



# A Process for Technology Strategy Definition & Implementation

*We've made a list ~ what  
happens next....?*

# Introduction

- WDL has developed an effective assessment process for ranking powertrain technologies
- The process moves through:
  - Drivers
  - Value
  - Cost-Benefit
  - Supplier capability
  - Market Timing
- The end results is a clear implementation plan for technologies, prioritised by customer value & ability to deliver
- The example shown is from a diesel powertrain study; it can be applied generically to automotive systems

# The Process



- Confirm market trends & requirements
- Develop technology roadmap
- Assess current status of key technologies
- Assess cost/benefit impact
- Develop market-driven timing
- Define specific programmes

# Setting the Scene

- Product value & market success require the continuous application of 'affordable technologies'
- It is essential to pick 'winners' from the range available
- Technology evaluation & selection by OEMs is driven by:
  - Legislation
  - Customer desires & value perceptions
  - Application to a wide product range
- The chosen technologies must:
  - Arrive at the right time
  - Offer application flexibility
  - Offer high value
  - Be fully developed

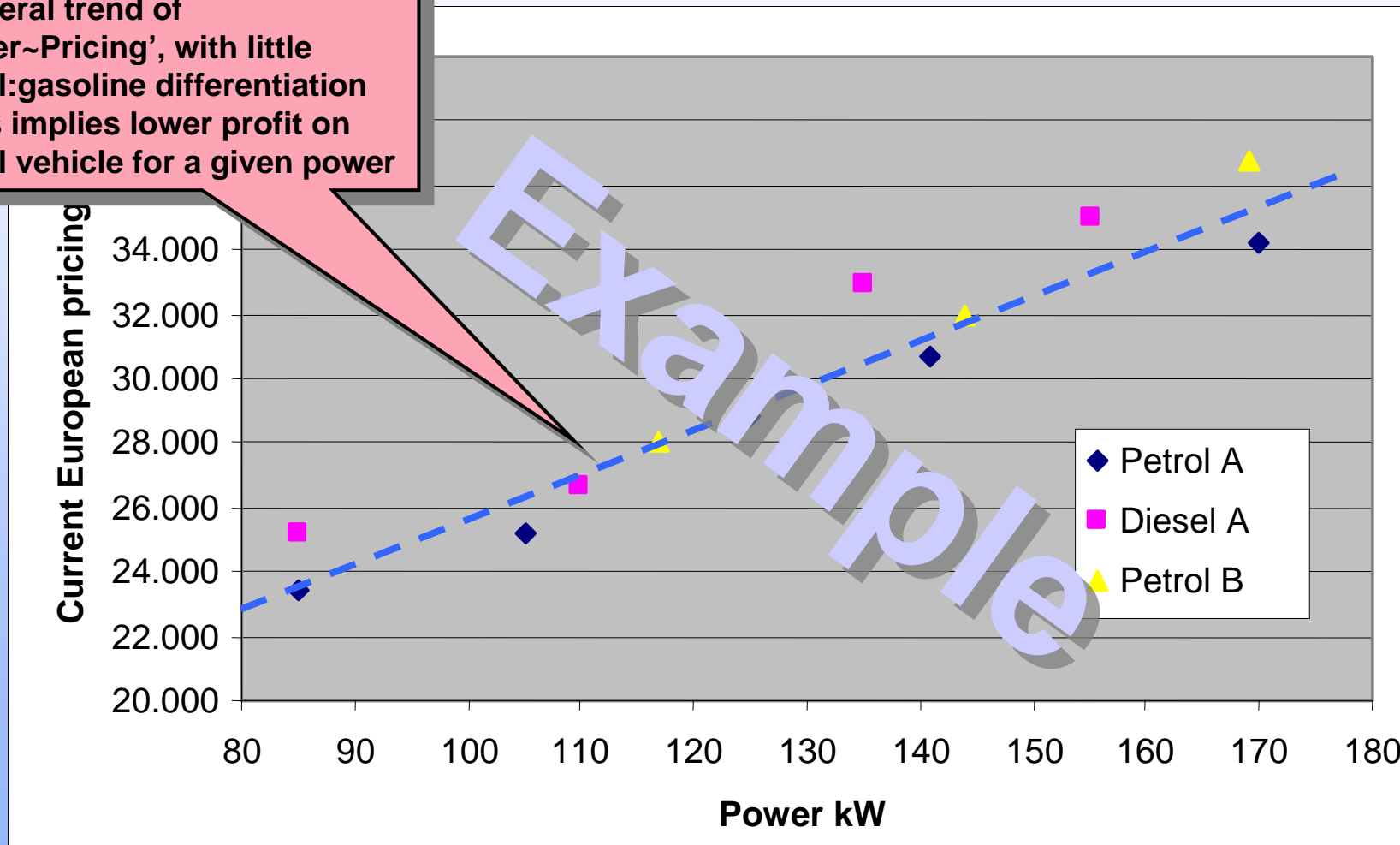
# Strategy



# Identify Market Drivers

- Market Pricing ~ Premium C/D Class Cars

• General trend of 'Power~Pricing', with little diesel:gasoline differentiation  
 • This implies lower profit on diesel vehicle for a given power



