

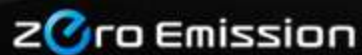


ISO50001 – What Counts!

October 31, 2012



Richard Russell, P.E.
Sr. Energy Engineer
Nissan North America



Nissan's Commitments To Improving Energy Performance

Cost Reduction
On Energy Spend

Nissan Green
Program
2016

ENERGY STAR®
Certification
Of Plants

DOE
Better Plants

Smyrna Vehicle Manufacturing Plant

Conditioned Space Area 5.5 MM Sqft

Production Capacity 550,000 Vehicles Per Year

Energy Sources

Typical Annual Use

Electricity

220,000 MWH

Natural Gas

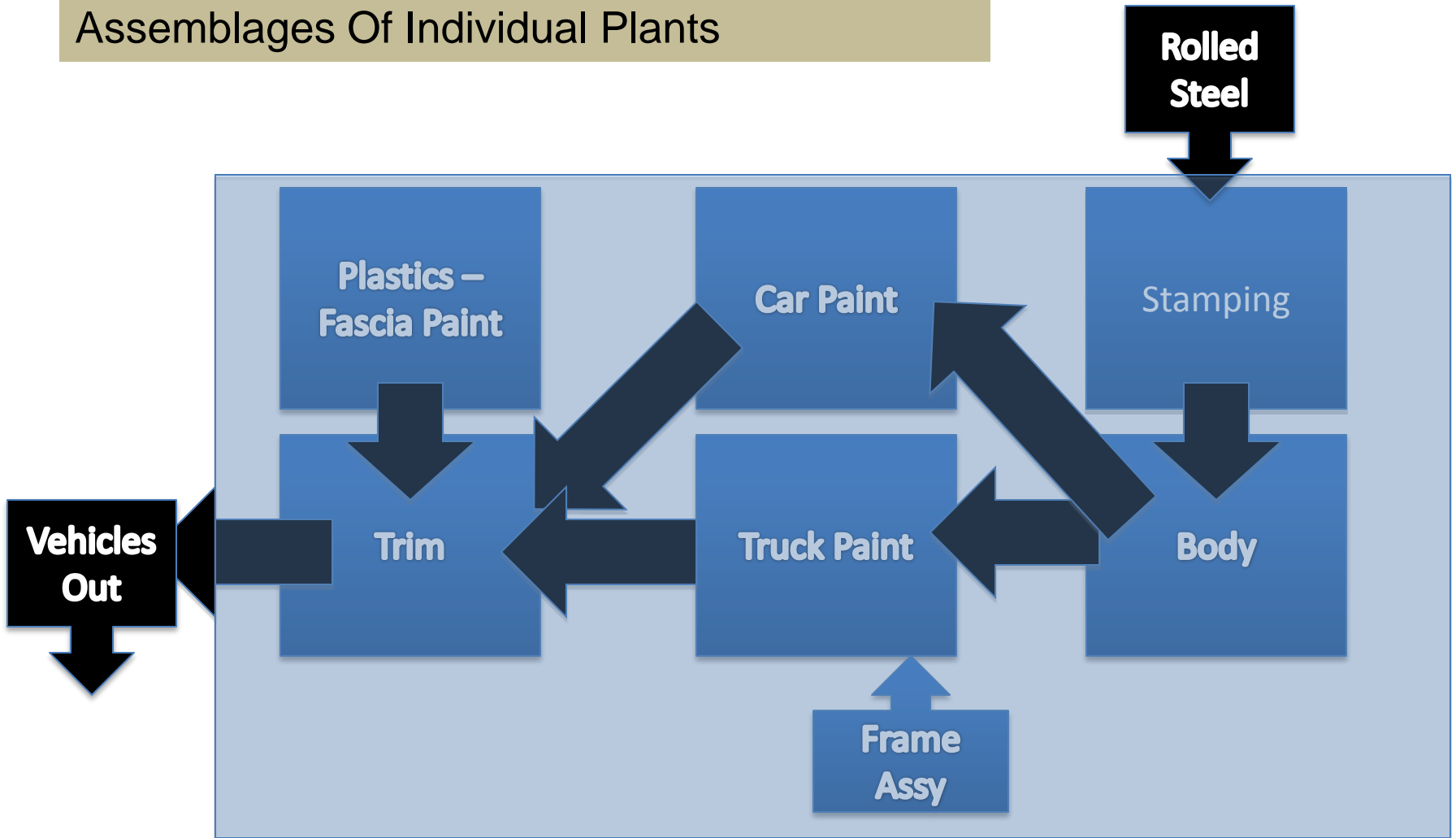
650,000 MCF

Coal

12,000 Tons



Modern Vehicle Assembly Plants Are Complex Assemblages Of Individual Plants



SCOPE – Vehicle Plant + Frame Fabrication Plant

NISSAN

SCOPE & BOUNDARY
Nissan North America, Inc.
Monozukuri - Smyrna

ISO 50001 & Superior Energy Performance

The scope of the NNA-S Energy Management System (EnMS) includes the manufacturing operations located at the Smyrna, Tennessee site, as illustrated within the boundary identified in the attached Figure 1-1. Fuel use for transportation, emergency backup generators, and lab testing is excluded.

