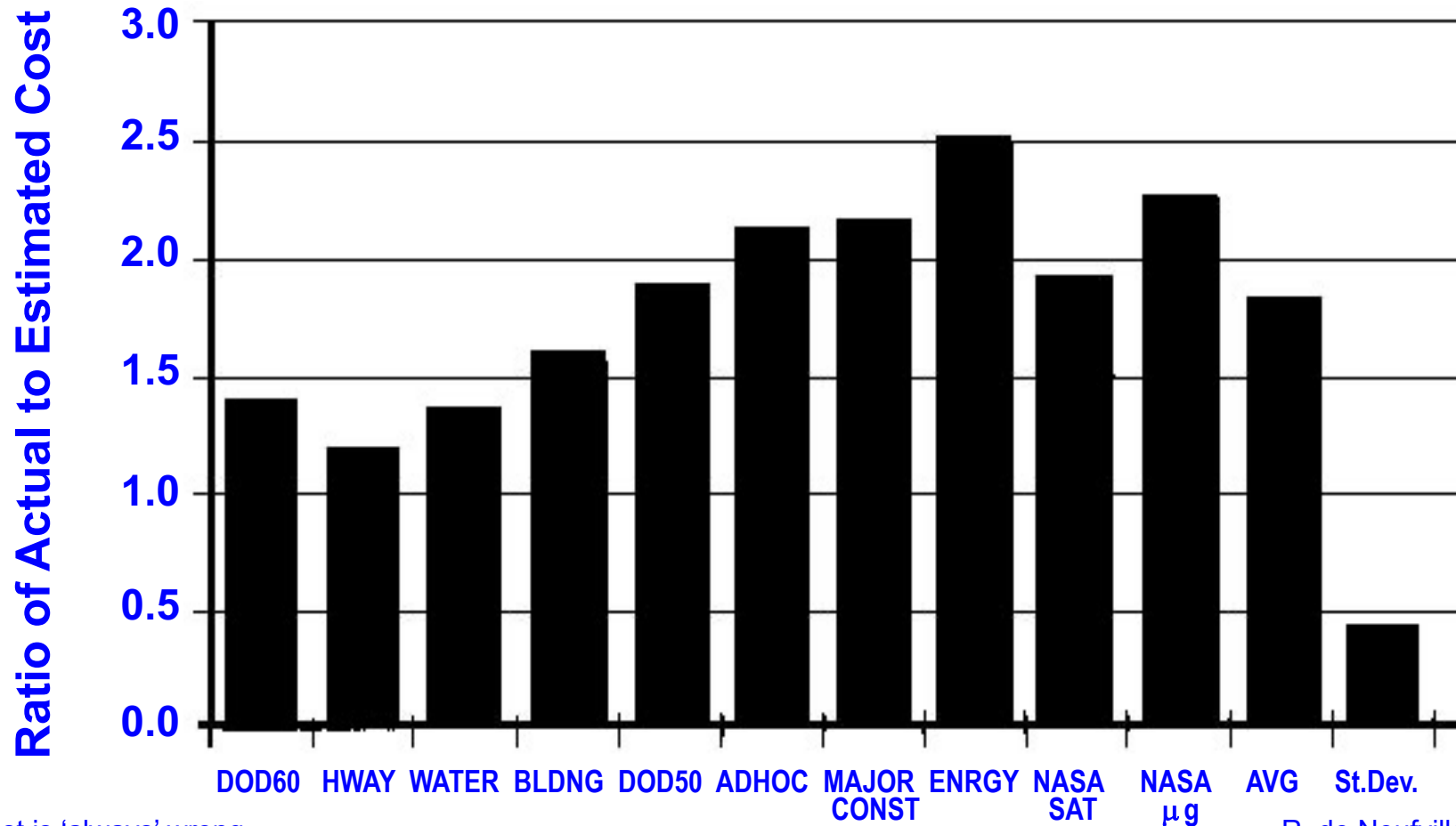
Evidence

- 1. Costs of System**
- 2. Prices**
- 3. Production**
- 4. Overall demand**
- 5. Local demand (Worse)**