# Develop Attributes & Values

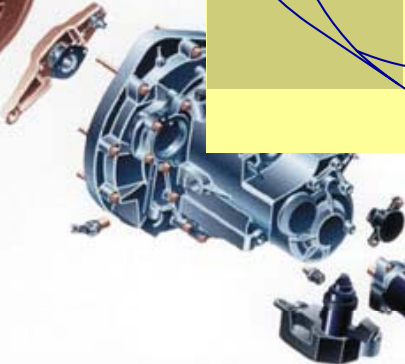
<b>Driver</b>	<b>Attribute</b>	<b>Value</b>
Legislation	Emissions	Marginal(a)/Incentives
	Safety	Marginal(a)
	CO2	Medium/Incentives
	Noise	Marginal(a)
Customers (External/Internal)	Performance	High
	Economy	Medium/High
	Driveability	Medium
	NVH	Medium
	Cost of Entry	Low/High
Market Presence	New technologies	Marginal(b)
	Product range	High

Marginal (a) = Must be 'Class Leading' to have perceived Value

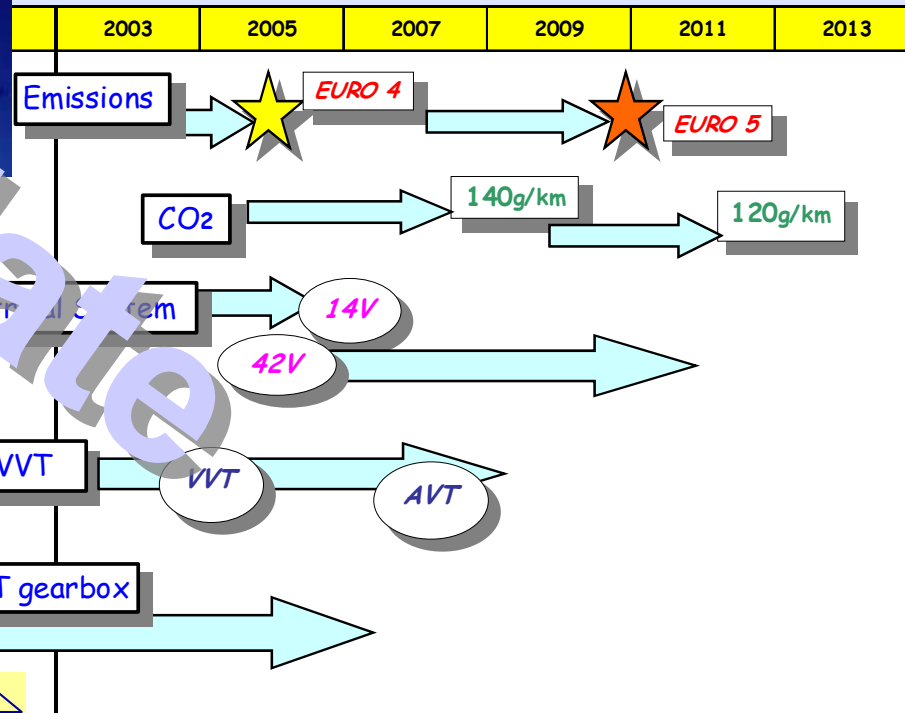
Marginal (b) = Must be 'First to Market' to have perceived Value

# Draw a Map & ....

- Typical technology roadmaps from:
  - Foresight Vehicle
  - ACEA
  - FUIRORE
  - Workshops & surveys



update



# .....Make a List

- Technology Checklist

**New Technologies:**

- Gen.3 Common Rail (1800 bar)
- E-Boost (EDC/EAT)
- Electric VNT
- Electric EGR
- VVT/AVT (mech./hyd./electric)
- Active cooling/electric pumps
- 42V system
- CSG (crankshaft SG)
- ESG (belt/external SG)
- Vehicle thermal management
- NOx trap
- Plasma/catalysis
- HCCI
- Combustion Control
- AMT/CVT
- Powertrain Integration (Hybrid)
- *Electric Accessories*

# Some Technology Issues



- Definition:
  - ‘Enabling’ (eg. 42V)
  - ‘Delivering’ (eg. High-pressure fuel system)
- Customer Response:
  - ‘Passive’ (invisible, assumed available, cost-driven)
  - ‘Active’ (interactive, added-value, price-driven)
- Application:
  - Containable within single system (easy to apply)
  - Crosses system boundaries (difficult to apply)

# Perform Studies

- **42V Systems**

- Necessary to support all anticipated loads (*Enabler NOT Deliverer*)
- Major vehicle design impact
- Some technical problems not resolved
- ESG is only application which does not impact on powertrain design

## CONCLUSION

Advances in the areas of power electronics and electric motor drives along with fault tolerant electrical distribution systems and control electronics enable the transforming of the present automotive power systems into the 42V systems. The future electrical power system for conventional cars will most likely be a single voltage bus (42V DC) with provision for hybrid and multi-voltage level distribution.