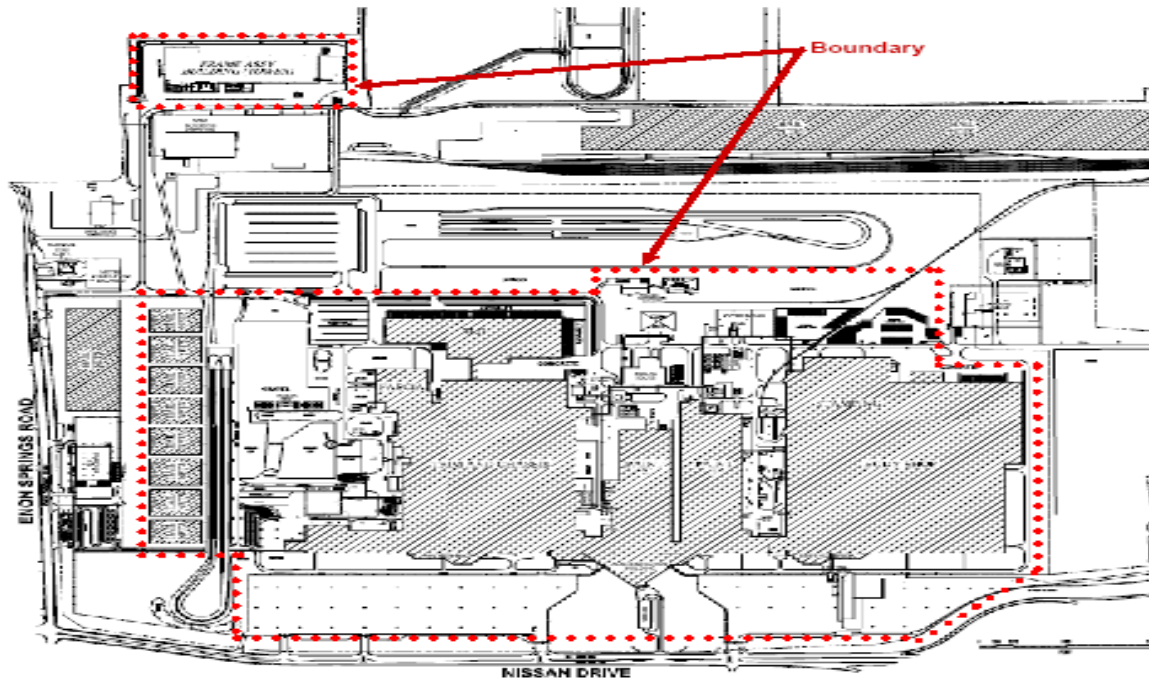


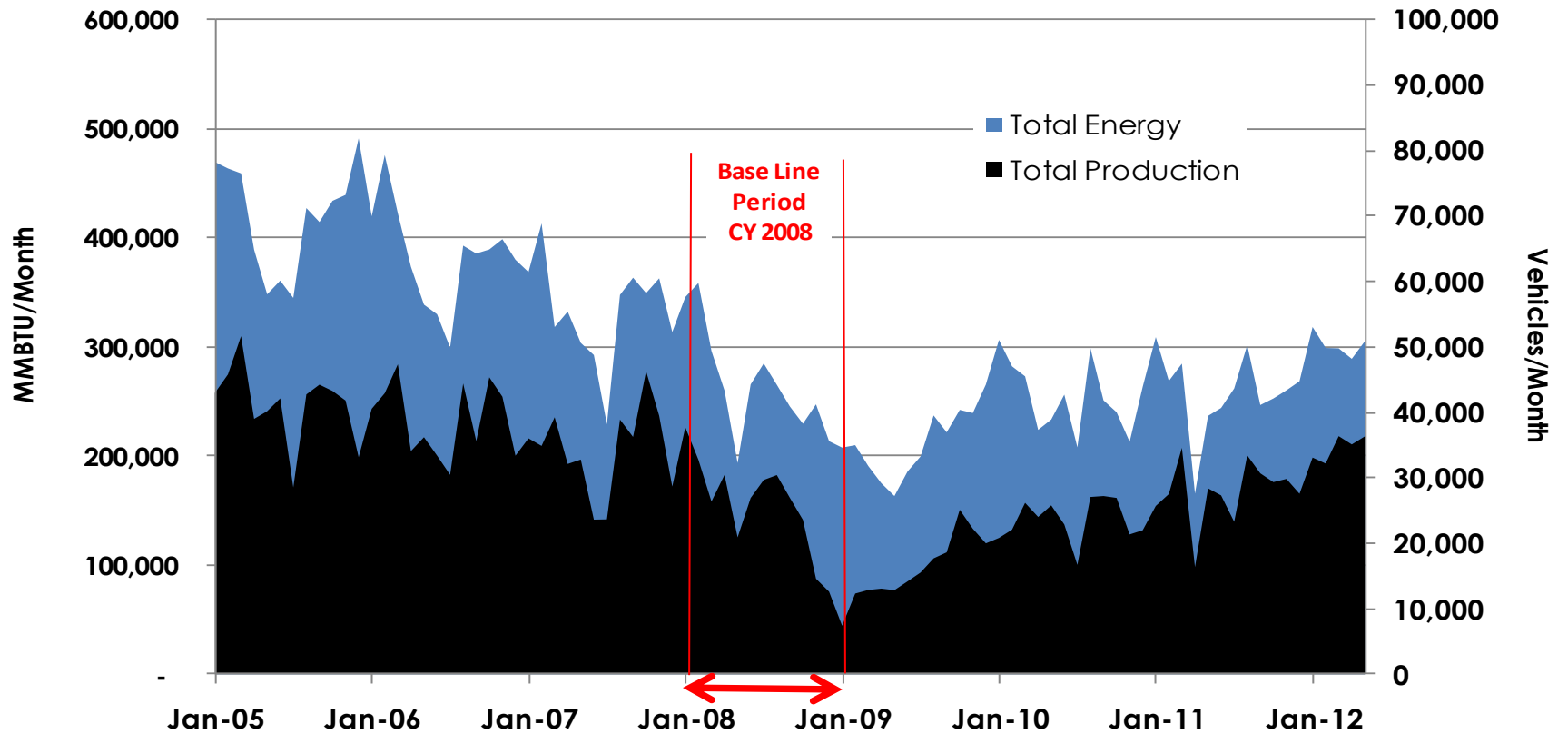
Figure 1-1

Approved by: _____
Energy Management Representative

Date: _____

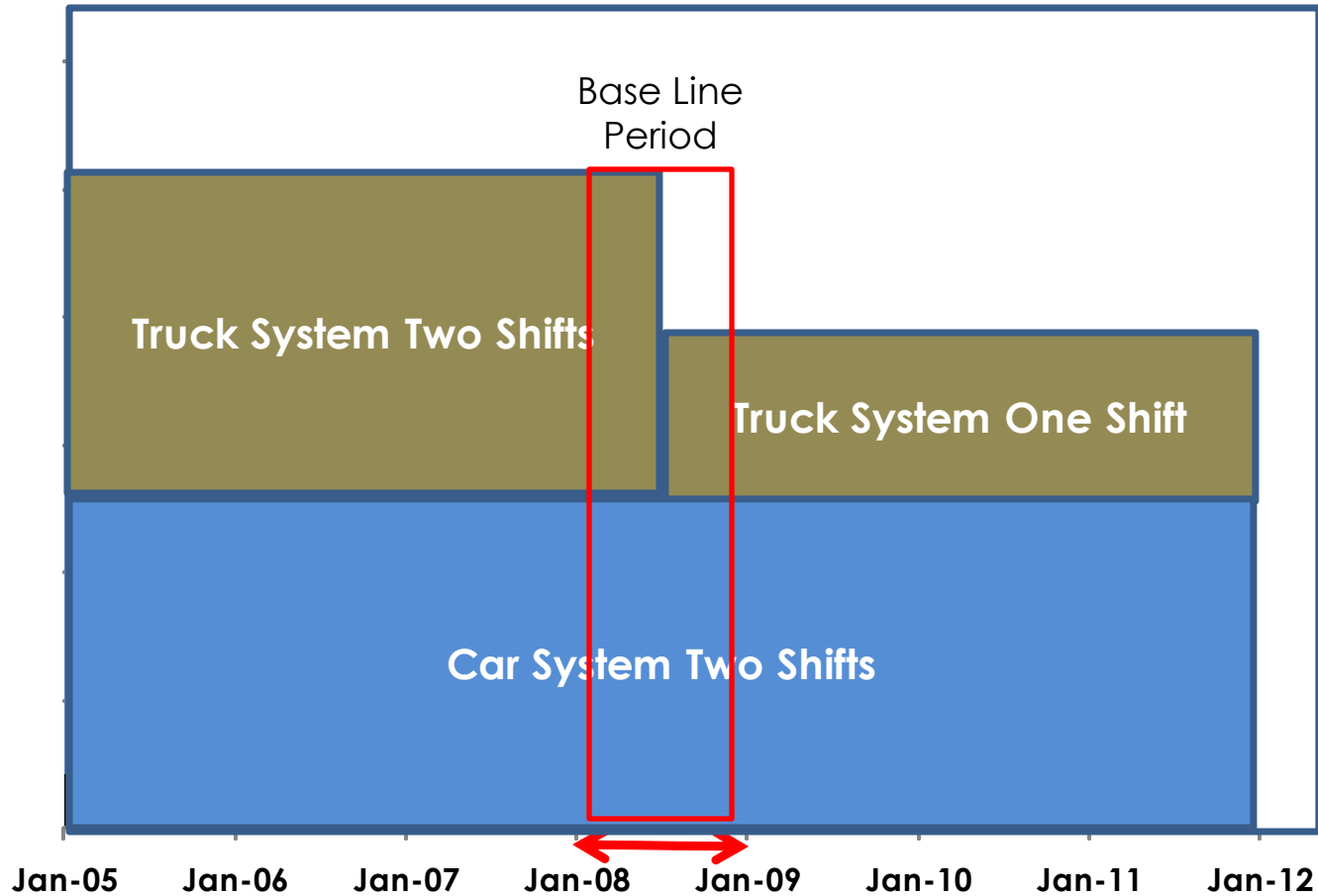
Baseline Year

Smyrna Manufacturing Plant Monthly Energy Use & Production 2005 To Present



Set-up for For SEnPI Chaining

Smyrna Manufacturing Plant Production Shifts 2005 To Present



Model Testing - Analysis Of Relevant Variables

Smyrna Manufacturing Plant Regression Model Study Of Energy Consumption

	Data	Energy Source	Parameter Evaluated						Multiple Regression R square	Multiple Regression F-Test	Models	
			Production Volume (Total)	Product Mix Car	Product Mix Truck	Heating Degree Days	Cooling Degree Days	Average Humidity				Average Temperature
Smyrna Vehicle Plant	CY 2008	Electricity	●				●	X	X	0.870	0.000	$E = 2.93 \times (\text{Prod}) + 127.08 \times (\text{CDD}) + 93617$
		Electricity		●	●		●	X	X	0.880	0.00056	$E = 2.134 (\text{Car}) + 3.786 (\text{Truck}) + 138.3 (\text{CDD}) + 98947$
		Gas	●			●		X	X	0.920	0.000	$G = 2.326 \times (\text{Prod}) + 84.732 \times (\text{HDD}) - 27486$