Ratio of Real to Estimated Costs



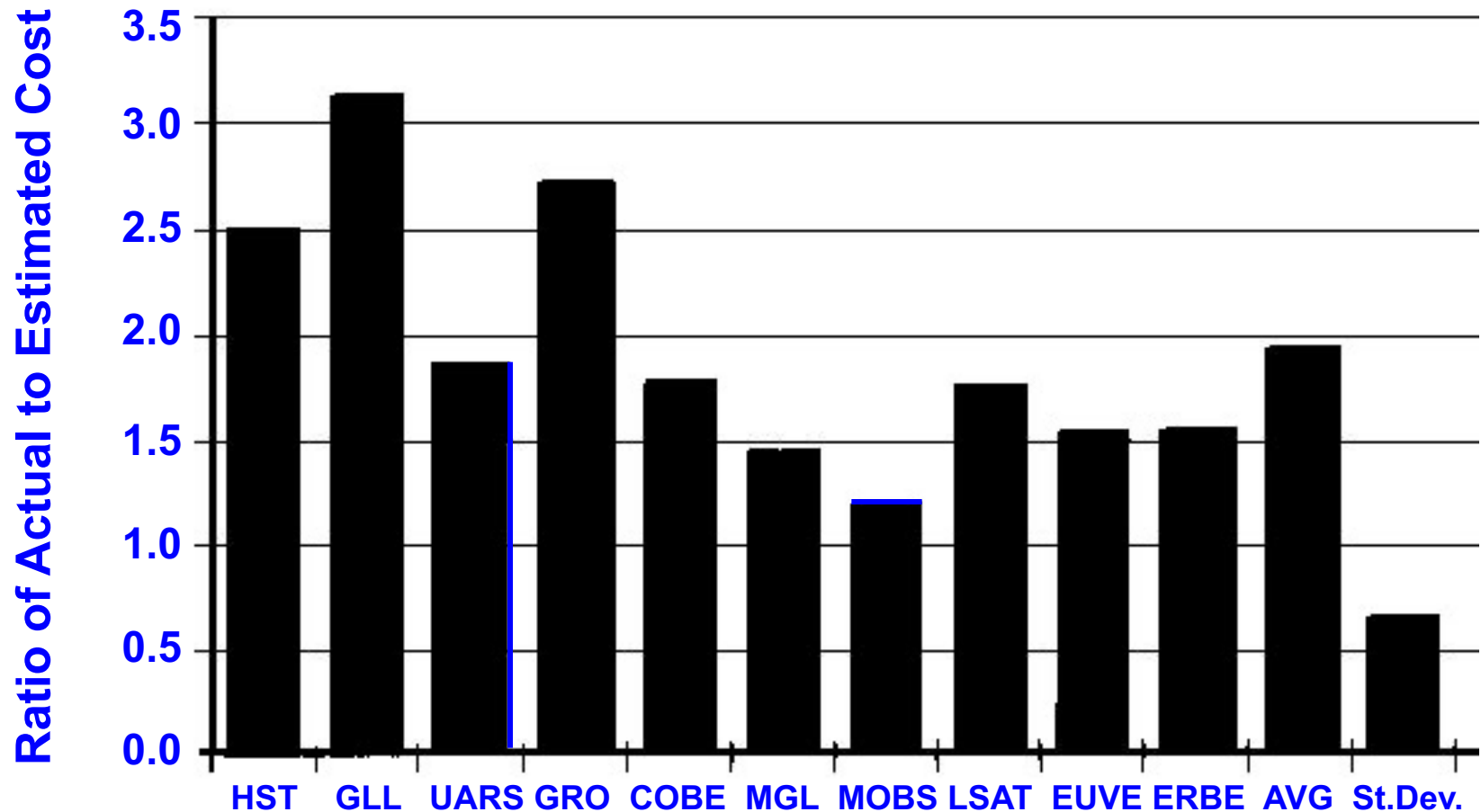
Cost Growth for Various Projects



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NASA Projects Cost Growth

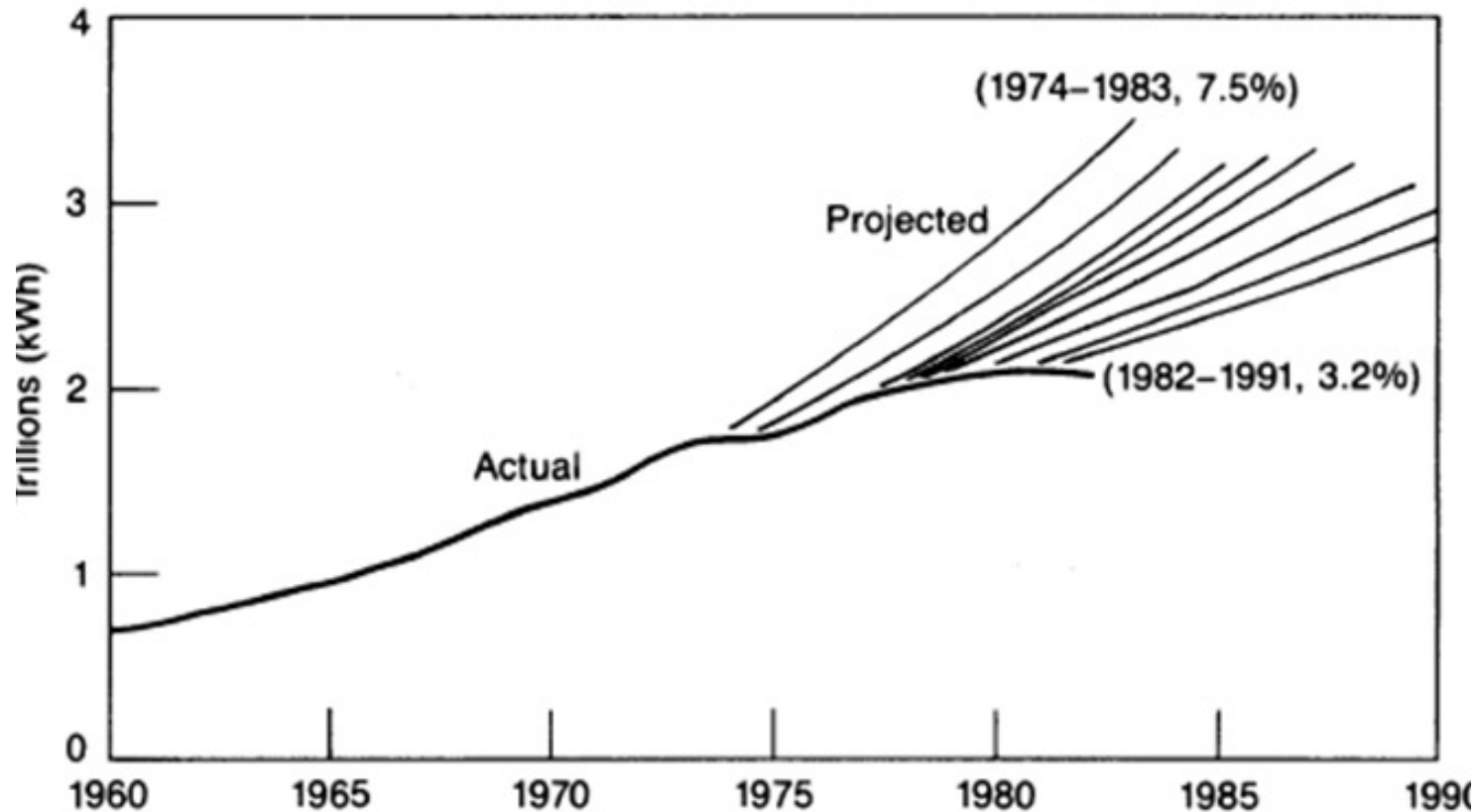


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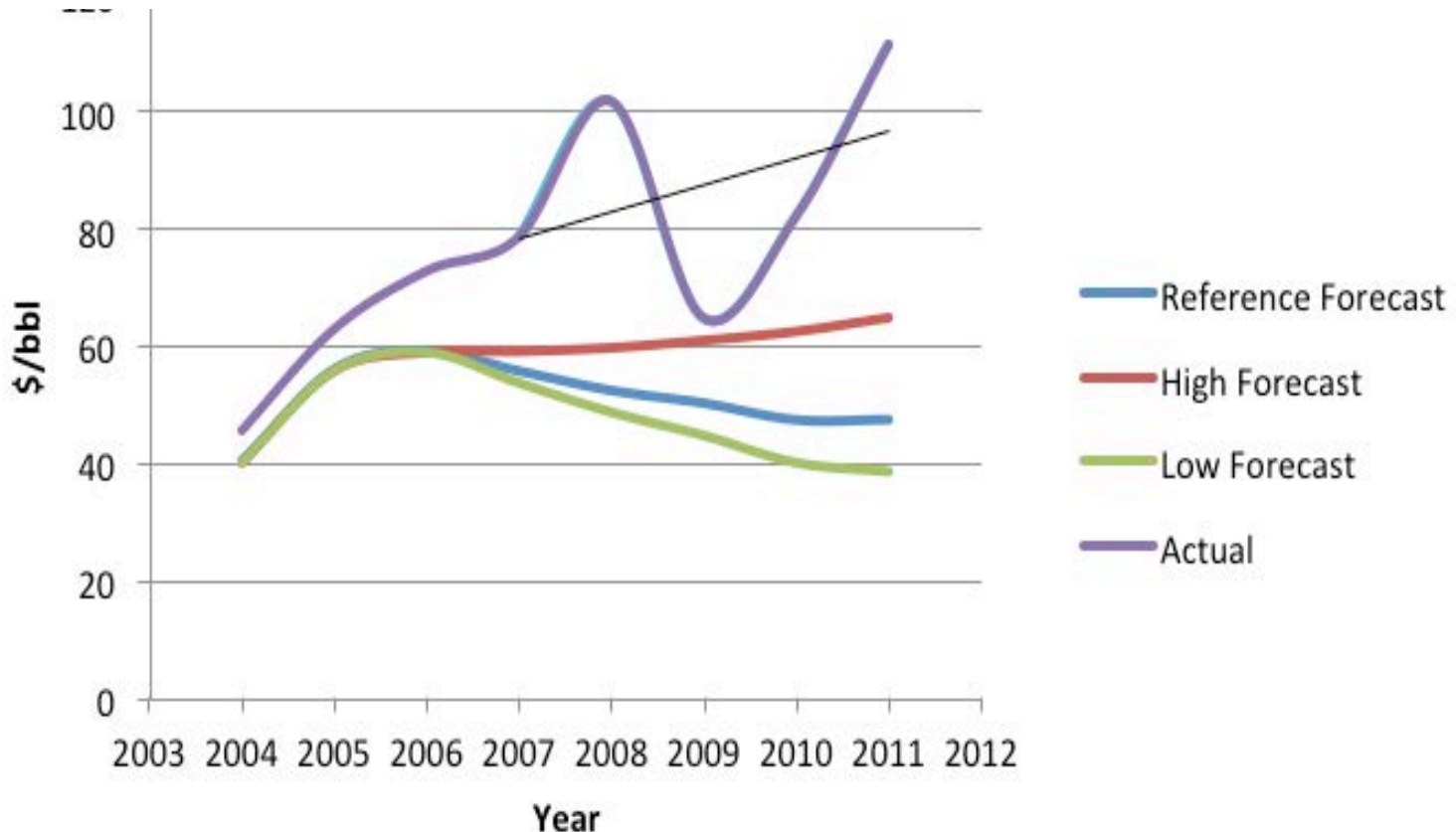
Projected vs Actual US Electric Power Use

Source: Nelson and Peck 1985, *Journal of Business & Economic Statistics*



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Oil price forecasts



EIA Annual Energy Outlook 2006

BP Statistical Review of World Energy June 2012 Per Julia Kimmerly, 2012

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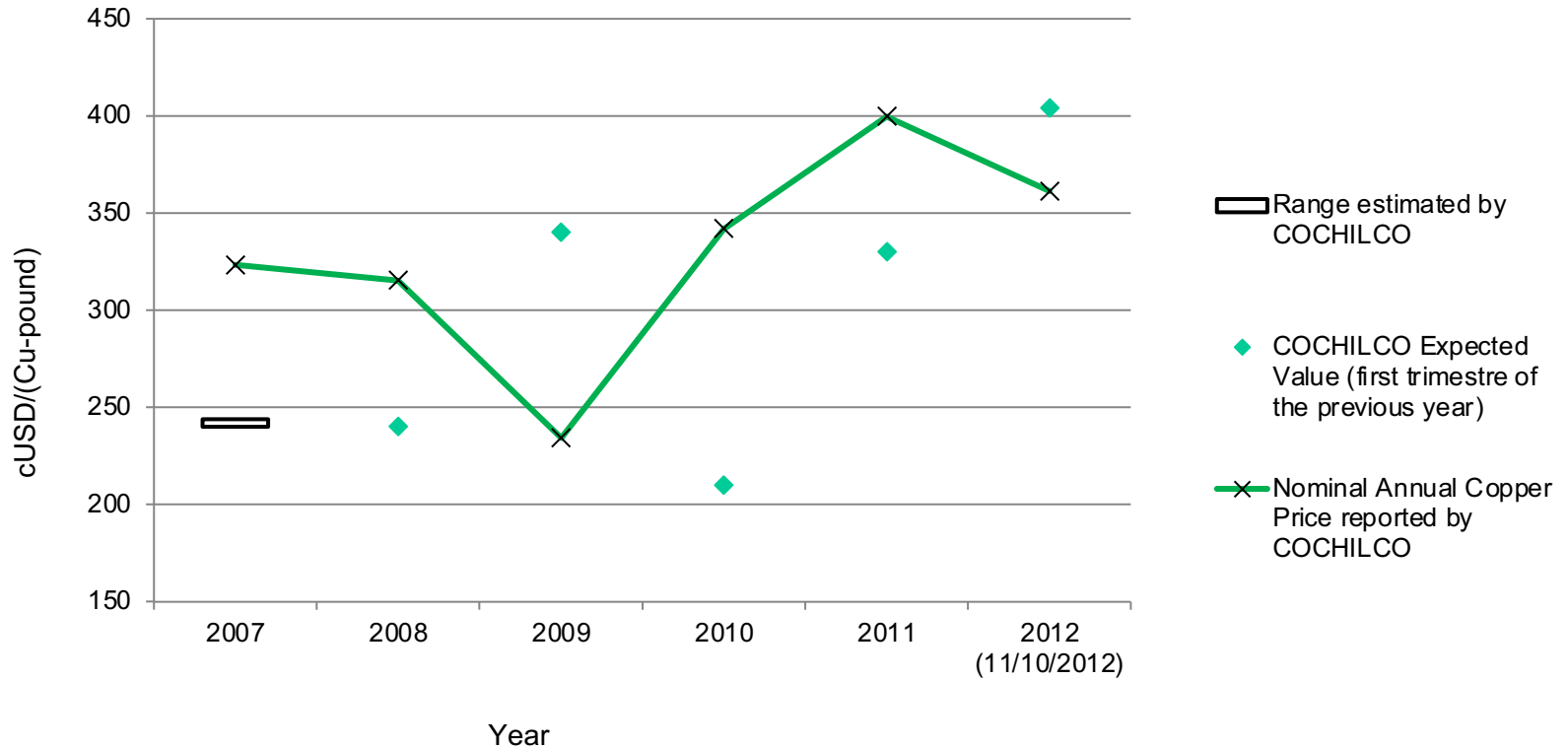
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World Copper Prices



