DEMAND FORECAST

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Demand Forecasting

Outline

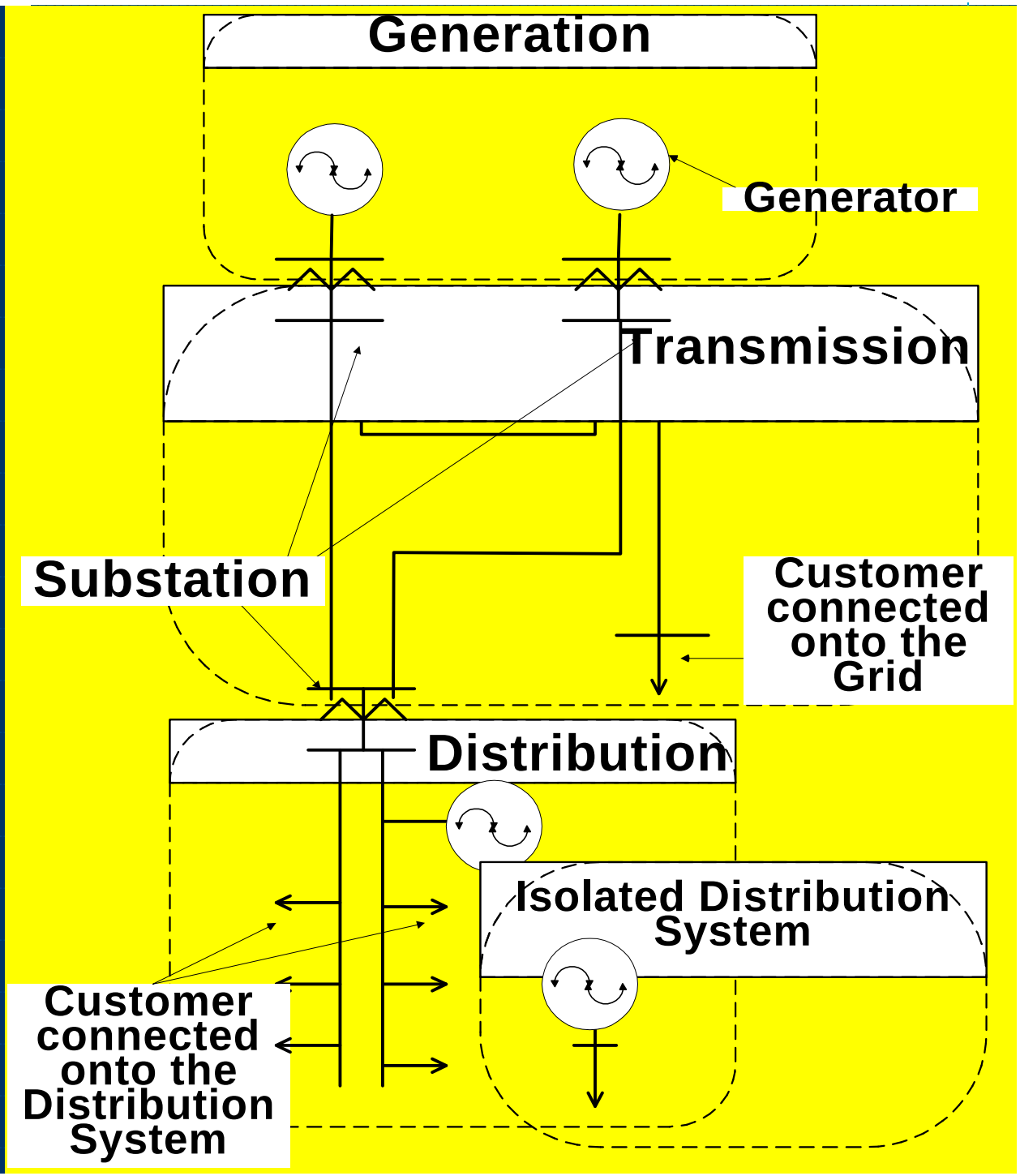
- Power System Structure
- Demand Forecasting Process
- Assumptions
- Scenario Results and Trend Checking
- Recommendations

Power System Structure
Before and After Restructuring

- Power system facilities will not change after restructuring
- Energy transfer structure (Real Time) among entities will change
- Transactions (including Forward, Future and Real Time) will change drastically

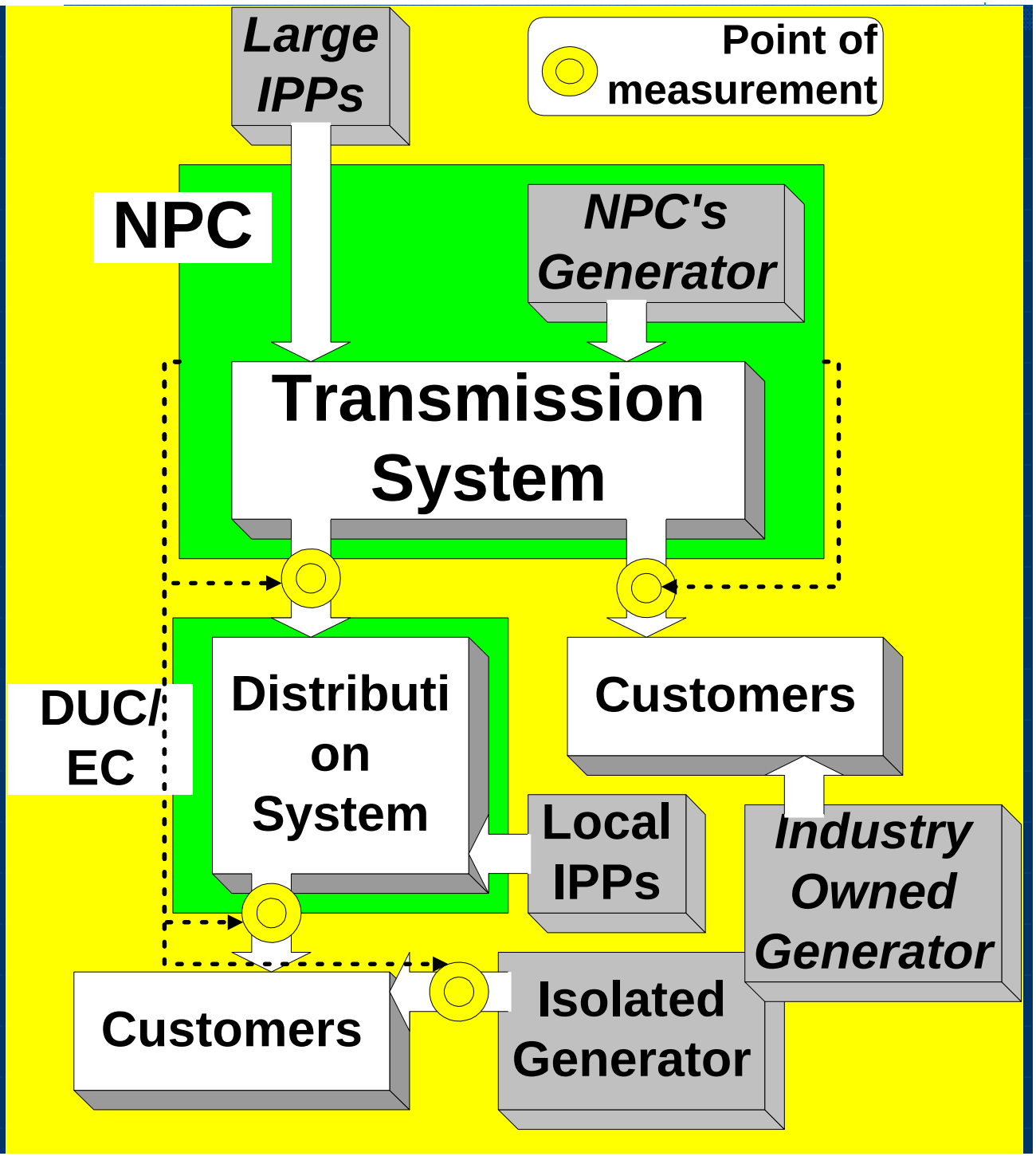
Power System Structure

[Before] and [After] the restructuring of power sector, system facilities will not change



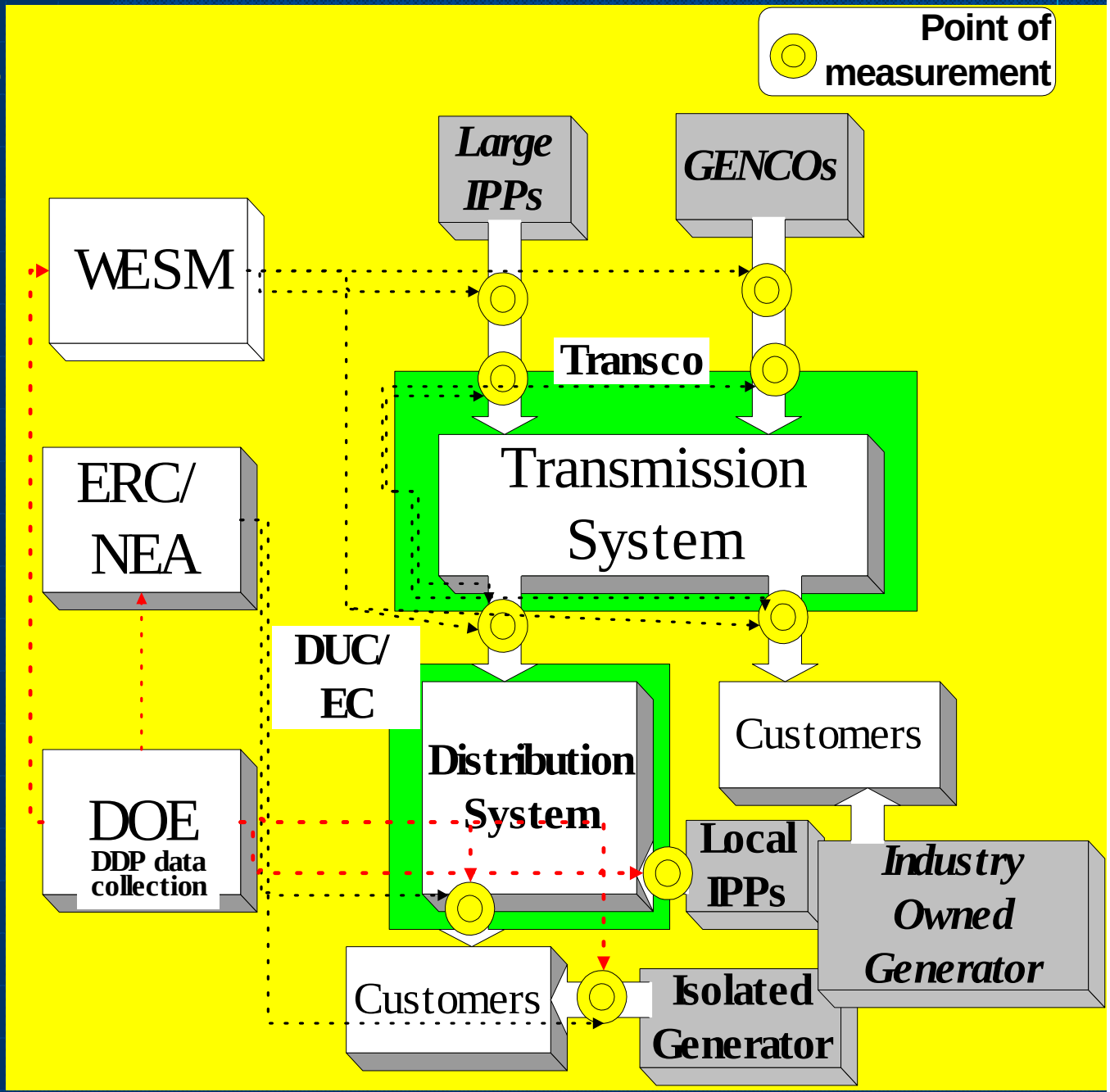
Power Measurement point *[Before]* Restructuring