Power Rating of Some Automobile Electric Loads

Electric Load	Power Rating, KW
Electric Powerpoint	1.2
Starter-Generator	3.0-5.0 (Continuous)
Electric Active Suspension	0.1-1.25 /Corner
Electro-Mechanical Valve Actuation	0.25-4.0
Electric Turbo Supercharger	5-15
Electric Roll Stabilization (Exclusive of Electric Active Suspension)	0.5-2.5
4-Wheel Steering	1-2
Electric Brake	1-2

# Technology Value Score-chart

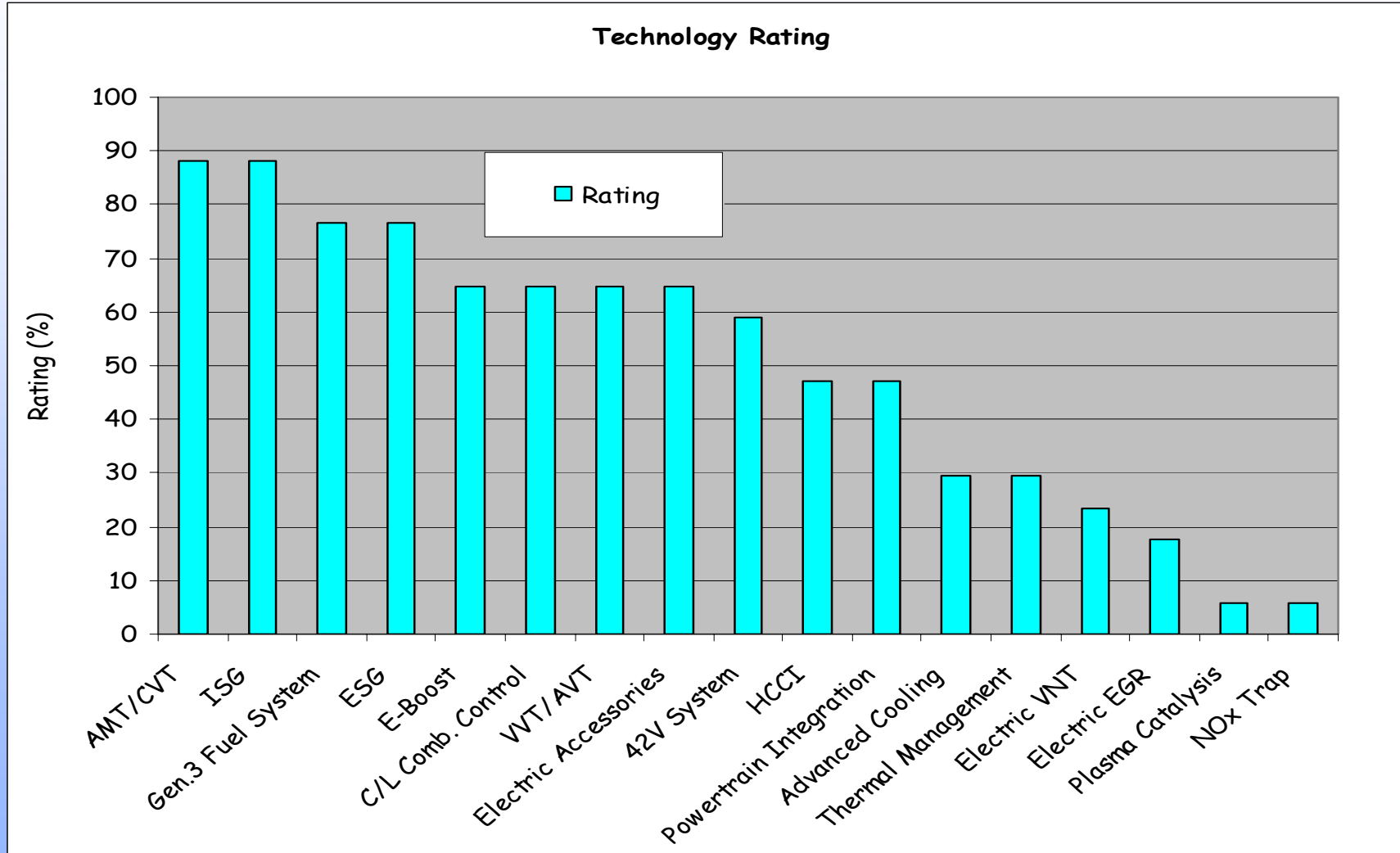


- Customer needs identified & weighted (1 ~ 3)
- Technology values rated (0 or 1)