		Gas		●	●	●		X	X	0.930	0.00005	$G = 1.68 \times (\text{Car}) + 3.111 \times (\text{Truck}) + 79.261 \times (\text{HDD}) - 20852$
		Coal	● 0.323	● 0.689	● 0.642	●		X	X	0.920	0.000	$C = -0.188 \times (\text{Car}) - 0.254 \times (\text{Truck}) + 46.091 \times (\text{HDD}) + 19568$
		Coal				●		X	X	0.910	0.000	$C = 46.091 \times (\text{HDD}) + 19568$
Not Evaluated	X											
P value <0.2	●											
P value >0.2	●											
Applied												

Model Year First Row
 Model Year Last Row

Model OK

Variables to be Included

<input type="checkbox"/> Yes	Car Production	<input type="checkbox"/> Yes	Cooling Degree
<input type="checkbox"/> Yes	Truck Production	<input type="checkbox"/> No	Total Production
<input type="checkbox"/> No	Heating Degree		

Evaluate Model

Show All Rows

	Y1	X1	X2	X3	X4		
	Date	Electricity (MMBtu)	Car Production	Truck Production	Cooling Degree Days	Model	Electricity (MMBtu) / Model
37	1/15/2008	176,500	22,608	15,021	-	204,062	0.86
38	2/15/2008	213,470	19,141	13,555	3	191,527	1.11
39	3/17/2008	192,534	15,996	10,329	2	172,464	1.12