NPC collect sales data by customer from distribution utilities



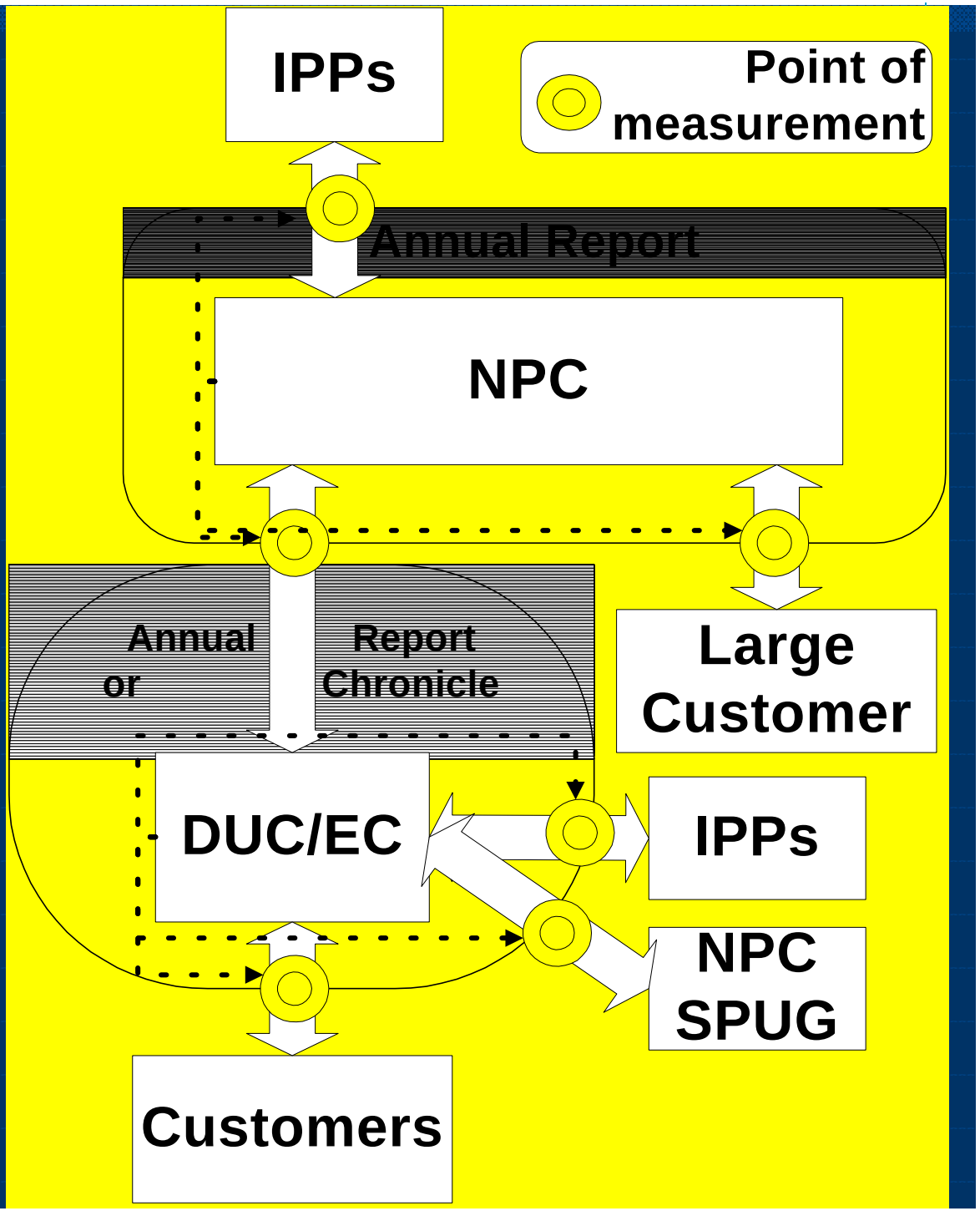
Power Measurement point *[After]* Restructuring

With restructuring, NPC's generation and transmission activities will be unbundled. DOE monitoring will rely on data collected from WESM and distribution utilities.



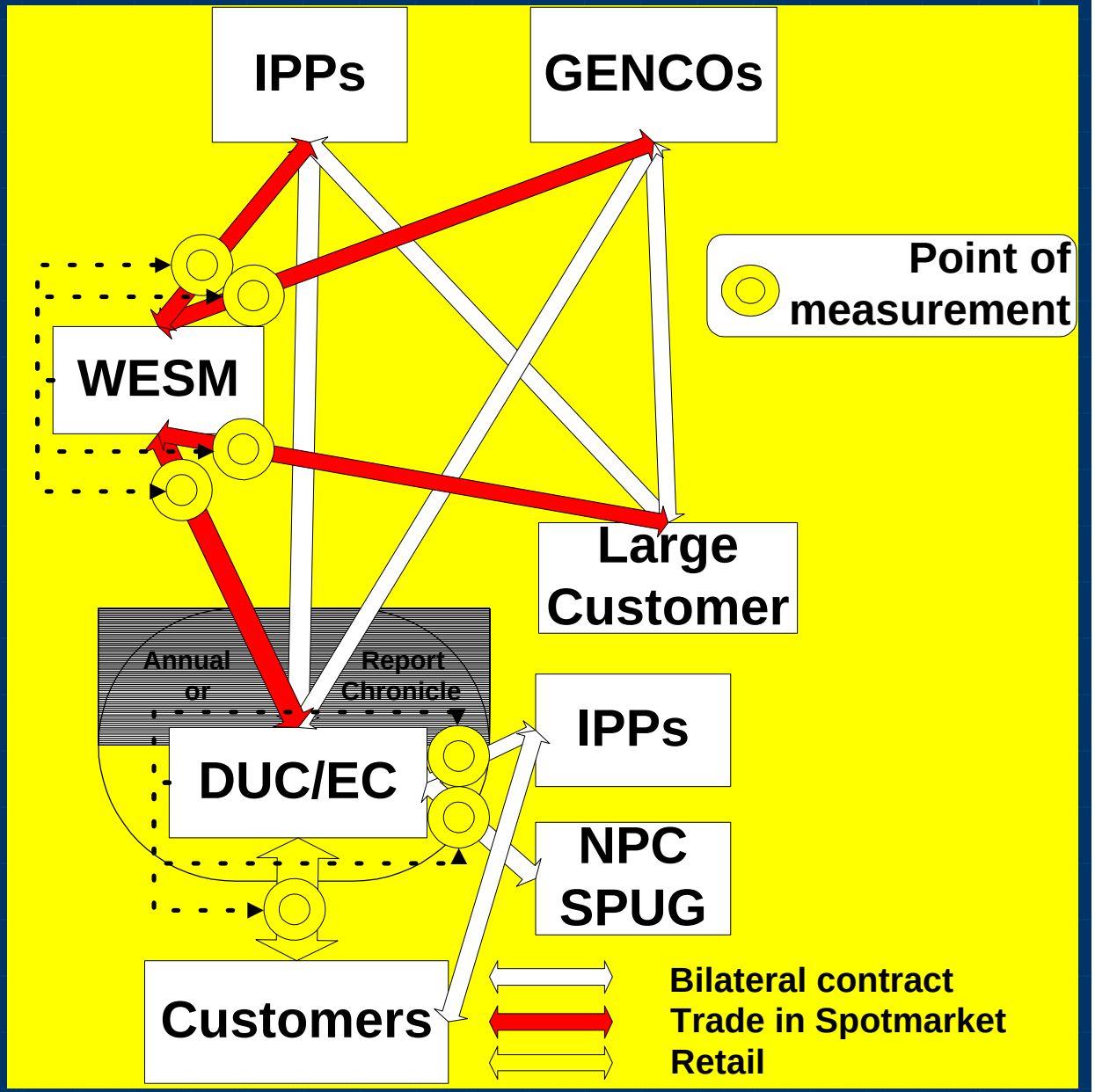
Transaction *[Before]* Restructuring

Transactions among entities are simpler than after restructuring



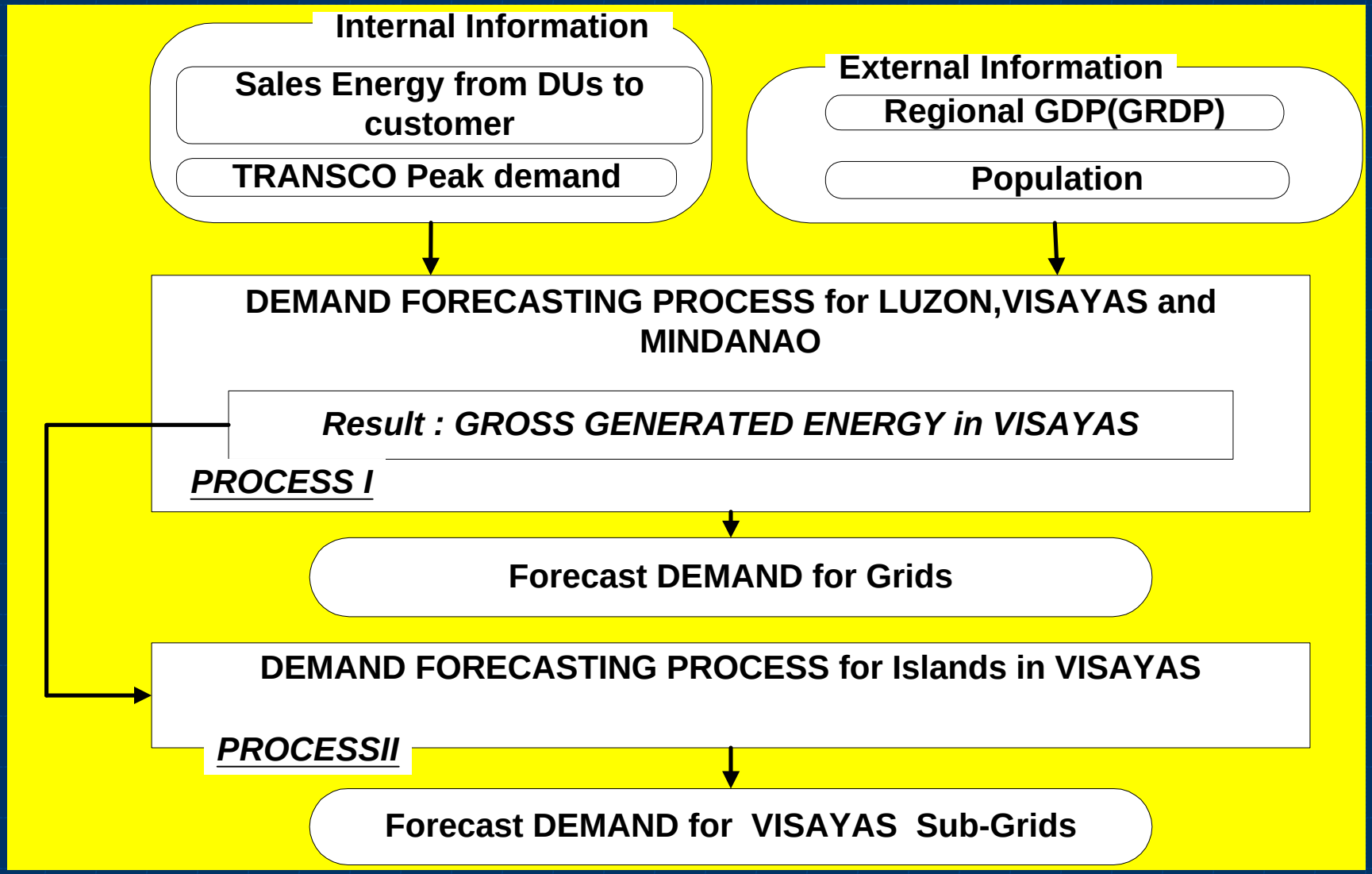
Transaction *[After]* Restructuring

- Transactions among entities becomes complicated
- Bilateral transaction and spot market trading exists
- Possibility of double counting
- Real energy sales and purchases data from DUs and GENCOs are necessary



