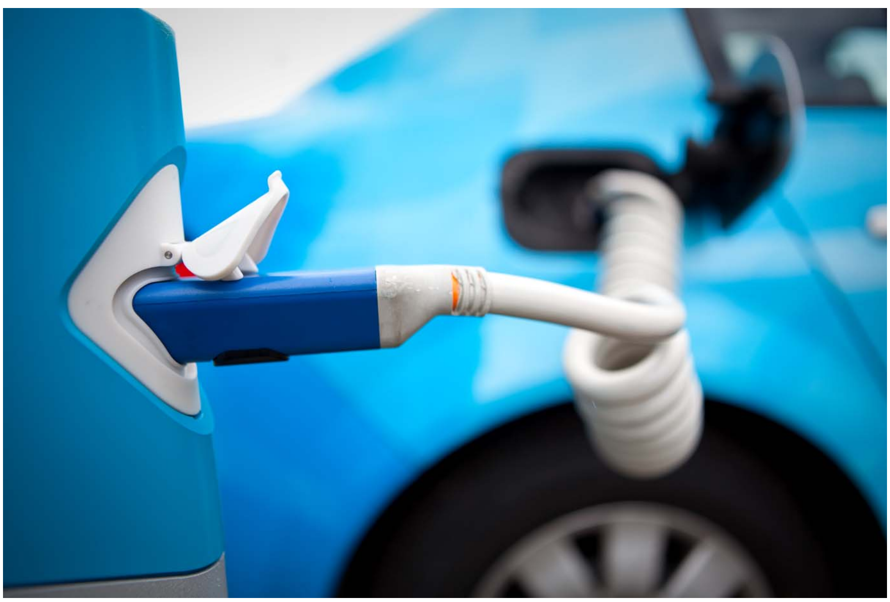
North America United States
Consumer Autos & Auto Parts

3 November 2009

Deutsche Bank

Electric Cars: Plugged In 2

A mega-theme gains momentum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FITT Research

Fundamental, Industry, Thematic, Thought Leading

Deutsche Bank's Company Research Product Committee has deemed this work F.I.T.T. for investors seeking differentiated ideas. In our June 2008 FITT report entitled "Electric Cars: Plugged in", we suggested that a number of factors, including rising oil prices, regulations, and battery technology advancements set the stage for increased electrification of the world's automobiles. We see implications not only for automakers and traditional auto parts suppliers, but also for raw material producers, electric utilities, oil demand, and the global economy.

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Companies featured	
A123 Systems Inc. (AONE.OQ),USD19.66	Hold
BMW (BMWG.DE),EUR33.60	Hold
Daimler (DAIGn.DE),EUR33.04	Buy
Ener1 Inc. (HEV.OQ),USD4.99	Buy
Fiat (FIA.MI),EUR10.46	Buy
Hitachi (6501.T),¥292	Hold
Honda Motor (7267.T),¥2,820	Buy
Hyundai Motor (005380.KS),KRW102,000.00	Buy
Johnson Controls (JCI.N),USD23.92	Hold
LG Chem (051910.KS),KRW197,000.00	Buy
Nissan Motor (7201.T),¥650	Buy
Peugeot SA (PEUP.PA),EUR23.18	Hold
Renault SA (RENA.PA),EUR30.58	Buy
Samsung SDI (006400.KS),KRW137,500.00	Buy
Sanyo Electric (6764.T),¥228	Sell
SK Energy (096770.KS),KRW108,000.00	Hold
Toyota Motor (7203.T),¥3,570	Hold

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Fundamental: Dramatic changes in veh technology appear to be inevitable

In the 18 months since we published our original thesis on vehicle electrification, the momentum behind vehicle electrification has been building. Europe and Japan have proposed automotive CO2 emission standards for 2020 that are unlikely to be achieved without significant penetration of zero emission vehicles. The U.S. has tightened and accelerated national fuel economy standards through 2016, changed regulations to disproportionately benefit electric cars, and it has effectively given California a larger role in regulating fuel economy.

Industry: Incentives, costs, new business models could propel rapid growth

Governments around the world have pledged to spend $15 billion over the next 5-years to help propel electric vehicles, batteries, and infrastructure. And they have dramatically increased incentive, subsidies, and other benefits to encourage consumer adoption. These external factors should help propel an industry that is already on a steep cost reduction curve, with battery prices expected to decline by 50% over the next 10 years. Alternative business models, based on the cost advantage of electricity versus gasoline driving, could also play a significant role in accelerating penetration, by dramatically lowering the price for these vehicles.

Thematic: We believe the automotive market could change rapidly

Based on our analysis of automakers' product disclosures, and discussions with global suppliers, we estimate the world's automakers will introduce at least 120 hybrid (HEV), plug-in hybrid (PHEV), and electric vehicle (EV) models onto the market by 2012, compared with 29 (mostly hybrid) vehicles on the market today, and 13 in 2008. Overall, we believe by 2020, 17% of the global automobile market could be comprised of HEVs, PHEVs, and full EVs, up from 1% today.

Thought Leading: The battery is key technical enabler

High energy, cost effective, long lasting, and abuse tolerant batteries are key to growth in vehicle electrification. Major advances have been made over the past 5 years, and industry participants expect a doubling of battery performance over the next 7 years. We update our forecast for the lithium ion battery market; raising our market projection to $66 billion by 2020. About a dozen co's appear to be positioning themselves for leading roles in the burgeoning market for Automotive "Advanced Lithium Ion Batteries", including PEVE (Toyota/Panasonic), Sanyo, A123 Systems, GS Yuasa, Hitachi, LG Chem, AESC (Nissan/NEC), Ener1, Li-Tec (Evonik/Daimler), JCI/Saft, SB LiMotive (Samsung/Bosch), Toshiba, and BYD. Within this report, we initiate coverage of two U.S. leaders: Ener1 and A123 Systems.

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Executive summary

In our June 2008 FITT report entitled "Electric Cars: Plugged in", we suggested that a number of factors, including concerns about dependence on oil, increased societal concern about climate change, and significant advances in battery technology have the potential to drive profound changes for the global auto industry over the next five to ten years.

Evidence in support of our view has been mounting. We believe this potential for major change has gained increased recognition over the past 18 months, as a result of

- *Recent regulatory actions taken by governments*: Europe and Japan have proposed automotive CO2 emission standards for 2020 that are unlikely to be achieved without significant penetration of zero emission vehicles (the Japanese government has projected 40% penetration for HEVs, PHEVs, and EVs by 2020, and newly proposed targets could drive 50%+). The US has tightened and accelerated national fuel economy standards through 2016, changed regulations to disproportionately benefit electric cars (plug-in cars are counted twice in weighted average fuel economy calculations), and it has effectively given California the mantle for regulating fuel economy (the California Air Resources Board believes that achieving their "Pavley 2" standards would require 30% HEV / PHEV / EV penetration by 2017-2018, and 50% by 2025).
- *Strong financial support has become available*: Governments around the world have dramatically ratcheted up subsidies for HEV, PHEV, and EV purchases. High profile programs include credits of up to $7,500 in the U.S., €5,000 in France, and RMB 60,000 ($8,800, for public use vehicles) in China. Denmark, Israel, Japan, Spain, and others also offer substantial financial incentives for these products. There has also been significant financial support for manufacturers of "advanced technology" vehicles, batteries, components, and infrastructure. Boston Consulting Group estimates that governments worldwide have already pledged to spend $15 billion in this area over the next 5 years (EV projects accounted for a large proportion of the US DOE's $25 billion Advanced Technology Vehicle loan and $2.4 billion grant programs).
- *A barrage of HEVs, PHEVs, and EVs have been revealed*: Based on our analysis of automakers' product disclosures, and discussions with global suppliers, we estimate that the world's automakers will introduce at least 120 HEV, PHEV, and EV models onto the market by 2012, compared with 29 (mostly hybrid) electrified vehicles on the market today. IHS Global Insight estimates that the number of models will rise to at least 150 by 2014 and that at least 200 models will be available by 2019.
- *Battery companies, and suppliers are gearing up to capitalize on the opportunity*: Over the past 2 years, we estimate global battery companies have announced plans to spend approximately $7 bn to construct over 36 million kilowatt hours of battery production capacity for automotive lithium ion batteries/battery packs; enough to power 15.0 million HEVs or 1.5 million EV. Industry consultant A.T. Kearney estimates that the global market for advanced lithium ion batteries for vehicles (which will be used in most of these vehicles) will rise to $22 billion per year by 2015, and $74 billion per year by 2020, versus only $32 million in 2009.

Figure 1: Hybrid (HEV), Plug-in Hybrid (PHEV), and Electric (EV) Models by year (HEV unless otherwise indicated)

2008 (13 Models)	2009 (29 Models)	2010 (61 Models)	2011 (98 Models)		2012 (119 Models)	
Ford Escape	Ford Escape	Ford Escape	Ford Escape	BMW 3 Series	Ford Escape	BMW 3 Series
GM Lg SUV's	GM Lg SUV's	GM Lg SUV's	GM Lg SUV's	BMW 5 Series	GM Lg SUV's	BMW 5 Series
GM Malibu	GM Malibu	GM Malibu	GM Malibu	Daimler C-Class	GM Malibu	Daimler C-Class
Honda Civic	Honda Civic	Honda Civic	Honda Civic	Daimler B-Class [EV]	Honda Civic	Daimler B-Class [EV]
Nissan Altima	Nissan Altima	Nissan Altima	Nissan Altima	Dongfeng Aeolus	Nissan Altima	Dongfeng Aeolus
Toyota Prius	Toyota Prius	Toyota Prius	Toyota Prius	Ford Flex	Toyota Prius	Ford Flex
Toyota Camry	Toyota Camry	Toyota Camry	Toyota Camry	Ford Focus [EV]	Toyota Camry	Ford Focus [EV]
Toyota Highlander	Toyota Highlander	Toyota Highlander	Toyota Highlander	GM Mid CUV's	Toyota Highlander	GM Mid CUV's
Toyota Estima	Toyota Estima	Toyota Estima	Toyota Estima	GM Sm CUV's	Toyota Estima	GM Sm CUV's
Toyota Crown	Toyota Crown	Toyota Crown	Toyota Crown	GM Lg Sedan	Toyota Crown	GM Lg Sedan
Toyota Lexus GS	Toyota Lexus GS	Toyota Lexus GS	Toyota Lexus GS	GM Volt [PHEV]	Toyota Lexus GS	GM Volt [PHEV]
Toyota Lexus RX	Toyota Lexus RX	Toyota Lexus RX	Toyota Lexus RX	GM Small CUV [PHEV]	Toyota Lexus RX	GM Small CUV [PHEV]
Toyota Lexus LS	Toyota Lexus LS	Toyota Lexus LS	Toyota Lexus LS	Honda Acura RL	Toyota Lexus LS	Honda Acura RL
	BYD E6 [EV]	BYD E6 [EV]	BYD E6 [EV]	Honda Odyssey	BYD E6 [EV]	Honda Odyssey
	BYD F3DM	BYD F3DM	BYD F3DM	Hyundai Tucson	BYD F3DM	Hyundai Tucson
	Changan Jiexun	Changan Jiexun	Changan Jiexun	Mitsubishi Colt	Changan Jiexun	Mitsubishi Colt
	Daimler S-Class	Daimler S-Class	Daimler S-Class	Nissan Serena	Daimler S-Class	Nissan Serena
	Ford Fusion	Ford Fusion	Ford Fusion	Nissan Infiniti M	Ford Fusion	Nissan Infiniti M
	Honda Insight	Honda Insight	Honda Insight	Nissan Fuga	Honda Insight	Nissan Fuga
	Hyundai Elantra	Hyundai Elantra	Hyundai Elantra	Nissan Van [EV]	Hyundai Elantra	Nissan Van [EV]
	Jianhuai Yuebin	Jianhuai Yuebin	Jianhuai Yuebin	Peugeot 3008	Jianhuai Yuebin	Peugeot 3008
	Mitsubishi iMiEV [EV]	Mitsubishi iMiEV [EV]	Mitsubishi iMiEV [EV]	Peugeot 408	Mitsubishi iMiEV [EV]	Peugeot 408
	Subaru Stella [PHEV]	Subaru Stella [PHEV]	Subaru Stella [PHEV]	Renault Kangoo [EV]	Subaru Stella [PHEV]	Renault Kangoo [EV]
	Tata Indica [EV]	Tata Indica [EV]	Tata Indica [EV]	SAIC Roewe 750	Tata Indica [EV]	SAIC Roewe 750
	Tesla Roadster [EV]	Tesla Roadster [EV]	Tesla Roadster [EV]	Subaru Legacy	Tesla Roadster [EV]	Subaru Legacy
	Tianjin Messenger [EV]	Tianjin Messenger [EV]	Tianjin Messenger [EV]	Th!nk Ox [EV]	Tianjin Messenger [EV]	Th!nk Ox [EV]
	Th!nk City [EV]	Th!nk City [EV]	Th!nk City [EV]	Toyota Avalon	Th!nk City [EV]	Toyota Avalon
	Toyota Lexus H	Toyota Lexus H	Toyota Lexus H	Toyota Tundra	Toyota Lexus H	Toyota Tundra
	Zotye Auto [EV]	Zotye Auto [EV]	Zotye Auto [EV]	Toyota Sequoia	Zotye Auto [EV]	Toyota Sequoia
		Bestrun B50	Bestrun B50	Toyota RAV4	Bestrun B50	Toyota RAV4
		BMW X6	BMW X6	Toyota Yaris	BMW X6	Toyota Yaris
		BMW 7-Series	BMW 7-Series	Toyota Lexus ES	BMW 7-Series	Toyota Lexus ES
		BMW Mini-E [EV]	BMW Mini-E [EV]	Toyota [PHEV]	BMW Mini-E [EV]	Toyota [PHEV]
		BYD F6DM [PHEV]	BYD F6DM [PHEV]	VW Polo	BYD F6DM [PHEV]	VW Polo
		Chery Qilin M1	Chery Qilin M1	VW Touareg	Chery Qilin M1	VW Touareg
		Chrysler Ram	Chrysler Ram	Volvo C30 [EV]	Chrysler Ram	Volvo C30 [EV]
		Chrysler Mid SUV	Chrysler Mid SUV		Chrysler Mid SUV	BMW MegaCity [EV]
		Chrysler / Fiat [EV]	Chrysler / Fiat [EV]		Chrysler / Fiat [EV]	Changan EV [EV]
		Coda Sedan [EV]	Coda Sedan [EV]		Coda Sedan [EV]	Chery ZC7050A [EV]
		Daimler M-Class	Daimler M-Class		Daimler M-Class	Chrysler / Fiat [EV]
		Daimler E-Class	Daimler E-Class		Daimler E-Class	Daimler Smart Fortwo [EV]
		Fisker Karma [PHEV]	Fisker Karma		Fisker Karma	Fisker Nina [PHEV]
		Ford Taurus	Ford Taurus		Ford Taurus	Ford Escape [PHEV]
		Ford Edge	Ford Edge		Ford Edge	GM / Reva JV [EV]
		Ford Transit Connect [EV	Ford Transit Connect [EV]		Ford Transit Connect [EV]	Hyundai [PHEV]
		Geely EK-1 [EV]	Geely EK-1 [EV]		Geely EK-1 [EV]	Nissan Infiniti [EV]
		Great Wall Oula [EV]	Great Wall Oula [EV]		Great Wall Oula [EV]	Peugeot [PHEV]
		Honda CR-z	Honda CR-z		Honda CR-z	Renault City [EV]
		Honda Fit	Honda Fit		Honda Fit	SAIC Roewe [PHEV]
		Hyundai Sonata	Hyundai Sonata		Hyundai Sonata	Tesla Model S [EV]
		Hyundai Accent	Hyundai Accent		Hyundai Accent	Toyota [EV]
		Kia Lotze	Kia Lotze		Kia Lotze	VW Porsche Cayenne
		Lifan 320 [EV]	Lifan 320 [EV]		Lifan 320 [EV]	VW Porsche Panamera
		Nissan Leaf [EV]	Nissan Leaf [EV]		Nissan Leaf [EV]	VW Passat
		Peugeot Ion [EV]	Peugeot Ion [EV]		Peugeot Ion [EV]	VW Up [EV]
		Peugeot Berlingo [EV]	Peugeot Berlingo [EV]		Peugeot Berlingo [EV]	VW Audi Sport [PHEV]
		Renault Fluence [EV]	Renault Fluence [EV]		Renault Fluence [EV]	Volvo V70 [PHEV]
		Tata Nano [EV]	Tata Nano [EV]		Tata Nano [EV]	
		Tianjin Siabao [EV]	Tianjin Siabao [EV]		Tianjin Siabao [EV]	
		Toyota Corolla	Toyota Corolla		Toyota Corolla	
		Toyota Auris	Toyota Auris		Toyota Auris	
		Toyota Sienna	Toyota Sienna		Toyota Sienna	
		VW Golf [PHEV]	VW Golf [PHEV]		VW Golf [PHEV]	

Source: Deutsche Bank compilation from various news sources, company press releases, JD Power, Ward's Automotive, just-auto.com

Our June, 2008 report introduced our vehicle electrification thesis. In this report, we aim to take our analysis a step further:

- *We discuss recent regulatory developments*, including new incentives that have already been adopted by governments, and new standards being proposed for the US, Europe, and China through 2020, which have reinforced our view that increased electrification of vehicles is inevitable.
- *We update our forecast for the lithium ion battery market*; raising our market projection to $66 billion by 2020 vs. $35 billion previously. We would also note that our forecast through 2014 is considerably more detailed, as automakers and battery companies have provided additional disclosure regarding their product and capacity plans. Our analysis also includes an assessment of automakers' and battery companies' cost/price projections through 2020.
- *We have upgraded our analysis of newly emerging business models*, including EV infrastructure companies such as Better Place, which we see as having the potential to drive much more rapid adoption of electric vehicles by taking advantage of a widening electric drive/gasoline drive arbitrage. Such models, which are structured to accelerate penetration of EVs by offering consumers vehicles that are attractively priced at the point of initial purchase, could shift the industry from one that's driven by regulatory push, toward one driven by consumer pull, resulting in much larger penetration.
- *We identify specific ways for investors to express this electrification theme*, including A123 Systems, which we initiate with a Hold recommendation, and Ener1, which we initiate with a Buy recommendation.

Electrification of the automobile appears to be inevitable

There is widespread recognition that the efficiency of internal combustion powered vehicles can be further enhanced through application of a variety of technologies and strategies.

- Turbocharging and downsizing of engines,
- Direct gasoline injection,
- Gasoline homogeneous charge compression ignition,
- Diesel engines,
- Advanced two stroke (such as OPOC) engine designs,
- Cylinder deactivation,
- Variable valve timing,
- Electric steering,
- Dual clutch transmissions,
- Electric air conditioning,
- Reduced mechanical friction,
- Improved aerodynamics,
- Low rolling resistance tires,
- Weight reduction

Nonetheless, it has become increasingly apparent to industry participants that the industry will ultimately shift towards increased use of electric propulsion. Irrespective of the technical gains that can be achieved through mechanical and electronic tweaks, the various mechanical processes that occur within engines and transmissions (i.e. intake of air and fuel into the cylinder, compression of air and fuel, combustion and expansion, driving of the crankshaft, gearing of the engine's mechanical power via the transmission, transferring this power to the wheels through a transfer case and/or differential) will always be less efficient than electric motors, which convert electrons into mechanical energy. According to the DOE's web site dedicated to fuel economy, only 15%-20% of the energy contained in gasoline is used to propel the vehicle; the rest is lost primarily as waste heat. In contrast, electric motors are able to convert 86%-90% of available energy into motive power.

It should be noted that this brief description oversimplifies the gasoline versus electric comparison, and that a more holistic approach takes into account the efficiency of electric power generation. Nonetheless, most industry experts still believe that electricity is more efficient than gasoline even when taking into account the efficiency of coal fired power plants, and losses through transmission. This is because these large power generation facilities are far more efficient than small gasoline or diesel powered motors, even when the source fuel is coal or natural gas (see our June 2008 Electric Cars report for a more detailed explanation of this issue).

We believe that several factors are driving the auto industry towards electric. These include:

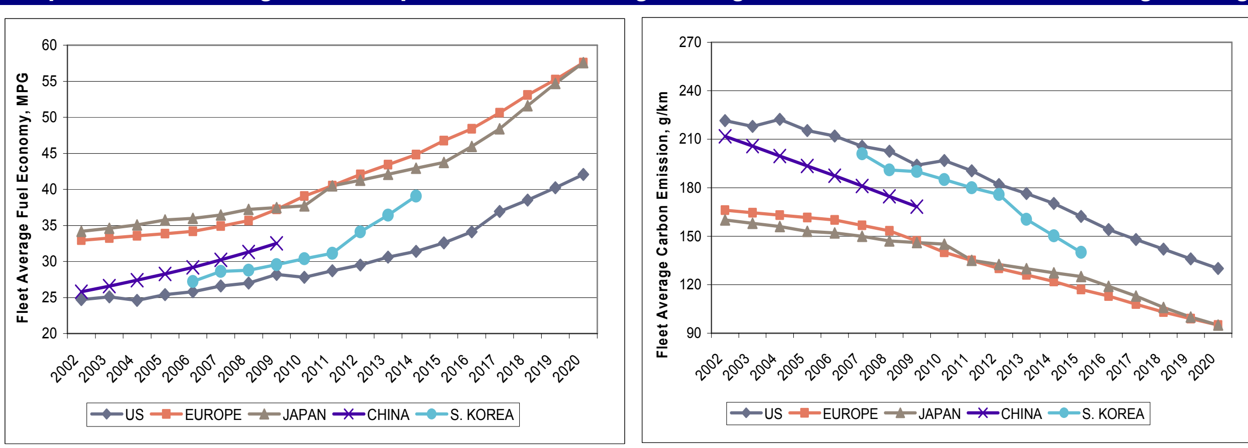
- Government regulations/standards in the 2020 timeframe (in Europe, North America, and Japan) do not appear to be achievable without significantly increased penetration of electric drive.
- We believe that China, which is rapidly becoming a venerable market force in the global auto industry, is likely to adopt policies aimed at raising penetration rates for "Alternative Energy Vehicles", primarily consisting of PHEVs and EVs.
- We expect increasingly compelling financial incentives/penalties from governments—feebates, tax breaks, and congestion charges will become increasingly prevalent, providing an economic incentive for consumers to shift away from less efficient modes of transportation.
- Significant advances in battery technology/performance are likely to continue: Industry experts project a doubling of advanced lithium Ion battery performance over the next 7 years.
- We expect a steep cost reduction curve for batteries (50% decline over 10 years), and electric drive components.
- Deutsche Bank's Integrated Oil Research Team sees potential for oil prices to rise dramatically—including potential for a brief spike to $175 per barrel—given limited excess supply, rising demand, and chronic underinvestment in new oil production capacity. We see the convergence of alternative propulsion technology, combined with rising oil prices, as a major catalyst for consumer and government behavior.
- A very large market opportunity appears to be developing through the emergence of new business models based on the cost advantage of electricity versus gasoline driving. Combined with government incentives already in place, these business models have the potential to dramatically lower the entry price for electric vehicles—potentially making them cheaper to purchase and operate.
- Several new US, European, and Chinese ventures have been formed to challenge established automakers in the EV arena, where they believe they can offer competitive and/or superior products. Several appear to be well capitalized, have experienced management (product development, procurement, and manufacturing experts that have come from other automakers), and credible plans to achieve commercial scale.
- We anticipate that consumers will respond to increased xEV options, and the favorable driving experience for EVs vs. ICEs.
- We also believe increased societal concern regarding environmental/climate risks can and will affect purchase decisions.

The regulatory environment is pushing automakers toward electrification

As noted earlier, we believe that regulatory actions taken by governments worldwide are now clearly pushing the auto industry toward much more aggressive adoption of vehicle electrification. Many of these initiatives can be traced back to rising concerns about greenhouse gas concentrations, and the Kyoto Protocol of 1997 (note that CO2 and fuel economy regulations are essentially the same, since each gallon of gasoline/diesel burned will always produce 19.4/22.2 pounds of CO2).

In 2006 Sir David Stern published the first major research which looked into the economic consequences of climate change and rising GHG emissions. Stern concluded that a rise of global temperature by more than 2°C would inevitably change global economic conditions and could result in irrevocable changes to the way people live, work and consume. The review argued that to prevent this from happening immediate policy change is required. An IEA report published in 2008 indicated that in order to limit the global increase in temperature to 2 C, atmospheric CO2 levels would need to be limited to 450 parts per million by 2030. The transportation sector would need to pursue dramatic change, as it accounts for 44% of total CO2 emissions. To achieve the "Scenario 450", light vehicles would need to reduce CO2 emissions by at least 49% by 2030 (to 90 g/km from 176 g/km today). Importantly, we would note that in order to achieve this average output for the total light vehicle stock, new vehicles would need to reduce emissions to an even larger extent. On July 8, 2009 all members of the G8, including President Obama, pledged to adopt regulations which would limit the rise in global temperature to 2 C.

Figure 2: Summary of regional fuel economy and emissions trajectory. U.S. forecast is based on 2016 gov't mandates and DB est through 2020. Europe based on 2012 mandated target and assumes that the EU goal of 95 g/km by 2020 becomes regulation. Japan fcst is based on gov't targets. S. Korea forecast is based on gov't targets.