Attribute/Value												
Technology	Fuel Economy	Performance	Emissions	NVH	Driveability	Weight	Warm-up	Safety	Image	Score	% Score	
<b>Weighting Factor</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>17</b>	<b>100</b>	
Gen.3 Fuel System	1	1	1	1	1	0	0	0	1	13	76	
E-Boost	0	1	1	0	1	0	1	0	1	11	65	
C/L Comb. Control	0	0	1	1	1	0	1	1	1	11	65	
AMT/CVT	1	1	0	1	1	0	1	1	1	15	88	
VVT/AVT	1	1	1	0	1	0	0	0	1	11	65	
Electric VNT	0	1	1	0	0	0	0	0	0	4	24	
Advanced Cooling	1	0	1	0	0	0	1	0	0	5	29	
Electric EGR	0	0	1	1	0	0	0	0	0	3	18	
42V System	0	0	1	1	1	0	1	0	1	10	59	
Electric Accessories	1	0	1	1	0	0	1	1	1	11	65	
ESG	1	1	1	0	1	0	1	0	1	13	76	
ISG	1	1	1	1	1	0	1	0	1	15	88	
Thermal Management	1	0	1	0	0	0	1	0	0	5	29	
HCCI	1	0	1	1	0	0	0	0	1	8	47	
Powertrain Integration	1	0	0	1	0	0	0	1	1	8	47	
Plasma Catalysis	0	0	1	0	0	0	0	0	0	1	6	
NOx Trap	0	0	1	0	0	0	0	0	0	1	6	

# Plot a Value Chart

- Technologies in value order



# Add the Costs...

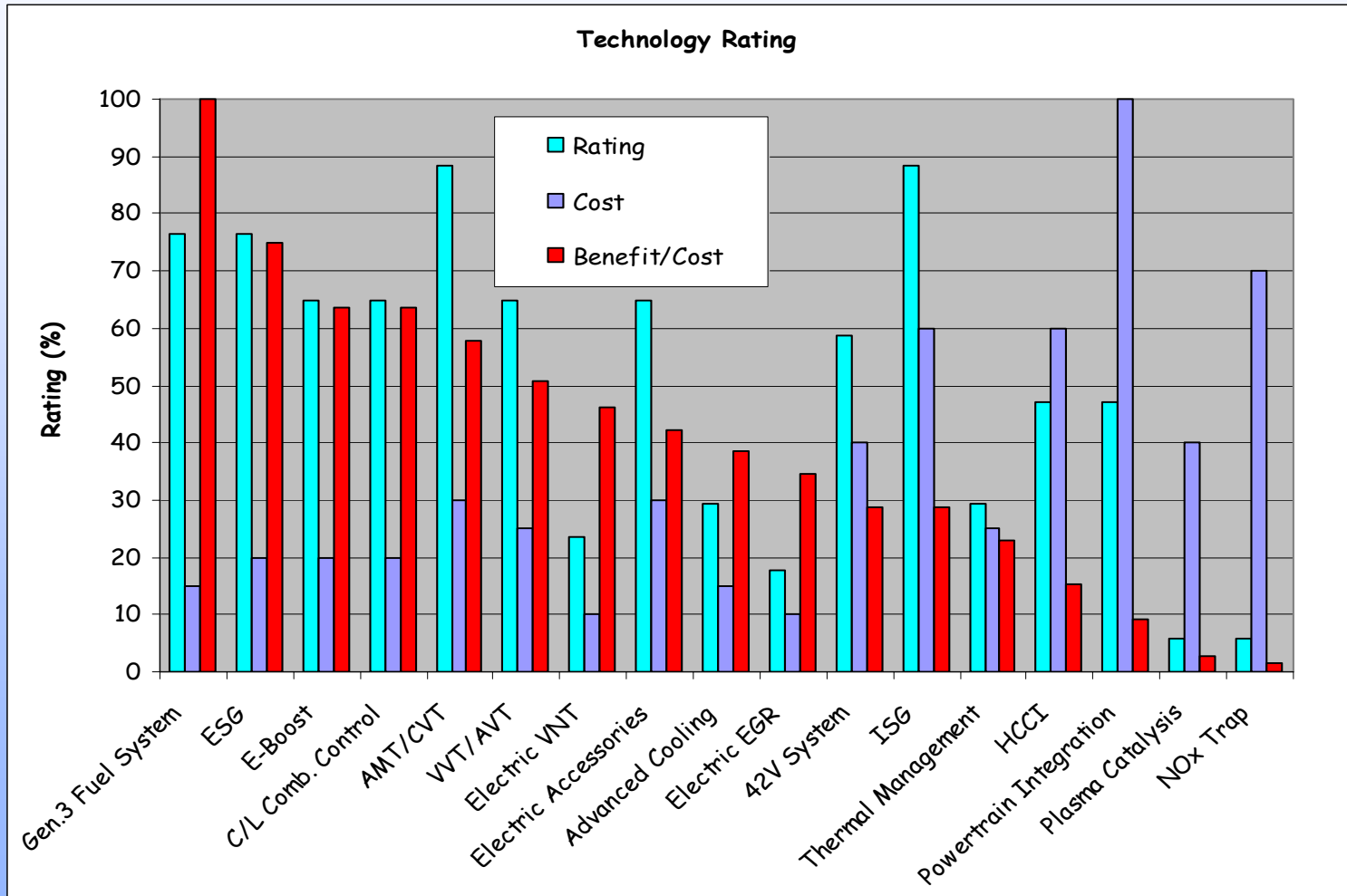
- Values from previous matrix
- Allocate unit costs (\*)
- Calculate Value/Cost