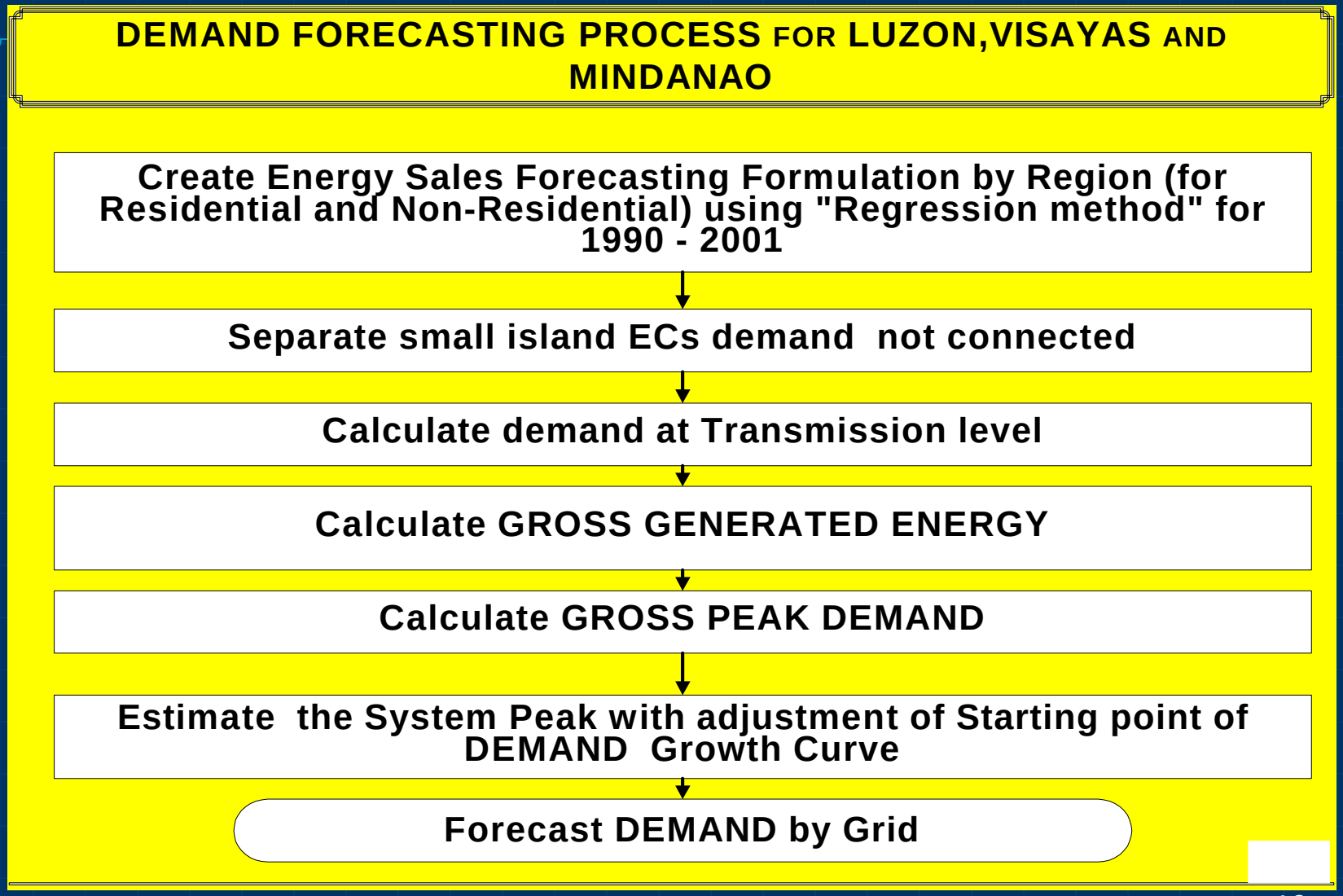
Demand Forecasting

Process Flow



Demand Forecasting

Flow (Process I)



Demand Forecasting

Flow (Process II)

DEMAND FORECASTING PROCESS FOR VISAYAS SUB-GRIDS

Calculate Sales data, and converge to transmission level Demand

↓

Calculate GROSS PEAK DEMAND by islands

↓

Estimate the System peak and then adjust Starting point of DEMAND Growth Curve"

↓

Forecast DEMAND for Visayas Sub-Grids

Demand Forecasting Process

1. Forecast Sales

- **Regression model for estimation of "Regional Sales Energy of Distribution Companies", Data from 1990-2001**

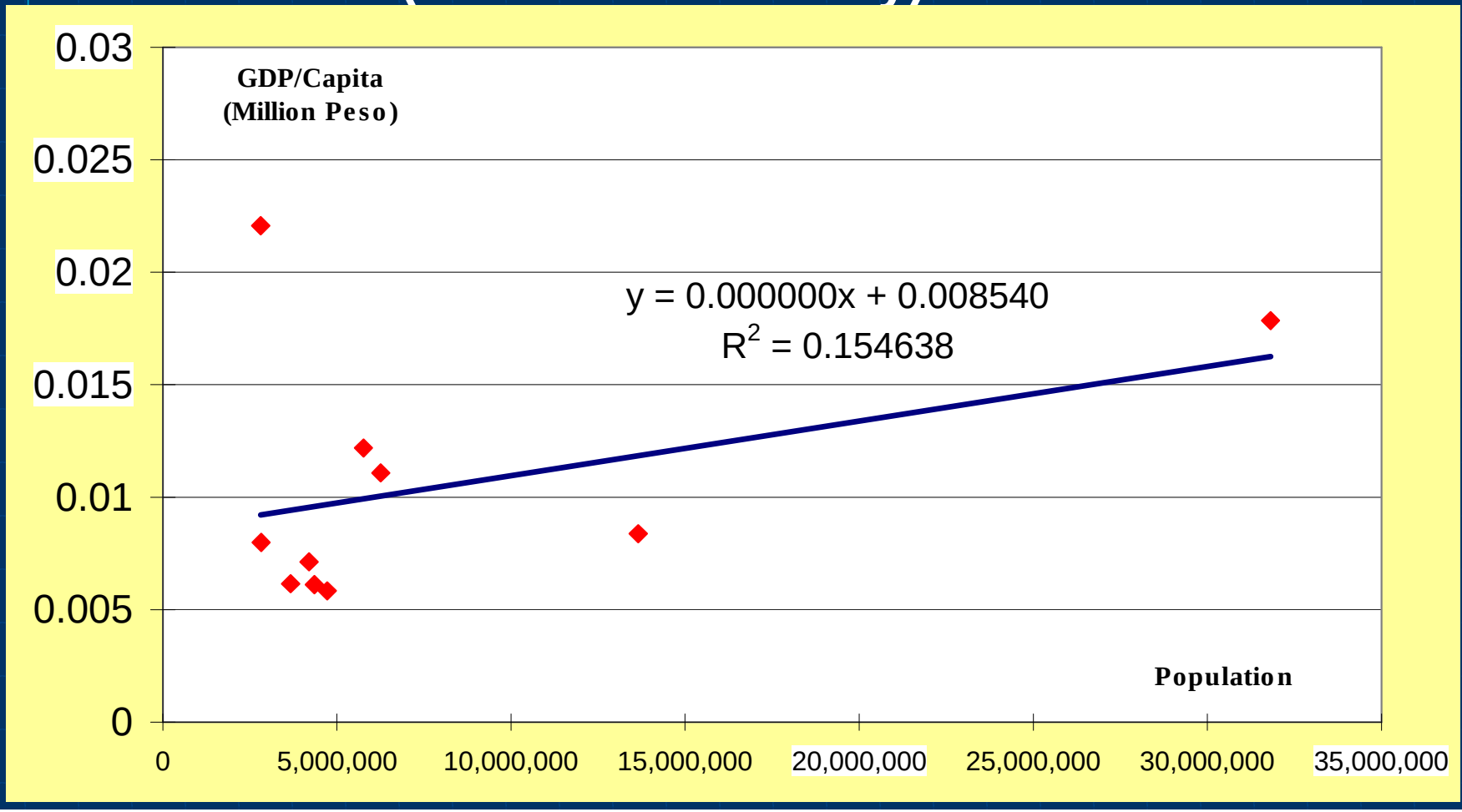
Residential Sales(GWh) **= a + b*Regional Population + c* Regional GDP/Capita**

Non-Residential (GWh) **= a + b*Regional GDP**

Demand Forecasts Variables

GDP/Capita and Population

- **GDP/Capita and Population are not highly correlated (no multicollinearity)**



Demand Forecasting Process

2. Estimate Gross Generation

Gross Generation (GWh) by Grid

- **Energy Sales in Distribution * (1+ AF)**

where:

AF - Adjustment factor

- % average from 1999 to 2001 of:
  1) Sales on Transmission
  2) Distribution and Transmission Losses
  3) Generation for own Use

Note: After WESM starts, AF can be estimated from settlement data recorded in WESM

Demand Forecasting Process

3. Estimate Peak Demand

- Gross Peak Demand (MW)

  = (Gross Generated Energy (GWh) * 1000) /

  8760Hours / Load Factor

4. Adjust Base Year (Starting Point)

a. Demand forecasts by Grid (2002-2015) were results of the models based on the historical sales data of the DUs from 1990 to 2001

b. Final demand forecasts were adjusted to reflect actual peak demand in 2002 and then applied the growth rates obtained in (a) to 2003 up to 2015

Demand Forecasting Process

Adjusting the Starting point

Original Result

	NEDA LOW GDP CASE			
	Phils	Luzon	Visayas	Mindanao
2002	**7,753**	5,850	910	993
2003	**8,276**	6,251	978	1,047
2004	**8,885**	6,720	1,055	1,110
2005	**9,558**	7,239	1,140	1,179
2006	**10,314**	7,823	1,234	1,256
2007	**11,045**	8,391	1,326	1,328
2008	**11,869**	9,031	1,429	1,409
2009	**12,756**	9,722	1,539	1,495
2010	**13,686**	10,448	1,655	1,583
2011	**14,662**	11,213	1,777	1,673
2012	**15,687**	12,017	1,905	1,765
2013	**16,763**	12,864	2,040	1,860
2014	**17,894**	13,756	2,182	1,956
2015	**19,082**	14,695	2,331	2,055