Source: J. Esteban Montero, 2012

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Production Hours/wiring harness

	Planned hours	Actual hours
CD4.1 M1a BB	160	235
CD4.2 M1a BB	160	382
CD4.1 M1b BB	320	407
CD4.2 M1b BB	320	457
CD4.1 FDJ	480	455
CD4.2 FDJ	480	409
CD4.1 VPa	450	513
CD4.2 VPa	450	628
CD4.1 TTa	480	601
CD4.2 TTa	480	

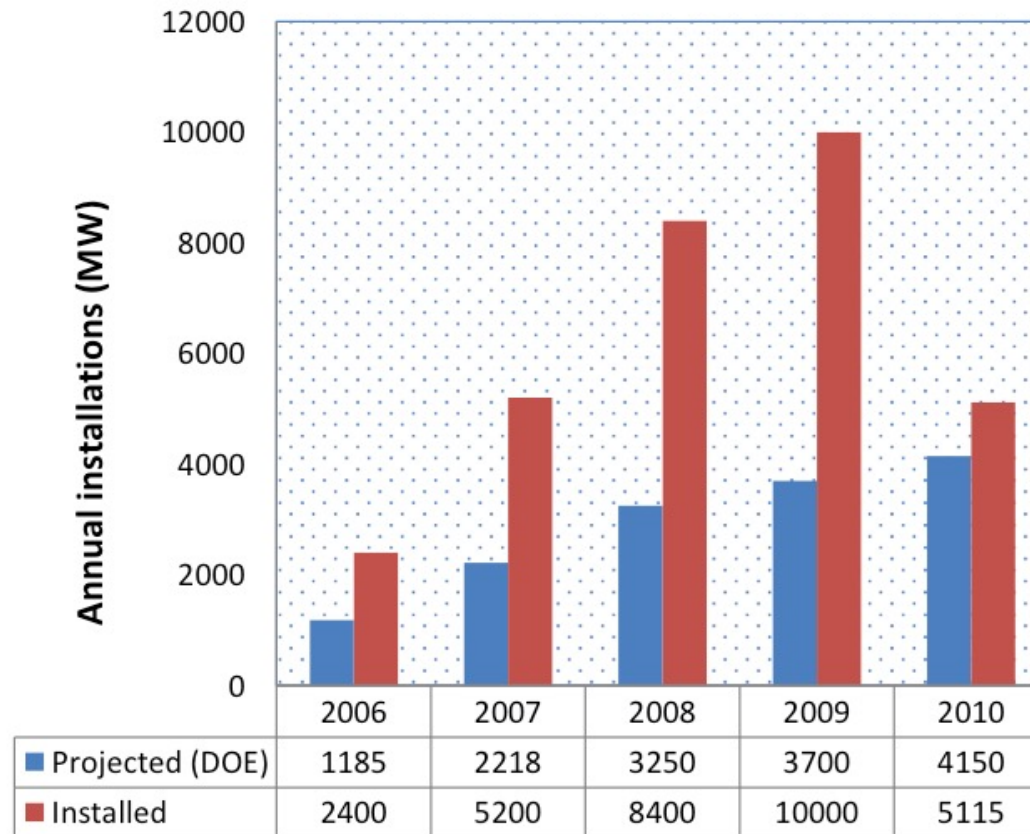
Source: Karla Beristain, 2011

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Wind Energy Production



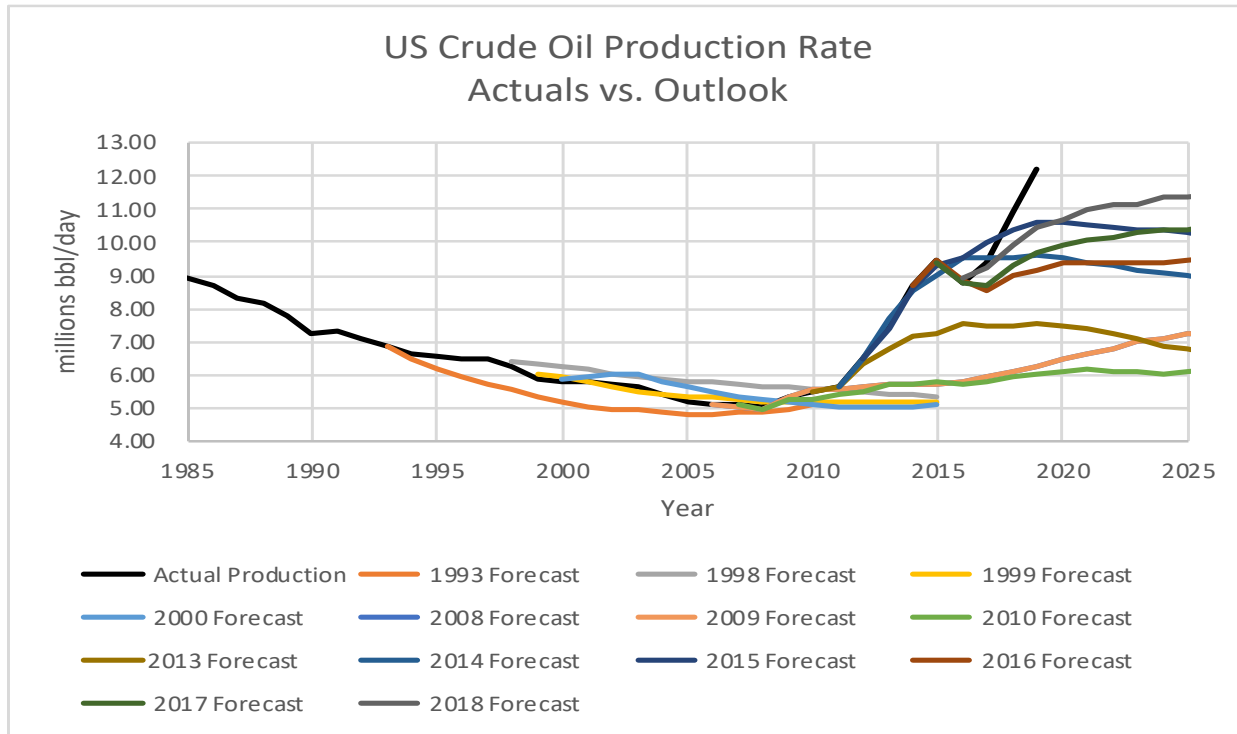
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20% wind energy by 2030: Increasing wind energy's contribution to U.S. electric supply, US DOE, July 2008.
Per Padmabhushana Desam, 2011