Source: International Council on Clean Transportation, U.S. DOE, DB estimates

The US has clearly set a new direction

It is clear that the drumbeat of tightening regulations has accelerated over the past two years… particularly in North America. The dramatic spike in oil prices during the summer of 2008 appears to have also been a major catalyst for change, as it galvanized political support for fuel efficiency mandates, neutralized political opposition to them, and exposed massive strategic risks for automakers that had placed lesser priority on fuel efficiency (even USconsumers appear to be prioritizing fuel economy). In fact, based on discussions with leaders in Washington and elsewhere, we believe many are particularly focused on the economic and strategic ramifications of dependence on oil, and the potential positive economic implications associated with increased domestic energy sourcing (i.e. increased dependence on electricity, which can be derived from domestic coal, gas, nuclear, or renewables). Figure 3 highlights the potential for increased U.S. cash outflow, for imports, if oil rises by $80 per barrel—from the low of $40 that was reached in February 2009. Oil's price sensitivity to economic growth could effectively create a natural braking mechanism, or contra-stimulus, for the major oil importing economies.

Figure 3: The U.S. Contra Stimulus – A rise in oil prices of $80 / barrel drives $300bn out of the U.S. economy [BPD = Barrels per Day]

BPD consumed in U.S. (mm barrels)	18.5
BPD produced domestically (mm barrels)	8.0
BPD imported (mm barrels)	10.5
	x 365
Barrels per Year imported (billion barrels)	3.8
U.S. economic impact from $80 rise in oil	$300 bn

Source: Deutsche Bank

In May 2009, the U.S. essentially adopted California's vehicle emissions regulatory policy. The regulation, which mandates a 30% increase in fuel economy by 2016, ended a 7-year behind-the-scenes battle between the US administration, the major automakers, and California (note that 16 states representing 40% of the light vehicle market had adopted California's policy). While the 2016 increases appear significant, we believe they would likely be achievable through improvements to internal combustion engines (EPA believes that 5% xEV penetration will be required). More important to electrification, however, is that we expect the EPA and California (in pursuit of its legislative mandate to reduce greenhouse gases 40%-50% by 2025, compared to 2016, and 80% by 2050) are pushing for post-2016 regulatory guidelines that will absolutely require significant penetration of xEV's—it has been estimated that California's Pavley 2 standards would require 30% HEV penetration by 2017-2018 and 50% by 2025. Additionally, we believe that the Obama Administration and California are studying programs that would incentivize consumers through rebates on high-efficiency vehicle purchases, and taxes on low efficiency vehicle purchases (similar feebate systems exist in several European countries) [based on conversations with Administration contacts and persons studying feebates on behalf of California Air Resources Board].

Figure 4: CARB Emission reduction targets

Model Years	Regulatory Driver	GHG Reduced
Now-2016	Pavley 1	30%
2017-2025	Pavley 2	40-50%
2015-2050	ZEV 2	~80%

Source: California Air Resources Board

US appears to be pursuing a 3-pronged strategy

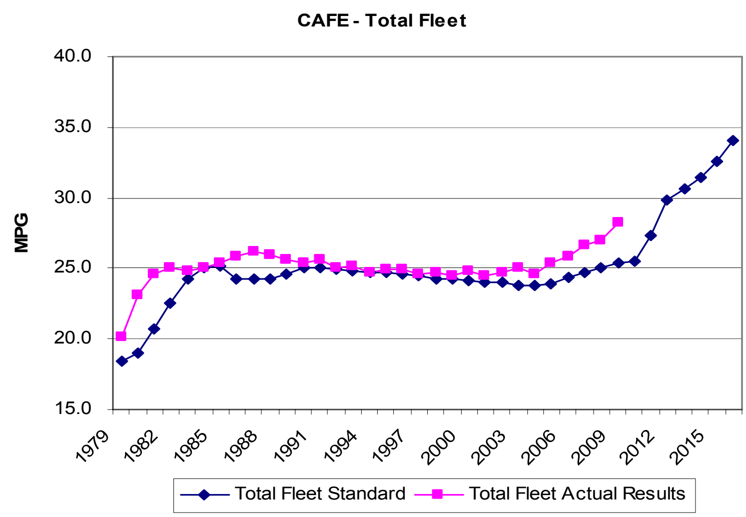
The current US administration has quickly taken an aggressive approach to managing vehicle emissions. We believe its strategy involves a 3-pronged approach.

- Mandate the development of advanced technologies by OEMs through enactment of stringent fuel economy / emission standards.
- Foster the development of advanced technologies through low-cost loans and grants to automakers and through the supply chain.
- Incentivize the consumer to purchase advanced technology vehicles.

CARB now appears to be the de facto US emissions regulator

New emissions/fuel economy standards set by the Environmental Protection Agency (EPA) and Department of Transportation (DOT) will require US vehicles to achieve CO2 emissions of less than 250 g/mile, and MPG of 35.5 by 2016. This represents an approximately 40% increase to the current fuel economy standard, and it would result in an approximate 30% improvement in emissions and fuel economy vs. currently achieved levels. The average car will be required to achieve 38.0mpg by 2016 vs the current standard of 27.5mpg, and the average truck will be required to achieve 28.3mpg vs the current standard of 23.1mpg. Achieving these improvements is expected to add ~$1,100 to the cost of the average automobile (due to increased fuel economy technology).

Figure 5: U.S. Fuel Economy Standards and Achieved Results – Total Fleet. Note: Decline in the vehicle standard from 1992-2005 is driven by increase truck penetration which drove the wtd average standard downward



Source: NHTSA

This historical agreement between federal lawmakers, California lawmakers, and the major automakers lays out a stringent trajectory of fuel economy improvements which actually pulled forward by four years the national standard of 35mpg by 2020 set forth in the Energy Independence and Security Act of 2007 (EISA). In addition, we'd highlight three other important ramifications:

1) It significantly increased the EPA's vehicle regulation authority. Until now, the US only had a national fuel economy standard (how much fuel is consumed per unit of distance), which was administered by the National Highway Transportation and Safety Administration (NHTSA), an agency of DOT. In 2007, the Supreme Court ruled, in Massachusetts vs. EPA that, not only did the Clean Air Act give the EPA statutory authority to regulate vehicle emissions, the agency cannot decline to do so. This was an important driver for the EPA to become involved in the new standards. This puts the US more in the mainstream of global standards, as most other regions, as well as California, regulate tailpipe emissions (how much greenhouse gas is actually emitted from a vehicle's tailpipe per unit of distance). We believe having the EPA involved could lead to more stringent future standards, since the agency has a particular mission to reduce particulate emissions and has fewer historical connections with the auto industry than NHTSA.

2) New regulations dramatically favor EVs. Until recently, there was uncertainty over whether EVs would be counted as zero-emission, or whether some estimate of electric power facility emissions would be imputed onto the vehicle. The EPA / NHTSA proposed rules that not only count EVs as zero, but propose to count each "plug-in" vehicle as somewhere between 1.2x and 2.0x a normal vehicle in the weighted average calculation. Below, we've illustrated the potential impact of this clause for Chrysler, the mainstream OEM with the most significant gap to the 2016 standard. If Chrysler were to achieve a 5.5% penetration of EVs, all the rest of its vehicles could improve by only half of the mandated improvement, and the overall company would still meet the standard.

Figure 6: Chrysler example of potential impact of EV

	Current ICE	2016 ICE	2016 EV	2016 Total
Volume (15mm unit mkt @ 7.5% share)	1,120,000	1,058,400	61,600	
Volume (incl 2x multiplier for EV's)			123,200	1,181,600
Average CO2 Emission (g/km)	243	221	0	198
Target				198

Source: Deutsche Bank

3) Probably most importantly, **the new standard is essentially an adoption of the California Pavley 1 standard which basically means that, as of now, California is the de facto regulator of vehicle emissions in the U.S**. This also sends automakers a clear message to expect increasingly stringent fuel economy regulations through 2020 and beyond. California's Air Resources Board (CARB) has a goal, backed by 2002 legislation (nicknamed Pavley after the lawmaker who spearheaded the legislation), to reduce GHG emissions in the state by 80% by 2050 (vs. a 1990 baseline). Pavley 1, the policy that was essentially adopted by the US, requires 30% GHG reductions by 2016. Pavley 2 would drive a further decline in GHG's of 40%-50% (vs. 2016) by 2025. The state's ZEV2 (zero emissions vehicle) plan, which has yet to be fully outlined, will be the driver of the long-term initiative of 80% GHG reduction. CARB is expected to begin outlining post-2016 plans in early 2010.

In terms of electrification, CARB believes Pavley 2 will require 30% of light vehicle sales to be at least HEV by 2017-2018 and 50% by 2025. At that point, they expect basic HEV penetration to decline as PHEV / EV models become the mainstream technology. CARB would certainly welcome an earlier transition to PHEV / EV.

CARB's vision for the 2050 US vehicle fleet breaks down as displayed in the chart below:

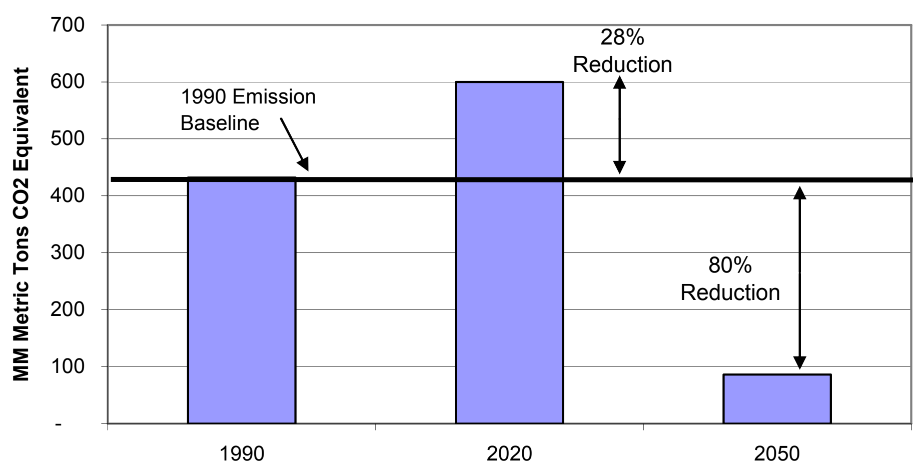
Figure 7: CARB 2050 vision

Vehicle Type	MPG	% of Veh's in Operation	% of Fuel Consumed
Conventional ICE	40	10%	30%
HEV / Biofuel	60	18%	30%
Electric / Hydrogen	80+	72%	40%

Source: California Air Resources Board

Even if the US does not adopt California's regulations post 2016, it is important to note that CARB's influence will remain significant, given that 16 other states have adopted or are moving to adopt California's vehicle emissions protocol. Together with California, this group represents 40% of the US light vehicle fleet. Given this size, we believe that initiatives adopted by this group will become the de facto US standard, as automakers will be forced to plan for the most burdensome standard. The 16 states are Arizona, Colorado, Connecticut, Florida, Maine, Maryland, Massachusetts, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Utah, Vermont, and Washington.

Figure 8: California's overall CO2 emission reduction targets



Source: California Air Resources Board

Manufacturing infrastructure support – Federal grant / loan programs are leading to significant US lithium-ion battery capacity

Section 136 of the Energy Independence and Security Act of 2007 contains a clause (ATVM loan program) that allocates $25bn to fund direct loans to automakers and component suppliers for projects that will result in "Advanced Technology Vehicles", defined as a vehicles that achieve 25% better fuel economy than the average comparable vehicle. The cost on the loans will be equal to the interest rate equivalent to the cost of funds to the Dept of Treasury for obligations of comparable maturity (approximately 2%-3%) plus 0 spread. The term of the loan will be the lesser of the projected life of the eligible project and 25 years. For every $1 of the loan spent, the company will have to contribute $0.20 of their own capital. So far, four loan packages have been awarded. We assume additional loan packages will be awarded shortly, including loans to US battery-makers Ener1 and A123.

Figure 9: ATVM loans awarded to date

Company	Loan Amt ($MM)	Disclosed purpose
Ford	5,900	Funds to upgrade facilities to produce 13 fuel-efficient vehicles
Nissan	1,600	Retool Smyrna, TN plant to build adv tech veh's and build a battery mfg facility
Tesla	465	Build electric veh's and powertrains in California
Fisker	529	Complete development of Karma and fund R&D for new line of lower-cost PHEV's
Tenneco	24	Engrg / mfg of emission control products (aftertreatment and exhaust components)
Total	8,518	

Source: Company Filings

The American Recovery and Reinvestment Act of 2009 (stimulus bill) also allocated $2bn in grants to support the development and manufacture of advanced batteries and other EV components. These grants do not have to be repaid. For every $1 of grant money deployed, a company will have to contribute $1 of its own capital.

The highlighted areas below are direct investment into production of lithium-ion cells for light vehicle xEV batteries. Combining the $1bn below (plus $1bn of matching funds), plus the Nissan ATVM loan, $500 million of which will be used for a lithium ion battery facility, we believe approximately $2.5bn will be deployed over the next several years to build lithium ion battery capacity in the US. At a very rough estimate of 5 Whs per $ of investment, this implies US lithium ion battery capacity of approximately 12.5 million kWh. At 25kWh per EV battery, this implies capacity for 500k EVs (equivalent to ~5 million HEVs) by 2015.

Figure 10: List of ABMI grant awardees and amount ($ MILLION)

	Award ($MM) and Award Type					
Company	Cell, Battery, and Mtl Mfg Facilities	Advanced LIB Recycling	Electric Drive Component Mfg	Advanced Veh Electrification - Infrastructure and Prototype Veh's	Adv Electric Drive Education Pgms	Total
GM	106		105	31		241
Ford			63	30		93
Chrysler				70		70
Navistar				39		39
JCI	299					299
Delphi			89			89
Allison Transmission			63			63
Remy Inc.			60			60
Magna			40			40
UQM Tech			45			45
A123	249					249
Ener1	119					119
CPI (LG Chem)	151					151
Dow Kokam	161					161
Saft America	96					96
Exide	34					34
East Penn	33					33
Celgard / Polypore	49					49
Toda America	35					35
Chemetall (Rockwood)	28					28
Honeywell	27					27
BASF	25					25
Smith Electric Veh's				10		10
Electric Trans Engrg Corp				100		100
Various Universities					39	39
Other	70	10	32	68		180
Total	1,482	10	497	347	39	2,375

Source: U.S. Department of Energy

Incentivizing the consumer: We expect additional actions to push consumers towards high-efficiency vehicles

The Obama Administration has a well-publicized goal of 1 million PHEVs/EVs on US roads by 2016. We believe there will be enough vehicles and capacity to meet that goal, which leaves consumer demand as the remaining question. The 2009 stimulus bill allocated $2bn to a Plug-in Vehicle Tax Credit. The credit acts as a subsidy on vehicles that are propelled by a battery of 4 kWh or more ($2,500 for any 4kWh vehicle, plus $417 for each additional 1 kWh up to a max credit of $7,500 for a vehicle with a battery of 16 kWh or more). Each automaker will get 100% credit for their first 200,000 eligible vehicles sold, 50% credit for the next two quarters, and 25% credit for the final two quarters.

In terms of HEVs, credits of up to $3,400 have been available since 2005. But the credits phase out over a 1-year period for a given manufacturer once it has sold over 60,000 eligible vehicles. Honda and Toyota have already phased out and Ford is now in the phase-out period (through March 2010). Given that these are the major HEV makers, this incentive program has lost much of its impact. We know of no initiative to extend or expand the program.

As mentioned above, we believe the federal government and California are studying major consumer-based incentive systems that will likely begin the legislative process by early 2010. [based on conversations with Administration contacts and persons studying feebates on behalf of California Air Resources Board]. We believe a feebate (bonus / malus) system, similar to many European programs, would provide further assistance to the automakers in terms of selling advanced vehicles, as well as providing a pricing offset to the additional content required to meet the standards.

US expected to reach 23% xEV penetration by 2020

In determining our outlook for xEV penetration in the US, we estimate the mix of vehicles that would result in compliance with the 2016 US emission standards (163 g/km) and our current expectation for the 2020 standard (130 g/km). Overall, we expect that HEVs will continue to be the dominant xEV type in the US through 2015, particularly due to the early market acceptance of HEVs in the US (2.8% penetration in 2009E), as well as their compelling economics at low fuel prices. Subsequent to 2015, however, growth in HEVs is likely to slow in favor of PHEVs/EVs, due to expected battery cost reductions, the slowing of HEV efficiency gains, and the likely rise of fuel prices. By 2020, we expect HEVs and PHEVs/EVs to each represent 11%-12% of US market sales (total of 23%).

Below is a look at our simple demand model for the US, which uses the following assumptions:

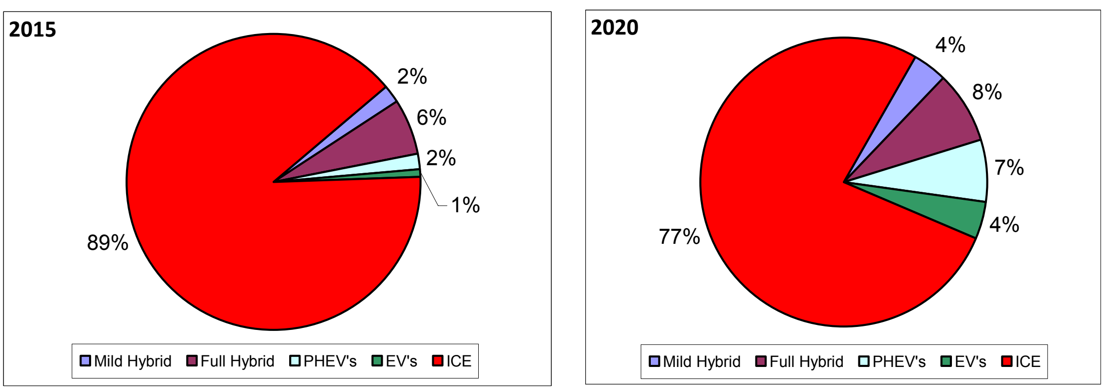
- We assume that California and the 16 additional states that support CARB emissions policies will set 2020 emission standards at approximately 130 g/km (versus current levels of ~200 g/km). This projection corresponds with California's Pavley 2 standard, which calls for a 40% reduction in emissions by 2025 (vs. 2015 levels). This would require emissions of approximately 95 g/km by 2025. Our 130 g/km estimate for 2020 is essentially halfway there.
- We estimate that traditional (i.e. non-hybrid) ICE vehicles in the US reduce emissions by 12% by 2015, and a further 10% by 2020. Under the CAFE fuel economy test (which lead to unrealistically high fuel economy estimates), these improvements would result in 2015 / 2020 MPG levels of 32 MPG / 35 MPG, versus today's average level of 28 MPG.
- We assume that micro hybrids / mild hybrids / full hybrids achieve 7.5% / 20% / 45% better emissions levels than traditional ICE vehicles. We assume a PHEV will emit approximately 45 g/km currently. We assume that each type of vehicle improves by 10% through 2015 and a further 10% through 2020.

Figure 11: U.S. demand model to meet regulatory targets for CO2 emissions

CY	2009e	2010e	2015e	2020e
Total U.S. PC sales ('000)	10,300	12,500	15,900	16,900
Vehicle Penetration				
traditional ICE	97.2%	94.4%	74.4%	37.0%
Micro hybrid	0.0%	2.0%	15.0%	40.0%
Mild hybrid	0.6%	0.8%	2.0%	4.0%
Full hybrid	2.2%	2.6%	6.0%	8.0%
PHEV	0.0%	0.1%	1.8%	7.0%
EV	0.0%	0.1%	0.8%	4.0%
Units by segment				
traditional ICE	10,012	11,800	11,830	6,253
Micro hybrid	0	250	2,385	6,760
Mild hybrid	62	100	318	676
Full hybrid	227	325	954	1,352
PHEV	0	13	286	1,183
EV	0	13	127	676
Totals	10,301	12,501	15,900	16,900
CO2 new vehicles (tons/km)	2,008	2,399	2,589	2,205
Average CO2 emission per unit	195	192	163	130
Target	195	192	163	130

Source: Deutsche Bank

Figure 12: U.S. xEV penetration by type (2015 and 2020)



Source: Deutsche Bank

Figure 13: U.S. xEV Volumes (000 units)

	2009E	2015E	2020E
Mild Hybrid	63	318	676
Full Hybrid	231	954	1,352
PHEV	-	286	1,183
EV	-	127	676
ICE	10,206	14,215	13,013
Total	10,500	15,900	16,900

Source: Deutsche Bank

Europe appears poised to set standards that would be difficult to achieve without electrification

In order to achieve its central policy objective of reducing GHG emissions by 20% by 2020 against 1990 levels, the EU has put together an energy-policy package encompassing all of these dimensions and affecting all areas of the economy. Transport, accounting for about 20% of European CO2 emissions is obviously one of the targeted areas for improvement, with passenger cars (12% of total) presenting the biggest contributor. In its effort to become the leading low carbon society the EU has put a tough regulatory framework in place, requiring Europe to take the global lead in fuel economy improvements.

Initial EU regulation will kick in from 2012 onwards

In late 2007 the European Commission introduced its regulatory framework for regulating Automotive CO2 emissions starting in 2012. The regulations target average new car fleet emissions of 130g/km, and will be phased in through 2015 (65% of new car sales will have to comply in 2012, gradually rising to 100% by 2015).

The European system will be weight based… i.e. manufacturers with a "heavier" mix will be allowed to emit relatively more. However, the "steepness" of the curve implies relatively larger cuts need to be made for heavier vehicles. This can easily be seen by the respective company targets, as premium brands need to improve their fuel efficiency substantially more than companies which focus on entry level mass market segment products such as Fiat, PSA or Renault.

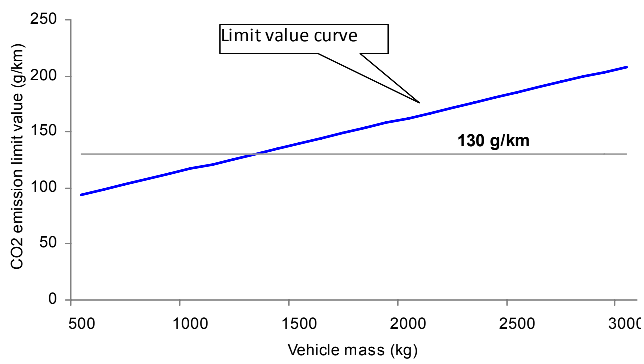
Figure 14: European emission targets and current levels by OEM

	CO2 target 2015	Current CO2 level	Weight (kg)	Variance to target
Fiat	121	138	1,172	13%
Suzuki	122	156	1,190	22%
Mazda	125	158	1,256	21%
Toyota	127	147	1,305	14%
Peugeot-Citroën	128	139	1,333	8%
GM	128	153	1,327	17%
Renault	129	143	1,341	10%
Ford	129	152	1,354	15%
Hyundai	130	149	1,365	13%
Honda	130	154	1,381	15%
Nissan	131	161	1,395	19%
Volkswagen	133	159	1,429	17%
Daimler	135	175	1,494	23%
BMW	138	154	1,540	11%

Source: Transport and Environment

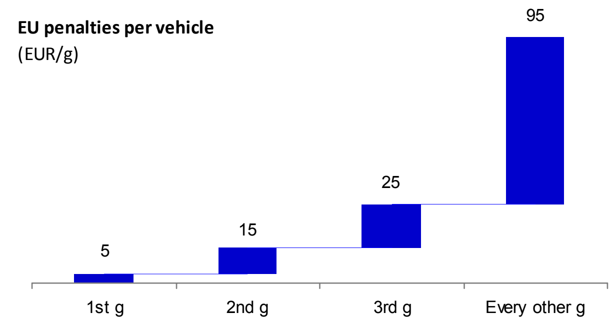
We note that missing the individual company targets is not a viable option, since the EU has imposed severe penalties. As can be seen below, the penalty eventually rises to E95 per vehicle per gram CO2 shortfall against the individual target. Knowing that most automakers generate no more operating profit than E500 per car on average in the European market a 7g/km miss would thus erase any profitability.

Figure 15: Limit value curve (see formula below)



Source: EU Commission

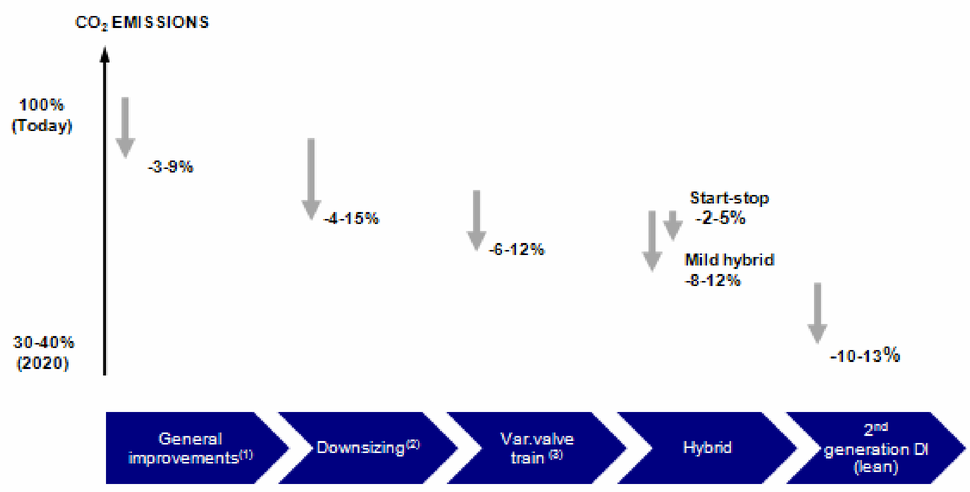
Figure 16: CO2 fleet emission penalties for OEM's



Source: EU Commission

Achieving these targets requires massive improvements to conventional powertrains. Hence we see substantial efforts in this direction by all automotive manufacturers. Below we display the various technological possibilities and their respective savings potential.