40	4/17/2008	184,449	19,219	11,158	25	185,662	0.99
41	5/18/2008	159,887	13,265	7,597	109	171,092	0.93
42	6/18/2008	224,858	17,036	9,825	401	227,959	0.99
43	7/19/2008	247,905	20,517	9,088	458	240,482	1.03
44	8/19/2008	228,990	23,779	6,571	439	235,287	0.97
45	9/19/2008	207,262	22,316	4,571	273	201,635	1.03
46	10/20/2008	169,366	18,683	4,842	62	165,726	1.02
47	11/20/2008	134,397	10,995	3,561	-	135,893	0.99
48	12/21/2008	123,536	9,303	3,282	1	131,364	0.94

	X1	X2	X3	X4
Electricity (MMBtu)	Car Production	Truck Production	Cooling Degree Days	
P-Values	0.17376	0.03702	0.00	
F-Test	0.00056			
r ²	0.88			
m	2.13	3.79	138.30	0.00
b	98947			

Regression Model

$y = (2.134)*X1 + (3.786)*X2 + (138.304)*X3 + (0)*X4 + 98947$	
Round coefficients (m)	3
Round constant (b)	0

**EnPI Tool
 Analysis Of
 Relevant Variables**

Y1 Model OK
 Y2 Model OK
 Y3 Model OK
 Backcast Data Valid
 Forecast Data Valid

Confirm Modeled Period for Each Utility Are Same

Utility	Electricity	Natural Gas	Coal
First Row	01/15/08	01/15/08	01/15/08
Last Row	12/21/08	12/21/08	12/21/08