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US Crude Oil Production

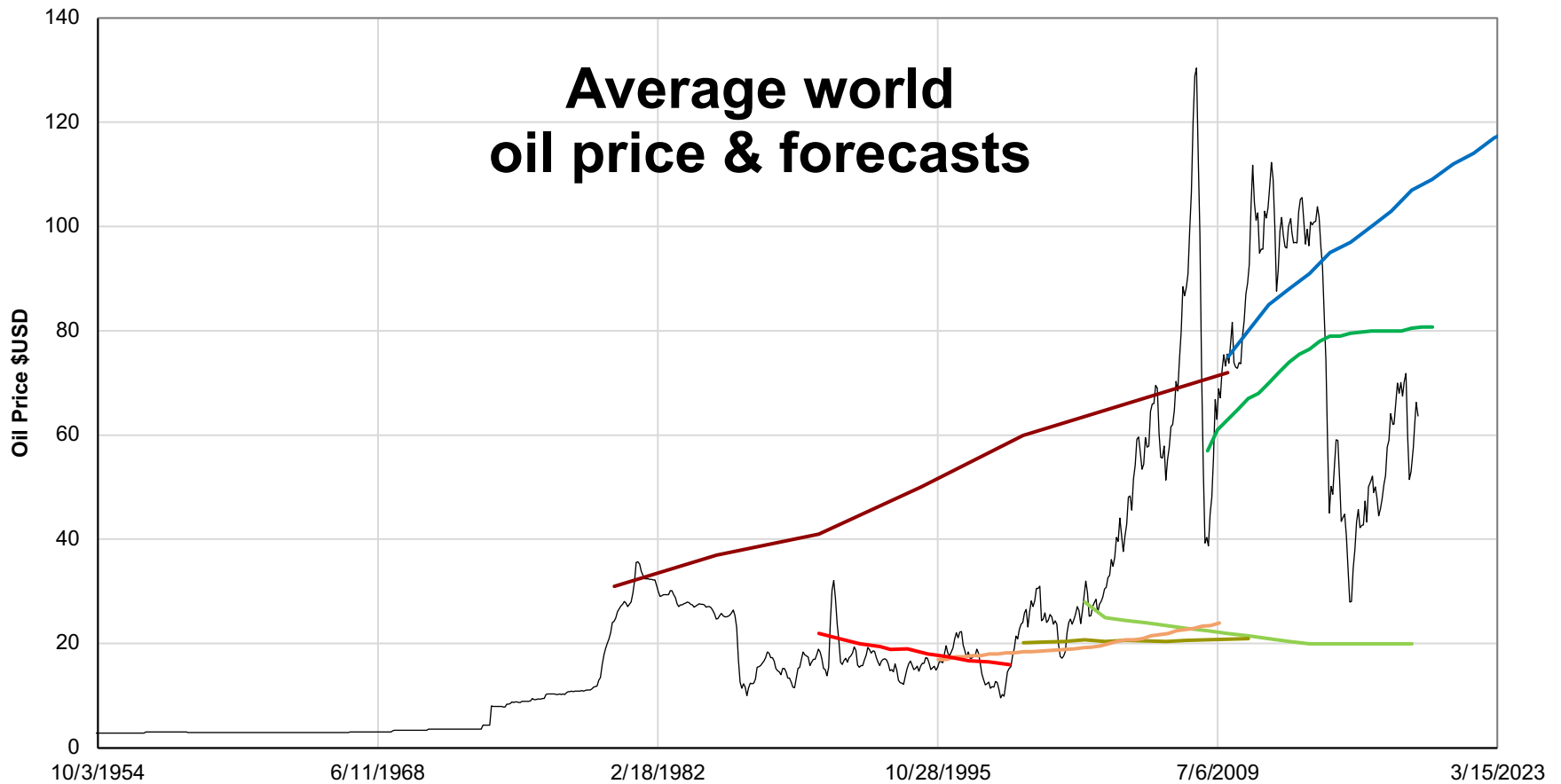


<https://www.eia.gov/outlooks/aeo/archive.php>

<https://www.macrotrends.net/2562/us-crude-oil-production-historical-chart>

Via Fei Yang

Oil Prices, Actual vs Projected



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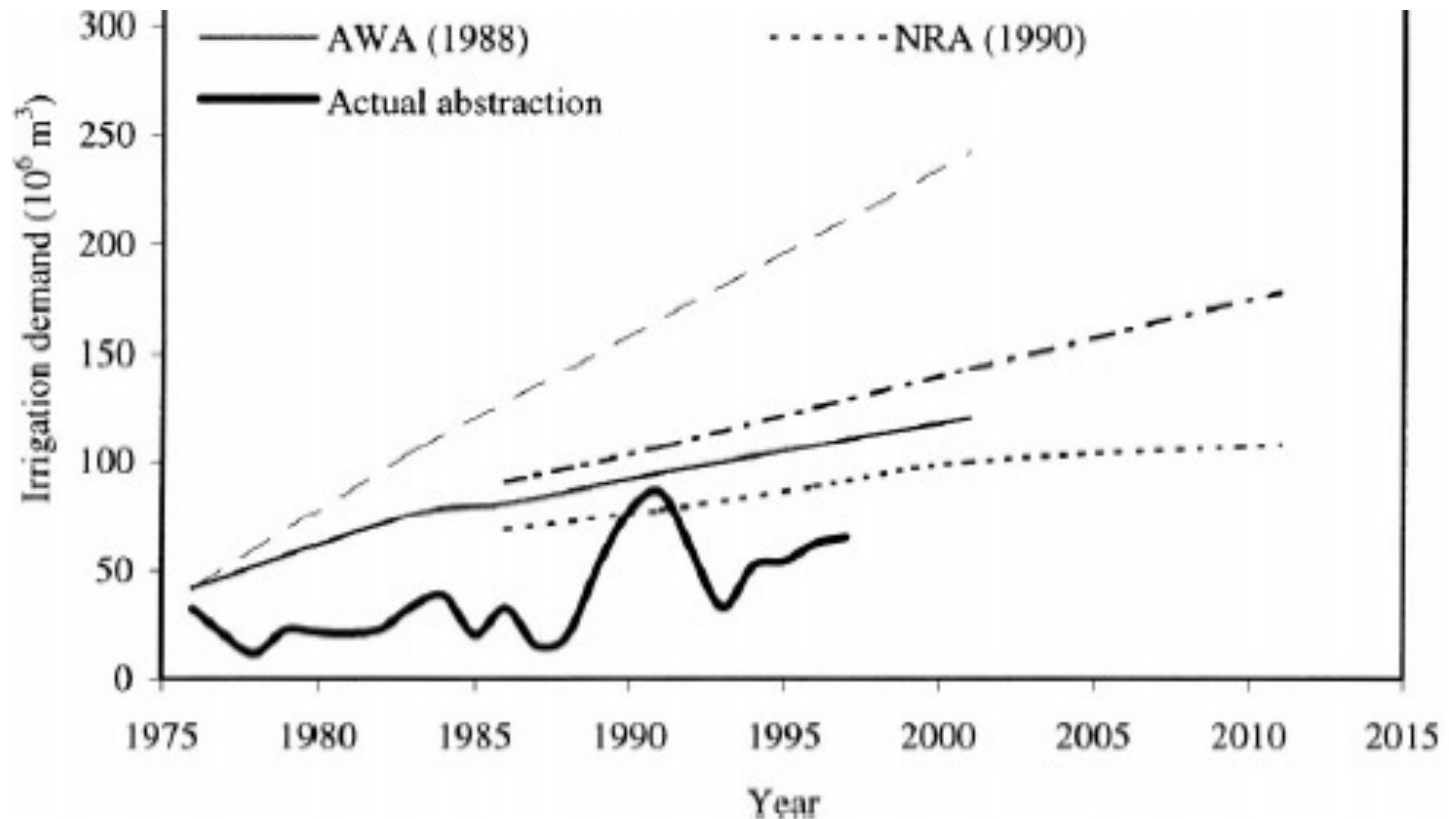
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Source: Benjamin Partington, 2019 Airports 2019 R de N ©

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Demand for Water in Anglia UK



Source: E.K. Weatherhead, J.W. Knox: Agricultural Water Management 43 (2000) 203-218
Per Arthur Gueneau, 2011

Use of Port of Miami Tunnel

Year	2005	2010	2015	2016	2017	2018	2020	2025	2030	2035
Forecasts	25,924	30,649	36,086				42,354	49,590	57,950	67,618
Actual			9,630	10,867	12,011	13,510				

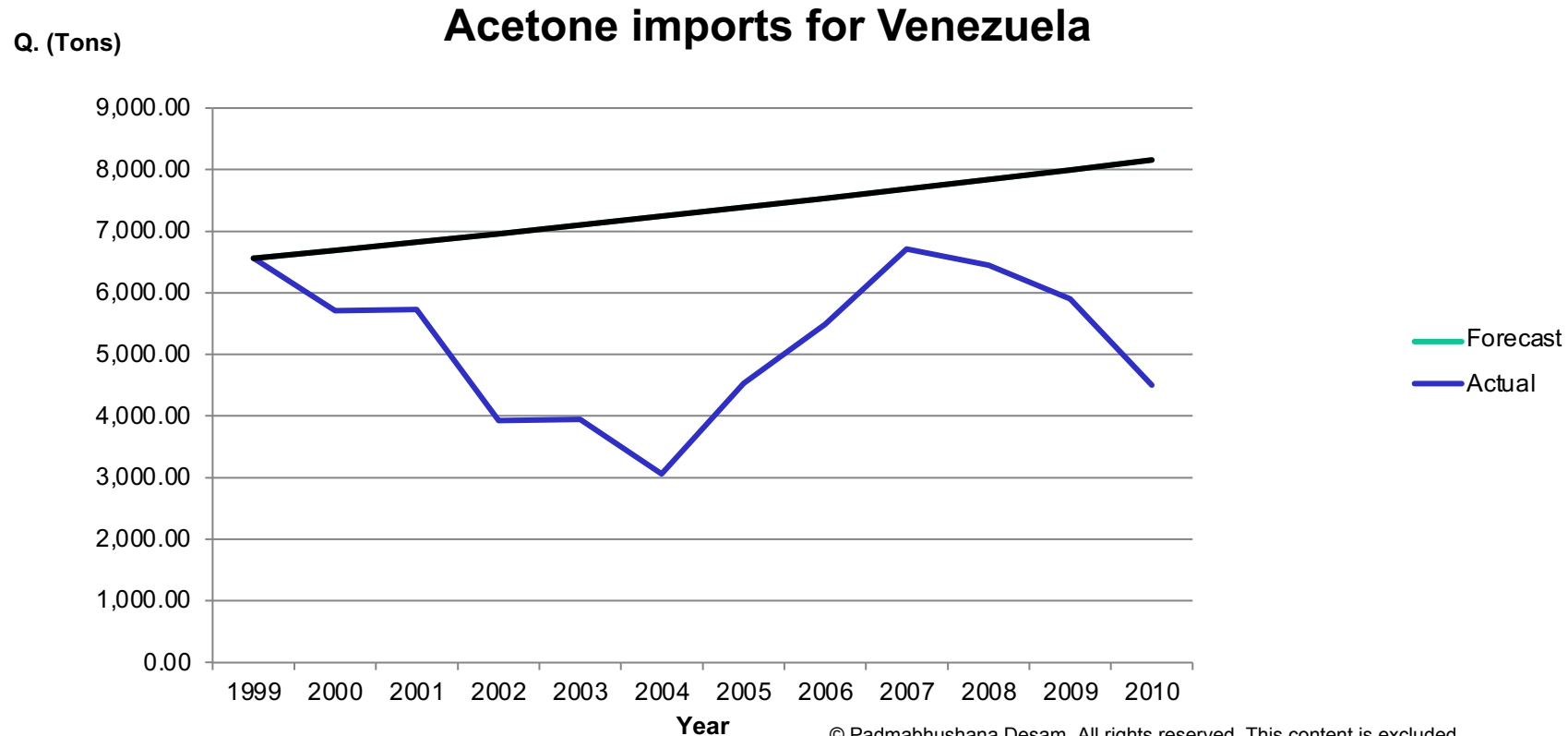
Average Daily Vehicular Traffic

Sources:

<http://www.portofmiamitunnel.com/system/js/back/ckfinder/userfiles/files/news-clips/06-0216-PIM-Final.pdf> and <https://tdaappsprod.dot.state.fl.us/fto/>

via Y. Hashimoto 2019

Acetone Imports Venezuela



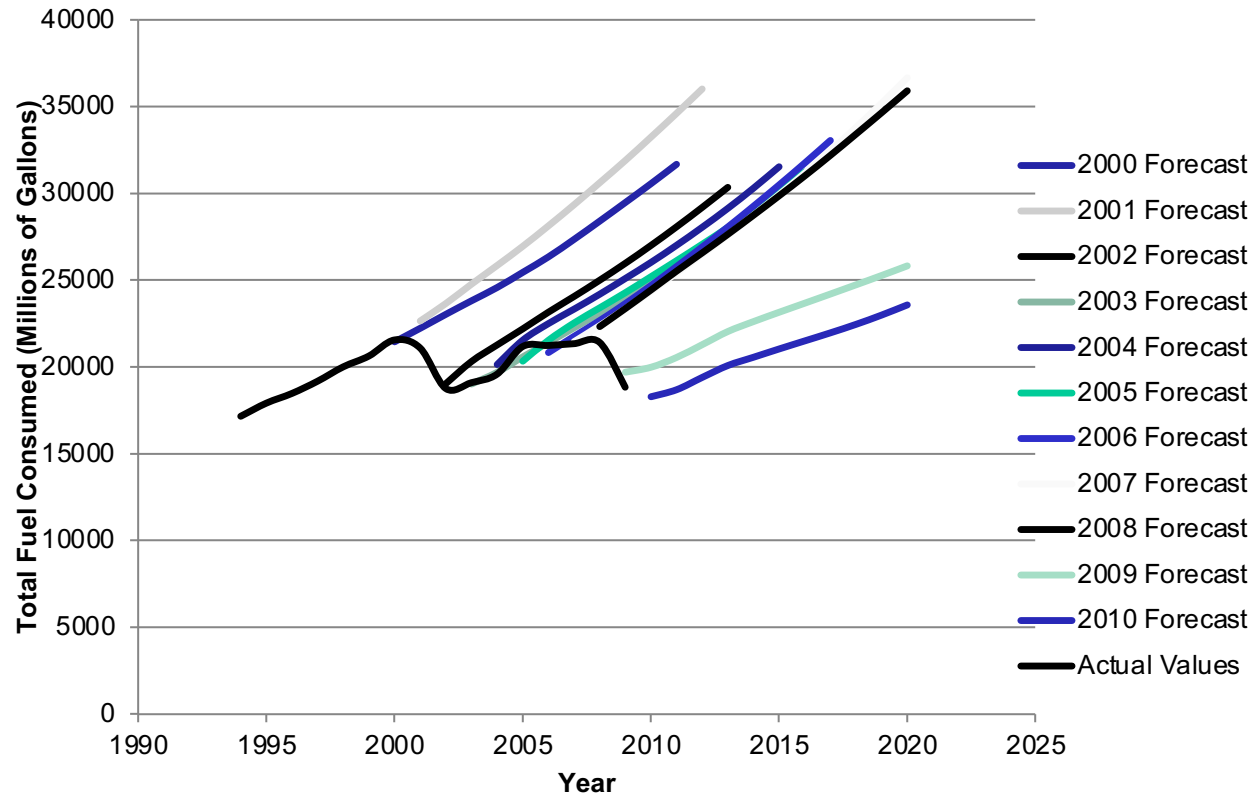
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Source: Claudia Hernandez, Fall 2011

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US Consumption of Aviation Fuel



http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecast/s/aerospace_forecasts/
Per Morgan Edwards 2011

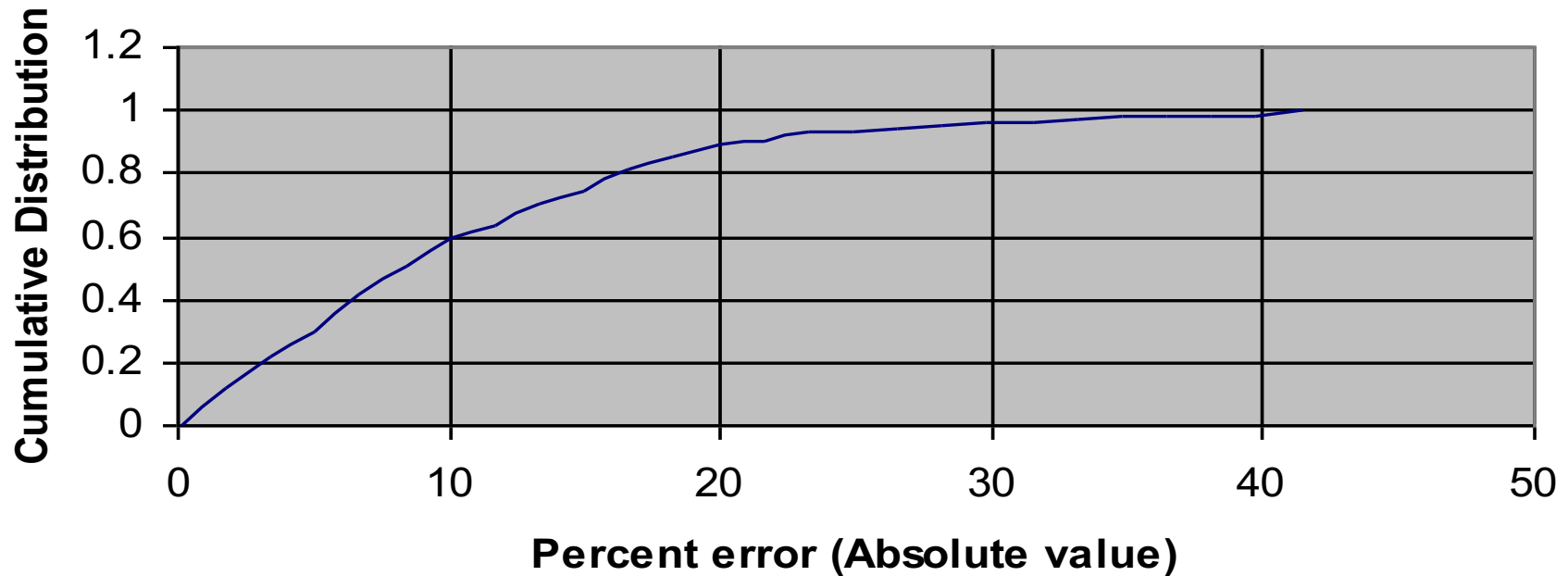
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Analysis of FAA Forecasts, 1

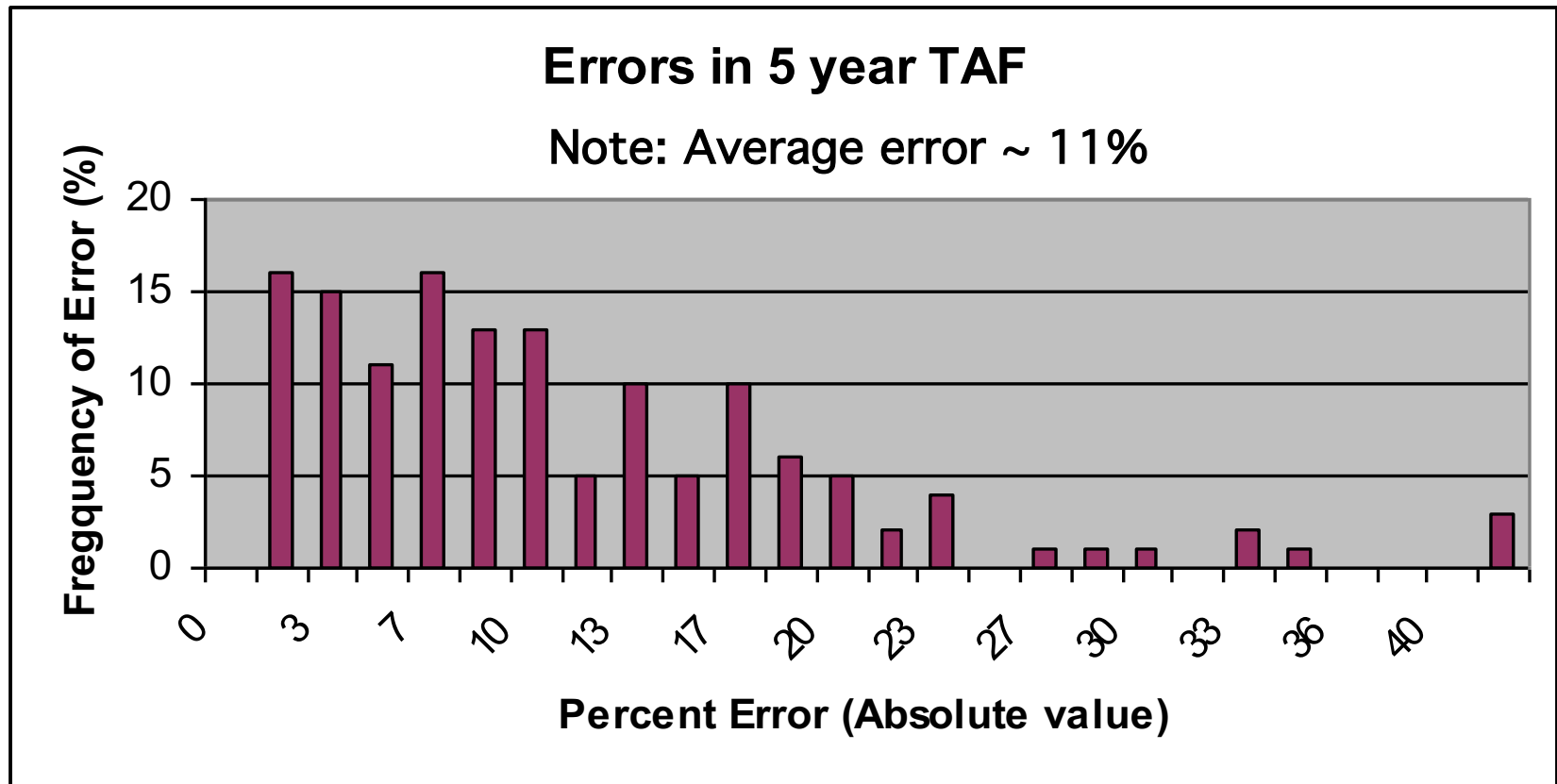
Errors in 5 year TAF



Adapted from: Terminal Area Forecast (TAF) Accuracy Assessment Results
Jerome Friedman, MITRE CAASD, Sept. 30, 2004