Adjusted Result

NEDA LOW GDP CASE			
Total Ph.	Luzon	Visayas	Mindanao
7,970	6,039	936	995
8,508	6,454	1,006	1,049
9,134	6,937	1,085	1,112
9,827	7,473	1,172	1,181
10,604	8,076	1,269	1,259
11,357	8,662	1,363	1,331
12,204	9,323	1,469	1,412
13,117	10,036	1,582	1,498
14,074	10,786	1,702	1,586
15,079	11,575	1,827	1,676
16,133	12,406	1,959	1,769
17,241	13,280	2,097	1,864
18,404	14,201	2,243	1,960
19,627	15,171	2,397	2,060

1. Adjust 2002 data to actual

2. Calculate demand from 2003 using same elasticity as in the original forecasting results

Demand Forecasting Process

Demand Disaggregation by Islands (Visayas)

- Determine sales data of each DUs in the Visayas (Regions 6 to 8) and their % share to the total sales of the Visayas region
- Estimate future share of sales using trend of % share of sales in Visayas.
- Compute "Gross Generation" by using the "Energy Sales" by Island obtained in #2 by using the formula below:

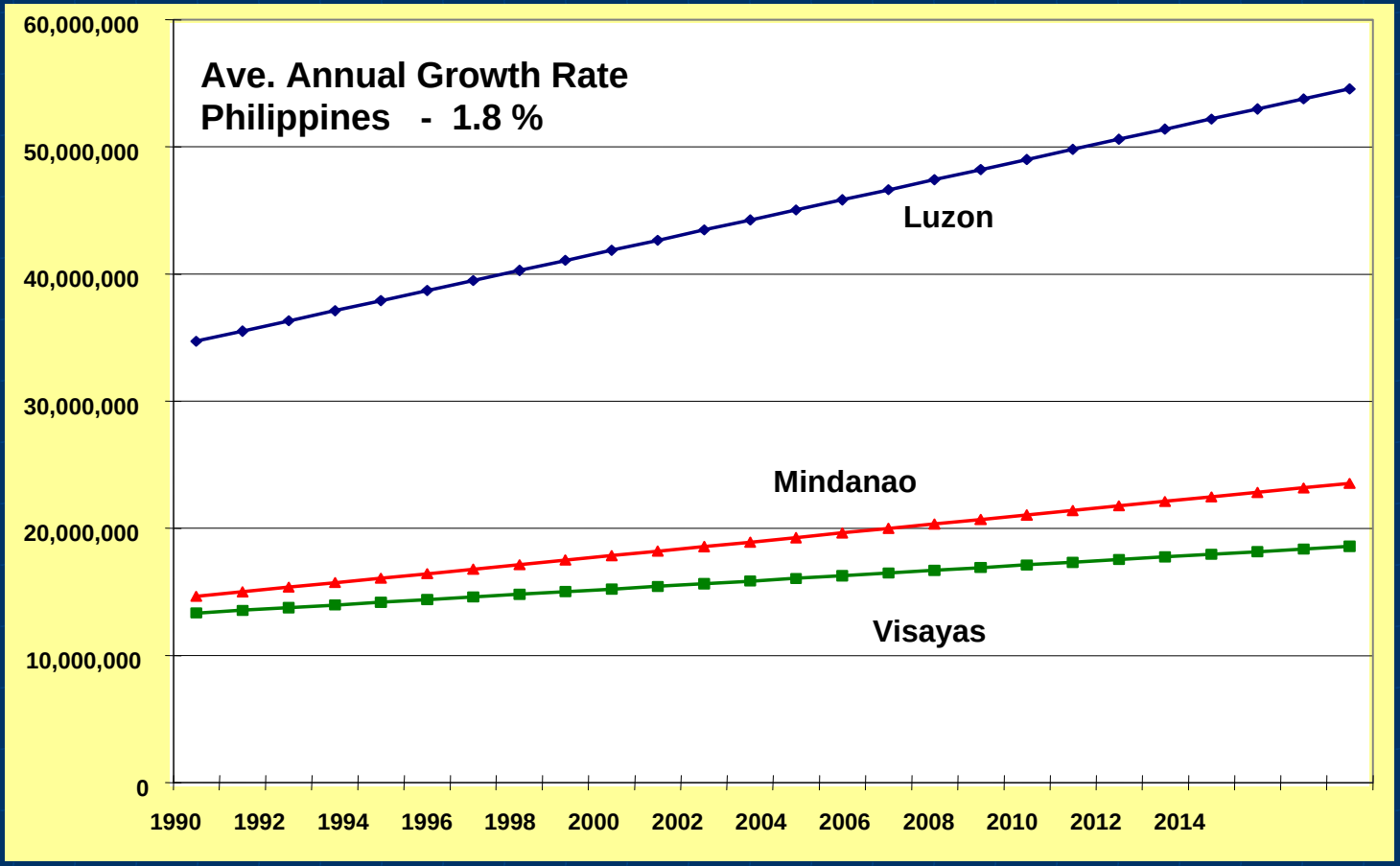
Gross Generated Energy(GWh)

= Energy Sales of DUs * (1+AF)

Assumptions

Population

- Based on official NSO-NSCB's population projections (national and regional)



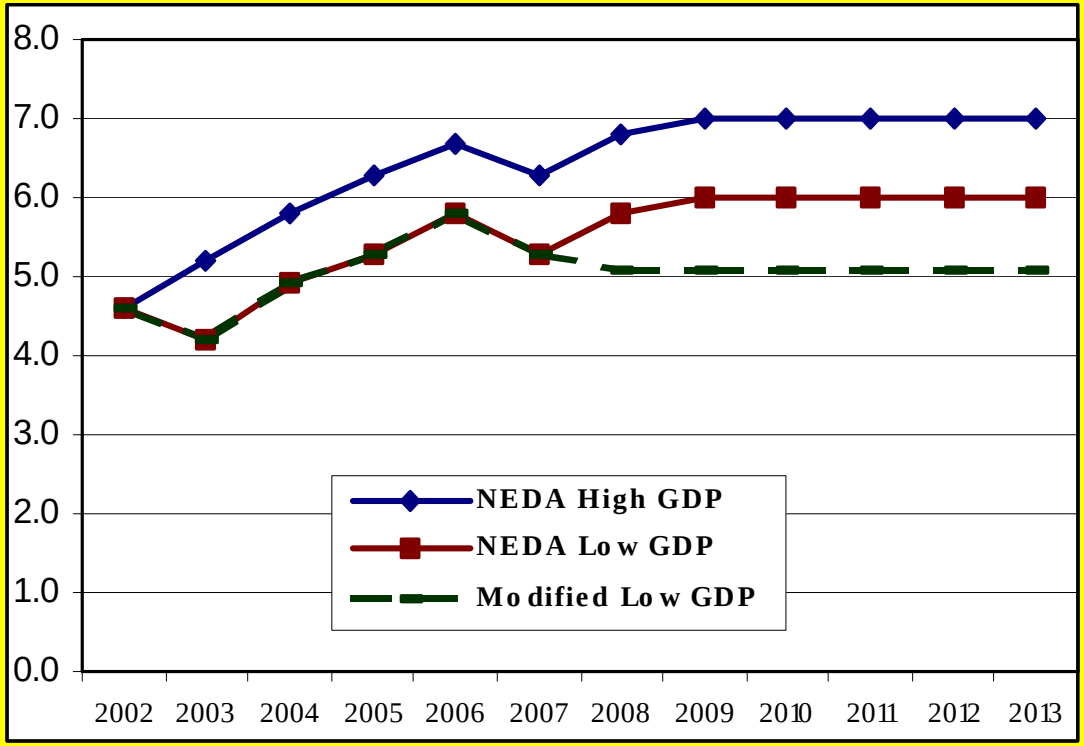
Assumptions

GDP

- NEDA's GDP Projections
  - **Low**
  - **High**
  - **Modified Low GDP**

In %

	NEDA High GDP	NEDA Low GDP	Modified Low GDP
2002	4.6	4.6	4.6
2003	5.2	4.2	4.2
2004	5.8	4.9	4.9
2005	6.3	5.3	5.3
2006	6.7	5.8	5.8
2007	6.3	5.3	5.3
2008	6.8	5.8	5.1
2009	7.0	6.0	5.1
2010	7.0	6.0	5.1
2011	7.0	6.0	5.1
2012	7.0	6.0	5.1
2013	7.0	6.0	5.1
AAGR(%)	**6.6**	**5.6**	**5.1**



Assumptions

Load factors

- Load Factors assumed constant

  (Based on Assumptions in 2002 PDP)

Grid	Load Factor (%)
Phils	**59.0**
Luzon	**71.2**
Visayas	**70.0**
Leyte-Samar	66.0
Cebu	64.0
Negros	52.0
Panay	59.0
Mindanao	**70.0**

FORECAST SCENARIOS AND RESULTS

Demand Forecasts

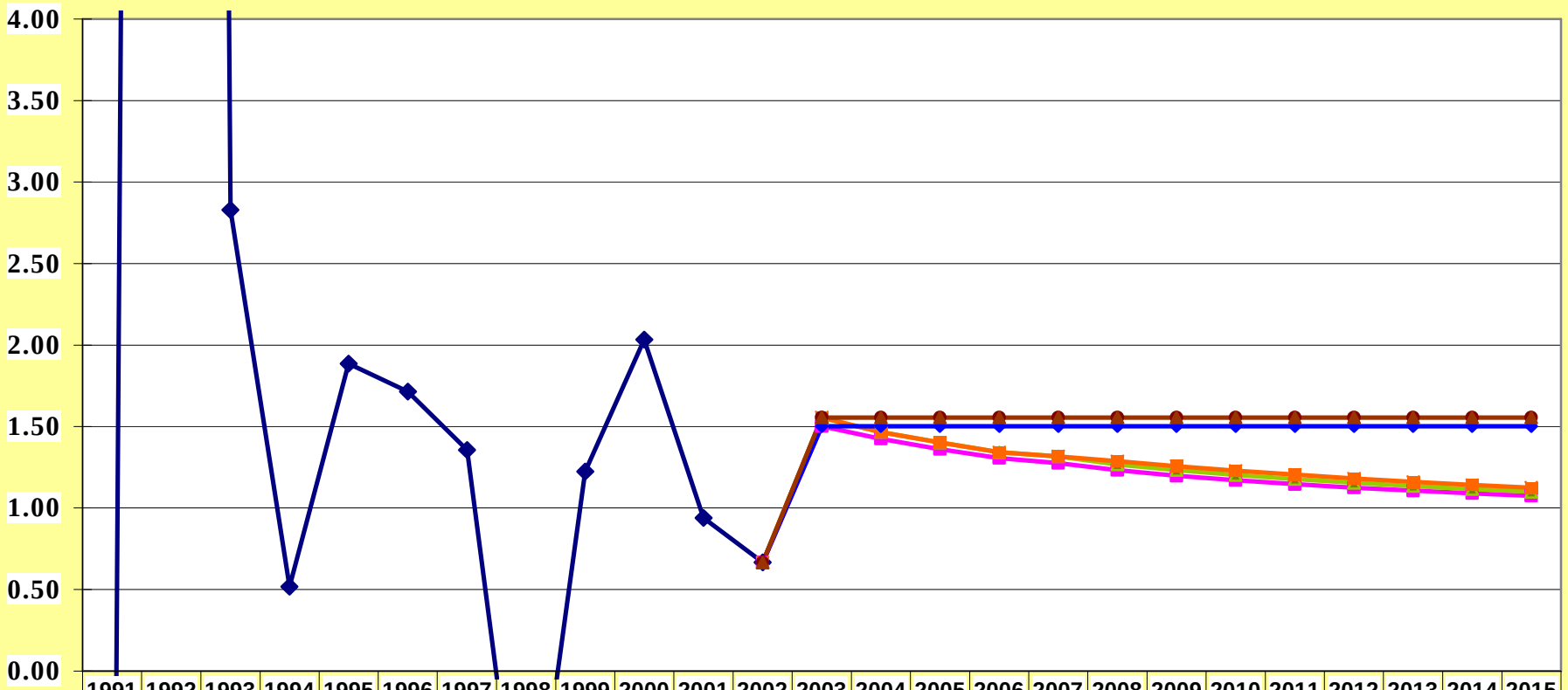
Scenarios

- **Scenarios are combination of the following**:

- Elasticity
  - Declining (D) – result of original forecast models
  - Constant (C) - assumes 2003 elasticity
- GDP
  - Low (L)
  - High (H)
  - Modified (M)

Elasticity Trend

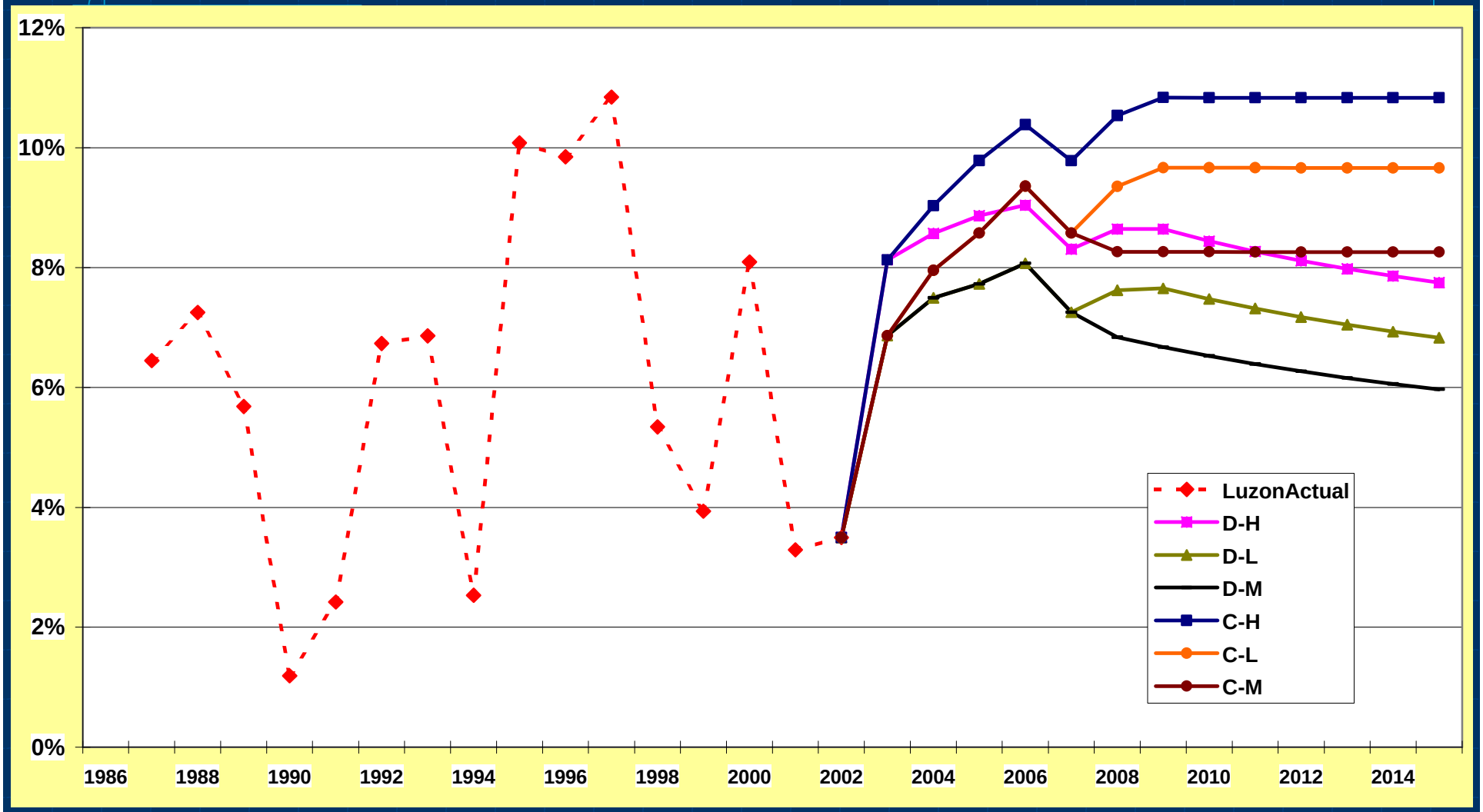
Luzon



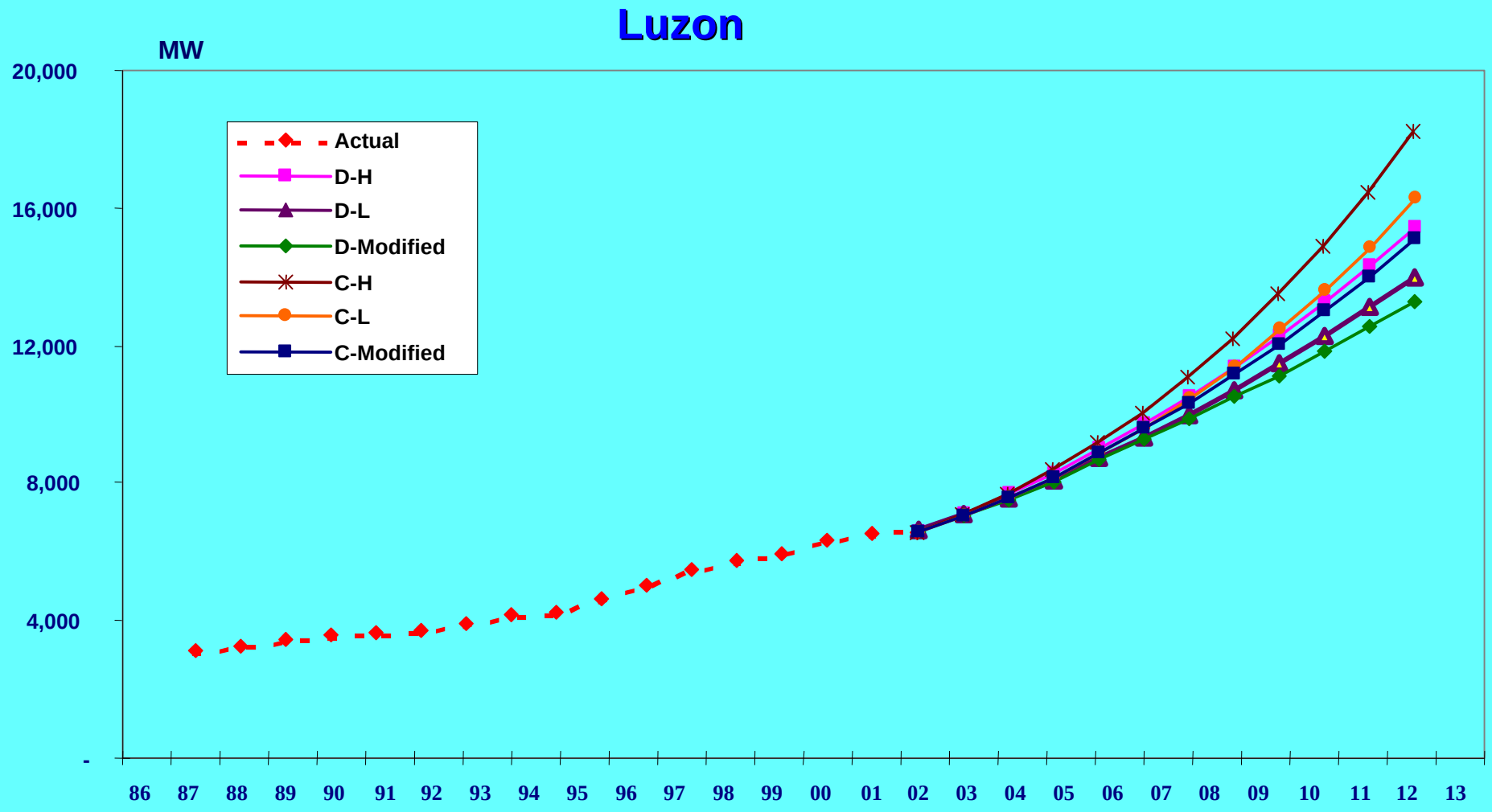
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Actual	-3.82	85.76	2.83	0.52	1.88	1.71	1.36	-1.42	1.22	2.03	0.94	0.67													
D-H												0.67	1.50	1.42	1.36	1.31	1.28	1.23	1.20	1.17	1.15	1.12	1.11	1.09	1.07
D-L												0.67	1.56	1.47	1.40	1.34	1.32	1.27	1.23	1.20	1.18	1.15	1.13	1.12	1.10
D-M												0.67	1.56	1.47	1.40	1.34	1.32	1.29	1.26	1.23	1.20	1.18	1.16	1.14	1.12
C-H												0.67	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
C-L												0.67	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
C-M												0.67	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56