Hide Unused Rows

Select Modeling Method **Chaining**

	Year Zero	Last Year
First Row	01/15/08	09/30/10
Last Row	12/21/08	08/26/11

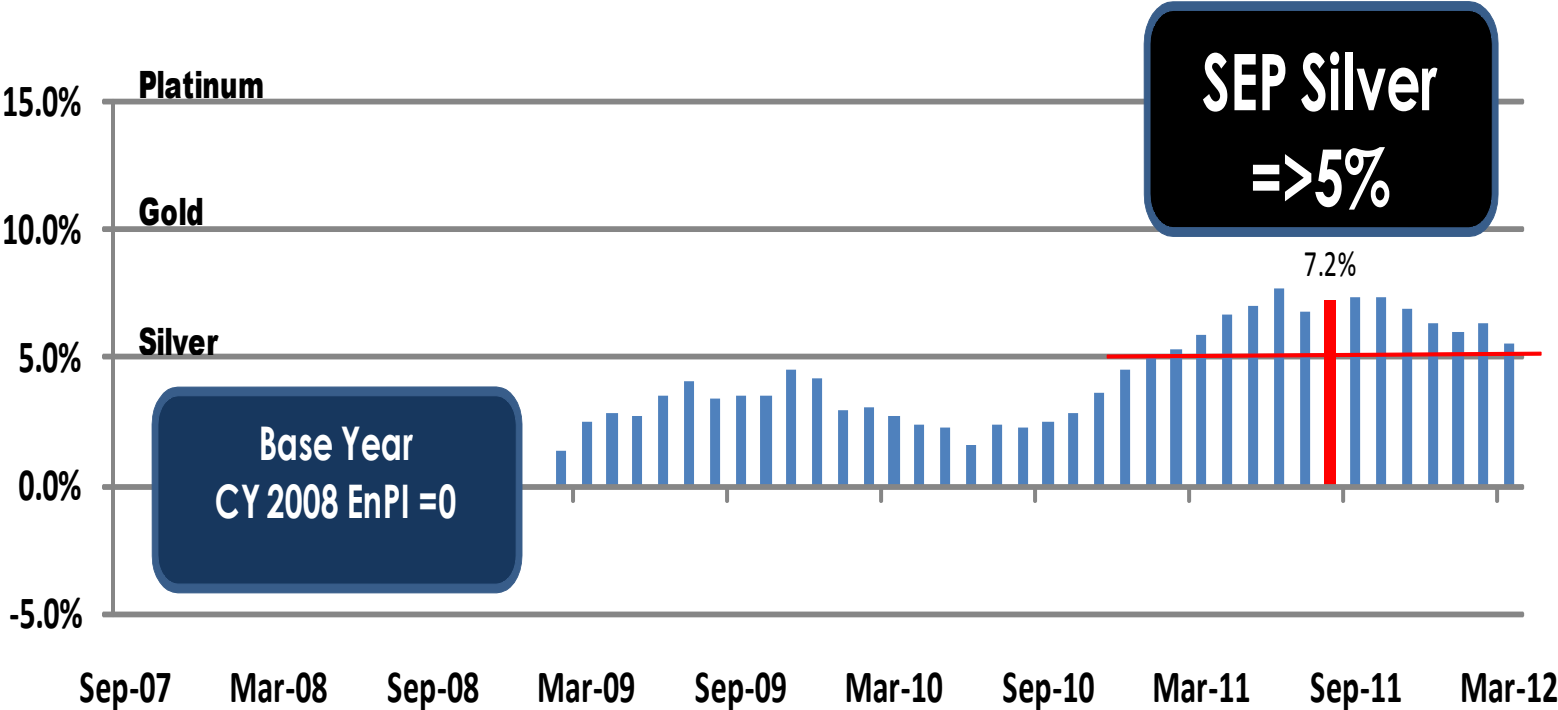
Performance Improvement (+) or Decline (-) **7.2%**