Score	% Score	Cost	Cost	Benefit/Cost	Benefit/Cost
17	100	(€)	(%)	(-)	(%)
13	76	150	15	5.10	100
13	76	200	20	3.82	75
11	65	200	20	3.24	63
11	65	200	20	3.24	63
15	88	300	30	2.94	58
11	65	250	25	2.59	51
4	24	100	10	2.35	46
11	65	300	30	2.16	42
5	29	150	15	1.96	38
3	18	100	10	1.76	35
10	59	400	40	1.47	29
15	88	600	60	1.47	29
5	29	250	25	1.18	23
8	47	600	60	0.78	15
8	47	1000	100	0.47	9
1	6	400	40	0.15	3
1	6	700	70	0.08	2

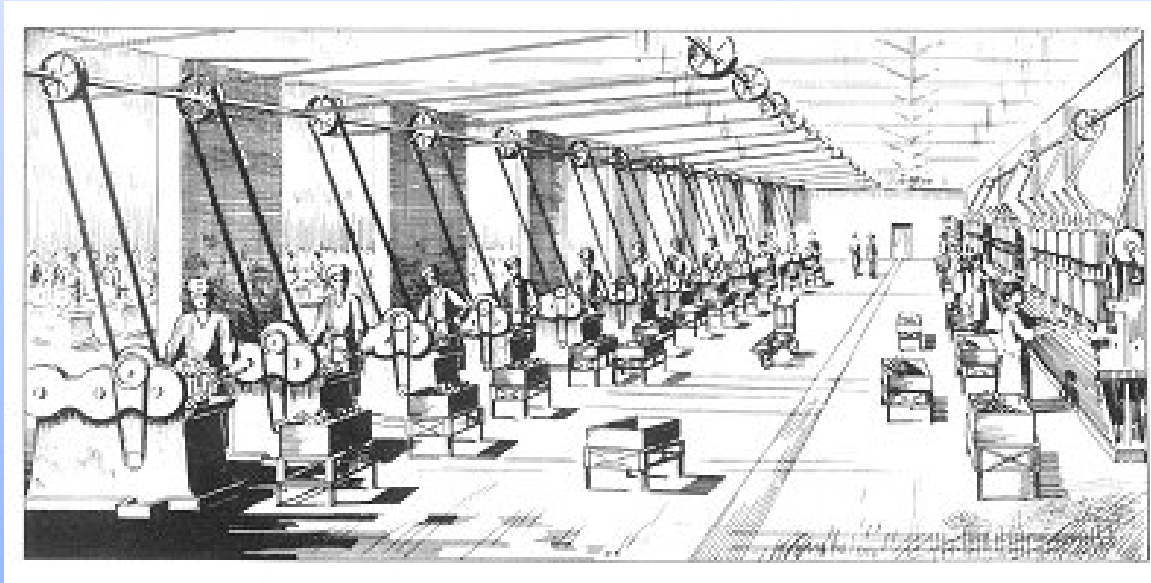
(\*) Example shows unit costs only; engineering & investment costs should also be assessed

# ... & Plot a Value/Cost Chart

- Technologies now in Benefit(value)/cost order
- Significant re-ordering from value-only assessment