Demand Growth Rate Trend

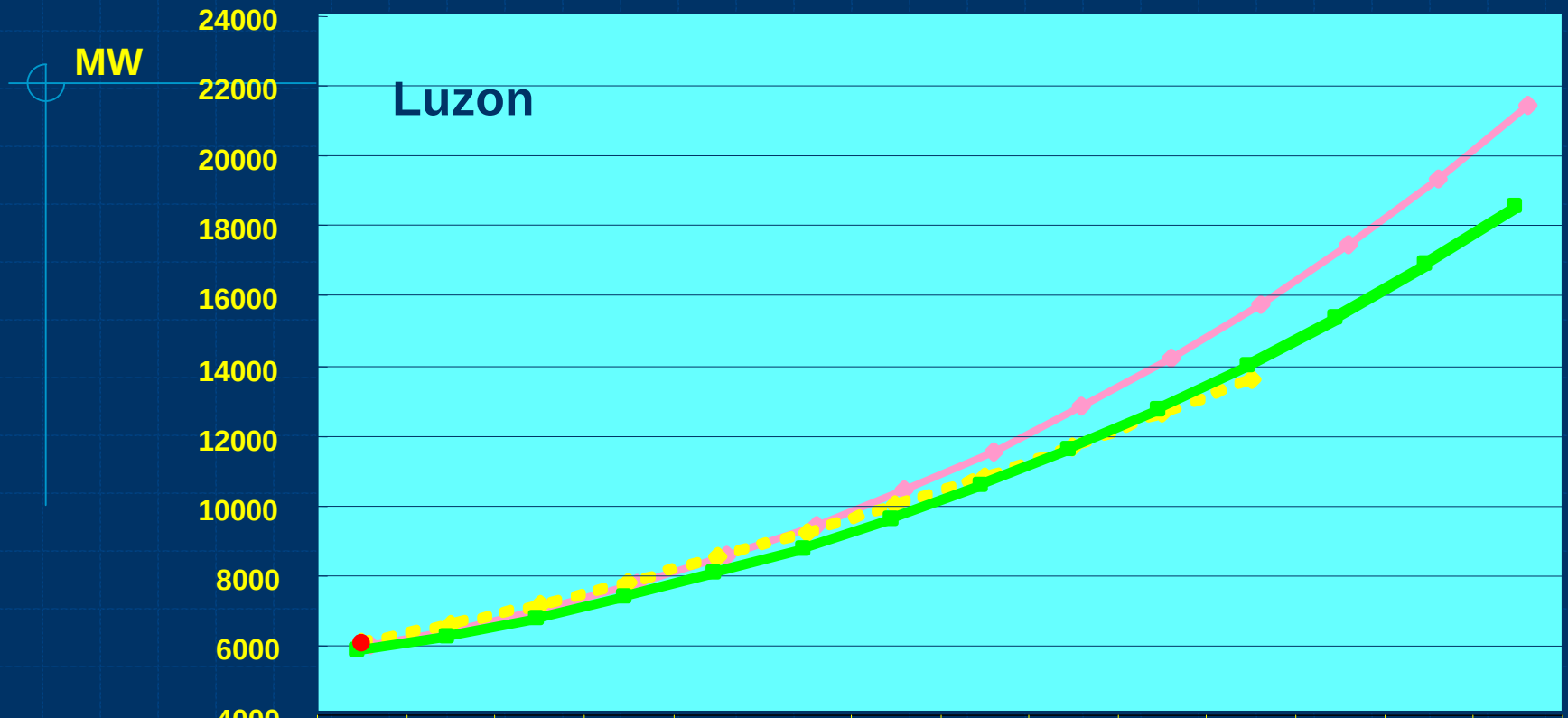
Luzon



Demand Scenario



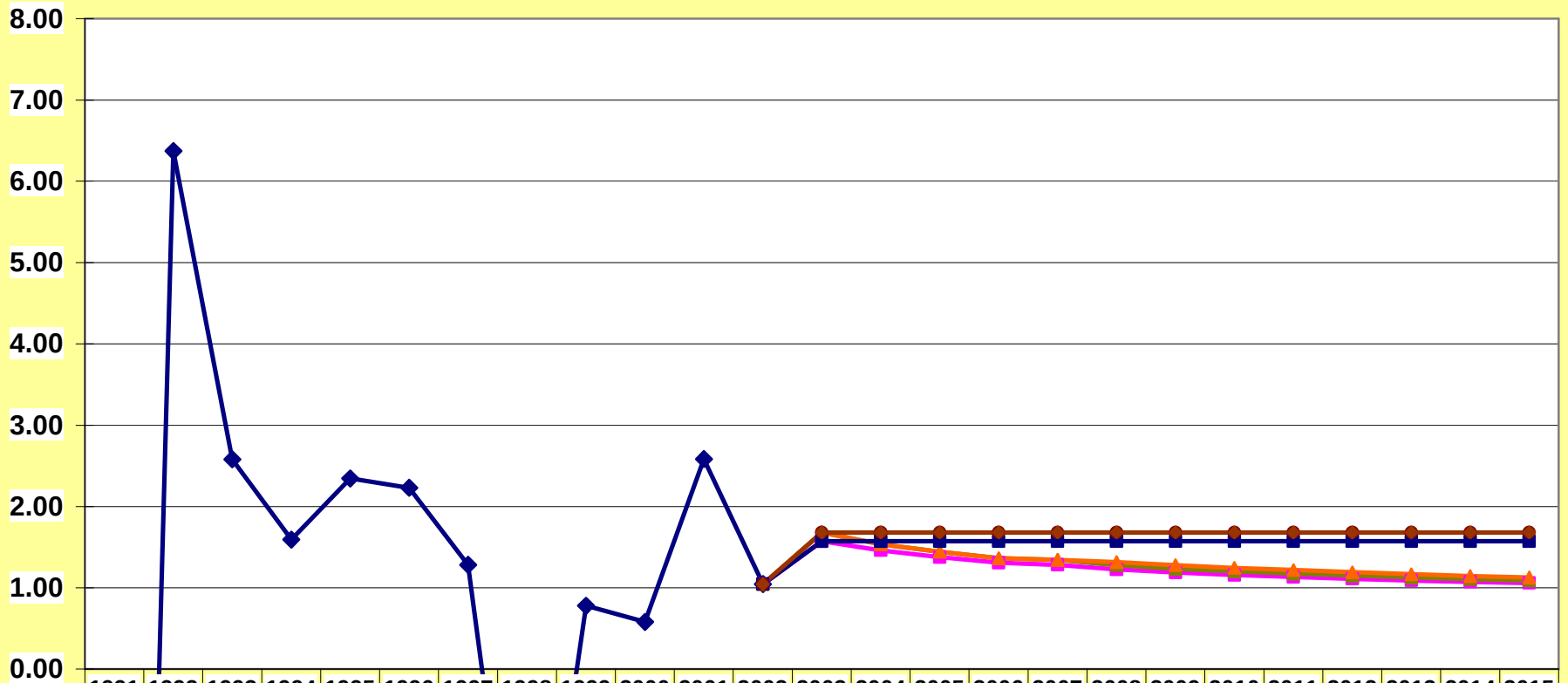
Peak Demand



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
PDP 2003 High GDP	6039	6530	7120	7816	8628	9472	10470	11605	12862	14256	15800	17512	19409	21511
PDP 2003 Low GDP	6039	6454	6967	7564	8272	8982	9822	10771	11812	12954	14206	15579	17084	18735
PDP 2002 Low GDP	6307	6788	7357	7994	8711	9438	10186	10992	11862	12804	13815			
Actual	6039													

Elasticity Trend

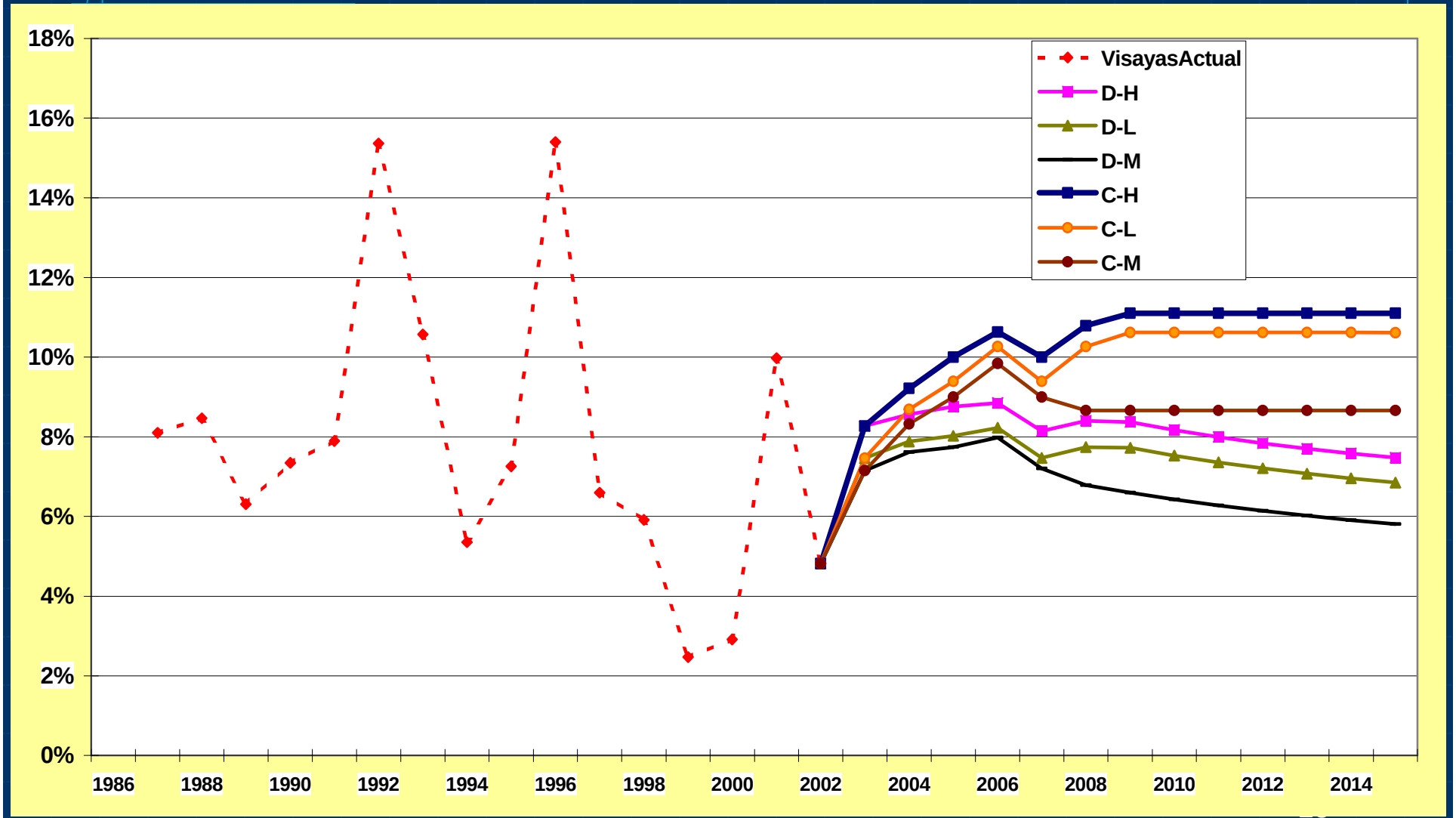
Visayas



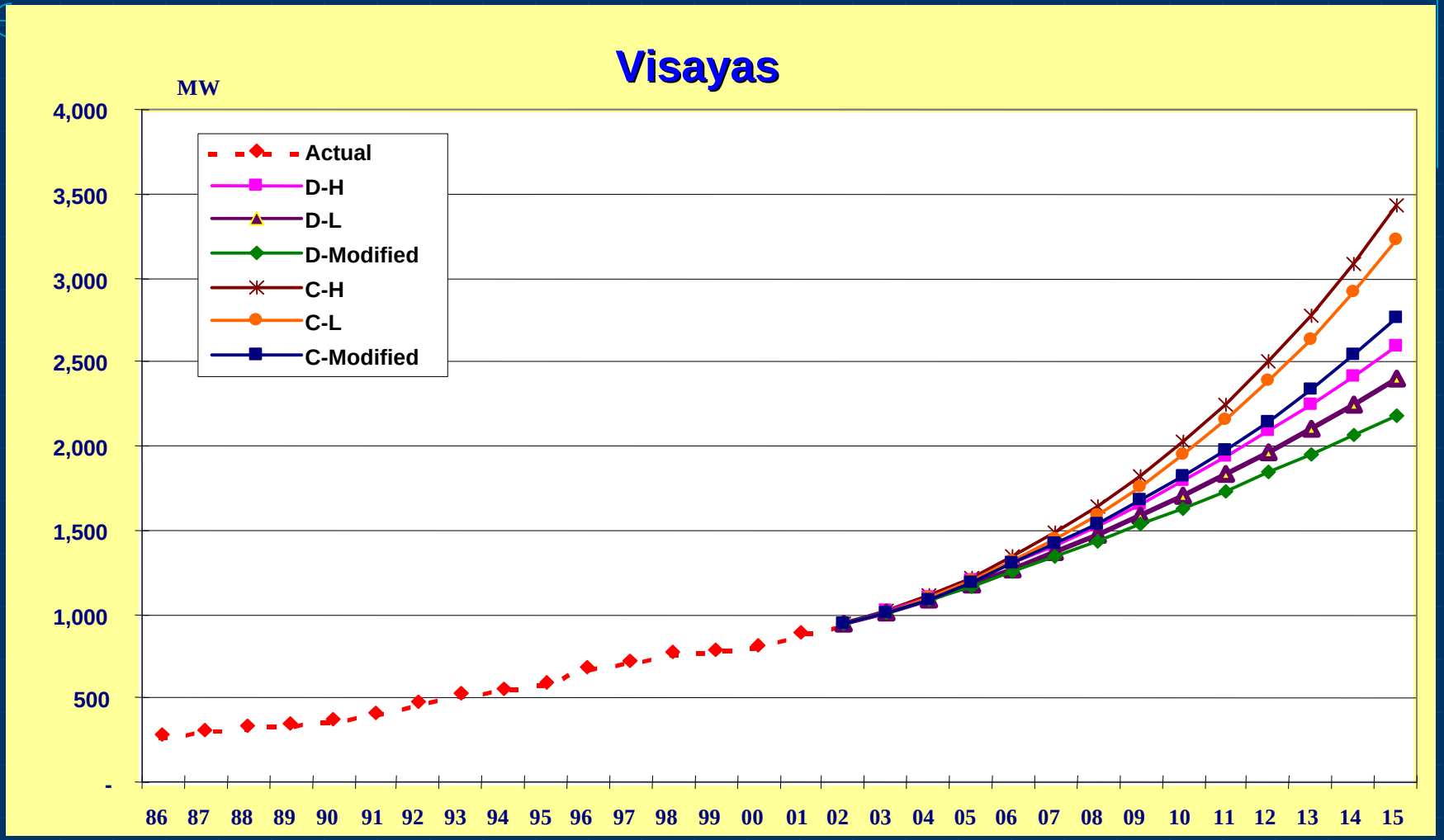
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Actual	-20.1	6.37	2.58	1.59	2.34	2.23	1.28	-4.17	0.78	0.58	2.58	1.05													
D-H												1.05	1.57	1.46	1.38	1.31	1.28	1.22	1.19	1.16	1.13	1.11	1.09	1.07	1.06
D-L												1.05	1.68	1.54	1.44	1.36	1.34	1.28	1.23	1.20	1.17	1.15	1.13	1.11	1.09
D-M												1.05	1.68	1.54	1.44	1.36	1.34	1.31	1.28	1.25	1.22	1.19	1.17	1.14	1.13
C-H												1.05	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57
C-L												1.05	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
C-M												1.05	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68