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Analysis of FAA Forecasts, 2



From: Terminal Area Forecast (TAF) Accuracy Assessment Results, Jerome Friedman, MITRE CAASD. Study dated Sept. 30, 2004, but data until 2000. Deliberate omission of 2001, 2002 – when traffic dropped enormously

Error Data from U.S

Source: MITRE CAASD and FAA

City	5 YEAR FORECAST FROM / TO			
	92 97	93 98	94 99	95 2000
ATL	10.8	-10	-15.5	-13.3
BOS	-0.8	-2.1	-0.2	8.9
BWI	27.4	6.3	-5.8	7.5
CLE	-13.4	-14.6	-17.5	-13.3
CLT	7.8	15.8	10.9	18.1
CVG	-0.9	-4.3	-14.5	-9.5
DCA	7.5	13.8	2.7	-5.1
DEN	18	19.6	19.9	5.5
DFW	2.6	-3.2	7.8	14.2
DTW	-13.2	-6.5	-8.6	3.1
EWR	-12.2	-5.9	-0.1	5
FLL	17.2	3.4	-3.8	-11.6
HNL	28.2	40.9	23	14.9
IAD	-6.4	-9.5	-41.4	-41.2
IAH	-8.1	-12.3	-8.9	-25.4
JFK	-0.9	6.2	11.7	3.8

Locid	City	Airport Name	Preliminary CY08 Total Enplanements	Forecast 2004 TAF in thousands	% Difference
CVG	Cincinnati	Cincinnati/Northern Kentucky International	6,488,422	13193	-103.3
IAD	Washington	Washington Dulles International	11,287,621	15861	-40.5
MDW	Chicago	Chicago Midway International	8,019,338	10714	-33.6
MSP	Minneapolis St. Paul	Minneapolis-St Paul International/Wold-Chamberlain	16,352,653	21361	-30.6
BWI	Baltimore Washington	Baltimore/Washington International Thurgood Marshal	10,206,399	13135	-28.7
HNL	Honolulu	Honolulu International	9,000,365	11483	-27.6
DTW	Detroit	Detroit Metropolitan Wayne County	16,993,820	20183	-18.8
LAX	Los Angeles	Los Angeles International	28,612,013	33628	-17.5
ORD	Chicago	Chicago O'Hare International	33,668,545	38760	-15.1
TPA	Tampa	Tampa International	8,869,806	10182	-14.8
BOS	Boston	General Edward Lawrence Logan International	12,784,965	14658	-14.7
LGA	New York	La Guardia	11,549,790	13225	-14.5
PHL	Philadelphia	Philadelphia International	15,577,122	17817	-14.4
PHX	Phoenix	Phoenix Sky Harbor International	19,433,827	22175	-14.1
FLL	Fort Lauderdale	Fort Lauderdale/Hollywood International	11,018,382	12557	-14.0
SLC	Salt Lake City	Salt Lake City International	9,889,030	11180	-13.1
MCO	Orlando	Orlando International	17,271,885	19192	-11.1
STL	St. Louis	Lambert-St Louis International	6,644,199	7359	-10.8
ATL	Atlanta	Hartsfield - Jackson Atlanta International	43,737,608	47130	-7.8
DFW	Dallas/Ft.Worth	Dallas/Fort Worth International	27,206,541	29202	-7.3
LAS	Las Vegas	McCarran International	21,011,949	22424	-6.7
SAN	San Diego	San Diego International	9,007,602	9437	-4.8
SFO	San Francisco	San Francisco International	18,101,502	18496	-2.2
IAH	Houston	George Bush Intercontinental/Houston	19,850,397	20070	-1.1
EWR	New York	Newark Liberty International	17,578,856	17604	-0.1
PDX	Portland	Portland International	7,073,767	6956	1.7
SEA	Seattle	Seattle-Tacoma International	15,815,133	15456	2.3
DCA	Washington	Ronald Reagan Washington National	8,692,131	8336	4.1
JFK	New York	John F Kennedy International	23,601,779	22306	5.5
DEN	Denver	Denver International	24,266,328	22817	6.0
MIA	Miami	Miami International	16,369,998	15369	6.1
CLT	Charlotte	Charlotte/Douglas International	17,271,119	14678	15.0

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**Actual 2008 traffic compared to that forecast
in 2004 TAF**

Source: US FAA

Sum	-426.5
Average	-13.3
Sum Absolute	507.7
Average Absolute	15.9

Actual vs. Forecast 10 years earlier

Source: FAA Aerospace Forecast FY 2006-2017

Domestic Commercial Emplanements	
Year being forecast	Actual vs. Forecast
1995	11.4
1996	12.2
1997	17.4
1998	14.9
1999	9.9
2000	5.5
2001	4.7
2002	14.5
2003	12.5
2004	20.0
2005	13.9
Median and Average	12.5

Note: These are aggregate data, in which greater local variations tend to cancel each other out

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International Passengers, Sydney

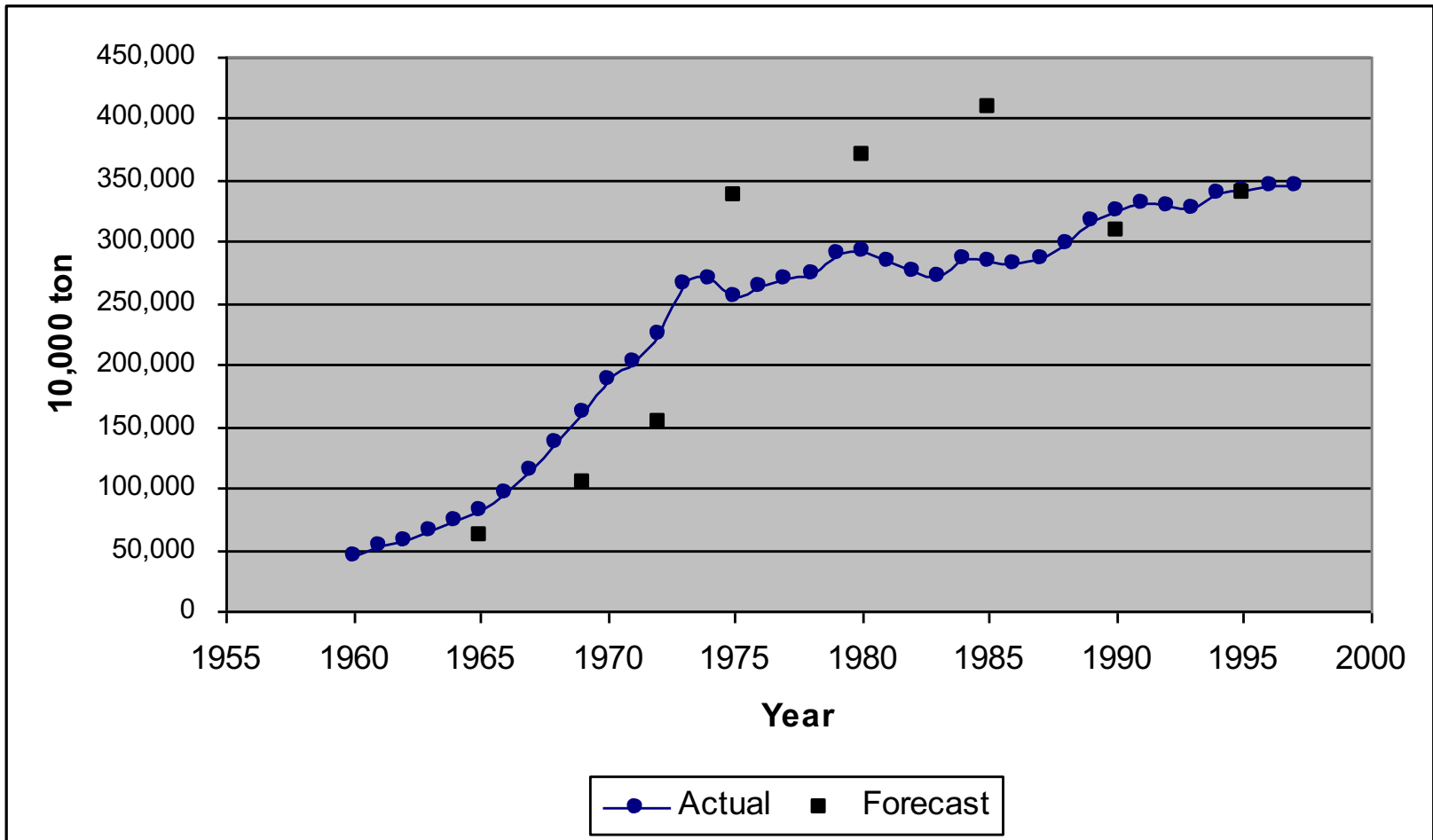
Forecast For Year	Source of Forecast, in Year		
	Consultant 1974	Regional Study 1978	National Ministry 1983
1980	3.77	2.98 - 3.46	
1985	7.4	3.87 - 4.34	2.674 - 3.047
1990	9.8	4.71 - 5.51	2.762 - 3.751
2000 projected	12.0	6.27 - 8.66	2.938 - 5.159
2000 actual	10		

Forecast vs. Actual International Pax in Japan

Forecast		Passengers (million)		Percent Error
For	Done In	Actual	Forecast	Difference/Actual
1980	1970	12.1	20.0	65
1985	1975	17.6	27.0	53
1990	1980	31.0	39.5	27
1995	1985	43.6	37.9	(13)