Figure 17: Engines' CO2 emissions can be improved by 30%-40%

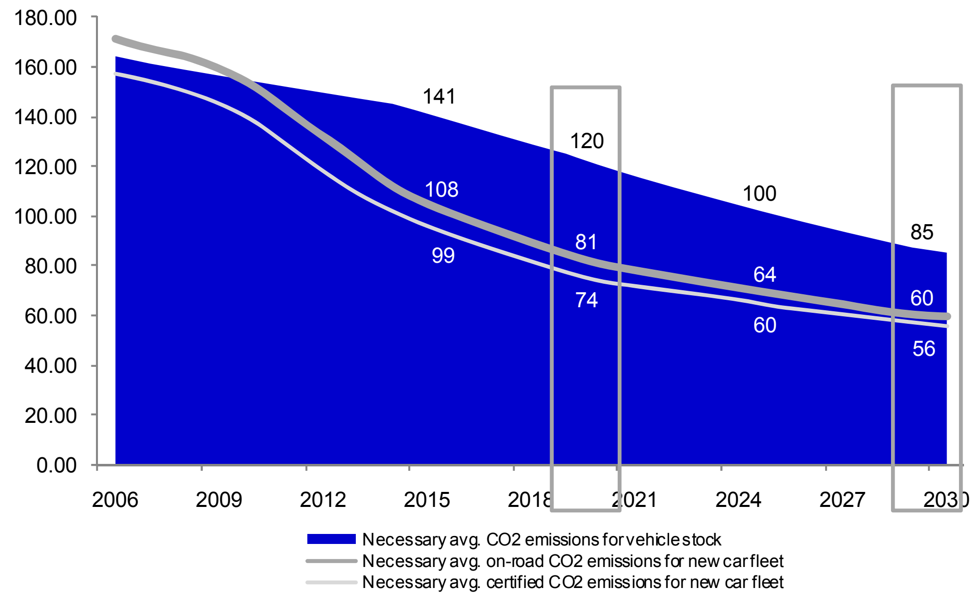


Source: Deutsche Bank, Roland Berger

Regulations will get tougher to meet through 2020

If the EU sticks to its 20% GHG reduction goal (for 2020 versus 1990 levels), much more dramatic change will be required. In fact the European Commission has already set a goal of 95 g/km for 2020 and we believe it is very likely that ultimately this goal will replace the current 130g/km regulatory level (note that the IEA's targets would require new vehicles to achieve 80 g/km in this timeframe, which implies that the European targets are not likely to be revised downward).

Figure 18: Simulation of CO2 fleet emission targets for new car fleet sales in Europe



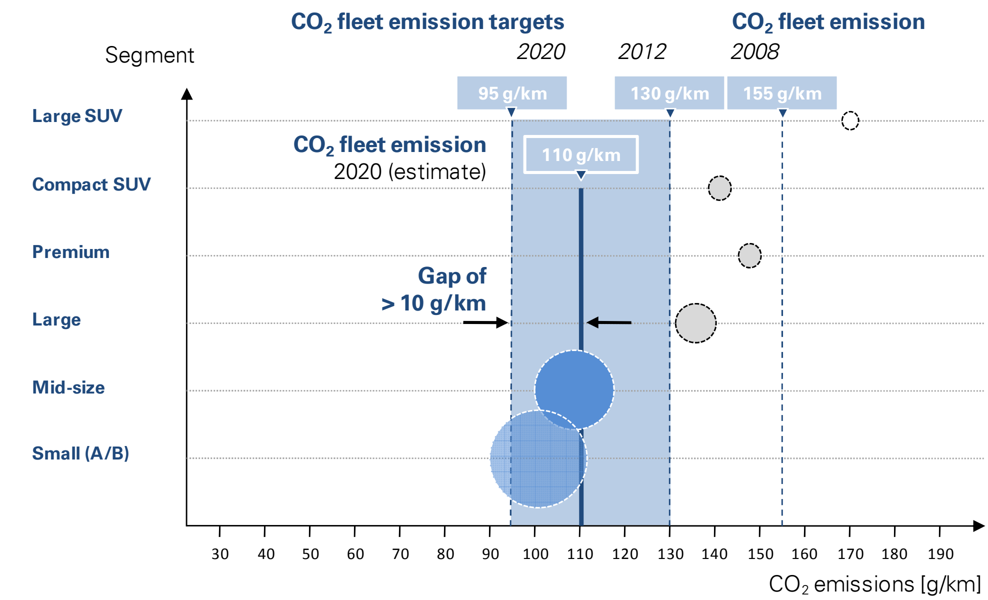
Source: Deutsche Bank, Roland Berger, IEA WOB 2008

Necessitating electrification

As can be seen in Figure 17, it is estimated that when combining all efforts to improve the ICE that are currently under development, CO2 emissions could theoretically be improved by an additional 30%-40%, bringing the weighted new vehicle CO2 emissions down to 105-110g/km (see Figure 19). More might be achievable, but it is unlikely to be economical. We also note here that the bulk of the improvement will need to be generated by the European B- and C-segment, as those segments stand for the bulk of the European market. Competition is fierce in both segments, allowing only very limited possibility to raise prices in order to compensate for higher vehicle cost.

Based on discussions with automakers and consultants, we do not believe the auto industry will be able to achieve a 95g/km target using conventional ICE technology, at least not in an economically justifiable way. The implication is that increased electrification appears to be inevitable. **Given the substantially lower CO2 footprint of xEV, adding these vehicles into the mix would bring down fleet average statistics substantially**. However, for automakers to achieve a meaningful contribution by 2020, they will be required to have broad xEV product portfolios at hand by around 2015. Put differently, carmakers already need to start a major push towards low/emission free driving.

Figure 19: Zero-Emission Vehicles are needed to reach 2020 EU 95 g/km CO2 limit



Source: J.D. Power, Roland Berger, Deutsche Bank

National governments local municipalities further help to jumpstart xEV demand/technology

We also see substantial support from national and local governments aimed at increasing momentum for electrified vehicles.

1. European national subsidies are already in place – helping to jumpstart demand

Beside the regulatory push, we note that there is active government support for vehicle electrification in nearly all major European countries—excluding Germany at the moment. Germany appears to have fallen behind mostly due a technicality, as the decision on a larger consumer stimulus came up during the run-up to the federal election; we expect action soon, now that a newly elected government has picked up.

As can be seen in the table below, many European countries already offer substantial consumer sales incentives for EVs—among the most aggressive comes from Denmark, which exempts EVs from vehicle taxes (ICEs pay a tax of 105% on the first 76,500 DKK ($14,000), and 180% for each additional krona). On a volume-adjusted basis, we estimate that European governments offer on average €3,000 per EV already, and this excludes support substantial in Germany, which we see as likely soon.

Figure 20: xEV incentive programs in Europe (if no end-date, the pgm is open-ended)

	Incentive	Intended to end by
Austria	E500 bonus for alternative fuel vehicles / EV are exempt from fuel consumtion tax and monthly vehicle tax	Sep-12
Cyprus	E700 bonus for purchase of EV (max. 7 cars per company/person)	
Czech Republic	Electric, hybrid and other alternative fuel vehicles are exempt from road tax	
Denmark	Evs weighting less than 2t are exempt from reistration tax	
Germany	Evs are exempt from annual circulation tax for 5 years / reduced taxes afterwards	
Spain	Various regional tex incentives for purchase of Evs and hybrids, up to E6,000 for purchase of EV	
France	E5000 bonus for cars emitting <60 g/km CO2 (max. 20% of purchase price)	2012
Greece	Evs and hybrids are exempt from registration tax	
Ireland	Evs and hybrids subject to reduced registration tax (up to E2,500)	End of 2010
Italy	E1,500 bonus for purchase of Evs/E3,000 if emitting =120g/km and E3,500 if <120g/km/Up to E2,000 for LCVs	
Netherlands	Hybrids are subject to reduced registration tax (up to E6,400 depending on CO2 emissions)	1st of July 2010
Portugal	Evs are exempt from registration tax/Hybrids benefit from 50% reduction in reg. Tax	
Romania	Evs and hybrids are exempt from special pollution tax (equal to reg. tax)	

Source: ACEA

Figure 21: Summary of European subsidies for electrified vehicles (in Euros)

	Size of market (2008 registrations)	Market weight	DBe avrg. Incentive (Euro)	DBe impact	Comment
Austria	293,697	2.0%	500	10	E500 bonus for alternative fuel vehicles / EV are exempt from fuel consumtion tax and monthly vehicle
Denmark	150,143	1.0%	16,000	163	Evs weighting less than 2t are exempt from reistration tax
France	2,050,282	13.9%	5,000	695	E5000 bonus for cars emitting <60 g/km CO2 (max. 20% of purchase price)
Germany	3,090,040	21.0%	300	63	Evs are exempt from annual circulation tax for 5 years / reduced taxes afterwards
Greece	267,295	1.8%	5,000	91	Evs and hybrids are exempt from registration tax
Ireland	151,603	1.0%	2,500	26	Evs and hybrids subject to reduced registration tax (up to E2,500)
Italy	2,161,675	14.7%	4,500	660	E1,500 bonus for purchase of Evs/E3,000 if emitting =120g/km and E3,500 if <120g/km/Up to E2,000 for
Netherlands	499,918	3.4%	5,000	170	Hybrids are subject to reduced registration tax (up to E6,400 depending on CO2 emissions)
Spain	1,161,176	7.9%	6,000	473	Various regional tex incentives for purchase of Evs and hybrids, up to E6,000 for purchase of EV
United Kingdom	2,131,795	14.5%	5,000	723	EVS and PHEV between GBP 2,000 - 6,000
Czech Republic	182,554	1.2%	100	1	Electric, hybrid and other alternative fuel vehicles are exempt from road tax
Sum average incentive				**3,074**	

Source: Deutsche Bank

2. Circulation tax legislation is increasingly switched to CO2-based system

Increasingly all European countries are transitioning their circulation taxes (annual registration fee charged to the consumer) towards a CO2-based system, which favours EVs as a result of low emission. While this change is not so significant by itself (EUR300 per car benefit in Germany for example DBe), it will nevertheless lower the relative cost of ownership. Currently we note that 30% of all countries have already made the transition towards a CO2-based system and we believe it is fair to assume that by the end of the next decade all European countries will have made such move.

3. Local governments support EV demand as well: Larger cities will likely favor EVs for inner city traffic

We note that several European larger cities (London as the most prominent example) are penalizing larger gas guzzlers and favor electrified power trains through congestion charges for inner city traffic. This can be quite material (London's congestion charge is rising to GBP10 per day, but it is free for zero emission vehicles) and we would not be surprised to see other large European cities following this example once the availability of EVs has increased and the infrastructure has been rolled out. Furthermore we note that there are other benefits provided by local governments, including the provision of reserved and incentivized parking opportunities for EVs.

4. Battery technology R&D supported, and infrastructure subsidized

Part of the European fiscal stimulus has been oriented toward infrastructure for electric driving, and build-out of battery technology. For example, Germany has dedicated €500m towards investments into battery technology, infrastructure and R&D projects. France has moved even more aggressively, spending €1.5bn on infrastructure to recharge vehicle batteries with a target of achieving 4.4 million vehicle recharge points by 2020. Furthermore, the French government is providing loans to transform existing OEM plants into EV factories.

5. Governments will purchase EVs themselves – leading by example

An often overlooked point is in our view that most governments by themselves are large vehicle customers. Several countries (France for example) have announced to buy 50-100k EVs over the next few years. We believe once availability of electric powered vehicles has increased it will be hard for governments to argue against the usage of EVs in their fleets.

European demand outlook

Similar to our thoughts in other regions we lay out our key assumptions for European demand, based on the assumption that 95 g/km will have to be met by 2020. We include in our model an assumption that traditional ICE efficiency continues to improve (mostly until 2015, as discussed in the regulatory section) and respective CO_2 levels for the individual products. Our key assumptions include:

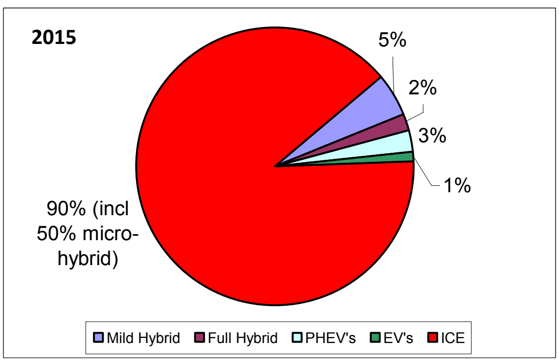
- Micro hybrid will be standard by 2015-20 across all European product categories. Already today, stop-start technology is a relatively cheap way to improve CO_2, as we estimate that this adds only €400 cost per car.
- We see limited demand for full hybrids, and much higher demand for PHEVs (14% of the market by 2020). The incremental cost to switch to PHEV is comparably minimal (slightly larger battery etc.); especially compared with the CO_2 savings potential of PHEVs. We would also note that PHEVs would enable most consumers to perform their daily commutes almost exclusively in electric drive mode. We also note that PHEVs are viewed as particularly attractive for larger premium vehicles, as the relative price increase will be smaller.
- We forecast that full EVs will rise to 1% of total market by 2015, and to approximately 5%-6% by 2020. Limited range could remain a key competitive disadvantage. However, we acknowledge governments' aggressive push in this direction (tax breaks, etc.), we note that most drivers (80%) are using their vehicles less than 40km on a daily basis today, and we note that new technologies (i.e., battery swap, quick charges, widespread recharging infrastructure) could lead to significantly higher growth trajectories for this technology.

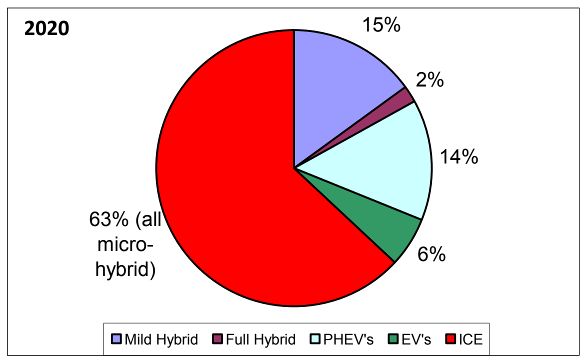
Figure 22: Europe demand model to meet regulatory targets for CO2 emissions

CY	2009e	2010e	2015e	2020e
Total Europe PC sales ('000)	13,940	12,730	16,000	17,000
Vehicle Penetration				
traditional ICE	93.0%	93.0%	39.5%	0.0%
Micro hybrid	5.0%	5.0%	50.0%	63.0%
Mild hybrid	1.0%	1.0%	5.0%	15.0%
Full hybrid	1.0%	1.0%	2.0%	2.0%
PHEV	0.0%	0.0%	2.5%	14.0%
EV	0.0%	0.0%	1.0%	6.0%
Units by segment				
traditional ICE	12,964	11,839	6,320	0
Micro hybrid	697	637	8,000	10,710
Mild hybrid	139	127	800	2,550
Full hybrid	139	127	320	340
PHEV	0	0	400	2,380
EV	0	0	160	1,020
Totals	13,939	12,730	16,000	17,000
CO2 new vehicles (tons/km)	2,075	1,866	2,029	1,574
Average CO2 emission per un	149	147	127	93

Source: Deutsche Bank

Figure 23: European xEV penetration by type (2015 and 2020)





Source: Deutsche Bank

Figure 24: European volumes by xEV type (000 units)

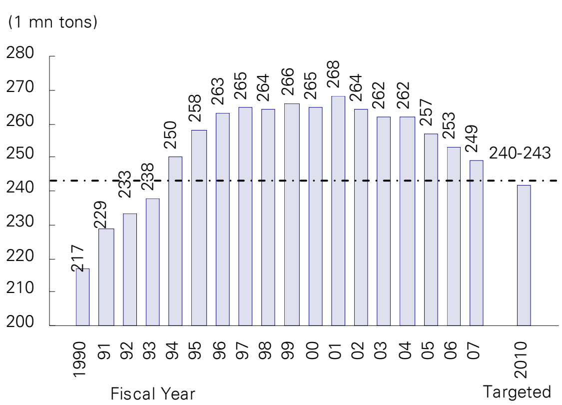
	2009E	2015E	2020E
Mild Hybrid	140	800	2,550
Full Hybrid	140	320	340
PHEV	-	400	2,380
EV	-	160	1,020
ICE	13,691	14,320	10,710
Total	13,970	16,000	17,000

Source: Deutsche Bank

Japan: Hybrids and other electrified vehicles could account for over half of the market by 2020

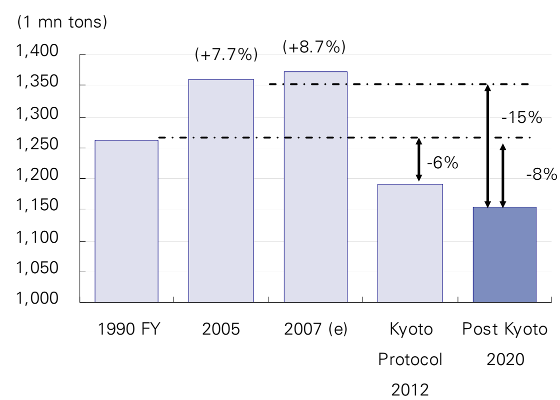
The Japanese auto industry has made significant efforts to improve fuel economy over the last ten years, and the government has already set a 15% average fuel efficiency improvement target for 2015 vs. 2007 (16.8km/l under a new fuel economy measurement methodology, which compares with 14.6 km/l calculated for 1997 under the same methodology). In addition, on June 09, 2009 former Japan Prime Minister Aso announced a new mid-term CO2 reduction plan for Japan that calls for a 15% CO2 emission reduction target by 2020. As part of this policy, the government also projected increased penetration of next generation vehicles—pure hybrids, PHEVs, and EVs—to 40% of new vehicle sales by 2020, up from 10% in 2009. Interestingly, the Democratic Party's (DPJ) win in recent elections could result in even more stringent CO2 mitigation targets. DPJ's targets would equate to a 25% reduction relative to 1990 (versus -8% currently). Historically cooperative auto industry leaders have pushed back on this proposal, given the scale and speed of implementation required. Nonetheless, the prospect of increased vehicle electrification in Japan is increasingly clear.

Figure 25: Japan – CO2 levels and reduction target



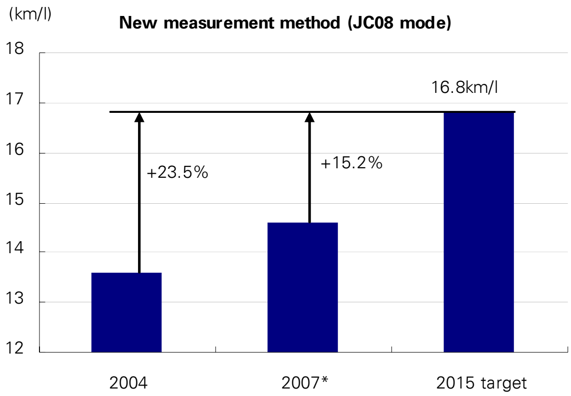
Source: JAMA, Government Affiliated entities, Deutsche Securities

Figure 26: CO2 emission in Japan's transport sector



Source: AMA, Kyoto Protocol Target Achievement plan, etc

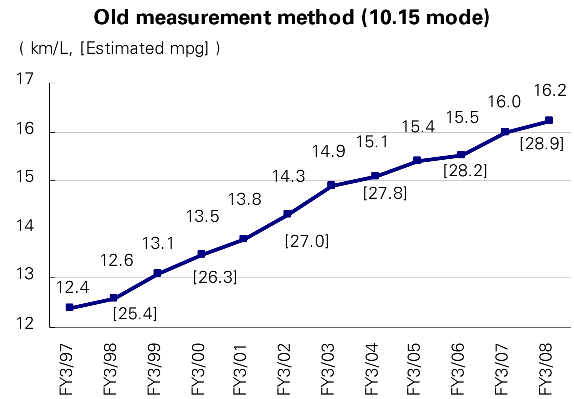
Figure 27: 2015 Average fuel efficiency targets for PC



*: 2007 value estimated calculation using 10.15 mode actual value
([JC08 mode fuel efficiency] = 0.9x [10.15 mode], according to JAMA)

Source: Ministry of Economy, Trade and Industry; Ministry of Land Infrastructure, Transport and Tourism , JAMA

Figure 28: Average Fuel efficiency of gasoline PC+mini



Note: Figures are for domestic-market new passenger cars only.
(km/l : 10.15 mode, mpg: 2010 EPA estimate)

Source: JAMA, Deutsche Securities Estimates

The market for alternative powertrain vehicles in Japan will be supported by tax policies

Apart from the consumption tax of 5% placed on general purchases, the basic auto tax in Japan consists of three types: 1) acquisition tax - one time charge upon initial acquisition of the vehicle, 2) annual weight-based tax (tonnage tax) and 3) annual ownership tax (automobile tax). We estimate the upfront tax burden of an auto purchase is generally 11-15% of the list price.

The Japanese government has rolled out tax policies to stimulate demand for more fuel efficient vehicles through an Eco Tax program. Under this program, next generation vehicles such as EVs, PHEVs, HEVs, clean diesels, and natural gas vehicles are exempt from acquisition and tonnage taxes. For example, a Prius buyer would save approximately ¥140k ($1,550).

Japan has also launched programs that subsidize the cost of electrifying a standard car up to a maximum value of the cost of the base car. It uses a different formula to calculate the subsidy on a mini-car based EV (MMC, Subaru) and a non-mini based EV (not yet launched Nissan Leaf). The subsidy offsets 50% of the cost of electrification for a mini car, and 25% of the cost of electrification for a non-mini.

Figure 29: Eco-Tax program to stimulate fuel efficient vehicles

Vehicle Type	Requirements	Reductions/Exemptions	
		Acquisition Tax	Tonnage Tax
Next-Generation Vehicles	Electric (including fuel cell) vehicles; plug-in hybrid vehicles clean diesel vehicles, hybrid vehicles, natural gas vehicles*	Exempt	Exempt
Fuel-Efficient and Low-Emission Vehicles (Passenger cars and mini-vehicles)	Compliant +25% compared to 2010 fuel efficiency standards and emissions down by 75% from 2005 standards	75% reduction	75% reduction
	Compliant +15% compared to 2010 fuel efficiency standards and emissions down by 75% from 2005 standards	50% reduction	50% reduction
Applicable until		31-Mar-2012	30-Apr-2012

Note* vehicles subject to certain emissions and weight requirements

Source: JAMA, Deutsche Securities

Below we have illustrated the tax treatment on select vehicles combining the Eco Tax and the EV subsidies. The Eco Tax is essentially making the hybrid cars tax neutral while the subsidy on EV is a significant savings over the base price. Nonetheless, the absolute upfront vehicle price of the EV is still approximately 60% higher than an ICE version. This is one reason Nissan is considering a lease for the battery, lowering the base price of the EV, and making the battery lease equivalent to gasoline cost. Currently, MMC is marketing its iMiEV with a 5-year lease for ¥60,000 (US$650) per month.

Figure 30: Japan Market - Vehicle price net of tax reductions and subsidies

(¥1m = US$11,00)	Base vehicle price w/ battery	Tax & Subsidy details			Vehicle Price (Net of tax & subsidies)	Vs. base price
		(+) Acquisition tax (a) & Tonnage tax (b)	(-) Eco tax reduction (Reduction rate)	(-) EV Subsidy		
Evs*	¥m	¥m	¥m	¥m	¥m	
MMC iMiEV	4.6	0.00	0.00	-1.4	3.2	-30%
FHI Stella EV	4.7	0.00	0.00	-1.4	3.3	-30%
Nissan Leaf (estimate)*	*4.0*	*0.00*	*0.00*	*-1.2*	*2.8*	*-30%*
Hybrids						
Toyota Prius	1.95	+0.14	-0.14 (100%)	NM	1.95	0%
Honda Insight	1.80	+0.14	-0.14 (100%)	NM	1.80	0%
ICE						
Toyota Vitz 1.3l	1.24	+0.11	-0.08 (75%)	NM	1.27	2%
Honda Fit 1.3l	1.15	+0.11	-0.08 (75%)	NM	1.17	2%
Nissan Tiida 1.5l	1.60	+0.13	-0.10 (75%)	NM	1.63	2%

* DB estimate for vehicle price including battery. Nissan may sell the car but lease the battery.