Demand Growth Rate Trend

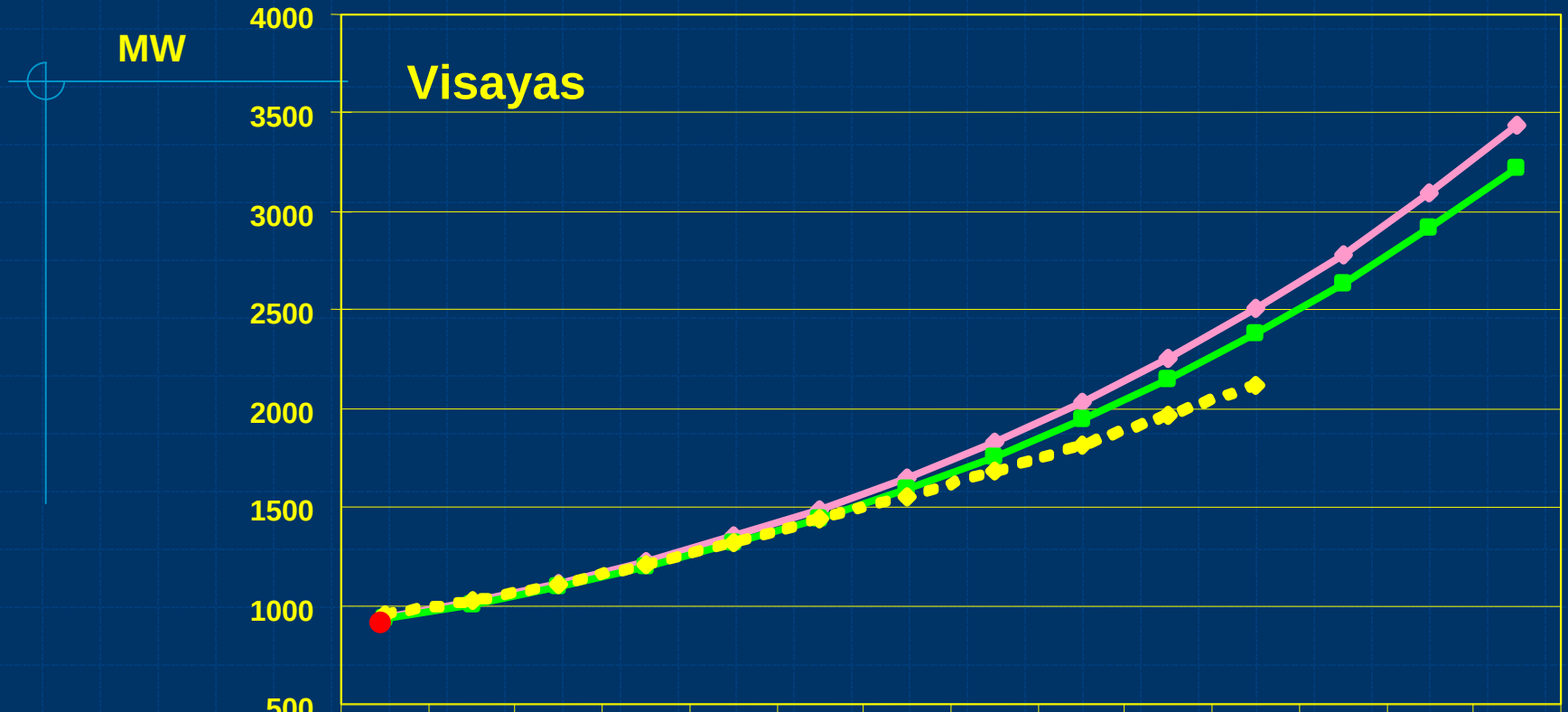
Visayas



DEMAND SCENARIOS



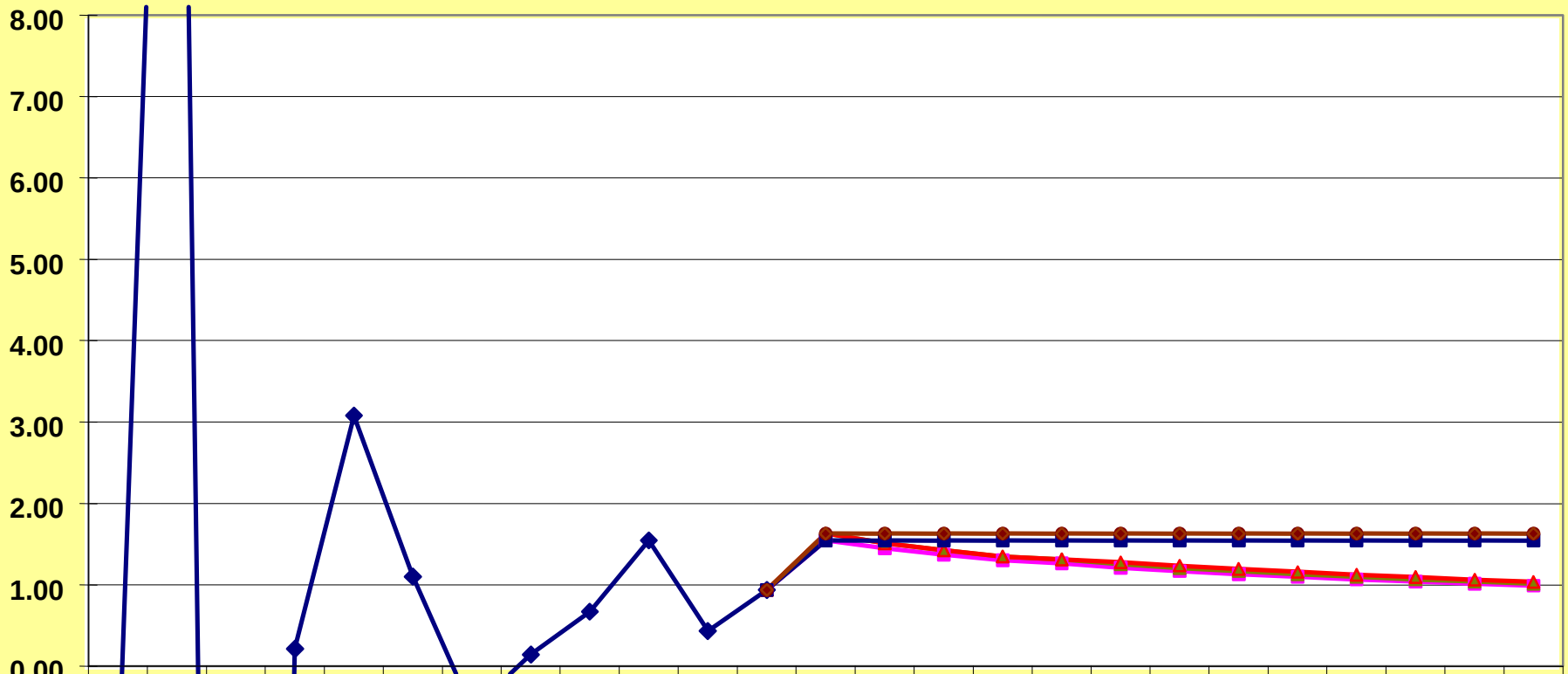
PEAK DEMAND



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
PDP 2003 High GDP	936	1013.4	1106.8	1217.5	1346.9	1481.7	1641.5	1823.8	2026.2	2251.2	2501.1	2778.8	3087.4	3430.1
PDP 2003 Low GDP	936	1005.8	1093.2	1195.9	1318.6	1442.4	1590.5	1759.4	1946.1	2152.7	2381.3	2634	2913.7	3223
PDP 2003 Low GDP	940.96	1013.8	1099.3	1193.7	1313.4	1427.8	1542.7	1675.1	1808.8	1952.7	2105.8			
Actual	936													