Forecast vs. Actual

International Pax to Japan

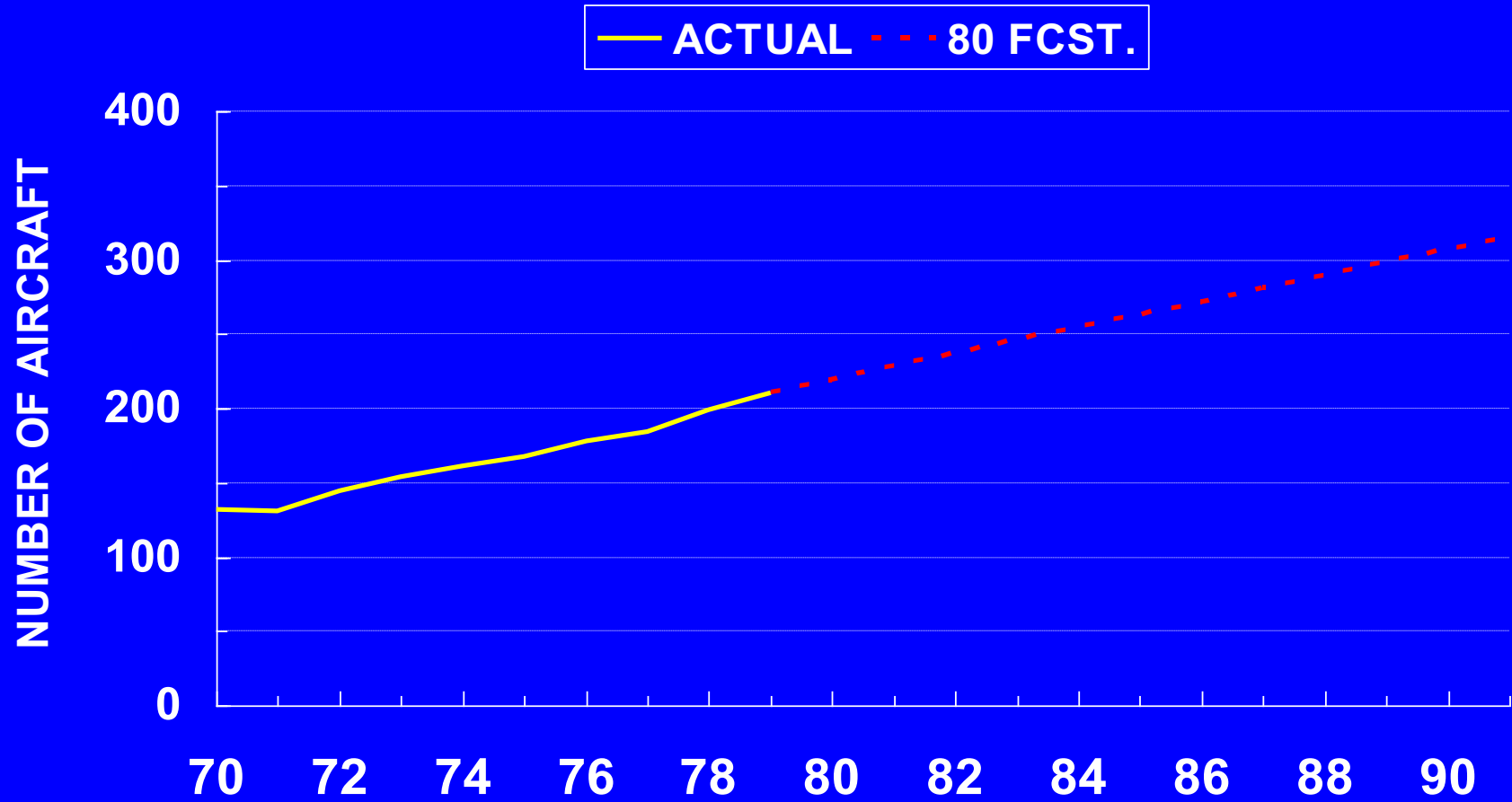


Notice the Pattern!

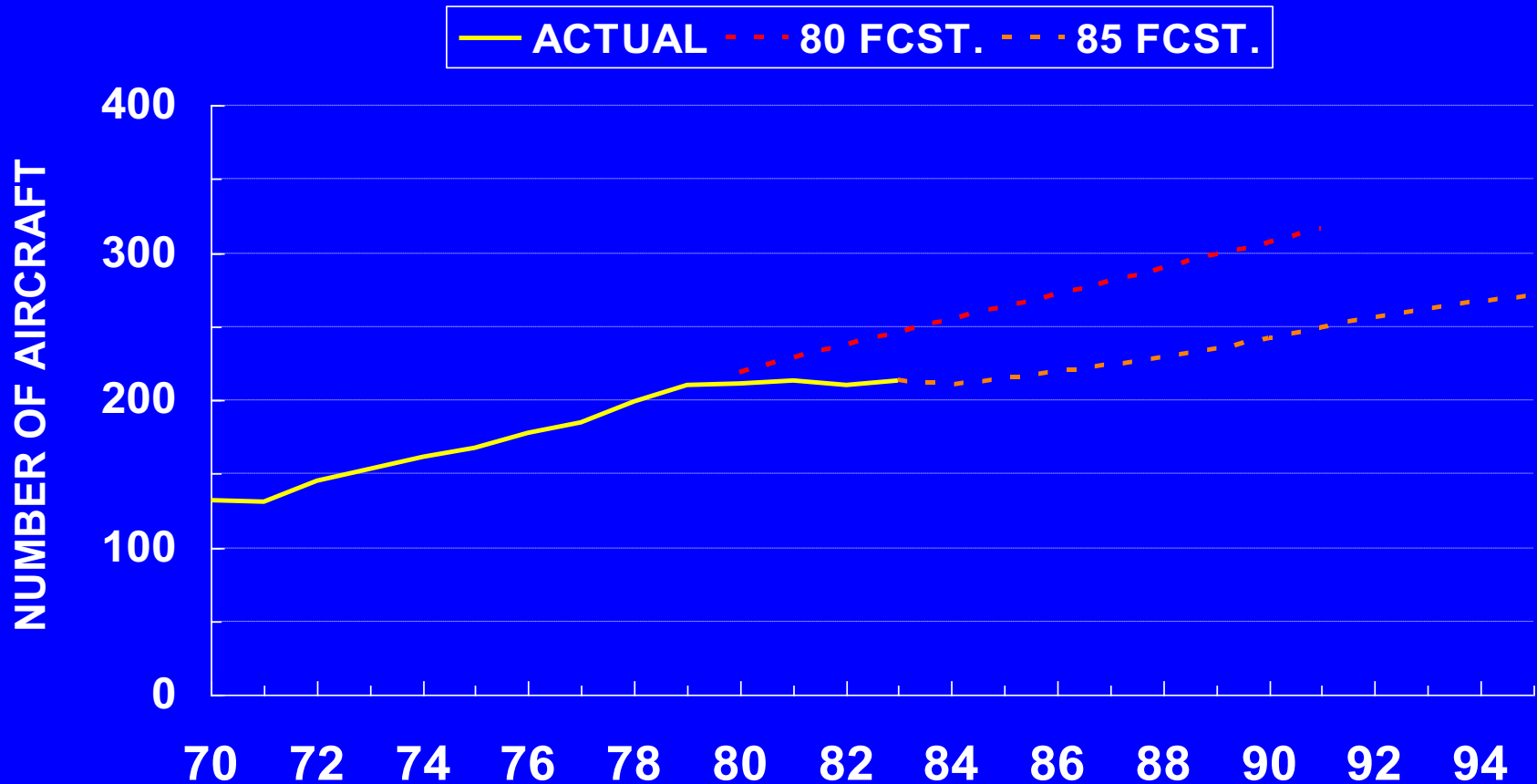
- **Forecasting is an exercise in projecting past into future – ...like steering car by looking into rear view mirror!**
- **Past low growth => under estimation**
- **Past high growth => over estimation**

Almost never right!