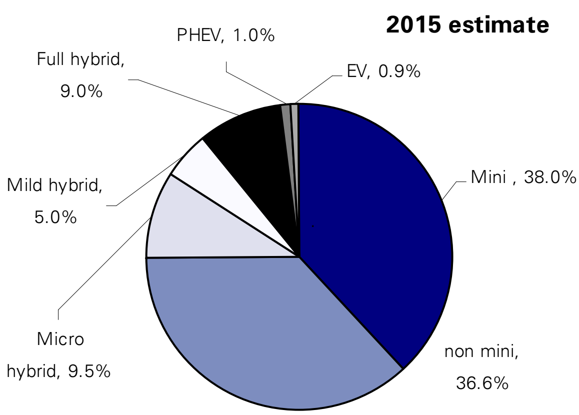
** We estimated Nissan's EV subsidity as a percentage of that for the competitor products. As the policy is currently written it is our understanding the the subsidity on a product the size of the Leaf could be significantly less. There is also uncertainty over the treatment of the situation where the consumer buys the car but leases the battery.

Source: JAMA, Deutsche Securities estimates

Japan demand outlook

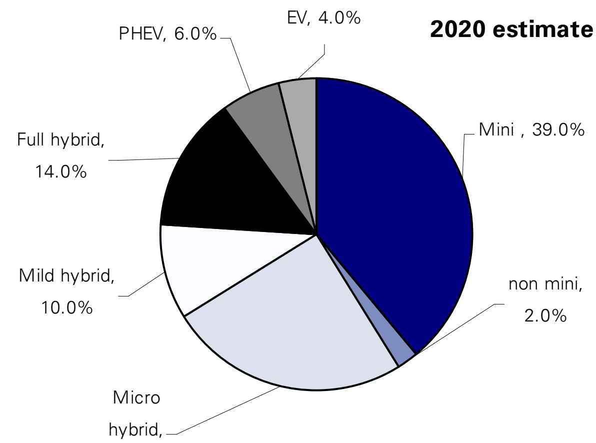
We expect the demand for alternative vehicles to be focused on mild and full hybrids through 2015 and expect to see micro hybrids taking a larger share. The larger moves, however, are in the 2015-2020 period where we expect standard non-mini ICE to almost disappear and for all non-mini vehicles to have some form of electrification. In the most complex form, we estimate EV and PHEV to combine for 10% market share in 2020.

Figure 31: Japan 2015 market estimate



Source: Deutsche Securities estimates

Figure 32: Japan 2020 market estimate



Source: Deutsche Securities estimates

Below list detailed assumptions from our CO2 model with respect to how the market will likely move toward expected goals for 2015 and 2020. Key expectations include:

- Hybrid penetration will grow progressively in non-mini segment – We assume that non-mini cars account for 60% of the Japanese market in 2020. We further assume that nearly all of these non-mini cars need some form of hybridization by 2020 (from micro to full hybrid). Interestingly, we believe hybrids already account for over 20% of Toyota's non-mini sales in Japan. And we expect both FHI and Mazda to add to the full hybrid share between 2015-2020. We expect Honda to dominate the market for mild hybrids through 2015, and beyond that for both Nissan and the truck makers to add to this segment.
- EVs and PHEVs are likely to gain some traction in 2015-2020: We anticipate very small penetration of EVs and PHEVs through 2015, at just over 1% of the market, with growth to 10% by 2020. Given their product plans, we expect Nissan to dominate the EV market through 2015, with MMC, FHI, and other makers contributing. We expect the other majors to get involved in the market beyond this but expect more of a focus on PHEV from Toyota and Honda.
- Minicar remains key sector: We expect minicars (engine size <660cc) to remain a major segment of the market, assuming 39% in 2020. The key reasons include affordability and energy efficiency.

Figure 33: Japan demand model to meet regulatory targets for CO2 emissions

CY	2009E	2010E	2015E	2020E	Comments
Total Japan PC sales ('000)	4,475	4,450	5,000	5,000	Government midterm forecasts
mini	1,689	1,673	1,900	1,950	DB estimates
non mini	2,786	2,777	3,100	3,050	DB estimates
Vehicle Penetration					
Mini	37.3%	37.6%	38.0%	39.0%	Do not assume hybridization of mini cars
non mini	53.2%	52.5%	36.6%	2.0%	ICE
Micro hybrid	0.0%	0.0%	9.5%	25.0%	assume regenerative braking capability
Mild hybrid	2.3%	2.7%	5.0%	10.0%	also includes motor assist driving
Full hybrid	6.5%	7.0%	9.0%	14.0%	includes motor-only drive capability
PHEV	NM	0.0%	1.0%	6.0%	includes EV mode
EV	NM	0.2%	0.9%	4.0%	
Hybrid total	8.8%	9.7%	24.5%	55.0%	
Hybrid (ex-micro)	8.8%	9.7%	15.0%	30.0%	
PHEV + EV	0.0%	0.2%	1.9%	10.0%	
Total alternative powertrain	8.8%	9.9%	25.4%	59.0%	
Units by segment					
Mini	1,671	1,673	1,900	1,950	
non mini	2,381	2,338	1,830	100	
Micro hybrid	0	0	475	1,250	
Mild hybrid	101	120	250	500	
Full hybrid	291	312	450	700	
PHEV	NM	0	50	300	
EV	1	7	45	200	
Totals					
Hybrid total	392	432	750	1,500	
Hybrid (ex-micro)	1	7	45	0	
PHEV + EV	393	439	795	1,500	
CO2 new vehicles (tons/km)	658	648	624	476	
Average CO2 emission per unit	147	146	125	95	Assume 95g/km similar to Europe
Average CO2 emission g/km per unit (estimate)					All using Japan JC08 mode
Mini	137	136	122	110	
non mini	167	166	149	142	
Micro hybrid	151	149	134	120	
Mild hybrid	89	89	85	80	
Full hybrid	75	75	72	68	
PHEV	42	42	40	32	
EV	0	0	0	0	

Source: JAMA, Japan Ministry of Land, Infrastructure and Transportation, Deutsche Securities estimates

Understanding the mini factor: Japan has one characteristic that is not shared with N. America and Europe—37% of the market (in 2008) is comprised of mini-cars (engine size <660cc). We see this segment as a permanent fixture in the overall auto market due to its low cost. Currently, a basic mini-car costs approximately ¥1-1.1m. The cheapest hybrid car, in contrast, cost over 2x's as much. Even a typical, global compact car such as the Toyota Yaris is 28% more expensive in comparison to the Daihatsu Mira. While minicars may have somewhat higher CO2 g/km than HEV/PHEVs given lack of electrification, the overall energy efficiency of minicars appears highly competitive. And we believe this segment should help the overall Japanese market achieve CO2 emission targets that appear difficult to achieve in other markets.

Figure 34: Vehicle affordability

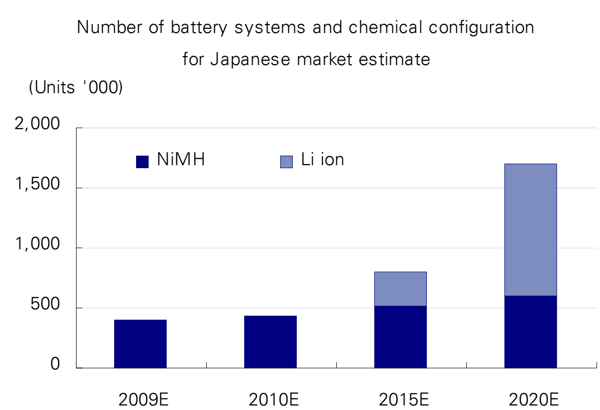
company/model	Daihatsu Mira	Suzuki Wagon R	Toyota Yaris	Toyota Prius	Honda Insight
Classification	mini	mini	non-mini	non-mini	non-mini
List price (¥ '000)	981	995	1,180	2,095	1,952
Basic tax structure					
Total acquisition expenses	122	123	235	322	308
On-road cost (¥, net of tax & expenses)	1,103	1,118	1,415	2,417	2,261
Price difference with mini Daihatsu Mira		*101%*	*128%*	*219%*	*205%*
Equalized Tax structure (e)					
Total acquisition expenses	105	106	125	171	164
On-road cost (¥, net of tax & expenses)	1,086	1,101	1,305	2,266	2,116
Price difference with mini Daihatsu Mira		*101%*	*120%*	*209%*	*195%*

Source: Bureau of taxation, Ministry of Land, Infrastructure, Transport and Tourism, Company, National Tax Agency, Deutsche Securities estimates

Investment in NiMH should drive first wave

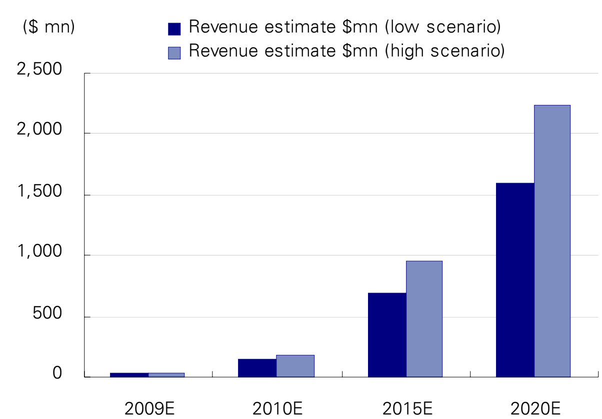
In projecting the market for lithium-ion batteries, we have to consider the strategy of dominant market players. With over 45% market share in non-mini vehicles, Toyota's large commitment to NiMH for its full hybrid system will shape the market through 2015e. Our by-type forecasts suggest that on a system basis (mild and full HEV, PHEV, and EV), NiMH will remain the majority in 2015e. However, we assume that by 2020, lithium-ion will be used in 65% of the total systems with the increase driven by a shift in penetration across the hybrid spectrum as well as utilization in PHEV and EV systems.

Figure 35: Japan market: NiMH & Li-ion based systems



Source: Deutsche Bank

Figure 36: Li-ion market for Japan domestic auto sales



Source: Deutsche Bank

Infrastructure projects in the beginning stages

In order to test the validity of these vehicles in societies as well as promote expansion, the government has picked model towns, listed in Figure 33, as EV/PHEV trial areas. Each area has come up with action plans as described including the number of vehicles expected to be installed for the trial. The total demand for these vehicles to be used for the EV/PHEV town scheme amount to approximately 30k units.

Figure 37: Japan local government action plans

Model town category	City/Town	Planned EV/PHV installation by 2013	Notes on action plans
EV PHV town areas (Wide area trial)	Tokyo	15,000	Incentives, promotions to corporations and organisation for mass purchases of EV, PHVs. Installation of recharge points. Collaboration with the olympics
	Kanagawa	3,000	Incentives to corporations and organisation for purchase of EV, PHVs. Installation of recharge points with corporate cooperation. Car sharing, car rental usage trial.
EV PHV town areas	Aomori	1,000	Use of nuclear, wind generated electricity for EV/PHVs. Use of EV/PHV at environmental tour sites and energy parks
	Niigata	2,000	Use on model island, Use in cold atmosphere with possible snow. Set up of infrastructure
	Fukui	600	Use of nuclear generated electricity for EV
	Kyoto	2,500	Incentives and infrastructure for early expansion. Extend usage to car sharing, car rental, and taxi usage.
	Aichi	2,000-3,000	Promotions to corporations and organisation for purchases of EV, PHVs.
	Nagasaki	500	Use of solar and wind generated electricity for EV/PHVs. EV usage in world heritage locations and state vehicles
Research areas	Okayama	700	Use as state vehicles and rental vehicles. Set up of infrastructure.
	Kouchi	1,000	Use of solar and wind generated electricity for EV/PHVs. Expansion by car sharing usage.
	Okinawa	500	A separate island model trial. Use of EV/PHV as rental vehicles for tourists.

Source: Ministry of Economy, Trade and Industry

The total government budget for the current year of roughly ¥2.5bn (US$28m) aimed at EV also supports infrastructure investments for charging stations. We illustrate the scale of the subsidies below. As shown below, this enables a ¥3.5mn rapid charger to be purchased at ¥1.8mn.

Figure 38: Japan EV/ EV Charger net price calculations (mn Yen)

Quick charger manufacturer	Charger cost	Net Charger cost estimate	Max subsidy
Takaoka Electric	3.5	1.8	1.7
Hasetec	3.5-4.2	1.8-2.5	
Takasago	3.5	1.8	
Tempearl	3.5	1.8	

Source: Next Generation Vehicle Promotion Center, Deutsche Securities

We have seen numerous commitments to infrastructure projects from both utility and industrial companies. The projects include both public and household infrastructure. Unlike the US, where we are seeing start-up companies entering the EV space, the only start-up we have seen thus far in Japan is Better Place, the California firm that is involved globally in EV recharging, battery exchange, and network management. In Tokyo Better PLace is initially planning to target taxi fleets, and it will begin its first battery switching project in Tokyo during 1Q 2010. This trial is a part of a project subsidized under the Ministry of Economy, Trade and Industry (METI) and will consist of four EV taxis (based on Nissan Dualis/Rogue/Qashqai) constructed to allow for battery swapping. The exchange spot will be based in central Tokyo and the vehicles will transport customers within a 5km driving range. The test will be done between January and March 2010. Taxis are said to be only 2% of Japan's domestic vehicles while it is said to be 20% penetration in CO2 emission, showing potential for CO2 reduction.

Figure 39: Major infrastructure projects in Japan to support EV/PHEV expansion

Company/organisation	Project	Charger type	Detail
Toyota Industries, Nitto Kogyo	Charger development	200V	Low cost charger (costs 0.5mn yen to set up and charges EV, PHV in 2-3hours.)
TEPCO	EV charger	Quick	Set up of charging spots in major areas in Tokyo
Tokyo Electric Park 24 (Times parking)	Charger setup	100V/200V	Setup of chargers at parking spaces in Tokyo and Kanagawa to enable EV/PHV charge while parking the car
Project Better Place	Charger setup	NA	Setup of chargers with cooperation from government or local entities.
	Battery exchange station	NM	Setup of battery replacement stations in various global locations to enable EV expansion.
Itochu Property Development	Homes with Chargers	200V	Development and retail of apartments which have EV/PHV chargers for each parking slot provided (A part of Kanagawa prefecture's aim to expand
Toyota Home	Homes with Chargers	NA	Development of energy managed home which car charge EV/PHVs
Japan Unisys	Charger management system	NM	Developed chargers and a management system tc manage the charging process. System trials to start from Autumn 2009 in Aomori prefecture.
Shikoku Electric	Charger setup	100V/200V	Pole(Y147k) or Wall hung type(Y78k)
Shin Meiwa Industreis	EV chargeable multi storey parking	200V	EV Chargeable power plug for multi level parking slots.
Nippon Oil Corporation	EV charging station	Quick	Set up of 22 charging spots at gas stations country wide to test recharging business model

Source: Company, Various news sources

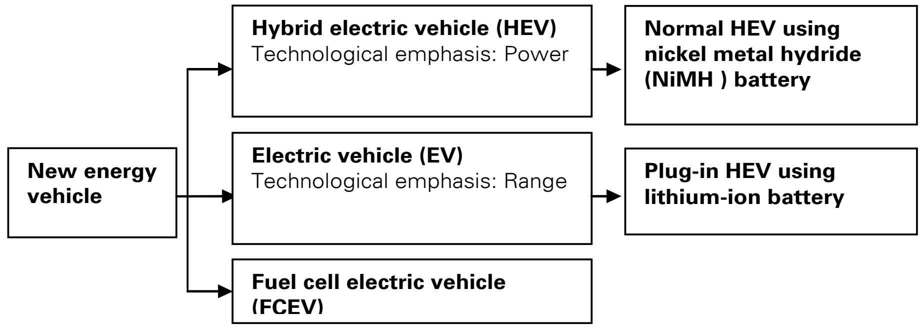
China is sending signals for more significant change

Although the Chinese auto market has just become the world's largest auto market in 2009, the country's home-grown automakers still lag behind Western companies with respect to internal combustion-based powertrains. Consequently, Chinese policymakers and automakers have been pushing ChineseaAutomakers to direct resources toward the arena of "New Energy Vehicles", where they feel that domestic producers could compete on a more level playing field. And many industry observers believe that China has many other reasons to foster a large domestic EV market.

- China already has a strong consumer electronics and consumer electronics battery manufacturing expertise.
- China possesses 27% of the world's lithium carbonate reserves.
- The country has 80% of the world's neodymium resources—a key component in the manufacturing of permanent magnets for EV motors.
- China is likely to become increasingly dependent on foreign oil, given its rapidly growing vehicle fleet.

Based on these factors, it comes as no surprise that the country is ramping up policies and incentives aimed at encouraging domestic manufacturers to participate in the burgeoning market for HEVs, PHEVs, and EVs. Based on "China Automobile Industry Restructuring and Revitalization Plan", China will target expansion of annual capacity for new energy vehicles to 500,000 units, which would equate to 5% market share for these vehicles by 2011 (assuming passenger car sales could surpass 10m units by 2011). And the country's Ministry of Science and Technology has proposed a 10% market share objective for these vehicles for 2012.

Figure 40: Major new energy vehicle categorization



Source: MIIT

Growth plans are still in their formative stages

To support the long-term development of Chinese new energy vehicles, China's Ministry of Finance (MOF), and the country's Ministry of Science and Technology (MOST) jointly launched subsidy policies for energy-saving and new energy vehicles in 13 pilot cities, e.g. Beijing, Shanghai and Chongqing. The sole focus is on public transportation vehicles such as buses (up 1,000 buses for each of 13 cities will receive a $70,000 subsidy) and taxis (up to $8,500 subsidy).

In addition, China's State Grid Corporation has recently announced that it will speed up the construction of electric vehicle charging stations in Shanghai, Beijing, Tianjin and other large cities as a first step

We do not expect explosive growth immediately

While we believe new energy vehicles should have bright prospects within China in the long run, near- to medium-term impacts may be more muted, given:

- High cost of ownership: Average prices of new energy vehicles are still much higher than conventional vehicles, even with the subsidies. Consequently, private sector demand is likely to be slow for now (note that BYD's fully electric F3DM model, which costs RMB 150,000, only sold 80 units in 1Q09. This compares with 21,000 units sold in March alone for the company's IC powered sister car, the F3, which cost RMB 59,800.
- The Chinese government's support is still in its formative stages: Consequently, most Chinese auto enterprises are still adopting a wait-and-see approach—i.e., they may have new energy vehicle products in the pipeline, but are generally delaying launches.
- Companies and regulators want to balance growth against the risk of over-capacity: The rapid growth of China's auto market in 2009 has prompted the major Chinese auto enterprises to consider capacity expansions. More recently, government officials have cautioned automakers about the need to grow more prudently.

Nonetheless, we believe that the market has potential to grow quickly

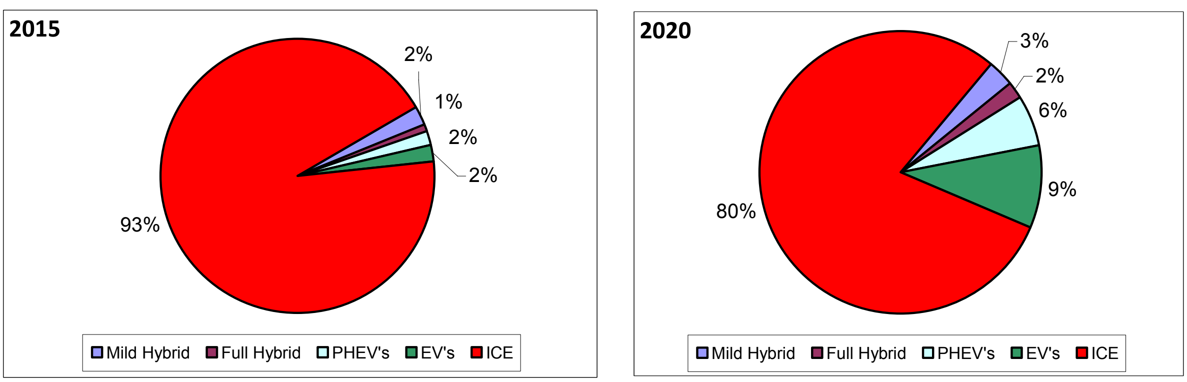
Unlike Western markets, China has the ability to mandate aggressive policies, and direct state sponsored enterprises to commit to product plans that meet national policy objectives. This can be witnessed within the transportation sector, having seen the impact of government bans on ICE-powered 2 wheelers from the centers of Beijing and Shanghai on certain days of the week, which has resulted in the world's largest market for electric motorcycles, scooters, and mopeds—20 million were sold last year. With this in mind, and considering the government's (and Chinese automakers') clear intention to focus on new energy vehicles, we believe that China has potential for surprisingly rapid growth.

Figure 41: Timeline of major news related to new energy vehicle development in China

Jan-09	The State Department put forward the strategy to develop new energy vehicles for the first time and arranged RMB10bn to support the industry in new energy vehicle R&D.
Feb-09	MOST and MOF launched subsidy policies for new energy public transportation vehicles in 13 cities (Refer to Figures 3 and 4).
Mar-09	More details of "China Automobile Industry Restructuring and Revitalization Plan" was laid out; Target new energy vehicle capacity will be 500,000 units with a target 5% market share within passenger vehicle segment by 2011.
Apr-09	Nissan and MIIT signed memorandum of cooperation on electric vehicle R&D and charging network construction.
May-09	The city of Chongqing issued subsidy policy to support individual purchases on new energy vehicles.
Jul-09	BYD signed the equity transfer agreement with Foshan Weishang to acquire the entire equity interests of Hunan Midea Coach in an effort to enter the new energy commercial vehicle business.
Sep-09	BYD set up the electric vehicle battery base in Huizhou, Guangdong Province.
Sep-09	MIIT released the "Directory of Energy Saving and New Energy Vehicle Demonstration and Application". BYD's F3DM plug-in hybrid sedan is the unique sedan product in the directory and the company has started selling the vehicle on pilot-testing basis.

Source: news compilation by Deutsche Bank

Figure 42: China xEV penetration by type (2015 and 2020)



Source: Roland Berger

Figure 43: China xEV Volumes (000 units)

	2009E	2015E	2020E
Mild Hybrid	19	332	570
Full Hybrid	10	158	380
PHEV	-	237	1,121
EV	10	348	1,767
ICE	9,613	14,751	15,162
Total	9,651	15,828	19,000

Source: Deutsche Bank, Roland Berger

Korea: "Green Car" program envisions 10% full EV's by 2020

Government regulation and incentives are the driving force

In July, 2009, the Korean government announced a long-term plan to inject W107tr ($90 bn) into green growth over the next 5 years. In conjunction with this plan, the government announced a 2015 corporate average fuel economy target of 17km/liter (CO_2 emission levels 140g/km), representing a 16.5% increase from current levels. Non-compliance would result in OEMs paying fines starting 2013.

Figure 44: Korea's fuel efficiency regulations

	2008~2011	after 2012	Remarks
below or 1,600cc	12.4km/liter	14.5km/liter	16.5% above current levels
above 1,600cc	9.6km/liter	11.2km/liter	including A segment vehicles

Source: FKI

On its own, the Korean government's plan does not appear any more ambitious than that of Europe or Japan. However, we believe that Korea will likely be a competitive player in this segment. In the near term, the Korean government will invest W400bn ($340 million), and private organizations W2.1tn ($1.7 bn) aimed at commercialization of Hybrid cars (through 2009), PHEVs (through 2013), and fuel cell electric vehicles (through 2018). In June 2009, the Korean government announced that it will provide up to W3.1m ($2,600) in tax benefits (special excise, registration and acquisition tax exemption) to buyers of hybrid cars. The plan is aimed at boosting OEMs efforts to build hybrids and help nation's "green growth'' initiative. In addition, starting next year, customers that buy hybrid vehicles to replace their old ones may receive a subsidy of up to W2m ($1,700). If finalized and approved, hybrid car buyers could save over 5 million won ($4,200) in total when combining tax breaks and the subsidy. Moreover, there is a debate that the Korean government should implement toll fee and parking fee discounts to hybrid cars, as they do for A-segment vehicles. If this happens, it will provide consumers with additional long-term incentives to purchase hybrid vehicles.

Figure 45: Government R&D and mass production subsidy breakdown

Project	Government Entity	Period	Amount (Wbn)
Green Car development	Ministry of Knowledge Economy	2004-2013	450.1
Eco-friendly Car development program	Ministry of Environment	2004-2013	125
Green Car safety standard development	Ministry of Land, Transport, Maritime Affairs	2009-2013	38.9

Source: Ministry of Knowledge and Economy

Tax benefits for green cars

Figure 46: Hybrid cars in the Korean market eligible for government subsidiaries

Model	Fuel	Engine (cc)	Fuel efficiency (km/liter)	Battery Volt	CO2 emission (g/km)
Civic Hybrid	Gasoline + Electric	1339	23.2	158	100.75
Lexus RX 450h	Gasoline + Electric	3456	16.4	288	142.4
Avante LPI Hybrid	LPG + Electric	1591	17.8	180	99
Forte LPI Hybrid	LPG + Electric	1591	17.8	180	99
Prius (3rd generation)	Gasoline + Electric	1800	25 (expected)	201.6	89

Source: Deutsche Bank, Hankyung newspaper

Korea looking to commercialize electric cars by 2011

The Korean government has also come up with a blueprint to commercialize electric cars by 2011, and the government is targeting 10% penetration of fully electric vehicles for the Korean market by 2020. In addition, the Korean government aims to help its domestic auto industry achieve 10% of the global market for electric vehicles. The government believes that the country has an edge in the global electric vehicle race as Korean companies such as LG Chem and Samsung SDI have leadership in battery technology (GM, BMW, Volkswagen, and Ford have all shown strong interest in sourcing batteries from these companies).