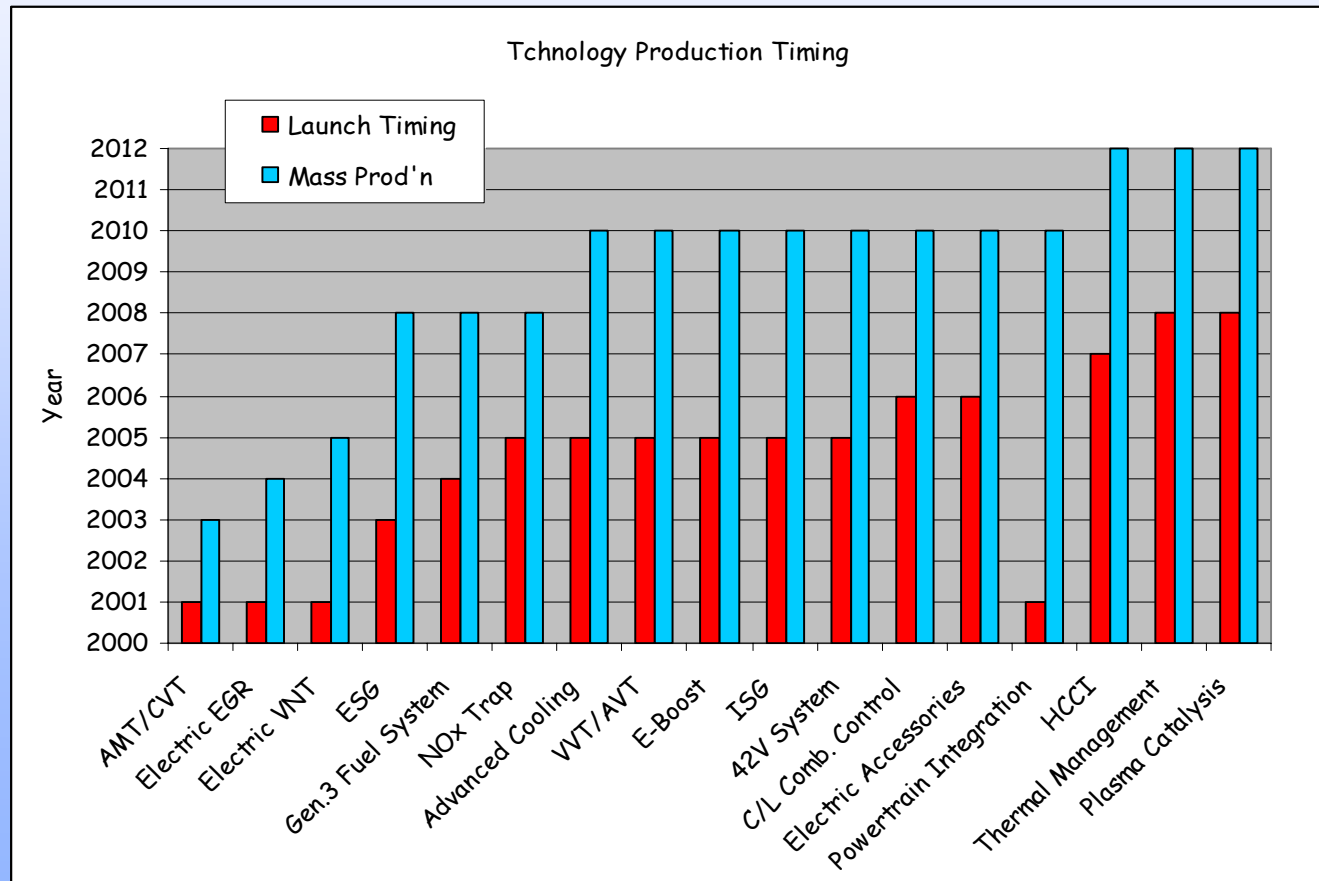


# Implementation



# Market Timing

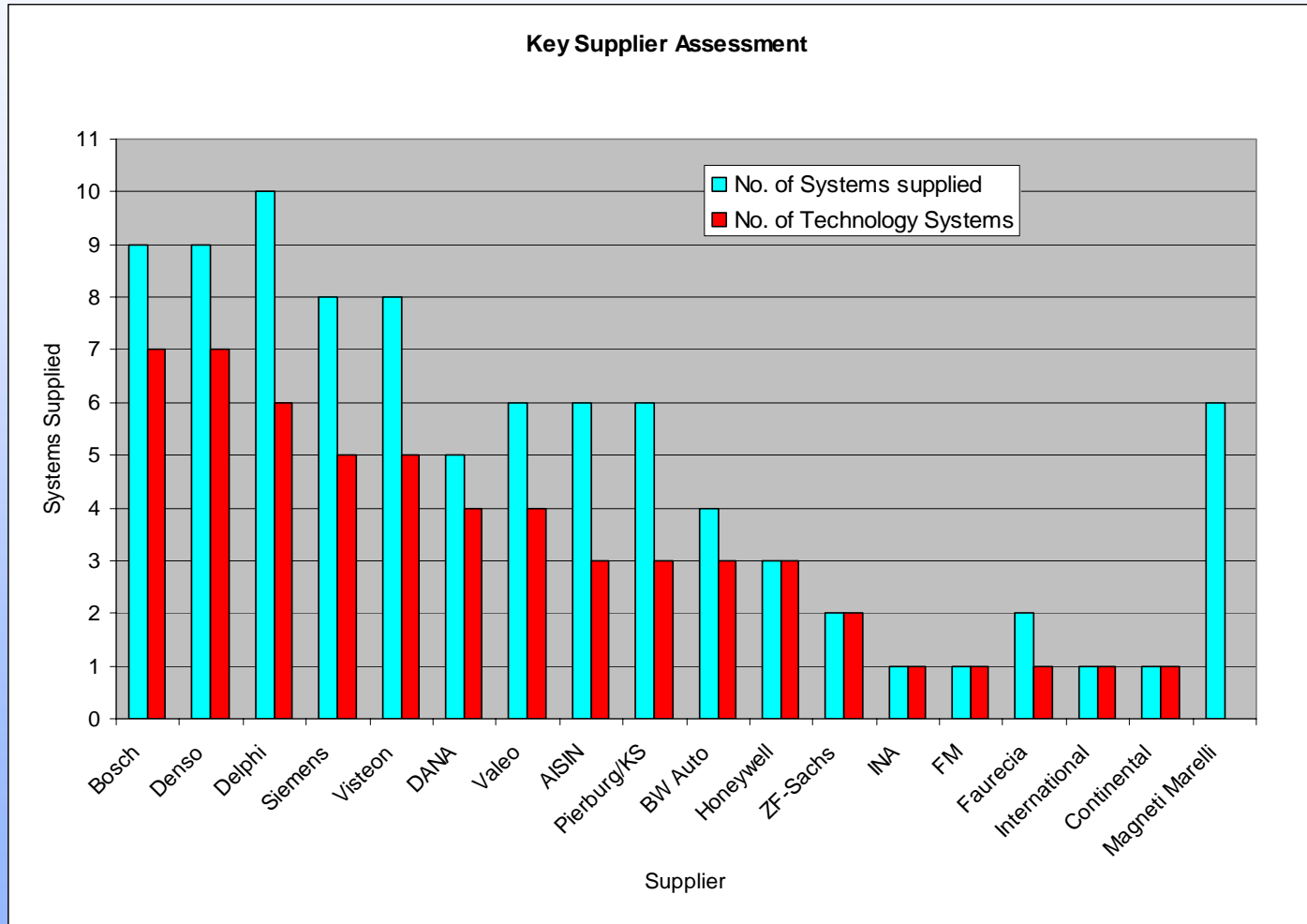
- Based on the OEMs market position & culture, technologies must be launched at 1 of 3 points in the cycle:
  - First to market: High risk (implementation & acceptance), high profit
  - Early acceptance: Medium risk (timing is critical), reducing profit
  - Mass acceptance: Low risk (but now 'price of entry'), marginal profit