Date	Electricity						Natural Gas						Coal						Actual Net Energy (MMBtu)	Model Net Energy (MMBtu)	
	Y1	X1	X2	X3	X4	B	Y2	X1	X2	B	Y3	X1	B								
	Electricity (MWh)	Car Production	Truck Production	Cooling Degree Days			Electricity (MMBtu)	Model	Natural Gas (MMBtu)	Car Production	Truck Production			Natural Gas (MMBtu)	Model	Coal (MMBtu)	Heating Degree Days				
1	01/05/05	25,788	23,144	19,733	-	-	263,965	223,044	142,077	23,144	19,733			142,077	132,040	83,810	664.00	83,810	50,173	489,852	405,257
2	02/04/05	28,138	23,021	22,676	-	-	288,023	233,922	122,846	23,021	22,676			122,846	132,271	74,928	554.00	74,928	45,103	485,797	411,296
3	03/06/05	26,831	24,887	26,638	-	-	274,643	252,904	132,138	24,887	26,638			132,138	145,908	73,463	531.00	73,463	44,043	480,244	442,854
4	04/05/05	29,539	18,200	20,718	26	-	302,360	219,817	72,609	18,200	20,718			72,609	88,280	37,533	178.00	37,533	27,773	412,501	335,869
5	05/05/05	25,880	19,443	20,644	118	-	264,907	234,913	88,234	19,443	20,644			88,234	81,974	15,583	75.00	15,583	23,025	368,723	339,912
6	06/04/05	29,871	20,431	21,615	363	-	305,757	274,582	78,689	20,431	21,615			78,689	80,709	8	-	8	19,568	384,453	374,860
7	07/04/05	29,953	13,904	14,553	502	-	306,603	253,142	61,580	13,904	14,553			61,580	47,776	473	-	473	19,568	368,655	320,487
8	08/03/05	36,589	20,360	22,290	530	-	374,524	300,083	81,749	20,360	22,290			81,749	82,690	-	-	-	-	456,273	382,773
9	09/02/05	35,253	23,103	21,031	313	-	360,853	271,159	81,578	23,103	21,031			81,578	83,539	-	2.00	-	-	442,431	354,698
10	10/02/05	32,727	23,522	19,649	83	-	334,993	235,012	89,102	23,522	19,649			89,102	95,320	35,730	196.00	35,730	28,602	459,825	358,934
11	11/01/05	29,570	22,408	19,307	15	-	302,678	221,935	120,422	22,408	19,307			120,422	110,060	39,635	419.00	39,635	38,881	462,735	370,875
12	12/01/05	28,828	17,443	15,624	-	-	295,086	195,321	154,449	17,443	15,624			154,449	124,028	64,343	845.00	64,343	58,515	513,878	377,864
13	01/01/06	23,612	19,532	20,923	-	-	241,688	219,840	146,874	19,532	20,923			146,874	122,850	40,768	578.00	40,768	46,209	438,330	388,908
14	02/01/06	27,826	21,068	21,770	-	-	284,825	226,324	160,903	21,068	21,770								50,772	497,790	413,017
15	03/04/06	26,038	22,602	24,638	14	-	266,528	242,392	133,926	22,602	24,638								39,802	443,002	410,750
16	04/04/06	29,104	16,488	17,510	113	-	297,906	216,051	68,650	16,488	17,510								24,039	396,581	309,094
17	05/05/06	26,576	15,935	20,186	126	-	272,028	226,799	87,214	15,935	20,186								22,749	359,814	323,729
18	06/05/06	28,318	16,855	16,466	327	-	289,864	242,479	59,368	16,855	16,466								19,568	352,401	320,732
19	07/06/06	25,478	14,990	15,395	491	-	260,789	257,126	58,408	14,990	15,395								19,568	319,495	328,914
20	08/06/06	33,814	22,141	22,171	540	-	346,125	304,816	73,518	22,141	22,171								-	419,643	390,128
21	09/06/06	32,473	16,165	19,360	217	-	332,393	236,749	71,508	16,165	19,360								20,260	411,366	324,726
22	10/07/06	27,335	21,033	24,220	58	-	279,803	243,546	91,748	21,033	24,220								29,801	410,951	380,767
23	11/07/06	27,595	21,214	21,082	9	-	282,461	225,276	99,828	21,214	21,082								38,327	420,599	376,229
24	12/08/06	25,262	19,038	14,263	-	-	258,580	193,573	96,879	19,038	14,263			96,879	100,517	44,435	568.00	44,435	45,748	399,894	339,838
25	01/08/07	19,800	21,170	14,776	-	-	202,672	200,065	129,553	21,170	14,776			129,553	117,266	52,013	714.00	52,013	52,477	384,237	369,809
26	02/08/07	24,852	19,086	15,710	-	-	254,382	199,153	126,139	19,086	15,710			126,139	121,427	52,288	774.00	52,288	55,243	432,808	375,823
27	03/11/07	21,995	22,102	17,066	53	-	225,143	218,054	77,578	22,102	17,066			77,578	89,575	32,898	255.00	32,898	31,322	335,619	338,950
28	04/11/07	24,136	17,476	14,574	49	-	247,060	198,193	75,417	17,476	14,574			75,417	75,162	29,013	269.00	29,013	31,967	351,489	305,323
29	05/12/07	24,127	17,583	15,137	214	-	246,965	223,373	75,659	17,583	15,137			75,659	57,120	155	17.00	155	20,352	322,779	300,845

EnPI Tool
 Analysis Of
 Performance

Performance Results

Performance To Commitment To Achieve SEP Certification 5% Qualifying Threshold
Smyrna Mfg Plant In Scope Electricity Gas & Coal Consumption