Figure 47: Summary of government incentives / subsidies for xEV consumer purchases, R&D, and infrastructure

Region / Country	Objective	Consumer Incentive	Infrastructure Support
U.S. Federal	1mm PHEV / EV by 2015	**Federal**: $2,500 credit for any vehicle with 4kWh+ battery + $417 add'l for evey add'l kWh, up to $7,500 (16kWh)	**Federal**: $2bn in DOE-funded grants for Adv Battery Mfg **Federal**: $25bn DOE loans for R&D / Capex, Adv Tech Veh's
U.S. State and local		Many U.S. State and Local Authorities provide incentives for EV and PHEV ownership, including the following examples: **Colorado:** Personal tax credit equal to 40% of vehicle purchase price for an EV **California** San Joaquin Valley $1000-$3000 EV Incentive **Georgia**: Tax credit for EV purchase of $2500 or 10% of the cost of the vehicle, whichever is less. **Illinois**: Rebate up to $4000 for "Alt Fuel Vehicle". **Maryland:** HEV or EV tax credit up to $2,000 **New Jersey:** EV's exempt from sales tax **Utah**: EV tax credit up to $3,000. **Washington**: >40mpg veh's exempt from sales / use tax **Washington:** sales/leasehold tax exemption for home charge spots	**Washington**: chging infrastructure req'd for state pkg / hwy rest stops by 2015 **Michigan:** $350mm in tax credits for EV / component mfg
Canada		**Quebec**: C$2,000-C$8,000 tax credit for xEV's through 2016	**Vancouver**: 20% of pkg spots must have charging infrastructure **Ontario**: C$500mm loan pgm for mfg of xEV's and components
EU		DB estimate of average EV incentive equals £ 3,074 per vehicle	€ 5bn funded by Seventh R&D pgm (FP7) for xEV development € 50.5bn committed through FP7 to research sustainable urban mobility
France	15% of fleet zero carbon within 2-3 years 5mm charge spotes within 3 years	€ 5,000 bonus for <60 g/km vehicles up to 20% of purchase price Free registration / free parking in select regions / locations	€ 650mm in gov't loans for low emission veh development
Germany		EV's exempt from annual circulation tax for 5 years Add'l bonuses for low-emission purchases expected soon	~€ 750mm in various research, electric mobility, smart grid pgms
UK	1mm xEV's by 2014	Gov't credits on EV / PHEV between £2,000 - 6,000 **London**: EV's exempt from £8 daily congestion tax (£2,000 annual)	Approx £75mm in charging infrastructure / EV development funding
Spain	1mm xEV's by 2014	Various regional incentives for xEV purchase (up to E6,000) Consumer loan subsidies for purchase of 120-140 g/km veh's (0% interest on first €10k, 2.5% up to €30,000)	~€ 800mm in automotive no-interest loans (90% for sustainable mobility)
Denmark		Registration tax exemption ($25k savings on $20k vehicle)	
Austria		€ 500 bonus for alt fuel veh's / EV's exempt from fuel consumption and monthly vehicle tax	
Cyprus		€ 700 bonus for purchase of EV	
Czech Republic		EV / Hybrid / other alt fuel veh's exempt from road tax	
Greece		Registration tax exemption: (avg Euro 5,000 savings)	
Ireland		Reduced registration tax (up to Euro 2,500 savings)	
Italy		Approx Euro 4,500 incentive for EV purchases	
Netherlands		Reduced registration tax (up to Euro 6,400 savings)	
Portugal		EV's exempt from registration tax / HEV's get 50% reduction in reg tax	
Romania		EV's and hybrids are exempt from special pollution tax	
Israel	Free of oil dependence by 2020	ICE veh's pay 92% tax, HEV's pay 30%, and EV's pay 10%	
Japan		$1,500 tax breaks for purchase of low-emission veh's	Support for projects in 11 cities to promote EV infrastructure expansion
China	5% of veh sales alt energy by '11 (500k units)	$8,800 rebate for EV public-service vehicles / $73k for buses Progressive tax on ICE's based on engine size	$3bn funding for 60,000 EV's for EV pilot pgm in 11 cities $1.5bn funding for battery / EV R&D pgms ('09-'11)

Source: ACEA, U.S. Dept of Energy, American Recovery and Reinvestment Act, Better Place

Rise of the electric vehicle

In considering the challenges facing the industry, including the need to dramatically increase fuel efficiency, and the desire to maintain many of the physical and performance attributes of today's vehicles, automotive engineers are recognizing that increased levels of electrification will be required. As noted earlier, hybrids describe vehicles that combine two or more sources of propulsion energy—fuel and electricity—and use internal systems to balance the use of an internal combustion engine and electric motors to achieve greater overall operating efficiency.

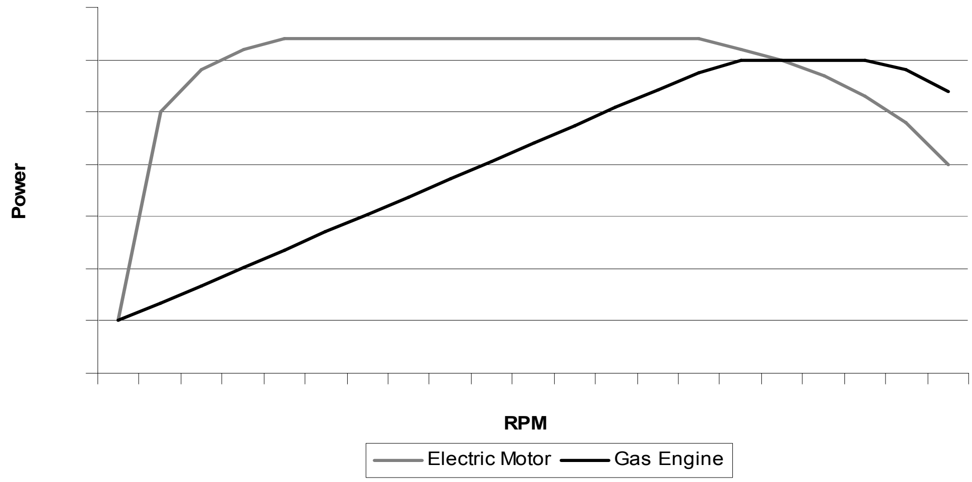
A typical HEV is able to increase the efficiency of a vehicle through 3 mechanisms…

- Shutting down the engine at idle when stationary, or traveling at low speeds, eliminating unnecessary fuel consumption;
- Recovering energy for future use through regenerative braking, and;
- Downsizing the internal combustion engine, and switching between the engine, the electric powertrain, or running both in order to operate each source near its optimal efficiency.

Of these factors, the third is by far the most significant. The biggest fuel efficiency gain for a hybrid vehicle comes from the differential efficiency curve of an ICE versus an electric motor. In simple terms, this means that conventional ICEs are relatively inefficient at slow speeds (as low as 5-10% efficient). But at full throttle, the efficiency for gas engine could be closer to 28%. On average a gasoline engine is estimated to be 15-20% efficient. A diesel engine at full throttle can reach 33% efficiency, versus the 23% average quoted by DOE. The problem is that engines rarely function at maximum power—especially in urban environments.

In contrast, electric motors have a very different efficiency curve. They are capable of producing maximum torque at launch, and they maintain a relatively flat efficiency curve until they reach a relatively higher speed. The advantage of the hybrid electric powertrain is its ability to use a combination of the two, maximizing the use of the electric powertrain at slow speed, and shifting to the internal combustion engine at speeds that give the internal combustion engine an advantage.

Figure 48: Electric Motor vs. Gas Engine Torque Curve



Source: Deutsche Bank, A123

Electric Vehicle Categories

The fuel savings potential of xEVs is largely dependent on the extent to which it can operate on electric power. This, in turn, is typically limited by the capacity (energy and power) of the battery. Today's electric vehicles, and those on the drawing board, are typically grouped into 5 categories: 1) Micro hybrid; 2) Mild hybrid; 3) Full Hybrid; 4) Plug-In Hybrid, and 5) Electric Vehicle. Each of these types of hybrids can progressively use electric power to a greater extent.

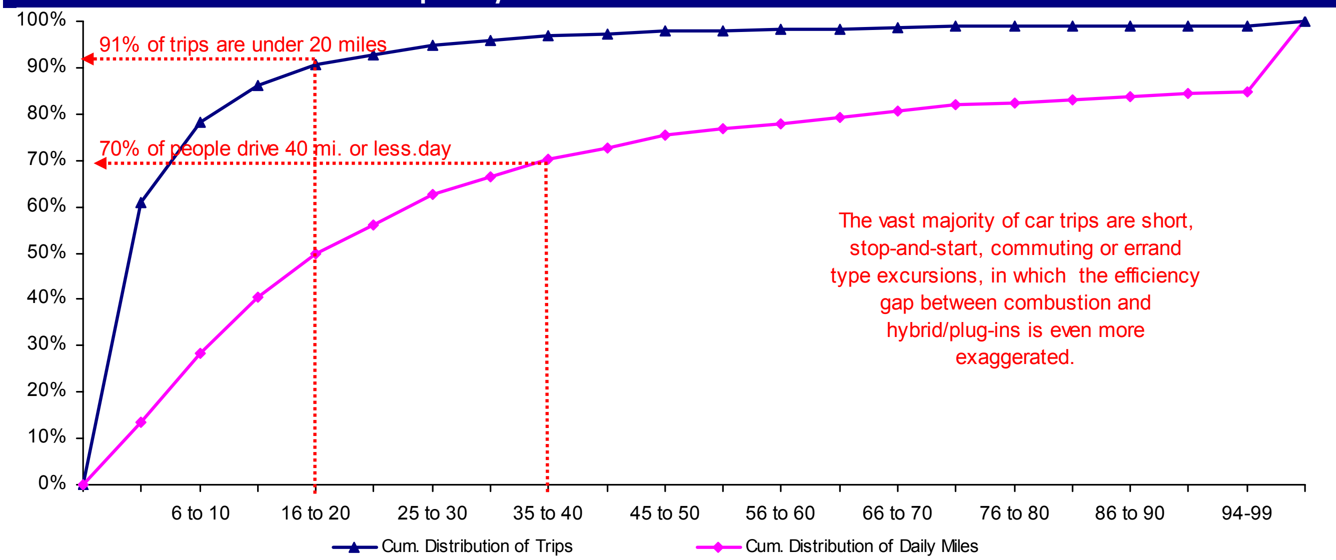
Micro Hybrids include systems that allow the engine to stop during idle, and instantly start when the vehicle is required to move. These types of vehicles offer minimal if any electric power to propel the vehicle, and the lowest level of regenerative braking. The cost of these systems is lowest, and they can be integrated into virtually any platform by replacing the starter/alternator with a high power starter alternator. Fuel consumption improvement from a micro hybrid is typically in the 5%-10% range (per Johnson Controls). NAS and EEA reports estimate the incremental cost of this technology at $563-$600 per vehicle, including the addition of electric steering (replaces hydraulic steering because hydraulic power is not available during engine stop), and upgrades to 42 volt electric power.

Mild Hybrids also have engine start stop capability. But they also include small electric motors and slightly upgraded batteries that are sufficient to provide some electric boost to the propulsion system. Although autonomous driving is not possible on the small electric motors built into mild hybrids, the boost potential does allow for some engine down-sizing. There are several versions of this technology, which affects the cost and benefit. Generally, fuel economy savings from mild hybrids are estimated in the 15% range. The Northeast States Center for Clean Air Future (NESCAF) study estimated incremental cost for mild hybrids at $2310-$2940.

Full hybrids provide all of the benefits of the prior three systems, and their electric motors and batteries are large enough to provide some level of autonomous driving on electric power. Full hybrids offer fuel efficiency gains ranging from 25% to 40%. EPA estimates the cost of full hybrids at $3700-$3850.

Plug-In Hybrids have even greater electric capability than full hybrids, and are characterized by providing the ability to charge the vehicle with electricity off of the electric power grid, which would enable the first tens of miles to be driven entirely on electric power. Since 50% of consumers drive less than 25 miles per day (70% drive a maximum of 40 miles per day), a significant portion of the energy consumed could come from electric power. Beyond an initial 10+ mile electric range, the plug-in hybrid would effectively operate like a full hybrid, with primary propulsion provided by the ICE, augmented by the low speed efficiency of an electric powertrain. Plug-in hybrid vehicles are expected to be designed such that they can operate 50% of the time on electricity. The other 50% of their operation would be at a Toyota Prius-like 46 mpg (5.1 liters per 100 km). Overall, PHEVs are expected to have the ability to deliver a 40%-65% improvement in fuel economy (versus non-hybrid vehicles), at a cost of $4,500-$10,200. Ultimately, the cost and fuel savings will be somewhat dependent on the size and cost of the battery.

Figure 49: The 2001 National Household Travel Survey determined that 91% of U.S. trips are under 20 miles, and 70% of vehicles drove less than 40 miles per day



Source: 2001 National Household Travel Survey, Federal Highway Administration, US Department of Transportation

Electric Vehicles. Moving beyond HEVs, we have observed an unprecedented amount of development work on electric vehicles being conducted by global automakers including General Motors, Nissan, Renault, Volkswagen, Mitsubishi, Chrysler, Subaru, Chery, BYD, and others. Electric vehicles are differentiated from plug-in hybrids in that they do not have dual mechanical and electrical powertrains—100% of their propulsion comes from zero emission electric motors, energized by electricity stored inside large on-board batteries. Positives include additional reliance on the electric grid for energy, which is inherently more efficient, more reliable (electric motors contain 1 moving part, versus 400 in a typical ICE), and potentially more fun to drive (electric vehicles can offer higher torque at low speeds). Drawbacks associated with this technology include range, cost, time to refuel/recharge, and size/weight.

Figure 50: Cost of EV-specific compoents excluding the battery, compared with cost of ICE components unnecessary to an EV

ICE-only Components (USD per unit)	
Engine, Exhaust, Fuel System	2,000
Transmission	800
Other components	200
Total	3,000

EV-only Components (USD per unit)	
Motor / Transmission	1,400
Power electronics	1,200
Charger / Junction box	700
Wiring harness	600
Heating / cooling	400
Regen Braking	100
Other components	600
Total	5,000

Source: Deutsche Bank

As shown above, the cost of producing an EV is currently higher than the cost of an ICE vehicle, even without the battery. But automakers believe this comparison is not likely to hold once EVs are produced in higher volumes (the components of an ICE are already being produced in the millions, which has allowed for cost reduction). Given their simpler design, and higher electronics content, the cost of an EV is expected to fall rapidly, and reach parity with ICE vehicles within a few years.

The battery is key

The primary constraint on electrifying vehicles has always been electricity storage. Lead acid, nickel cadmium, nickel metal hydride, and even lithium ion batteries have achieved progressively higher energy density (measured in watt hours per kilogram). But they have retained significant constraints relative to cost, energy, power (i.e., the amount of energy that can be released quickly), life expectancy, and safety. Despite these constraints, however, we have already seen a trend toward increased electrification starting with increasingly powerful hybrids (such as the Toyota Prius, Honda Insight, and Ford Fusion Hybrid), soon to be launched plug-in hybrids (such as the Chevrolet Volt and Ford Escape Hybrid), and fully electric vehicles (such as the Nissan Leaf, Ford Focus, Tesla Model S, Renault Fluence, and Mitsubishi iMiev).

Today: Nickel metal hydride (NiMH)

We would note that virtually all HEVs on the market today (with the notable exception of the Mercedes S Class and BMW 7 Series hybrids) are powered by NiMH battery chemistry. These batteries are reliable and have long life expectancies. But they are expensive (due to high nickel content), relatively heavy, have less than ideal energy conversion efficiency (i.e. they get hot), and they experience significant degradation if discharged completely, as would be the case in an electric vehicle.

To overcome these problems, NiMH batteries are typically used in automotive applications that require limited energy storage, such as in HEVs, but not in PHEVs or EVs. In an HEV application these batteries are typically discharged only briefly, in order to provide spurts of energy boost to support the internal combustion powertrain during its least efficient phase—i.e. during acceleration. But these batteries are not relied on heavily. In fact, the battery management system in a HEV typically aims to keep the NiMH battery around a 50% state of charge, and it typically only uses 20% of the battery's capacity during brief charges and discharges. Most of the extra capacity available in the NiMH battery is there as a buffer to ensure that the battery will meet a specified performance level after degrading somewhat though a 10-year design life.

Future: Advanced lithium ion chemistries

Of all metals available for battery chemistry, the battery industry has long considered chemistries based on lithium to be the most promising. Lithium is widely available (15 million tons of lithium occur in brine resources and more than 2 million is in ore deposits, enough to produce 1 billion fully electric or 10 billion hybrid electric vehicles), it is not toxic (lithium is used in drugs, and was an original component of the 7-Up soft drink), it is the lightest metal on the periodic table, it has a high specific energy content (i.e. it can store a significant amount of energy), and it possesses other desirable electrochemical properties (organic electrodes are protected from corrosion by "filming"; this film, called the SEI layer, protects the electrode, but still allows lithium ions to pass through).

Lithium ion batteries have several advantages…

When compared with NiMH batteries, lithium Ion battery modules have several advantages. These include:

- Higher power: They have 1.4x to 1.7x the power density of NiMH. Available energy per unit of volume at comparable power levels is 20%-80% higher, overall modules are 20%-30% smaller and 30%-40% lighter. This implies smaller and lighter batteries, and lower cost.
- More useable energy: For certain lithium ion chemistries, more of this power can be utilized safely, which also translates to lower cost, because lithium ion batteries can use smaller cells.
- Higher efficiency: Certain chemistries have better charge/discharge efficiency, which means they don't get as hot. This should lead to longer life and increased safety.
- Lower input costs: Lithium ion batteries typically have lower metal cost per kWh (though we note that they may have higher cost for other components).

For these reasons, the majority of portable electronic products (mobile phones, laptops, portable medical devices, cordless drills) have rapidly shifted to lithium ion batteries.

Figure 51: Cost and energy density comparison among battery types

Battery energy density and cost comparison

Energy Density	Cost	Charge Cycles
Lead Acid 30-40 wh/kg*	$/kWH 210	500-1000
NiCd 40+*	$/kWh 280	1000-2000
NiMH 71 WH/kg*	$/kWh 840	1000-2000
Li Ion 105-170 wh/kg**	$/kWh 650	2500+

Source:
*M. Keller and P. Birke, Continental Powertrain
**Deutsche Bank

Source: M. Keller and P. Birke, Continental Powertrain, DB Estimates

Challenges

We would note that there are many types of lithium ion batteries, and each face somewhat different challenges. Lithium ion batteries for consumer electronics generally use lithium cobalt oxide cathodes, and graphite or hard carbon anodes. But there are constraints in applying consumer electronics type (cobalt oxide) batteries for higher end applications such as for automobiles. These constraints include issues related to performance, safety, durability, and cost:

- Performance: Although consumer lithium ion batteries can store significant amounts of energy (kWh), they are not inherently powerful (it is difficult to release this energy quickly) because lithium is not inherently conductive. The consumer electronics battery industry has overcome the conductivity problem by adjusting the chemistry of these batteries through the addition of other materials (typically cobalt). This has made them practical for certain uses. But power still needs to be limited (or more batteries with sophisticated and expensive controls need to be added for high power applications) in order to ensure safety. Typically, more power is needed in advanced applications, such as accelerating an automobile. Moreover, most lithium ion cells have difficulty operating at very low/very high temperatures.

- Safety: Overcharging, charging in extremely cold weather, short circuits, and other abuse conditions could destroy the battery and potentially cause "thermal runaway", and fire (batteries contain combustible materials such as lithium, electrolyte solvents, and other gases).
- Durability: All batteries degrade over time. In conventional consumer lithium ion batteries, performance degrades by approximately 20% after 600-700charges (i.e., 2 years of cell phone charge and discharge cycling). Given the cost of large format batteries such as those required for automobiles, much greater durability is required: 300,000 charge/discharge cycles for HEVs, 2,500+ cycles for EVs, and 10+ year calendar lives are considered pre-requisites. Most automakers design extra margin into batteries in order to ensure that they still meet minimum performance levels after degradation (GM's 16 kWh battery for the Volt only requires 8 kWh of capacity). But this adds considerably to battery size, weight and cost.
- Cost: The US Advanced Battery Consortium (USABC), a partially DOE funded consortium of US automakers involved in funding battery research, has established a price target of $500/system for HEV batteries, and $1,700-$3,400 for 10-mile and 40-mile PHEV batteries. Today's batteries systems are still far from achieving these goals.

It has been recognized for some time that a variety of high-end applications will become possible once battery companies are able to address these issues. Applications such as automotive would dwarf the current battery market (A.T. Kearny estimates that the automotive lithium ion battery market could reach $74 bn by 2020, which compares with $8.5 bn for today's consumer electronics lithium ion battery market).

Advanced lithium ion batteries address these deficiencies

Automakers, battery companies, and government/private sector research groups have been working on advanced batteries for automotive propulsion for nearly two decades. And these initiatives have accelerated over the past 5 years, as a result of an increased focus on fuel economy/CO2 reduction targets. While the industry's goals (i.e. goals established by the USABC) have not all been met, significant progress has been made in terms of durability, safety, power, energy density, and cost as a result of breakthroughs in battery chemistry and battery management. And there is a widely held expectation that battery technology will continue to improve at a rapid rate.

Figure 52: U.S. Advanced Battery Consortium – published battery goals. (Note: SOC is state-of-charge)

EV Battery Goals	Minimum goals	Long Term Goal
Power Density (W/L)	460	600
Specific Energy (wH/kg)	150	200
Total pack size (kWh's)	40	40
Life (years)	10	10
Cycle Life (cycles)	1000	1000
Selling price per kWh ($/kWh)	<150	100
Operating environment (degree C)	-40 to +50	-40 to +85
Normal recharge time (hours)	6	3-6
High rate charge	20-70% SOC in < 30 minutes	40-80% SOC in 15 minutes

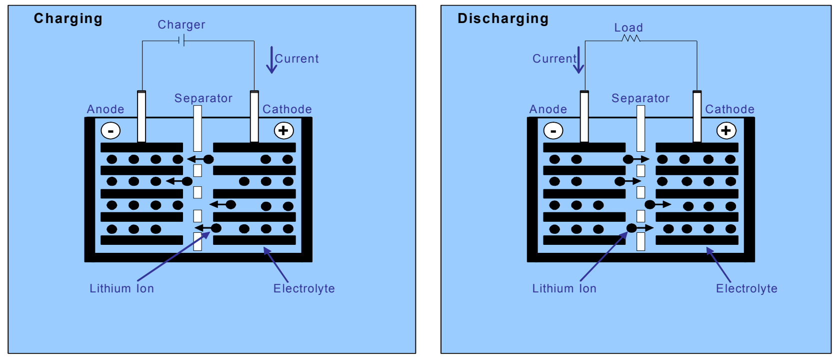
HEV Battery Goals	Power-Assist (minimum)	Power-Assist (maximum)
Pulse discharge power (kw)	25	40
Minimum round-trip efficiency	90% (at 25-Wh cycle)	90% (at 50-Wh cycle)
Cycle life (cycles)	300,000 (at 25-Wh cycle)	300,000 (at 50-Wh cycle)
Calendar life (years)	15	15
Maximum weight (kg)	40	60
Maximum volume (liter)	32	45
Temperature range (degree C)	-30 to +52	-30 to +52
Production price (at 1mm units) ($)	500	800

Source: USABC

There are four main types of automotive lithium ion batteries

Within the battery there are two host electrodes – one a cathode (+) and one an anode (-) – that can accommodate lithium ions. During discharge, the lithium ions travel from the anode to the cathode through electrolyte and a separator. During charge, the opposite occurs. As noted earlier, although they are all generically called lithium batteries, there is no generic standard. The composition of the cathode is the single biggest determinant of a lithium ion cell's energy, safety, life expectancy, and cost. Anodes have typically been made of graphite or hard carbon, but companies have also begun to experiment with changes to the anode material (titanium oxide, modified surface graphite, or even air) to mitigate some of the shortfalls of graphite.

Figure 53: Function of a battery



Source: Advanced Automotive Batteries

The batteries that will be used in the next generation of hybrid, plug-in hybrid, and electric vehicles are generically known as "Advanced Lithium Ion Batteries". As of today, industry participants in the Advanced Lithium Ion Battery industry group them into 4 broad categories, based on the formulation contained in the cathode: 1) NCA, or nickel cobalt aluminum; 2) NMC, or nickel manganese cobalt; 3) LMO, or manganese spinel, and; 4)LFP, or iron phosphate

Figure 54: Lithium-Ion cathode chemistry comparisons

Chemistry	Wh/Kg	Positives	Negatives	Makers
Nickel / Cobalt / Alum (NCA)	160	Energy density Power	Safety Cost / commodity exposure Life Expectancy Range of Charge	JCI/Saft PEVE AESC
Manganese Spinel (LMO)	150	Cost Safety Power	Life Expectancy Usable energy	Hitachi, AESC, Sanyo GS Yuasa, LG Chem Samsung, Toshiba Ener1, SK Corp, Altairnano
Nickel Manganese Cobalt (NMC)	150	Energy density Range of Charge	Safety (better than NCA) Cost / commodity exposure	PEVE, Hitachi, Sanyo LG Chem, Samsung Ener1, Evonik, GS Yuasa
Lithium Iron Phosphate (LFP)	140	Safety Life Expectancy Range of Charge Material Cost	Low temp performance Processing costs	A123, BYD GS Yuasa, JCI/Saft Valence, Lishen

Source: AABC, DOE Merit Review

While we have noted that a disproportionate number contracts so far for lithium battery hybrids, plug-in hybrids, and electric vehicles have been for NMC and LFP batteries, we do not believe that there has been a clear breakaway winner as of yet. Each of these chemistries has its own inherent positives and negatives. Overall, we believe that automotive engineers have become sufficiently comfortable with the power, energy, durability (10+ years), and safety characteristics/mechanisms of each, such that variants of each of them will appear in vehicles in the near future.