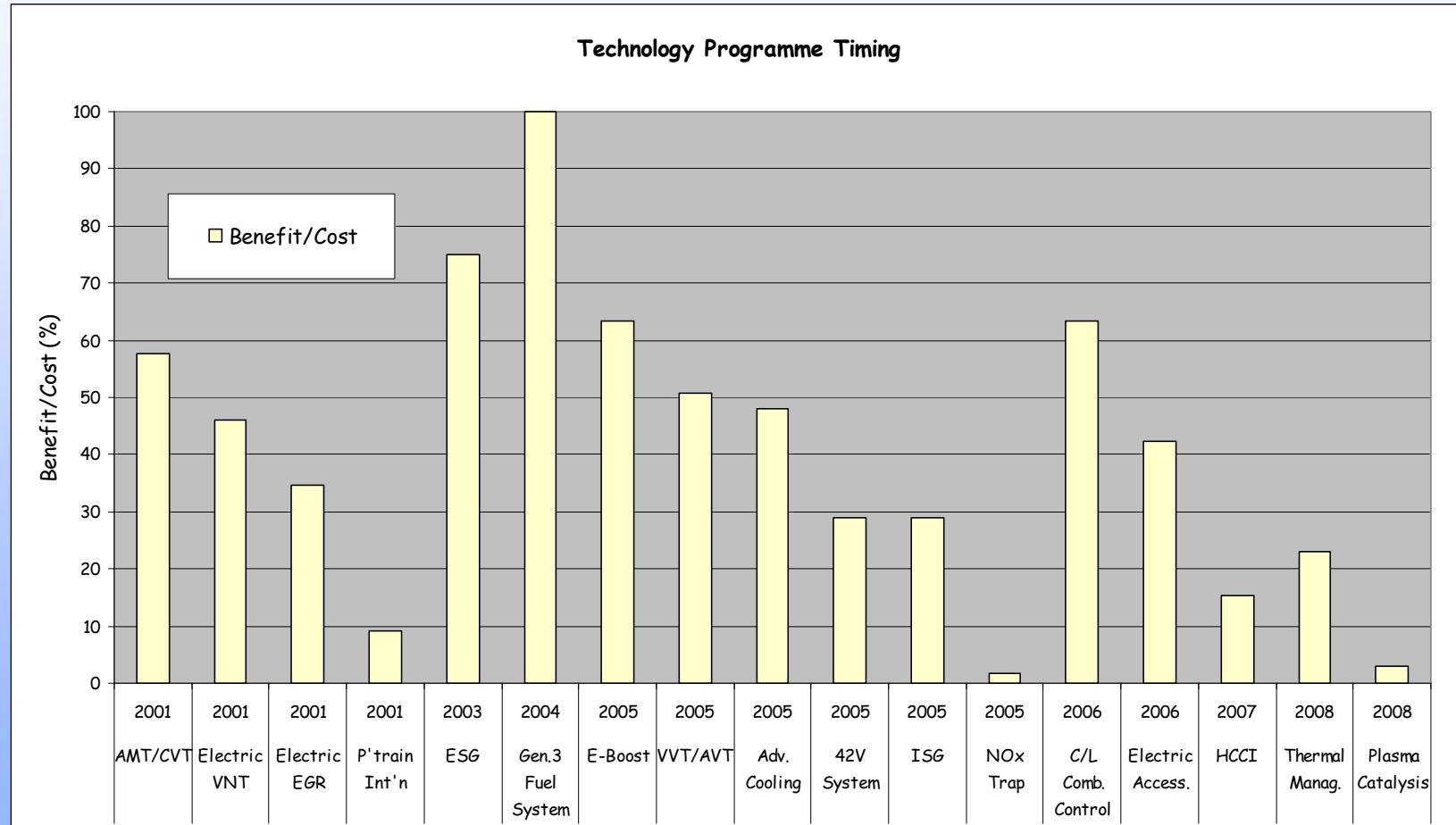
# Supplier Value

- Assessment is based on:
  - Range of systems produced
  - Number of high-value systems