Bottom-Up Sanity Check

Annual Savings MMBTU – By Source

Bottom-Up Analysis

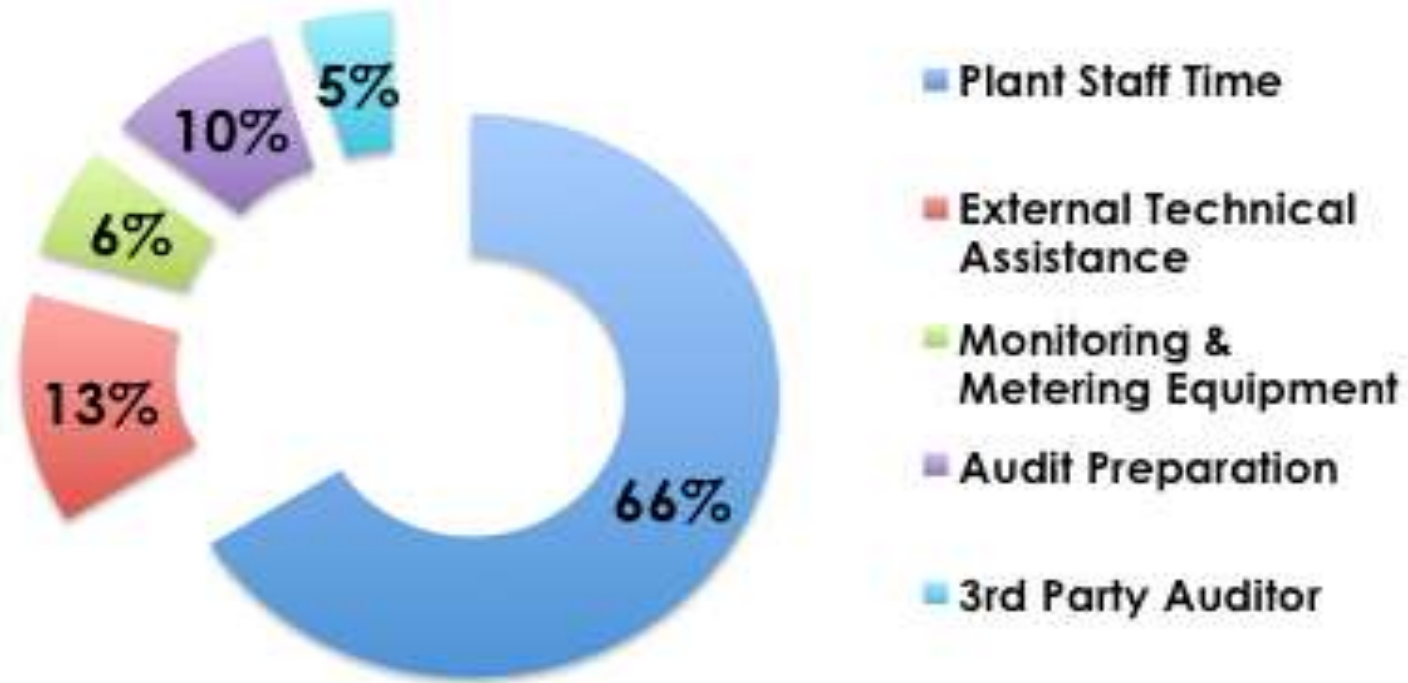
Electric Power	104,867			72,101
Natural Gas	52,078			51,139
Coal	93,174	<u>5% Threshold</u>		91,052
Total	250,119	173,091	<	214,292

Top 5 – 82%

Top 5 Projects Bottom-Up Analysis

- 1 Cascade Air & Dry Line Booth Controls Paint System 2
- 2 Boiler Flue Gas O2 Management & Insulation Projects
- 3 Compressed Air Management – Stamping Plant
- 4 Motor Speed Reduction – E-coat Circulation Pumps Paint System 1
- 5 Improved Start-up & Shutdown Procedures Paint System 1

Implementation Costs



Reflections

- **Extensive sub-metering pays dividends when verifying the performance of energy conservation measures (Bottom-Up Sanity Checks)**
- **When developing Energy Action Plans to achieve your targets, develop a strong measurement plan to verify results and see that it gets implemented**
- **Energy savings from operational improvements are not permanent. Savings when plants are down evaporate when plants get busy.**

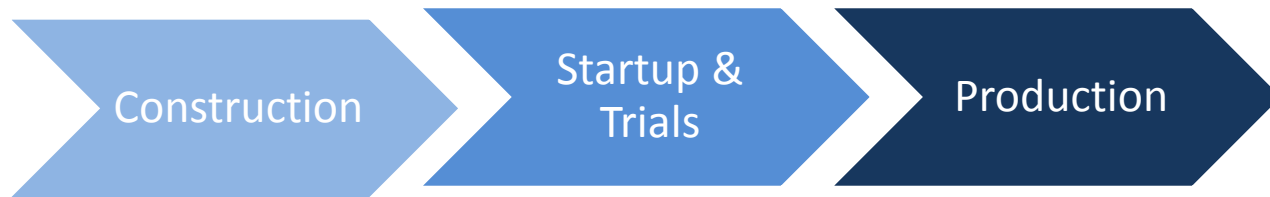
Opportunities

The use of multilinear regression models for the analysis of energy savings is an excellent tool for continuous improvement in complex manufacturing plants.

We have now extended the use of this tool to shops within our plant and processes to analyze and track performance to CO2 reduction targets and we are achieving results.

Challenges

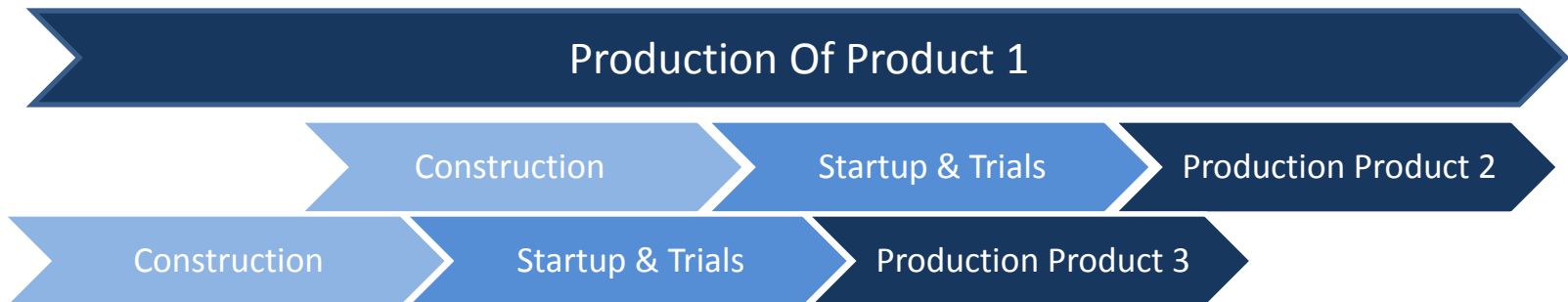
Baseline adjustments pose a challenge to the analysis of performance. Separating the effects of new model introduction activity & trials from ongoing manufacturing energy use, poses significant analysis work and interpretation.