NCA cathodes

NCA cathodes are a commonly used chemistry in consumer electronics. They are the most proven. This is also the chemistry used by Johnson Controls/Saft and Toyota in their initial designs. NCA appears to have the highest potential energy density (602 Wh/kg at the cathode level, and 170 Wh/kg at the battery level) and power. These batteries appear to have advantages in HEV applications, but they may be less suitable for PHEV, EV, and stationary power applications.

Disadvantages include safety concerns and cost. NCA cathodes are the most thermally unstable of the automotive lithium ion chemistries, and they begin to degrade at high charge levels (high charge increases the chances of thermal runaway, which may mean that these batteries cannot use all of their capacity). They are also the most expensive due to heavy use of cobalt and nickel. Safety and life expectancy concerns could be resolved through engineering—separators, cooling systems, and controls to prevent too low or too high a charge. But it will be difficult to make them cost competitive with other chemistries, due to heavy use of cobalt. Safety and cost concerns have resulted in the development of other materials, including NMC (explained below).

LMO and Manganese Polymer cathodes

LMO and Lithium Manganese Polymer cathodes are considered safer, and more environmentally friendly than Cobalt Oxide cathodes. They are much lower cost per kg, but since their energy density is lower, they may not necessarily be cheaper on a per watt hour. Safety and durability questions also remain. LG Chem and Electrovaya are among battery companies pursuing this technology.

Certain variants of this technology experience significant capacity fade during cycling and at more than 40°C, have more difficulty charging at low temperature (lithium metal plating occurs), and they can experience decay over time as manganese goes into solution and migrates to the Anode. LG Chem, AESC and Electrovaya are among the battery companies pursuing Lithium Polymer based cathode technology.

NMC cathodes

NMC cathodes, also called mixed oxide batteries, were originally developed as a safer alternative to Lithium Cobalt Oxide batteries for the consumer products industry. This battery type has been successfully commercialized in consumer products batteries since 2004. NMC's high charge density and high voltage properties lead to very good energy density and makes it an optimal choice for high energy applications, such as EVs. There is a long list of battery-makers using this chemistry for energy applications, including Panasonic, Hitachi, Sanyo, Ener1, LG Chem, Samsung, Evonik, and GS Yuasa. This cathode is not as advantageous for power applications like HEV.

Although NMC is considered more thermally stable than Cobalt-Oxide and NCA batteries, thermal runaway is still a concern that must be managed. For example, Ener1 uses a non-graphite anode (Hard Carbon) to improve the safety characteristics. From a cost perspective, Nickel and Cobalt components make the cathode expensive and more susceptible to commodity price fluctuations than LFP and LMO. Given the high energy characteristics, though, the cost difference is not as large on a per watt hour basis.

LFP cathodes

LFP cathodes appear to solve many of the safety problems associated with cobalt oxide and manganese spinel batteries. Many believe that they are the safest, because it is very difficult to release oxygen from their highly stable cathodes, which reduces the risk of fire, they are much more resistant to overcharge, and they may be the lowest cost. Although lithium iron phosphate cathodes have lower energy density versus cobalt based batteries (549 Wh/kg vs. 602-742 Wh/kg at the cathode level; 140 wh/kg at the battery level), this disadvantage is partly overcome by the fact that lithium iron phosphate batteries can use more of their capacity without running into safety or durability issues. Most iron phosphate batteries can be operated between 15% and 95% state of charge.

The low cost and ability to use a wide range of charge appears to make these types of batteries most suitable for PHEV and EV applications, which benefit from wide charge windows and low cost (because the batteries in these types of applications are the largest). On the negative side, LFPbatteries appear to have weaker cold weather performance, and they may be more challenging to monitor electronically (a flat voltage across a broad range of charge makes it difficult to determine the battery's state of charge). A123 Systems in the U.S., GS Yuasa in Japan, and BYD in China appear to be among the world leaders in developing this technology

Declining battery costs should also help propel increased xEV penetration

There are significant technical and design differences between the "power" batteries used in HEVs, and the "energy" batteries employed by HEVs and EVs. In an HEV, the battery is designed to produce short spurts of abundant electric power used to aid in acceleration. These types of batteries are typically constructed of a large number of thinly coated electrodes. PHEV and EV batteries are required to store more energy and release this energy over a longer period (i.e. over a 100 mile drive). Their designs typically involve fewer cells with thicker electrodes. Based on design differences, and other factors, HEV batteries are typically priced higher on a per kilowatt hour basis than EV batteries.

Battery prices are expected to be cut in half over the next 10-years
Based on discussions with our auto, auto parts, and bittery Industry contacts, we believe that the median price for lithium ion "energy battery" packs, which are used in electric vehicle and some plug-in hybrid vehicles, is currently around the $650 per kwh range. Power batteries, which are used in hybrid electric vehicles, are quoted in the $900-$1000 per kwh range. With additional volume, and with innovations currently under development, we believe the industry already has visibility on a 25% reduction from this level by 2015 (note that some industry players are already quoting prices below $500/kwh today for energy batteries). By 2020, the industry anticipates a 50% reduction in prices for energy batteries, to approximately $325/kwh.

Factors driving this cost reduction include:

- Internal economies of scale;
- Material supplier economies of scale;
- Design changes that remove components, and increase energy density;
- Chemistry changes.

At the same scale, battery manufacturers see no reason why the prices of Advanced Automotive Battery energy cells would be any higher than commercially available lithium cobalt oxide cells used in laptops. For reference, our research suggests that these batteries sold for $2.00/wh in 1995. Today they are selling for $0.24-$0.28/wh ($240-$280 per kWh). Including the cost of electronics, cooling/heating, fasteners, and other components of the pack, we believe that the overall cost of an EV battery should decline below $400 per kwh. Although the automotive manufacturing process may be more stringent (requires overhead for advanced product quality planning, or apqp), and it requires somewhat more sophisticated additives, the overall material cost is lower—the raw materials used in an iron phosphate based lithium ion battery only cost $15 per kilogram, compared with $35-$45 for a cobalt oxide battery.

Figure 55: Cost breakdown of lithium-ion battery (assuming scale of 100k per year)

Cost work-up for 180 Watt-Hour Nickel / Manganese / Cobalt cell (NMC Cells)
Assume production for approx 100k 25kWh EV packs per year

	Units	Amount	$/Unit	$/Cell	$ / EV Battery (25 kWh)	$ / kWh
Cathode active materials	kg	0.34	33.0	11.1	1,663	66.5
Anode active materials	kg	0.16	20.0	3.2	477	19.1
Electrolyte	kg	0.15	20.0	3.0	447	17.9
Separator	m2	2.03	2.0	4.1	608	24.3
Copper foil	kg	0.07	18.0	1.2	184	7.3
Can & headers & terminals	cell	1	7.0	7.0	1,050	42.0
Other materials	cell	1	2.5	2.5	375	15.0
Total Material Cost				**32.0**	**4,803**	**192.1**
Labor / Factory Overhead (est. 35%)				17.2	2,586	103.5
Total Cell Cost				**49.3**	**7,390**	**295.6**
Mechanical components (heating, cooling, fasteners)					2,053	82.1
Electrical connectors					299	11.9
Electronics (battery mgmt. system)					1,381	55.2
Labor					268	10.7
Pack Manufacturing / Electronics / Vehicle Integration					**4,000**	**160.0**
Total Pack Cost (25 kWh pack)					**11,390**	**455.6**
Warranty (2% of pack cost for 3yr warranty) - DB est					228	9.1
Gross Profit (30%)					4,979	199.2
Total Pack Price (25 kWh pack)					**16,596**	**663.9**

Source: Advanced Automotive Batteries, USABC, DB Estimates

There are literally hundreds of innovations being developed by battery companies aimed at achieving cost reduction at the cell level, through the reduction of cost and at the pack level.

One way to convey the cost opportunity is to point out that battery industry engineers believe that they are on a path to doubling the energy density of their batteries, which implies that half of the material (by weight) would go away for the same amount of storage capacity. A123's batteries, for example, currently use just 25%-30% of the space inside of their cells to store energy. In 2001 their cells were using <20% for energy storage. The rest of the material inside of the cell consists of binders, additives used to enhance conductivity, separators, electrolyte, etc. Many similar innovations have already been applied over the past 20 years in the consumer electronics battery market. For reference, laptop type (18650) lithium cobalt oxide batteries introduced by Matsushita in 1990 were achieving energy density of 90 wh/kg. Today's batteries typically achieve 232 wh/kg.

One specific example of cost reduction opportunity at the cell level has involved reducing the cost of separators (separators are membranes that are placed between the anode and cathode, but which still allow lithium ions to flow through them). These separators cost battery companies approximately $2 per square meter, and they account for 12%-16% of the material cost of a cell. The material cost involved in manufacturing these membranes is estimated at $0.20 per square meter, implying a significant cost reduction opportunity. In fact, over time many battery companies believe that it will be possible to remove the separator entirely, through the use of laminated electrodes.

Another cost reduction opportunity can be found at the pack level. Battery packs, which can cost up to $4000 today for a large, 25 kwh system (20%-35% of the cost of a battery system), consist of mechanical systems (55% of the cost of the pack, including the cooling systems, fasteners, etc.), electrical connectors (8% of the cost of the pack), and electronics (37% of the cost of the pack is related to the battery management system, or bms). At low volumes, many of the functions within the BMS are carried out using discrete chipsets. Manufacturing of discrete chipsets involves relatively low tooling costs. But the cost of the system is higher. At higher volume, battery manufacturers will begin using application specific integrated circuits, or ASICs, which are designed to manage many functions within the battery system. The tooling cost for ASICs is higher, but the overall cost of chipsets could decline by 80%.

Figure 56: Estimates for pricing to the OEM of high-energy EV batteries. Includes cost of cells, packaging, and battery management system. Includes warranty cost and 30% gross margin. $/kWh based on 25% decline by 2015 and 50% by 2020.

	2010	2015	2020
Price / kWh	650	488	325
kWh per battery	25	25	25
Total Battery System	16,250	12,188	8,125

Source: Deutsche Bank

Economics could be an even more important driver of electrification

While we believe a global regulatory push to lower emissions, and reduce oil consumption, represents the most tangible driver of electrification for vehicles, it may not be the most powerful. Ultimately, we believe consumers will drive this market.

Payback analysis

On initial review, one might conclude that given the high price of the battery, the payback period for a hybrid or electric vehicle could be prohibitively long. An electric vehicle with a 100 mile range would still require a 25 kwh "Energy Battery" pack costing $12,000 at $487/kWh (our 2015 price projection) or $8,125 at $325/kWh (our 2020 price projection). "Power Battery" packs, which are used in a hybrid (and some plug-in hybrid) electric vehicles, are quoted in the $900-$1000 per kWh range today. The cost of this type of battery may decline to $675 per kWh by 2015 and $450 per kWh by 2020 (A typical hybrid is equipped with the equivalent of 1-2 kWh of batteries, and a plug-in hybrid may contain 8-16 kWh)

Based on our analysis, however, we believe that the investment in HEVs, PHEVs and EVs will offer a reasonably compelling payback based on the cost differential between gasoline and electric driving, and based on incentives offered by governments aimed at persuading consumers to purchase zero emission vehicles. From the consumers' perspective, this payback period would accelerate as…

- The incremental cost of batteries and other associated electric drive technologies (i.e. motors, power electronics, chargers, harnesses, electric heating and cooling systems, regenerative braking systems, e-steering, and e-braking) decline;
- The cost of ICE vehicles rise (they will require increased content in order to comply with federal fuel economy/CO2 mandates);
- Oil prices rise;
- As governments roll out additional incentives/disincentives for zero emission/higher emission vehicles, and as alternative business models emerge to take advantage of the gasoline/electric drive arbitrage, and;
- As new business models emerge, in order to convey the electric drive/gasoline drive arbitrage opportunity to consumers.

Automakers and investors need to consider 2015 cost projections for batteries and other components

Given that the xEV market is not expected to reach significant mainstream volume until the 2013/2014 timeframe, and given that new vehicles are typically developed 2-3 years in advance of production (for global fuel economy standards which tighten dramatically through 2012 (Europe), 2016 (U.S.), and 2020 (U.S. and Europe)), we believe that automakers and investors will be examining payback periods projected for the 2015 and 2020 timeframe, in order to assess the xEV market's potential. While oil prices for this timeframe are difficult for most auto executives to predict with high confidence (although there is a general view that oil prices will rise), there is growing confidence in the trajectory of battery and other electric powertrain costs. Automakers also have reasonable estimates for the incremental cost associated with producing compliant (with fuel economy rules) ICE powertrains for this timeframe. And there is also growing confidence that governments in many parts of the world will provide incentives for "alternative" fueled vehicles such as EVs, just as they do today (i.e., the US provides a $7,500 tax credit for EV purchases, several US states exempt these vehicles from sales taxes, France provides €5,000 towards EVs, Denmark exempts EVs from 105-180% VAT, etc.)

In Figure 53, we illustrate the payback for an HEV, PHEV, and full EV versus an ICE. This analysis incorporates:

- A $3.00/gallon average price for gasoline and 33 MPG for a gasoline ICE vehicles;
- 49 MPG for a full hybrid;
- $0.10 per kWh and 4 miles per kWh for an EV;
- PHEVs are assumed to drive 1/3 in gasoline mode and 2/3 in electric mode;
- We assume the vehicle is driven 15,000 miles per year;
- We incorporate our ca. 2015 projection for battery costs (i.e. $487.50/kwh for an energy battery),
- We assume ICE vehicle fuel economy compliance costs rise by $1,000 per vehicle within this timeframe, and
- We assume current US Federal incentives for PHEVs and EVs (up to $7,500) are sustained through this period (incentives may be modified to penalize ICEs and benefit EVs to a much greater extent within this timeframe; Also note that we have ignored state and local incentives, which can also be substantial). We also assume renewal of incentives for HEVs, but at a lower level than PHEVs and EVs (we assume $1,500 per vehicle).

Under our low fuel price scenario ($3.00 per gallon), and incorporating mid-decade battery cost projections, we conclude an HEV would have a relatively fast payback period versus an ICE, at 1.6 years. PHEVs would follow closely behind, at 2.3 years. EVs would experience a payback period of 3.7 years.

Figure 57: U.S. payback analysis (assume mid-decade battery cost and $3.00 per gallon fuel)

	Full HEV vs. ICE	PHEV-40 vs. ICE	PHEV-40 vs. Full HEV	EV vs. ICE	EV vs. Full HEV	EV vs. PHEV - 40
Battery $/kWh	675.0	562.5	562.5	487.5	487.5	487.5
kWh	2.0	13.0	13.0	25.0	25.0	25.0
Battery total cost	1,350	7,313	5,963	12,188	10,838	4,875
Other incremental costs	1,875	1,500	(375)	-	(1,875)	(1,500)
ICE Increase	(1,000)	(1,000)	-	(1,000)	-	-
Government Subsidy	(1,500)	(6,250)	(4,750)	(7,500)	(6,000)	(1,250)
PV of Battery Residual Value	-	-	-	-	-	-
Total incremental costs	725	1,563	838	3,688	2,963	2,125
Annual fuel savings	458	694	237	998	540	304
Payback (years)	**1.6**	**2.3**	**3.5**	**3.7**	**5.5**	**7.0**

Source: Deutsche Bank

If we change the parameters of this model to reflect $4.00 gasoline in this timeframe, the payback period is reduced to 1.2 years for an HEV versus an ICE, 1.5 years for a PHEV, and 2.5 years for an EV.

Figure 58: U.S. payback analysis under higher fuel cost environment (assume mid-decade battery cost and $4.00 per gallon fuel)

	Full HEV vs. ICE	PHEV-40 vs. ICE	PHEV-40 vs. Full HEV	EV vs. ICE	EV vs. Full HEV	EV vs. PHEV - 40
Battery $/kWh	675.0	562.5	562.5	487.5	487.5	487.5
kWh	2.0	13.0	13.0	25.0	25.0	25.0
Battery total cost	1,350	7,313	5,963	12,188	10,838	4,875
Other incremental costs	1,875	1,500	(375)	-	(1,875)	(1,500)
ICE Increase	(1,000)	(1,000)	-	(1,000)	-	-
Government Subsidy	(1,500)	(6,250)	(4,750)	(7,500)	(6,000)	(1,250)
PV of Battery Residual Value	-	-	-	-	-	-
Total incremental costs	725	1,563	838	3,688	2,963	2,125
Annual fuel savings	610	1,009	399	1,456	845	446
Payback (years)	**1.2**	**1.5**	**2.1**	**2.5**	**3.5**	**4.8**

Source: Deutsche Bank

Looking out to 2020, we lower the energy battery cost to $325/kWh. We also assume that state and local government incentives/disincentives favoring EV's over ICE's decline to $3,000 over this timeframe (vs. $7,500+ today), and we assume that gasoline rises to $4.00 per gallon. Based on these assumptions, the payback for all xEV's versus an ICE would still be less than 3-years.

Figure 59: U.S. Payback Analysis (2020 Scenario: lower battery costs, lower subsidies, $4.00 per gallon fuel)

	Full HEV vs. ICE	PHEV-40 vs. ICE	PHEV-40 vs. Full HEV	EV vs. ICE	EV vs. Full HEV	EV vs. PHEV - 40
Battery $/kWh	450.0	375.0	375.0	325.0	325.0	325.0
kWh	2.0	13.0	13.0	25.0	25.0	25.0
Battery total cost	900	4,875	3,975	8,125	7,225	3,250
Other incremental costs	1,500	1,000	(500)	-	(1,500)	(1,000)
ICE Increase	(1,000)	(1,000)	-	(1,000)	-	-
Government Subsidy	-	(2,000)	(2,000)	(3,000)	(3,000)	(1,000)
PV of Battery Residual Value	-	-	-	-	-	-
Total incremental costs	1,400	2,875	1,475	4,125	2,725	1,250
Annual fuel savings	610	1,009	399	1,456	845	446
Payback (years)	**2.3**	**2.8**	**3.7**	**2.8**	**3.2**	**2.8**

Source: Deutsche Bank

And in Europe, assuming that battery costs decline to $325/kWh, we estimate that payback periods could decline to 1-2 years even if gasoline remains stable in the $6-$8/gallon range prevailing today (Figure 56 assumes a $7.00 gasoline price).

Figure 60: Europe Payback Analysis (same assumptions as U.S. 2020 analysis above, except $7.00 per gallon fuel)

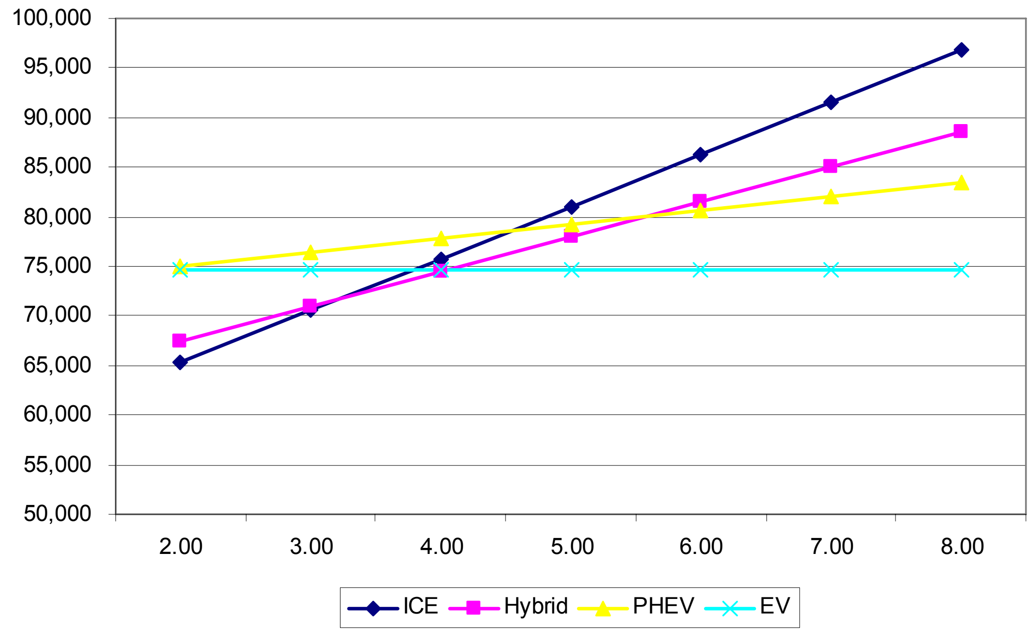
	Full HEV vs. ICE	PHEV-40 vs. ICE	PHEV-40 vs. Full HEV	EV vs. ICE	EV vs. Full HEV	EV vs. PHEV - 40
Battery $/kWh	450.0	375.0	375.0	325.0	325.0	325.0
kWh	2.0	13.0	13.0	25.0	25.0	25.0
Battery total cost	900	4,875	3,975	8,125	7,225	3,250
Other incremental costs	1,500	1,000	(500)	-	(1,500)	(1,000)
ICE Increase	(1,000)	(1,000)	-	(1,000)	-	-
Government Subsidy	-	(2,000)	(2,000)	(3,000)	(3,000)	(1,000)
PV of Battery Residual Value	-	-	-	-	-	-
Total incremental costs	1,400	2,875	1,475	4,125	2,725	1,250
Annual fuel savings	1,039	1,932	893	2,807	1,768	875
Payback (years)	**1.3**	**1.5**	**1.7**	**1.5**	**1.5**	**1.4**

Source: Deutsche Bank

Total cost of ownership model

Another way to look at the cost of electrification is through a total lifecycle cost of ownership model. In the following table, we calculate total cost of ownership (TCO) over a 10-year useful life, including initial cost of the vehicle (including the cost of a ca. 2015 battery system), fuel costs, maintenance costs, and cost of financing (assuming that the entire purchase price of the vehicle, including battery system, is financed for 10 years at 7.5%). While we don't discount the fuel savings achieved by xEV's in future years, and assume the additional financing cost related to the battery systems accounts for the time-value of money. We do not assume any government subsidy. Based on this analysis, we calculate that without any government subsidy, an ICE vehicle has the lowest TCO up to $3.00 per gallon, at which point the HEV becomes the low-cost vehicle. At just above $4.00, the pure EV is the best choice.

Figure 61: Total Cost of Ownership by vehicle type. Cost includes: Initial price of vehicle: Base price of vehicle, battery, and net additional cost of components to electrify the vehicle. Periodic Costs: 10 year cost of fueling, maintenance, insurance, and financing (assume finance total initial price of vehicle at 7.5% interest)



Source: Deutsche Bank

Alternative business models could accelerate the shift toward electrification

Until now, all but a few established automakers have generally considered electrification out of necessity—in order to achieve intensifying fuel economy/CO2 reduction mandates that would be difficult if not impossible to achieve with internal combustion technologies alone. Relatively few have seen it as an opportunity for differentiation, or growth. But we believe that this paradigm could change. Several automakers, finance, and infrastructure companies have been discussing business models that could help facilitate more rapid EV penetration.

An emerging group of EV infrastructure companies believe EVs can be cheaper than ICEs, at the point of purchase

The most advanced amongst an emerging group of EV infrastructure companies, Better Place, has based its businesses on the premise that EV purchases should be structured without batteries, so that the vehicle can be sold at the same price or lower than a conventional ICE-powered vehicle. They believe this will be a pre-requisite for electric vehicles to capture a significant share of the mass market (i.e. the mass market will typically migrate towards products that are less expensive at the point of purchase, and more convenient to use over time). Better Place intends to provide vehicle batteries to consumers at no upfront cost, and then sell consumers "Miles"—i.e. a per mile fee, equivalent to the per mile cost of driving a gasoline powered vehicle, which would cover the cost of the battery, electricity, widespread charging infrastructure, and a return on Better Place's investment.

The notion that EVs could be less expensive than an ICE-powered vehicle is a novel one. Even if we look out to 2020, advanced lithium ion energy battery prices are still likely to be in the $300-$400 per kilowatt hour range (down from roughly $600 per kWh today). Consequently, a mid-sized EV with a 100 mile range (25 kWh) will still likely to require a $7,500-$10,000 battery.

But many participants in the electric vehicle value chain believe that a lower price to the consumer is still possible, based on the fact that there is already a substantial arbitrage opportunity between gasoline and electric driving. To illustrate this point, we estimate the average small car (C-Segment vehicle such as the Ford Focus, Honda Civic, or Toyota Corolla) in the US achieves 28.5 miles per gallon in mixed city and highway driving. At relatively low gas prices in the U.S. ($2.55 per gallon currently), such a vehicle consumes 8.9 cents of gasoline per mile to drive. In markets such as Germany, France, Switzerland, or the UK, where gasoline costs are approximately $6.00-$8.00 per gallon, this vehicle would consume 21.1-28.1 cents per mile to drive. For comparison, we estimate that the global average price of electricity is approximately 10 cents per kilowatt hour, and that a similarly sized vehicle would achieve 4 miles per kWh, implying an e-driving cost of 2.5 cents.