Elasticity Trend

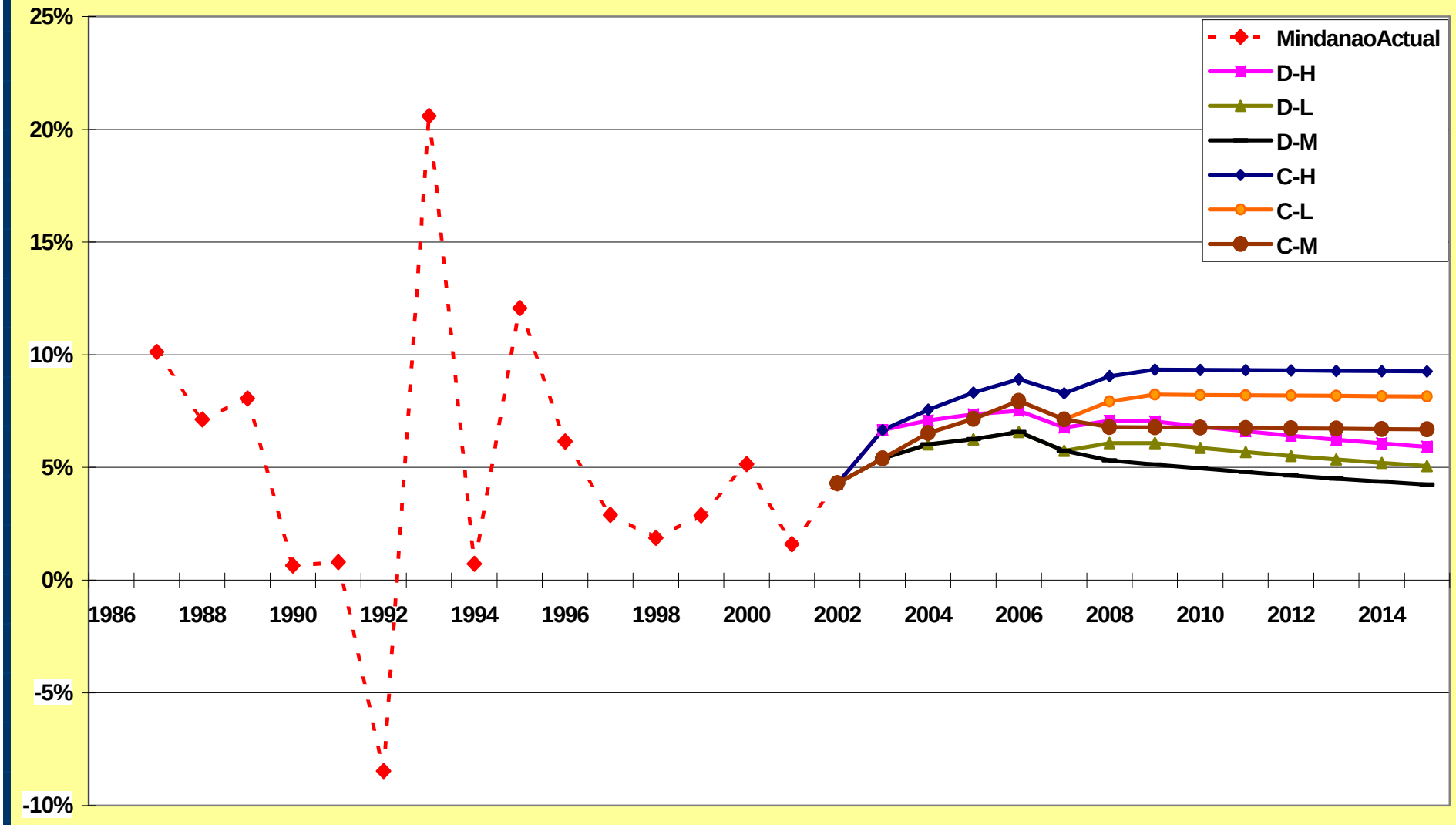
Mindanao



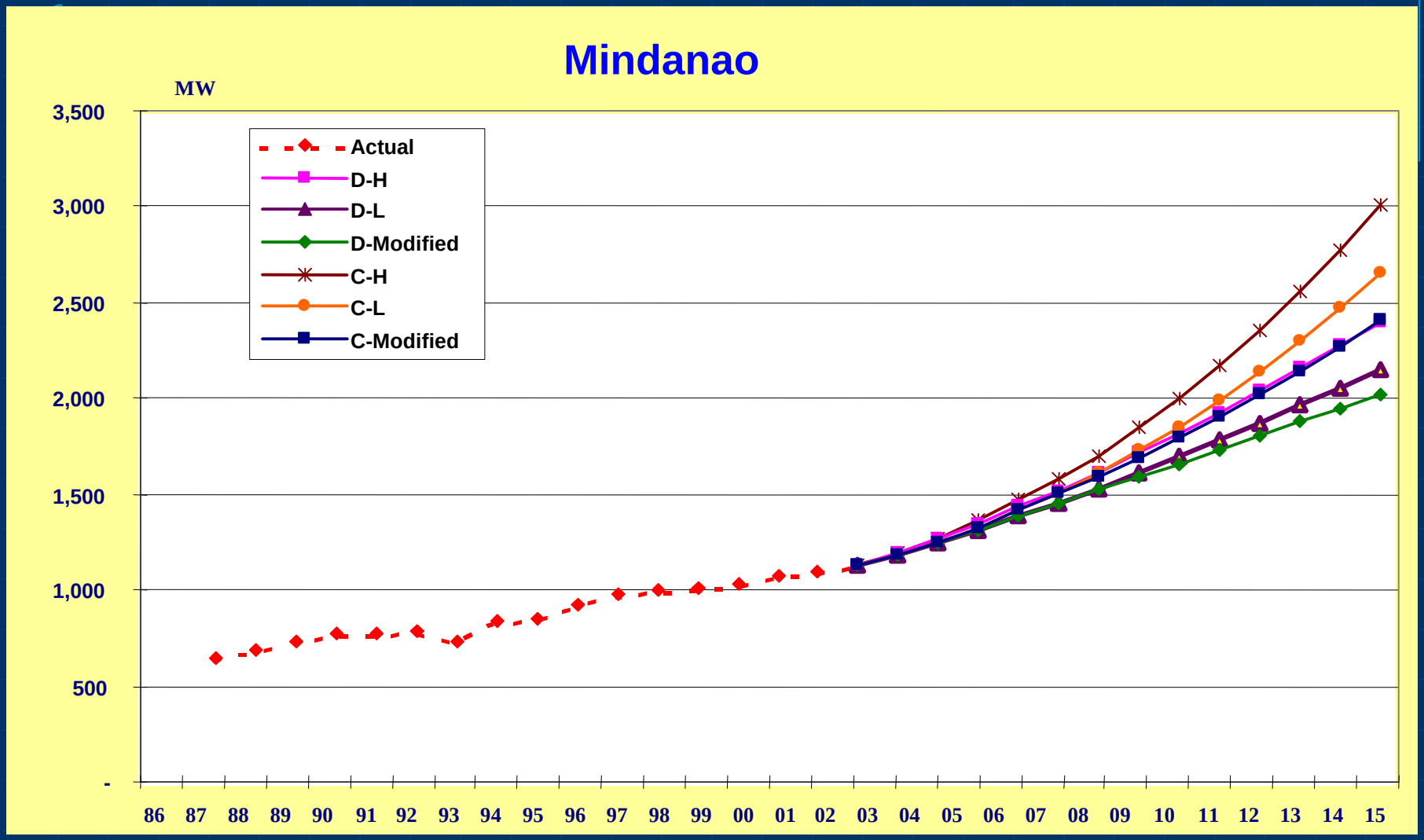
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Actual	-1.42	18.20	-32.4	0.21	3.08	1.10	-0.54	0.14	0.67	1.55	0.43	0.94													
D-H												0.94	1.55	1.45	1.37	1.30	1.26	1.21	1.17	1.13	1.10	1.07	1.04	1.01	0.99
D-L												0.94	1.63	1.51	1.42	1.35	1.31	1.25	1.20	1.17	1.13	1.10	1.07	1.04	1.01
D-M												0.94	1.63	1.51	1.42	1.35	1.31	1.28	1.23	1.19	1.16	1.12	1.09	1.06	1.03
C-H												0.94	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
C-L												0.94	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
C-M												0.94	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63

Demand Growth Rate Trend

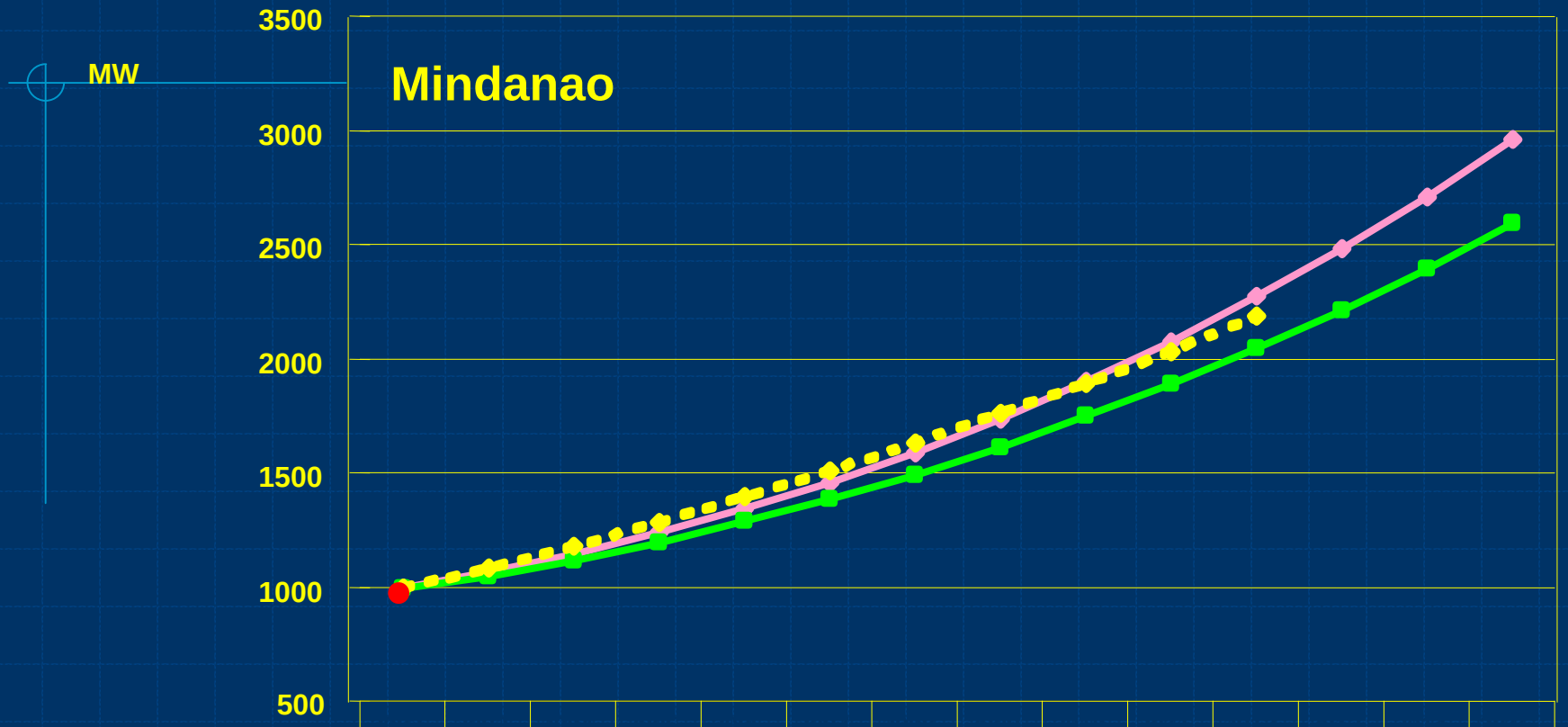
Mindanao



DEMAND SCENARIOS



PEAK DEMAND



PDP 2003 High GDP	995	1061.2	1141.5	1236.5	1346.7	1458.4	1590.4	1738.9	1901.1	2078.1	2271.3	2482.2	2712.3	2963.4
PDP 2003 Low GDP	995	1048.7	1117.1	1197	1292.2	1384.2	1493.9	1616.8	1749.7	1893.2	2048.2	2215.6	2396.3	2591.5
PDP 2002 Low GDP	999.76	1081.5	1176.1	1281.5	1399.9	1511.6	1630.3	1756.6	1890.9	2033.7	2185.6			
Actual	995													

Recommendations

- Low GDP – Constant Elasticity to be applied for the generation and transmission planning (Base Case)

- The other 5 scenarios can be presented as alternative cases (reference of industry participants business development)

Note: **NEDA's High GDP Scenario is not recommended since this scenario implies doubling of GDP/Capita from 2003 to 2013. Historically, the Philippines GDP/Capita level has been almost constant since the 80's.**

END OF PRESENTATION