Single Plant & Product Launch & Run



12 Mos To Establish Baseline



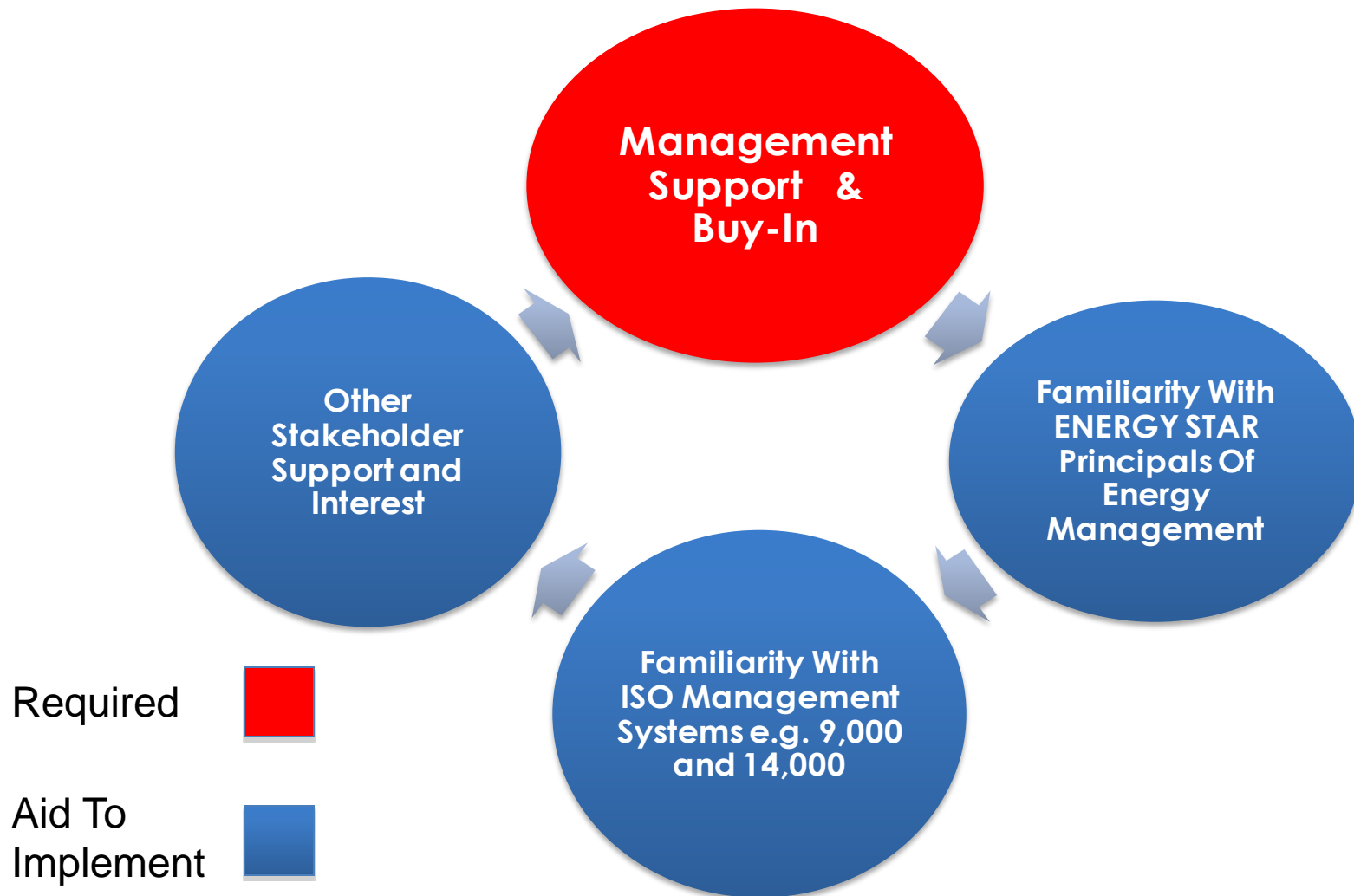
Complex Manufacturing Multi-Plant Multi-Product Launches

Should My Company Implement
ISO 50001 And Seek Recognition
Through Superior Energy
Performance?

That Depends

What does your Energy
Management Program consist of
now?

Accelerants To Implementing ISO50001 & SEP



Answer:

What Is Your Business Case?

Value Proposition:

Financial & Competitive Value – what is the value for each point of improvement in your energy spend ?

Brand Value Alignment -What is the enhancement of your product value or image to your stakeholders (share holders, customers...) from public recognition?

Cost Burden:

What **additional** costs will be required to initiate and administer the program? Are they justified from improved performance and brand alignment?

Is Energy Use A Competitive Advantage Of Your Product?