The arbitrage opportunity is likely to increase, which is why we believe that EV penetration rates are likely underestimated

The arbitrage opportunity should expand as gasoline prices rise (DB's Oil Team recently published a study that suggested that oil prices could reach $175 per barrel by 2016, implying $4.75 per gallon gasoline in the U.S. and $8.25-$10.25 per gallon gasoline in Europe), and as governments in many parts of the world provide electric vehicles with additional rebates, tax breaks, and other incentives (The US provides a tax credit of up to $7,500, several U.S. states exempts EVs from sales tax, France provides a €5,000 rebate, Denmark exempts EVs from VAT ranging from 105%-180%, Israel exempts EVs from taxes of approximately 92%; these incentives, and others are described in more detail in Figure 43).

The opportunity for arbitrage between gas driving vs. EV driving is among the key reasons why we believe that EV penetration rates (relative to HEV and PHEV) are likely to exceed prevailing estimates. Conveying this arbitrage to the consumer would require a paradigm shift in the marketing of Electric Vehicles—the battery would need to be sold separately from the vehicle. Proponents of this model argue that it is a mistake to package the battery, which is a consumable, with the vehicle, for the same reason that consumers don't purchase a lifetime supply of gasoline with a vehicle, or a lifetime supply of toner/ink with a printer.

Separating the battery from the vehicle would facilitate more rapid penetration of electric vehicles for a variety of reasons, including:

- *The business model simplifies the gasoline/electricity arbitrage for the consumer*. Service companies could invest in capital (the battery), lock in energy costs (through long term power purchase agreements with electric utilities), and convey the arbitrage to the consumer by billing for a service. In the most consumer oriented models that we have seen, the service providers intend to sell "miles" to the consumer every time the vehicle plugs-in to a charging device at home, at work, or any other public parking location. There is a widely used comparison of this business model to that of a mobile phone network provider, which invests in communications infrastructure, and provides highly subsidized (or free) phones in exchange for 2-3 years worth of "minutes". In the EV service providers' case, they would sell a 3-4 year contract for "miles". In exchange, the service provider would supply the vehicle with a battery, install a charging device at the owner's home, and it will endeavor to install ubiquitous recharging devices in the field (i.e. at work, on the street, parking lots, supermarkets, malls, etc). The charging devices communicate with the service provider, and the service provider bills the consumer directly based on terms of the plan: 1000 miles a month, 1500 miles a month; unlimited driving (i.e. a consumer charging at home would not pay a higher electric bill, since the utility would be aware that it is buying "miles" as part of the consumer's contract service contract, and the utility has sold electricity directly to the service provider under a long-term purchase agreement).
- *It should facilitate lower cost*. Management of batteries (i.e. maximizing returns on these investments) should facilitate cost reductions for consumers. For example, third party battery owners are expected to maximize the residual value of the batteries owned

by their networks. While financial models such as the one that we describe for Better Place, incorporate an 8-year depreciable life for the battery, and a 15% residual value, data from battery manufacturers suggest that much longer life expectancies are possible. Most of the battery companies that we have spoken to are willing to guarantee a 10-year life, and 2500 full discharge/recharge cycles for their batteries. And in the lab, these companies are now demonstrating 7,000 full charge/discharge cycles (19 years assuming 1 full charge/discharge cycle per day). And we would note that the battery should still have value at the end of its initial service life (end of life is defined as the point at which the battery falls below 80% of its original performance). We anticipate that service companies will aim to maximize returns by seeking secondary markets for "end of life" batteries. For example, there will likely be a market for a 100 mile automotive batteries that are only capable of 80 miles per charge (the service provider may shift such units to regions where driving distances are smaller, such as Las Vegas, or the Hawaiian Islands). End of life batteries are also expected find other applications, including electric utility needs (grid storage and ancillary services).

- *It adds convenience*. The service provider would be expected to install recharging infrastructure at home, and in public locations (including workplaces), and provide this information to the vehicle so that drivers are able to identify range extending resources over longer trips.
- *Lowers perceived obsolescence risk*. Consumers may adopt EV's more slowly if they are concerned about obsolescence of the battery, as battery technology improves (as noted in the "Declining battery costs should also help propel increased xEV penetration" section, Advanced Lithium Ion battery performance could double over the next 7 years). Not owning the battery eliminates the concern about investing in this asset, as it would allow the consumer to upgrade over time.
- *Reduces range anxiety*. Service providers are expected to provide infrastructure for range extension, including battery swap and fast charge stations.
- *Simplifies the consumer relationship*. Third party service providers are expected to manage the relationship between utilities and the consumer. For example, a customer living in Northern New Jersey, working in New York City, and vacationing in Atlantic City may travel travel through territories controlled by three or more utilities (PSE&G, ConEdison, and Atlantic Energy). But the consumer would likely want seamless roaming between the charging infrastructure provided in all of these locations.
- *Reduces infrastructure investment*. While the electricity demands of electric vehicles are not expected to overwhelm electric utilities' capacity (only 4% of electric utility capacity would be consumed if 25% of all U.S. vehicles were powered by electric), electric distribution infrastructure could be strained during peak charging times, or in specific areas (such as a parking lot) that have a disproportionate number of vehicles charging at once. Electric vehicle service companies have focused on network management systems and software in order to communicate with vehicles and/or charge points in order to ensure that this does not occur. Israel Electric Corp estimates that, in a scenario where all Israeli vehicles are EVs by 2020, they would require zero additional generation and transmission assets given the interaction of EV service provider Better Place. If charging were done on an ad-hoc basis, generation assets would have to increase by 21% and transmission / distribution assets would have to increase significantly.

Our analysis of Better Place's business model suggests that EVs could be economic in high gas price, and high mileage regions (or niches), even without government assistance. And the model could be adapted for other markets

We have analyzed Better Place's business model in some detail, and have concluded that the concept should be financially compelling in certain regions—from the perspective of service providers (in Israel, we estimate Better Place may be able to achieve a 60%+ EBITDA margin;

40%+ EBIT margin; 20% pretax margin; 35%+ return on equity), consumers (zero incremental upfront cost), and automakers (significant market share opportunity). And we believe the model can be adapted to regions with lower gas taxes or with lower annual utilization rates, with government support, different rate structures and/or lower margins.

We believe the Better Place model could significantly alter the EV value proposition from the consumers' perspective, because it should facilitate the acquisition of an EV at zero incremental upfront cost. In the Better Place model, the consumer purchases an electric vehicle without the battery. Better Place purchases the battery on the consumer's behalf, and charges the consumer for "miles", at a price that is consistent with the cost of gasoline driving of an equivalent vehicle. For illustrative purposes, we discuss several of the assumptions behind our Better Place Israel business model in the following sections.

Revenue and margins should experience a strong upward trajectory in Better Place's first markets

We believe the Israeli vehicle market offers certain unique attributes, which makes this market an interesting test-bed for electric vehicle and EV infrastructure deployment. Interesting features of this market include:

- A relatively small market, with 2 million vehicles in operation, and approximately 150k – 200k new cars sold per year. The market is also geographically small (about the size of New Jersey), with concentrated population centers and relatively few inter-city routes, enabling rapid and efficient deployment of charge and battery swap infrastructure.
- High gas prices ($6.50/gallon) and substantial government support should help facilitate strong demand for electric-based alternatives. ICE vehicle purchases in Israel are taxed at 92%. But under recently passed rules, EVs will be taxed at only 10% through 2014, and 30% starting in 2015.
- Fleet purchasers, including businesses, account for a relatively high 50%-60% of this market, because major employers typically provide their employees with vehicles as part of their compensation packages. Employees use these work-provided vehicles disproportionately within their households, because of lower vehicle ownership density, and because their employers pay for all of the costs associated with these vehicles (fuel, insurance, and maintenance are all covered). Consequently, average utilization of fleet vehicles in Israel is relatively high (18,600 miles per year). In addition, businesses are motivated to reduce risk associated with volatile fuel prices.

Better Place Israel is expecting to begin consumer services 3Q11. By 4Q15 and 4Q16, we have assumed that the company can capture between 4% (81,000) and 5% (110,000) of the Israeli car parc, based on the assumption that the company will add 14,000 subscribers in 2012, 16,000 in 2013, 22,000 in 2014, 25,000 in 2015, and 30,000 in 2016 (note that the company has already pre-sold 30,000 vehicles to fleet purchasers as of 4Q09, and that it is still 1.5 years away from commercial operations). We believe that the company will attempt to achieve rapid deployment of vehicles by allowing EV buyers to capture 100% of the tax savings associated with the government EV incentive program. We assume that Better Place charges consumers (or businesses, in the case of fleet purchasers) a per mile rate that is at a slight premium to the current cost per mile for gasoline. The gasoline cost per mile for C/D sized vehicles in Israel is approximately 23 cents. A 24.5 cent charge for EVs would capture some of the insurance and maintenance cost savings that is expected of EVs.

If Better Place achieves the penetration targets outlined above (81,000 subscribers by YE2015 and 110,000 by YE2016), we estimate this region will be running at an annualized revenue run rate of over $370 million by 4Q15 and over $500 million by 4Q16. After subtracting operating costs, including electricity (at 2.5 cents per mile), personnel, marketing, maintenance, depreciation, and other overhead expense, we estimate that Better Place Israel could achieve an operating margin of approximately 40% between late 2015 and 2016. One of the interesting observations that we made through our analysis of the battery market is that industry participants expect battery costs to decline by 50% over the next 10 years. If this happens, it should result in significant declines in depreciation expense for companies such as Better Place. At the same time, the EV vs. ICE transportation arbitrage opportunity could increase if oil prices climb.

Figure 62: DB Estimate of potential Better Place pricing methodology

Internal Combustion Fueling Cost	
Fuel cost per gallon	$ 6.50
Miles per gallon	28
Miles per year	18,600
ICE Fuel Cost / Vehicle / Year	4,318
ICE Cost / Mile	$ 0.23
Better Place EV Cost (including battery)	
BP Revenue / Vehicle / Year	$ 4,550
Customer Maint / Insurance Savings	$ (300)
Net cost to customer	$ 4,250
BP Price / Mile	$ 0.23

Source: Deutsche Bank

Figure 63: DB Estimate of BP Israel profitability

	4Q of 2015 Run Rate	4Q of 2016 Run Rate
Subscribers	81,500	110,100
Revenue / Subscriber	4,560	4,560
Revenue ($MM)	372	502
Electricity Cost	38	51
Personnel Cost	29	40
Marketing Cost	10	13
Maintenance Cost	10	13
Other Overhead	38	53
EBITDA	247	332
Depreciation	100	127
EBIT	148	205
EBIT Margin	39.7%	40.8%

Source: Deutsche Bank

Figure 64: Total Capital Deployed ($million) To achieve these revenue and margin objectives, we estimate that Better Place will have invested $1.1-$1.3 billion in Switch Stations, Charge Spots, Batteries, and Other Fixed Assets ($920 million of invested capital, and the rest funded through cash flow)

	2015YE	2016YE	Adj'd for 2020 Battery Price ($325/kWh)
Switch Stations	25	30	30
Charge Spots	107	137	136
Batteries	914	1,160	770
Other fixed assets	12	13	12
Total Investment	1,058	1,339	948

Source: Deutsche Bank

The investment in batteries is the most substantial investment for a Better Place network

We estimate that Better Place Israel will have $914 million invested in batteries at year end 2015 ($722 million on balance sheet, after adjusting for depreciation) and $1.1 billion at year end 2016 ($861 million on balance sheet, adjusting for depreciation). The assumptions underlying these projections correspond to our battery price projections ($14,000 per battery purchased in 2011; $13,000 in 2012; $11,500 in 2013; $10,500 in 2014; $9,500 in 2015). We incorporate an 8 year depreciation schedule for the battery into our earnings and balance sheet forecasts. The battery investment also includes extra batteries required at battery swap stations. We estimate a minimum of 12 batteries must be kept in inventory per swap lane in order to ensure battery availability: This is based on an assumption that a fully depleted battery can be charged over 1 hour. Therefore, in the worst case scenario, if all of the returned batteries are fully depleted, 12 batteries would ensure that a fully charged battery will be available once every 5 minutes. Proliferation of vehicle models will require higher inventory of batteries "standing by" in each lane, but statistical modeling suggests that this will not be linear (1 model requires 12 batteries per lane; 2 requires 18; 3 requires 21; 4 requires 23; 5 requires 25). We have assumed that the network in this region offers 4 different models by year-end 2014, and 5 by year-end 2015). The investment in extra batteries is not a major concern for us, as long as the returns for the network operator are sufficient to justify the incremental investment (we have assumed investment in 60 stations by YE 2016, and 25 extra batteries per station, implying 1,500 extra batteries in the network that should have 110,000 vehicles in operation).

Swap stations represent a unique, and somewhat controversial part of the Better Place business model. The system, which was demonstrated in Yokohama, Japan earlier in 2009, and which will be deployed in Japan, Israel, Denmark, Hawaii, and other markets, involves the deployment of infrastructure for relatively efficient (less than 60 second) removal and replacement of a batteries from/to a vehicles, as well as storage and charging of multiple battery types. The battery swap lanes are designed to accommodate many different types of current and future battery designs, so that automakers are not required to design their vehicles around a battery design standard (we believe that standardization will happen, but that it will take time). The advantage of the battery swap network is that it can alleviate the "range anxiety" that can be associated with an electric vehicle (although we note that this range anxiety is likely to become less of a concern as consumers recognize that unlike gasoline powered vehicles, electric vehicles are much more frequently "topped off" with an electrical charge whenever they have access to electricity). The swap station comes into play when a vehicle is driven for more than 100 miles in a day. We believe that this will be a relatively rare occurrence: A U.S. DOT survey in 1990 found that half of all motorists in the U.S. traveled 25 miles (40 km) per day or less, and that 80% drove a maximum of 50 miles (80km) per day or less. Another advantage of a swap station is that it eliminates the need for range extending equipment on-board every electric vehicle (every Chevrolet Volt will be equipped with an on-board gasoline motor/electric generator that will extend the range of the vehicle once the battery is depleted). We have modeled Better Place Israel to correspond with the company's planned initial deployment of 50 swap station lanes, at an initial investment of $25 million, since Better Place believes that this should be sufficient to establish infrastructure on every major inter-city route in Israel, at an interval of 20 km between each facility, and at strategic locations within cities. Additional lanes are added as the network load reaches 2,000 subscribers per lane, which is the maximum level according to BP's demographic modeling.

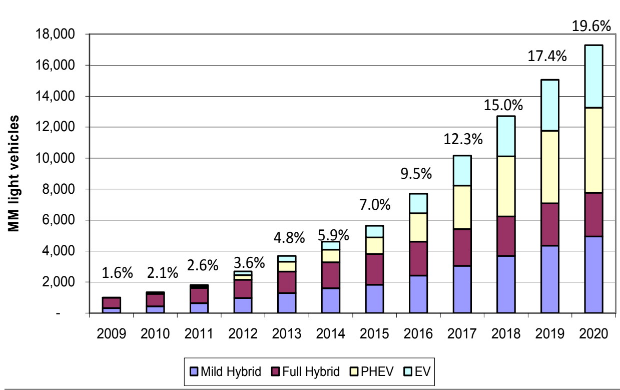
In addition to switch stations and batteries, Better Place is investing in vehicle charging infrastructure in all of the regions in which it operates. Typically, a network operator will endeavor to have at least 2 charge spots per subscriber initially (one is installed at home and one at or near work). The deployment of charging infrastructure is somewhat more complicated than it may sound, given that the recharging infrastructure needs to be able to communicate and control charging of individual vehicles in the field (Charge times are managed so as not to over-burden transmission infrastructure for a parking lot, or regional electricity distribution infrastructure during peak charging times; vehicles need to be identified and associated with owners irrespective of where the vehicle is charging). Some network operators and infrastructure suppliers (such as Coulomb Technologies) have promoted the deployment of smart charge spots, which contain communications, controls, and billing services at the charge point. Better Place's model involves less sophisticated, and less expensive charge infrastructure, and relies more heavily on the deployment of communications and control electronics within the vehicle. We estimate that Better Place will have deployed over 77,000 charge spots in Israel by year-end 2011 (5 per subscriber). We expect Better Place to have deployed 142,000 spots by year-end 2015 (1.7 per subscriber) and 182,000 by year-end 2016, which equates to $136 million invested in charging infrastructure ($750 per charge spot).

Global HEV/PHEV/EV market projections

After consolidating our regional forecasts, we estimate that the global market for xEVs will rise to 5.6 million vehicles in 2015 (7% of global light vehicle volume) and 17.3 million vehicles in 2020 (20% of global volume), up from approximately 1.3 million in 2010 (and 1.0 million in 2009). HEVs are likely to be the most prevalent xEV's in 2015, at about 5% of the overall vehicle market. But at that point, growth in full HEVs will likely slow down, replaced by growth in PHEVs and EVs. By 2020, we believe PHEVs / EVs will approach 11% of the global market, with HEVs at just below 9%. Importantly, we also point out that PHEVs and EVs utilize batteries that are up to 10x the size of those used in HEVs. This implies that the market for xEV batteries will likely gain momentum in the 2015-2020 timeframe. This also implies that the overall market for xEV batteries will be dominated by PHEVs and EVs—ff A.T. Kearney's $74 bn estimate for lithium-ion battery revenue in 2020, 42% was for EVs, and 45% was for PHEVs. Only 13% was for HEVs.

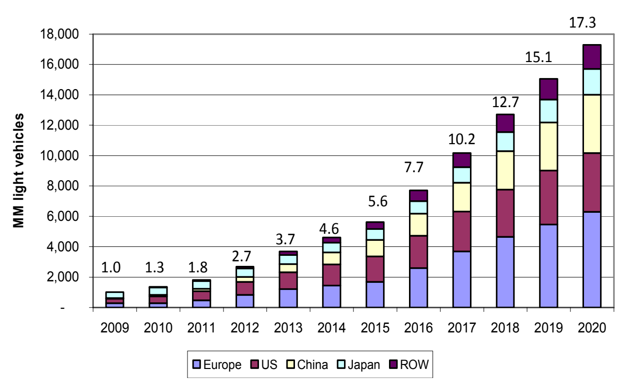
By region, we expect Europe (defined as Western Europe plus the 10 new EU members) to surpass the U.S. as the #1 xEV market around the 2015 timeframe, and for China to catch up to the US by 2020. We project that xEV adoption will likely lag in other emerging markets.

Figure 65: Global xEV volume by type (million units). %'s represent xEV volume as % of global vehicle sales.



Source: Deutsche Bank

Figure 66: Global xEV volume by region (million units)



Source: Deutsche Bank

Using the above volume estimates and other assumptions outlined below, we estimate the automotive related lithium-ion battery market will reach $18.4bn in 2015 and $66.2bn in 2020. Revenue becomes truly meaningful in 2012 ($7.3 bn), and from that point our forecast suggests a 32% CAGR through 2020. Given that lithium-ion powered xEVs only represent about 17% of global unit sales in 2020, the growth rate is likely to continue at a significant pace well past 2020 (note that xEVs as % of global sales, including NiMH-powered vehicles is expected to be 19.6% as illustrated in Figure 61).

We've incorporated the following assumptions into our revenue calculations:

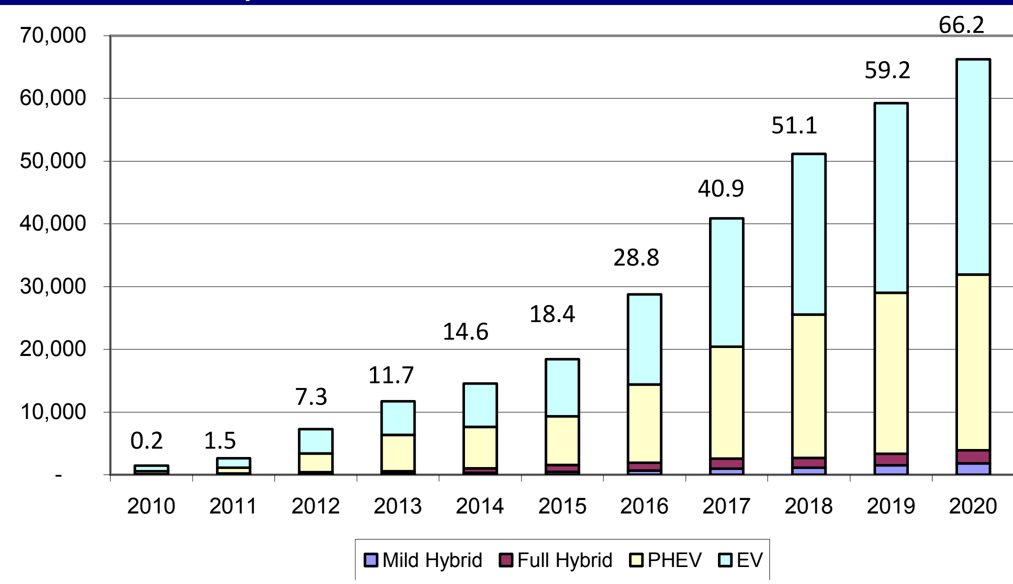
- We assume that all PHEVs and EVs are powered by lithium-ion batteries. For HEVs, we've assumed that Nickel Metal Hydride batteries power 85% of HEVs in 2013, 65% in 2015, 50% in 2018, and 30% in 2020. Nickel Metal Hydride revenue is not included in our battery market revenue forecast.
- We've assumed that EVs use 25 kWh batteries, PHEVs use 12.5 kWh batteries, full hybrids use 2 kWh batteries, and mild hybrids use 1 kWh batteries.
- Our price per kWh assumptions are outlined in Figure 63. Our assumption incorporates flat pricing through 2012. And then, starting in 2013 we assume that pricing declines by 7% per year through 2020.

Figure 67: EV battery price assumptions used in market estimates (price to OEM per kWh)

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hybrid	1,000	910	828	754	701	652	606	564	524
PHEV	780	710	646	588	547	508	473	440	409
EV	650	592	538	490	456	424	394	366	341

Source: Deutsche Bank

Figure 68: Global lithium ion battery revenue ($millions)



Source: Deutsche Bank

Figure 69: xEV Volumes by Region

	2010E		2015E		2020E	
	Units (000's)	Penetration	Units (000's)	Penetration	Units (000's)	Penetration
U.S. Volume						
HEV	425	3.4%	1,272	8.0%	2,028	12.0%
PHEV	13	0.1%	286	1.8%	1,183	7.0%
EV	13	0.1%	127	0.8%	676	4.0%
Total	450	3.6%	1,685	10.6%	3,887	23.0%
Europe Volume						
HEV	255	2.0%	1,120	7.0%	2,890	17.0%
PHEV	13	0.1%	400	2.5%	2,380	14.0%
EV	13	0.1%	160	1.0%	1,020	6.0%
Total	280	2.2%	1,680	10.5%	6,290	37.0%
Japan Volume						
HEV	467	10.5%	625	12.5%	1,200	24.0%
PHEV	-	0.0%	50	1.0%	300	6.0%
EV	9	0.2%	45	0.9%	200	4.0%
Total	476	10.7%	720	14.4%	1,700	34.0%
China Volume						
HEV	60	0.6%	491	3.1%	950	5.0%
PHEV	20	0.2%	237	1.5%	1,121	5.9%
EV	20	0.2%	348	2.2%	1,767	9.3%
Total	101	1.0%	1,076	6.8%	3,838	20.2%
ROW Volume						
HEV	36	0.2%	316	1.2%	707	2.3%
PHEV	1	0.0%	88	0.3%	498	1.6%
EV	2	0.0%	61	0.2%	366	1.2%
Total	39	0.2%	465	1.7%	1,572	5.2%
Global Volume						
HEV	1,243	2.0%	3,823	4.8%	7,775	8.8%
PHEV	47	0.1%	1,061	1.3%	5,482	6.2%
EV	56	0.1%	742	0.9%	4,029	4.6%
Total	1,346	2.1%	5,626	7.1%	17,287	19.6%

Source: Deutsche Bank

Figure 70: Global xEV Battery Revenue projections ($ millions)

	2010E		2015E		2020E	
Global Volume (000 units)	Units	Penetration	Units	Penetration	Units	Penetration
HEV	1,243	2.0%	3,823	4.8%	7,775	8.8%
PHEV	47	0.1%	1,061	1.3%	5,482	6.2%
EV	56	0.1%	742	0.9%	4,029	4.6%
Total						
Global Price per Unit	$ per unit		$ per unit		$ per unit	
HEV	1,649		1,147		715	
PHEV	9,750		7,347		5,111	
EV	16,250		12,246		8,519	
Global Revenue (incl NiMH)	Rev ($MM)	% of Total	Rev ($MM)	% of Total	Rev ($MM)	% of Total
HEV	2,051	60.1%	4,386	20.6%	5,559	8.2%
PHEV	456	13.3%	7,797	36.7%	28,023	41.3%
EV	908	26.6%	9,082	42.7%	34,326	50.5%
Total	**3,415**		**21,265**		**67,908**	
Lithium-Ion Penetration	% LIB		% LIB		% LIB	
HEV	4%		35%		70%	
PHEV	100%		100%		100%	
EV	100%		100%		100%	
Global Revenue (Lithium-Ion only)	Rev ($MM)	% of Total	Rev ($MM)	% of Total	Rev ($MM)	% of Total
HEV	84	5.8%	1,535	8.3%	3,891	5.9%
PHEV	456	31.5%	7,797	42.3%	28,023	42.3%
EV	908	62.7%	9,082	49.3%	34,326	51.8%
Total	**1,447**		**18,414**		**66,240**	

Source: Deutsche Bank

Battery capacity outlook

The availability of government funding in the US and Europe and the acceleration of automakers' xEV product plans have been a major impetus for battery capacity growth plans in 2009. We have tracked the announcements in the US, Europe, Japan, and South Korea. The details of these investments are varied—some manufacturers are planning to produce batteries for hybrids, and some for EVs. Moreover, there are many types/sizes of cells. We have attempted to translate all projects that we are aware of into a comparable kWh capacity table. And when details on kWh of capacity weren't available (i.e. when the battery manufacturer provided information in terms of HEV or EV battery packs of capacity), we translated the information that we had into a comparable number of EV equivalent packs. For instance, capacity stated in terms of full hybrids was translated at a ratio of 1 EV unit per 10 full HEV units. We used a ratio of 1/20 for mild HEVs and 1/2 for PHEVs. Combining data from several battery manufacturers, we believe that there is currently about 170k units of EV-equivalent capacity on the market today. Based on announced plans (and estimates for companies that have not provided sufficiently detailed disclosure), capacity is estimated to increase by 8.5x times by 2015 (over 50% CAGR) to roughly 1.45 million units of EV battery capacity (14.5 million HEV batteries).