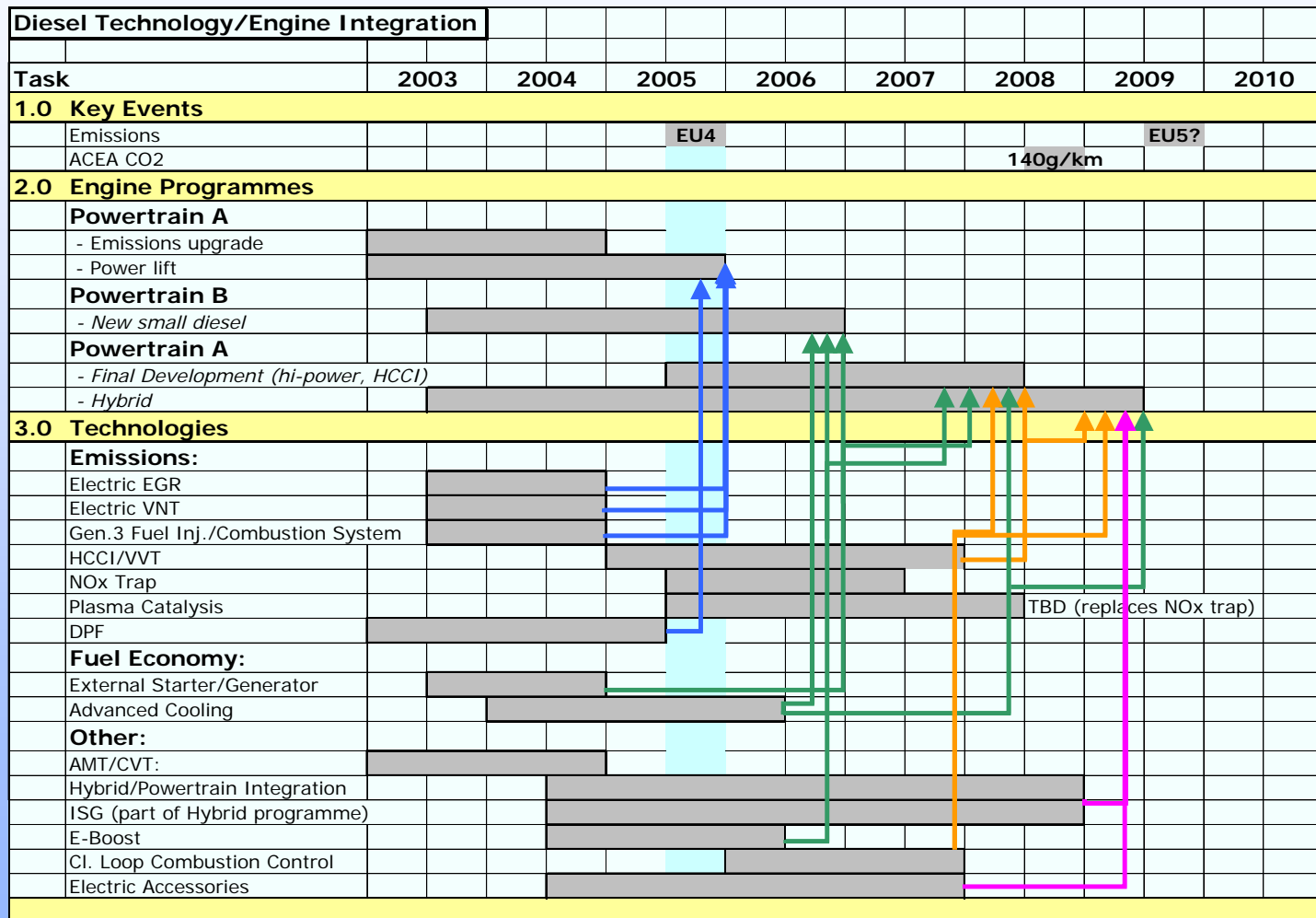
# Identify Programmes

- Select technologies based on market entry policy
- Prioritise timing in Value/Cost order
- Develop delivery times for chosen technologies



# Programme Alignment

- Technology programmes & delivery must be aligned to key events (external & internal)



# Conclusion

- WDL has developed a process for technology strategy & implementation; originally for use by OEMs & Tier 1 suppliers
- The basic process is simple & flexible
- It is ideally suited to projects such as SPRINTcar, with wide & varied inputs to, & expectations from, the final project/product
- From workshops & surveys, the inputs (technologies, ranking, values, costs) can be agreed
- The process then provides a ***consensus*** output (priorities, selection & timing)

*If the process & inputs are  
agreed, then everyone will  
agree on the outputs*