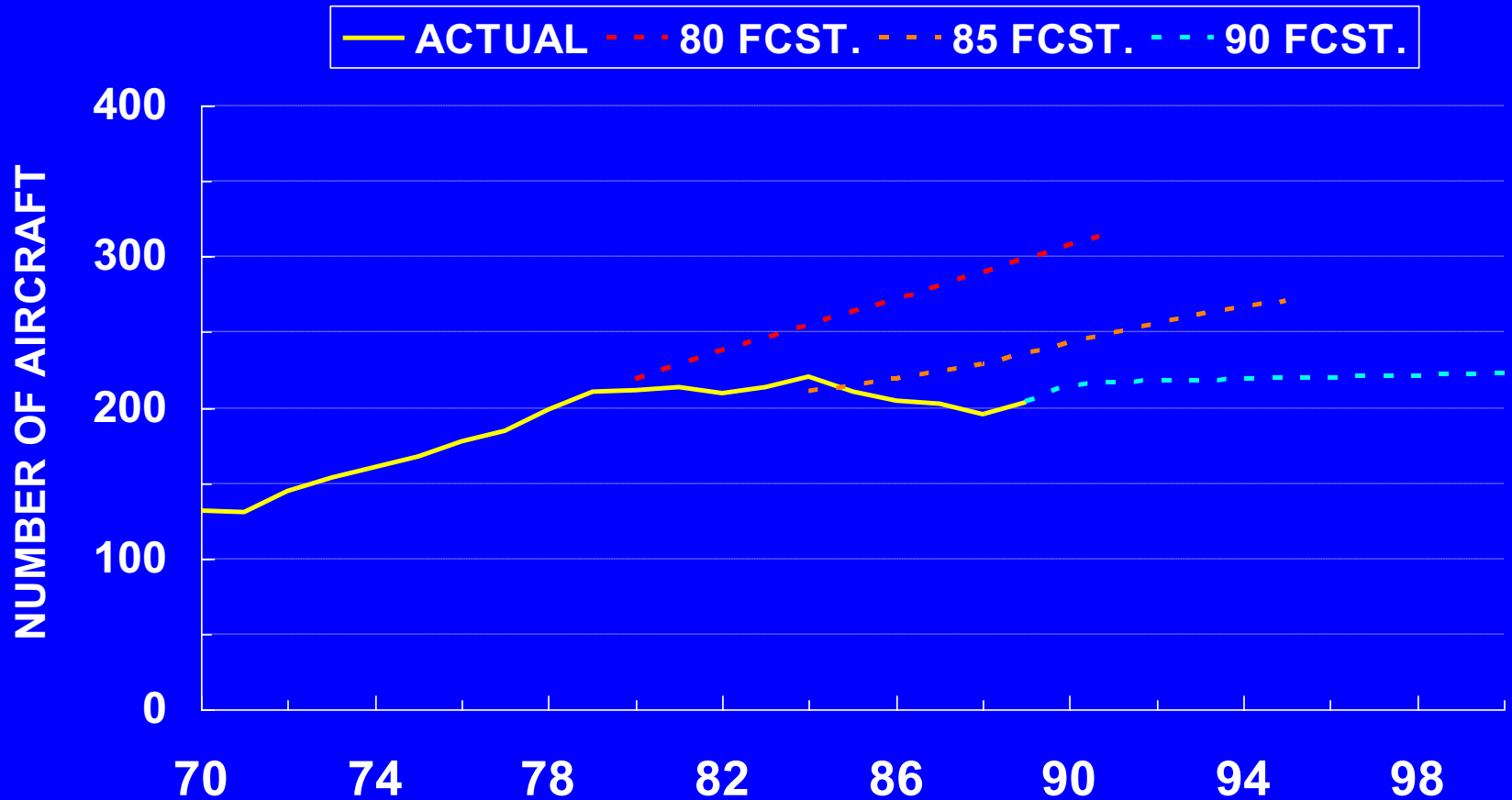
ACTIVE GENERAL AVIATION AIRCRAFT 1980 FORECAST



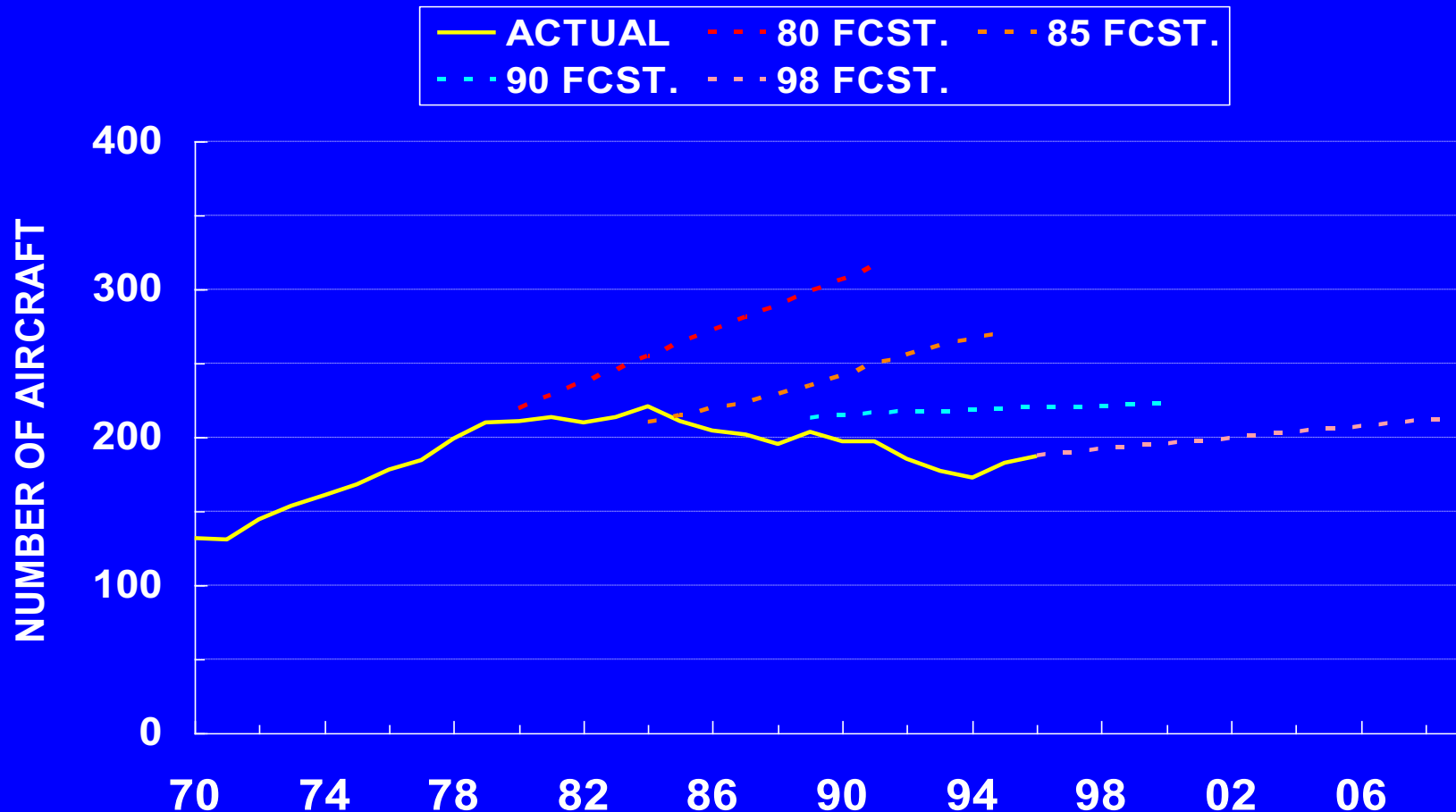
ACTIVE GENERAL AVIATION AIRCRAFT 1985 FORECAST



ACTIVE GENERAL AVIATION AIRCRAFT 1990 FORECAST

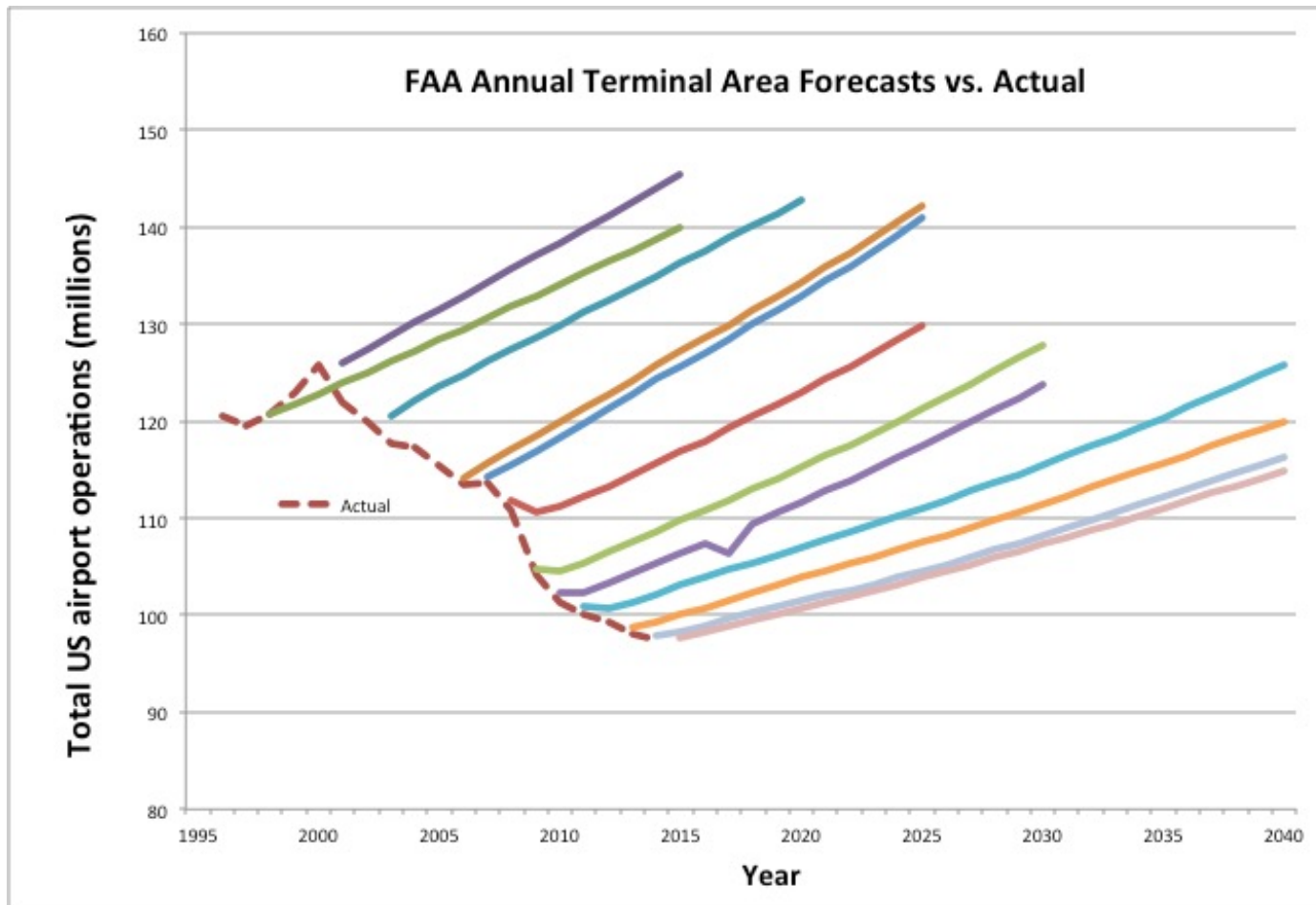


ACTIVE GENERAL AVIATION AIRCRAFT 1998 FORECAST



Terminal Area Forecasts vs Actual

“Porcupine” Diagram



Summary

- **Summary**

- Forecast Errors have been large
- Likely to continue

- **Recommendations:**

- Use general trends
- ...With large ranges
- Flexible Approach to Design!!!

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IDS.333 Risk and Decision Analysis
Fall 2021

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