Figure 71: Lithium ion battery production capacity from key U.S., Japanese, South Korean, and European producers

Company	Ownership: Key auto company	Ownership: Battery Company	Factory Location	Investment ($MM)	Capacity (EV-equivalent Units)	
					2010E	2015E
Ener1		Ener1 100%	Korea	20	15,000	15,000
			USA	600	30,000	120,000
Lithium Energy Japan	Mitsubishi 15%	GS-Yuasa 51%, Mitsubishi 34%	Japan	187	21,000	55,000
Blue Energy	Honda 49%	GS-Yuasa 51%	Japan	263	20,000	30,000
Panasonic EV Energy	Toyota 60%	Panasonic 40%	Japan (Li-ion)	111	9,400	9,400
AESC	Nissan 51%	NEC Group 49%	Japan	145	50,000	65,000
			USA	1000	0	200,000
			UK	330	0	60,000
			Spain	356	0	60,000
A123		A123 100%	USA	800	0	120,000
			Korea/China	0	15,000	15,000
Dow / Kokam	Dow	Kokam America	USA	350	0	60,000
JCI Saft	JCI 51%	Saft 49%	USA	600	0	140,000
Sanyo		Sanyo 100%	Japan (Li-ion)	315	2,000	110,000
Hitachi Vehicle Energy		Hitachi S / S 65%, Shinkobe 25%, Maxell 10%	Japan	456	10,000	70,000
Toshiba		Toshiba 100%	Japan	278	0	60,000
SB LiMotive*	Bosch 50%	Samsung 50%	S-Korea	500	0	149,000
LG Chem*		LG 100%	S-Korea		0	111,000
			USA	300		
SK Energy *		SK 100%	S-Korea	113	0	25,000
LiTec*	Daimler 49% Daimler 90%	Evonik-Degussa 51% (cells) Evonik-Degussa 10% (pack)	Germany	100	0	40,000
Total				**6,824**	**172,000**	**1,514,000**
			Average annual growth rate (2010-2015)			54%
			X times			8.8

*Notes: * Base capacity estimate made by DB team*
Source: Company, Various News sources, Deutsche Bank Group Estimates

In assessing the total capacity in the automotive battery market, we also had to consider the capacity for NiMH. Indeed, we continue to assume that NiMH will account for 65% of hybrid vehicle batteries through 2015, as key Japanese makers including Toyota and Honda continue to resist the adoption of lithium ion batteries for their hybrid systems. With targeted volumes of 1 million and 500,000 units respectively over the next several years from Toyota and Honda, these makers will rely on supply of NiMH batteries.

Figure 72: NiMH supply for Toyota and Honda

	Company	Key auto company	Battery Company		2010	2015e
NiMH battery capacity (HEV based units)	Panasonic EV Energy	Toyota 60%	Panasonic 40%	Japan (Ni-MH)	1,000,000	1,100,000
	Sanyo	-	Sanyo 100%	Japan (Ni-MH)	150,000	270,000
Subtotal					1,150,000	1,370,000

Source: Deutsche Bank

Considering the above, we have also examined the issue of capacity utilization to see if we will have capacity for too many or too few batteries relative to our xEV demand forecasts. In this exercise we isolated the capacity announcements of the key suppliers identified above in the US, Europe, Japan, and South Korea. While this excludes China, in this timeframe we are not concerned that this omission distorts our conclusions, as we believe that Chinese supply will be directed at the growth of the domestic market.

The key variables in our model include total demand, penetration by segment for mild/full/PHEV hybrids and EVs, as well as Li-ion battery penetration within each of those segments. We then convert our demand forecasts across segments into EV equivalent units to compare against our calculated EV equivalent units of capacity.

Figure 73: Li-ion battery demand, capacity, and utilization outlook

2015 scenario for US, Europe, and Japan

	Demand subtotal	LIB Penetration	LIB-Only	EV-Equivalent	% by EV-Equivalent	NMH Demand
Mild Hybrid	1,343	35%	470	24	3%	873
Full Hybrid	1,674	35%	586	59	7%	1,088
PHEV	736	100%	736	368	47%	-
EV	332	100%	332	332	42%	-
Total	**4,085**		**2,124**	**782**		**1,961**
	Capacity utilization - on 2015 capacity est			52%		

2017 scenario for US, Europe, and Japan

	Demand subtotal	LIB Penetration	LIB-Only	EV-Equivalent	% by EV-Equivalent	NMH Demand
Mild Hybrid	2,363	50%	1,181	59	3%	1,181
Full Hybrid	1,913	50%	957	96	4%	957
PHEV	2,061	100%	2,061	1,030	47%	-
EV	1,006	100%	1,006	1,006	46%	-
Total	**7,343**		**5,205**	**2,191**		**2,138**
	Capacity utilization - on 2015 capacity est			145%		

Source: Deutsche Bank

Based on our supply and demand forecasts, using headline capacity plans from global battery producers, lithium ion supply could theoretically exceed demand early in the next decade (we projected utilization rates in the 55% range in the 2015 timeframe). Suppliers do tell us, however, that capacity will be ramped up incrementally over time to correspond with end-market demand, so we are not particularly concerned by the headline calculation. Beyond 2015, it is clear that demand is likely to ramp up dramatically—particularly for battery intensive electric vehicles—and it appears plausible to us that demand will exceed supply. We project that cell demand will increase to the equivalent of 2.3 million EV units by 2017, exceeding currently identifiable capacity of 1.45 million. Of course, we acknowledge that projections of capacity 8-9 years into the future are not comprehensive, since there is we have no doubt that additional capacity will be announced during the intervening period. In addition, we believe very modest upside to our EV penetration assumptions could lead to dramatically higher battery capacity requirements. We also point out that the "large format" advanced lithium ion battery capacity being deployed for the automotive market can also be redeployed to serve other markets—including heavy-duty vehicles, grid storage, and uninterrupted power supply (UPS).

Figure 74: Diagram of battery-maker / automaker relationships (HEV: Hybrid / PHEV: Plug-in Hybrid / BEV: Pure electric vehicle (no internal combustion engine)). Note: Arrows represent investments in battery-making joint ventures.

Battery-maker		Joint Venture		OEM	Veh Type
Panasonic	→	PEVE	←	Toyota	HEV / PHEV
				Subaru	HEV
Sanyo				Ford	HEV
				Toyota	HEV / PHEV
				VW / Audi	HEV
A123				BMW	HEV
				Chrysler	BEV
				Daimler	HEV / Buses
				GM	???
				Magna / Volvo	Buses
				SAIC	BEV / HEV
GS Yuasa	→	Blue Energy	←	Honda	HEV
	→	Lithium Energy Japan	←	Mitsubishi	BEV
Hitachi	→	Hitachi Veh Energy		Isuzu	HEV
Shinkobe / Maxell	→			GM	HEV
LG Chem				GM	PHEV
				Hyundai / Kia	HEV / PHEV
NEC / NEC Tokin	→	AESC	←	Nissan	HEV / PHEV / BEV
				Renault	HEV / PHEV / BEV
				Subaru	BEV
Ener1				Think Global	BEV
				Volvo	PHEV / BEV
				Fisker	PHEV
				Zero Sport / Japan Post	BEV
Evonik	→	Li-Tec	←	Daimler	HEV / BEV
JCI	→	JCI / SAFT		Azure Dynamics	HEV
				BMW	HEV
				Daimler	HEV
				Ford	PHEV
Saft	→			Jaguar / Land Rover	HEV
				Volkswagen	PHEV
Samsung SDI	→	SB LiMotive		PSA	HEV
				BMW	EV
Bosch	→			Ford	HEV / BEV
Toshiba				VW	BEV
BYD				BYD	PHEV / BEV

Source: Company Filings, Deutsche Bank

North America United States
Consumer Autos & Auto Parts

3 November 2009

Ener1 Inc.

Reuters: **HEV.OQ** Bloomberg: **HEV UQ**

Initiating coverage with a Buy recommendation

We believe a number of factors distinguish Ener1…
…and suggest to us this company has potential to become a key player in the burgeoning market for automotive advanced lithium ion batteries. Ener1's technology is highly regarded, it has a strong management team, and we expect it to have similar capacity to its primary US competitors (i.e., JCI, A123, LG Chem) through mid-decade. Most importantly, the company has contracts that should generate an annual run-rate of $150+ million by 2H 2010. We believe Ener1's valuation is compelling, and initiate with a Buy recommendation.

The momentum behind vehicle electrification is growing
Based on our analysis of automakers' product disclosures, and discussions with global suppliers, we estimate the world's automakers will introduce at least 120 hybrid, plug-in hybrid, and electric vehicle models onto the market by 2012, compared with 29 (mostly hybrid) vehicles on the market today, and 13 in 2008. Overall, we believe that by 2020, 17% of the global automobile market could be comprised of hybrids, plug-in hybrids, and fully electric vehicles, and we project a $66 bn market for the advanced lithium ion batteries that make these vehicles possible.

We expect Ener1 will be an early-mover in lucrative EV/PHEV batteries
Ener1 will be amongst the first to achieve commercial production of EV and PHEV products given its contracts with Fisker, Think, Volvo, and Japan Post (through Zero Sports), which will be ramping up in 2010 and 2011. We estimate the company's contracts position them to secure a ~7% share of global PHEV / EV battery production through mid-decade. Furthermore, if Ener1 can prove production-readiness by executing these early programs well, we believe it will be significantly better positioned to secure contracts with other mainstream automakers.

Our $11 price target is based on a DCF analysis
Valuing Ener1 presents a unique set of challenges given we anticipate exponential industry growth beginning in 2012. We believe DCF is the most appropriate valuation method in this case (see Valuation section for our DCF model, which assumes terminal EBIT margin of 8% and a weighted average cost of capital of 12%). Risks center around revenue trajectory and execution risk. Loss of assumed customers, or poor execution of near-term battery programs could present downside.

Forecasts and ratios

Year End Dec 31	2008A	**2009E**	2010E
FY EPS (USD)	-0.42	**-0.40**	-0.23
DPS (USD)	0.00	**0.00**	0.00
Revenue (USDm)	6.8	**33.5**	156.6

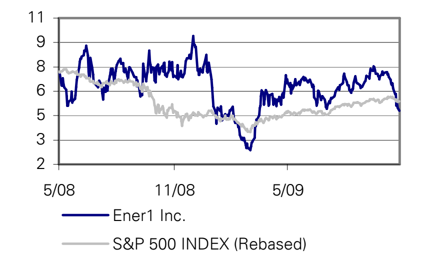
Source: Deutsche Bank estimates, company data

[1] Includes the impact of FAS123R requiring the expensing of stock options.

Buy

Price at 2 Nov 2009 (USD)	**4.80**
Price target	**11.00**
52-week range	**9.40 - 2.38**

Price/price relative

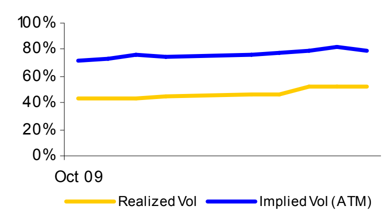


Performance (%)	1m	3m	12m
Absolute	*-30.8*	*-24.8*	*-38.7*
S&P 500 INDEX	*1.7*	*5.6*	*7.7*

Stock & option liquidity data

Market Cap (USDm)	560.2
Shares outstanding (m)	116.7
Free float (%)	100
Volume (2 Nov 2009)	262,620
Option volume (und. shrs., 1M avg.)	31,896

Implied & Realized Volatility (3M)



Model updated:01 November 2009

Running the numbers

North America

United States

Autos & Auto Parts

Ener1 Inc.

Reuters: HEV.OQ Bloomberg: HEV UQ

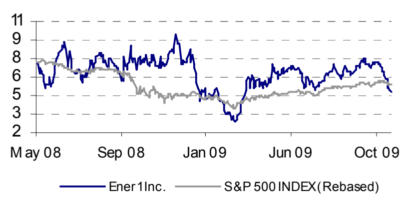
Buy

Price (2 Nov 09)	USD 4.80
Target price	USD 11.00
52-week Range	USD 2.38 - 9.40
Market Cap (m)	USDm 560 EURm 378

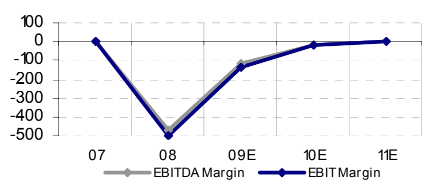
Company Profile

Ener1 engages in developing and manufacturing rechargeable lithium-ion batteries and battery systems in the United States (under Enerdel brand) and South Korea (under Enertech brand). It offers lithium-ion batteries for hybrid, plug-in hybrid, and electric vehicles, as well as for buses, trucks, and other alternative transportation vehicles.

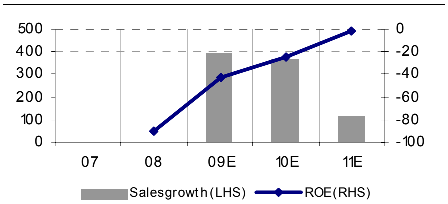
Price Performance



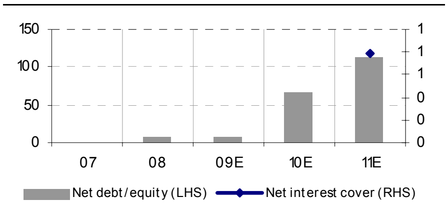
Margin Trends



Growth & Profitability



Solvency



Dan Galves
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Fiscal year end 31-Dec	2007	2008	2009E	2010E	2011E
Financial Summary					
DB EPS (USD)	-0.85	-0.42	-0.40	-0.23	-0.02
Reported EPS (USD)	-0.85	-0.42	-0.40	-0.23	-0.02
DPS (USD)	0.00	0.00	0.00	0.00	0.00
BVPS (USD)	-0.10	1.00	1.00	0.89	0.95
Valuation Metrics					
Price/Sales (x)	nm	107.1	16.7	3.9	1.8
P/E (DB) (x)	nm	nm	nm	nm	nm
P/E (Reported) (x)	nm	nm	nm	nm	nm
P/BV (x)	nm	7.2	4.8	5.4	5.0
FCF yield (%)	na	nm	nm	nm	nm
Dividend yield (%)	na	0.0	0.0	0.0	0.0
EV/Sales	nm	107.8	16.9	4.4	2.2
EV/EBITDA	nm	nm	nm	nm	51.0
EV/EBIT	nm	nm	nm	nm	106.2
Income Statement (USDm)					
Sales	0	7	34	157	342
EBITDA	-21	-32	-40	-27	15
EBIT	-21	-34	-46	-34	7
Pre-tax profit	-52	-43	-47	-44	-4
Net income	**-62**	**-43**	**-47**	**-29**	**-2**
Cash Flow (USDm)					
Cash flow from operations	**-27**	**-28**	**-43**	**-40**	**-9**
Net Capex	-1	-9	-12	-49	-64
Free cash flow	**-27**	**-37**	**-55**	**-89**	**-73**
Equity raised/(bought back)	47	30	65	25	11
Dividends paid	0	0	0	0	0
Net inc/(dec) in borrowings	4	0	14	115	18
Other investing/financing cash flows	0	-10	-12	-4	0
Net cash flow	**25**	**-17**	**12**	**48**	**-44**
Change in working capital	*-4*	*1*	*-5*	*-22*	*-14*
Balance Sheet (USDm)					
Cash and cash equivalents	25	11	24	71	27
Property, plant & equipment	4	40	47	90	146
Goodwill	0	0	0	0	0
Other assets	2	91	87	119	150
Total assets	**31**	**142**	**158**	**280**	**323**
Debt	16	19	31	146	164
Other liabilities	23	20	10	21	38
Total liabilities	**38**	**39**	**41**	**167**	**202**
Total shareholders' equity	**-7**	**103**	**117**	**113**	**122**
Net debt	*-9*	*8*	*7*	*75*	*137*
Key Company Metrics					
Sales growth (%)	nm	nm	389.6	367.1	118.5
DB EPS growth (%)	na	50.6	4.3	43.6	91.4
Payout ratio (%)	nm	nm	nm	nm	nm
EBITDA Margin (%)	nm	-471.6	-118.5	-17.5	4.3
EBIT Margin (%)	nm	-495.1	-137.7	-21.8	2.1
ROE (%)	nm	-89.6	-42.7	-24.9	-2.1
Net debt/equity (%)	nm	7.5	6.4	66.0	112.3
Net interest cover (x)	nm	nm	nm	nm	0.8
DuPont Analysis					
EBIT margin (%)	nm	-495.1	-137.7	-21.8	2.1
x Asset turnover (x)	0.0	0.1	0.2	0.7	1.1
x Financial cost ratio (x)	1.8	1.4	1.1	1.2	-0.3
x Tax and other effects (x)	1.6	0.9	0.9	0.7	1.4
= ROA (post tax) (%)	**-197.9**	**-49.6**	**-31.3**	**-13.1**	**-0.8**
x Financial leverage (x)	-4.5	1.8	1.4	1.9	2.6
= ROE (%)	**881.5**	**-89.6**	**-42.7**	**-24.9**	**-2.1**
annual growth (%)	*na*	*na*	*52.3*	*41.8*	*91.5*
x NTA/share (avg) (x)	-0.1	0.5	0.9	0.9	0.9
= Reported EPS	**-0.85**	**-0.42**	**-0.40**	**-0.23**	**-0.02**
annual growth (%)	*na*	*51.1*	*3.2*	*43.8*	*91.4*

Source: Company data, Deutsche Bank estimates

A combination of Japanese battery and US automotive expertise

We are initiating coverage of Ener1 with a Buy rating and an $11 price target (approx. 130% upside from current levels). Ener1 was formed in 1998 to develop a nanotechnology-based process to improve the production of lithium ion electrodes. With the help of its Japanese strategic partner Itochu Corp., Ener1 was able to hire some of Japan's premier lithium ion cell engineers from companies such as Hitachi Chemical Research Center and Quallion LLC. In 2004, Ener1 purchased the lithium ion battery operations of US auto parts supplier Delphi Corp. This was the genesis of EnerDel, a combination of the battery technology and production skills of Ener1, with the automotive engineering, design, and manufacturing expertise of Delphi. We believe a number of factors distinguish Ener1, and suggest to us that this company has potential to become a key player in the burgeoning market for automotive advanced lithium ion batteries.

- Ener1's technology is highly regarded. Ener1 has received funding support, and very favorable technical reviews from the US Big 3/Department of Energy (DOE) battery research consortium known as USABC, and it is one of only four battery companies to receive contracts from this group (JCI /Saft, A123, and LG Chem's CPI are the others).
- The company has a strong bench of battery and automotive industry talent. Under the leadership of CEO Charles Gassenheimer, Ener1 has developed into a credible competitor in this space. On the battery engineering side, COO Naoki Ota, former Sr Mgr of Technology Marketing for Hitachi Chemical Research Center, and his team, have produced products that many consider to be state of the art. The hiring of Cyrus Ashtiani, former Chairman of the USABC's technical committee, as well as a 12-year senior battery manager at Daimler Chrysler, rounds out a strong engineering team. On the manufacturing side, Richard Stanley was recently hired and appointed as President of Enerdel. The move to bring in Stanley, former President of Remy Inc., a tier 1 auto supplier and significant manufacturer of hybrid motors and transmission components, is a signal that Ener1 is transitioning from technology development to industrial manufacturing. Ulrik Grape, President of Ener1 Europe, has 15 years of business development experience within the lithium ion industry with Ener1 and, previously, Danionics. In addition, Ener1's manufacturing team contains many former Delphi employees, which we consider a strength in terms of familiarity with the standards and processes demanded by automakers.
- Proprietary technology. Ener1 has achieved a large number of advanced lithium ion battery innovations. Perhaps most notable among them is a proprietary lithium nickel manganese cobalt battery that is among the world's most energetic (highest energy density amongst automotive type lithium ion battery systems), while not sacrificing other key features such as safety and life expectancy.
- Ener1 is the only lithium ion battery company with meaningful production capacity in the US. And with recently awarded DOE grant funding, and assuming additional loan funding, we expect the company to achieve 3.4 million kWh of production capacity sometime after mid-decade (depending on supply requirements); enough to build approximately 135,000 EV units (or 1.35 million HEV units) per year—on par with its two major US- based competitors: A123 and Johnson Controls. We expect Ener1 to reach capacity of about 1.7mm kWh by 2014, which should be sufficient to drive revenue of nearly $1.1 billion in that year.
- We believe Ener1's production plans are amongst the world's most capital efficient. The company's $600 million capital spending plan is expected to yield an equivalent amount of capacity as other companies' $800 million capex plans.
- Ener1 will be one of the first to market. While other manufacturers, including Johnson Controls, will ramp up faster in terms of commercializing lithium ion battery packs for HEVs (JCI is currently producing batteries for the HEV versions of the Mercedes S-Class

and BMW 7-Series), Ener1 will be amongst the first to achieve commercial production of EV and PHEV products (note that we expect the EV and PHEV markets to be significantly larger revenue opportunities), given its contracts with Fisker, Think, Volvo, and Japan Post (through Zero Sports), which will be ramping up in 2010 and 2011. In fact, estimate that the company's contracts position them to secure a ~7% share of global PHEV / EV battery production through mid-decade. Furthermore, if Ener1 can prove production-readiness by executing these early programs well, we believe they will be significantly better positioned to secure contracts with other mainstream automakers.

- A DOE loan would serve to further validate Ener1's commercial prospects. Ener1 received a high profile grant for battery production capacity from the US DOE in August 2009 ($119 million was awarded to Ener1, $299 million was awarded to Johnson Controls, and $249 million was awarded to A123). But a more important catalyst could come from the award of a low cost loan (we believe Ener1 could receive a $250-$300 million loan; A123 expects to receive $235 million). We believe loan applicants underwent a far more rigorous due diligence process, including detailed analysis of the applicants' contract opportunities.
- Our estimates are likely conservative. We note, for example, that our Ener1 model only incorporates 7,500 units per year for the Fisker Karma sedan (Fisker's plan projects 15,000 units per year). A full 100% of plan would imply $124 million per year of revenue upside to our model. We have only assumed 7,500 Think vehicles per year. The company's 10,000 unit per year plan would imply over $42 million of upside to our model. We would also note that "not yet awarded" contracts only account for 20% of our revenue estimates for the 2012-2014 timeframe. Given the typical 2-3 year lead time for contracts in the auto industry, we believe additional contract wins are likely prior to this period. In fact, we can already identify several contract opportunities that would more than account for this plug in our model, including Fisker's high-volume sedan program, additional sales of the Think drivetrain, higher-than-expected volume with Volvo, or one of several other relatively large EV/PHEV contracts that are currently out for bid.
- Additional contract awards could also serve as catalysts. We believe Ener1 is currently bidding on several very large (multiple hundred million dollar revenue per year) contracts from mainstream mass market automakers. While it is difficult to gauge the likelihood of winning any of these, additional contracts would support the bull case for Ener1's stock.

Valuation

Our price target is based on a DCF analysis. Valuing Ener1 presents a unique set of challenges, given industry revenue won't accelerate until 2012 and beyond. We believe that DCF is the most appropriate valuation method in this case. We assume 8% terminal growth beginning in 2020 (given our projection that only 20% of global sales will be electrified in 2020, we believe that an 8% growth rate is reasonable). We assume a terminal EBIT margin of 8.0% and a weighted average cost of capital of 12.0%.

Risks

As noted above, we believe that our assessment of Ener1's revenue/earnings prospects are reasonably conservative. Nonetheless, we acknowledge that it is not yet possible to model the company's growth trajectory with precision—particularly in the 2012+ timeframe, which is most critical to Ener1's valuation. Additional risks include the potential for margin pressure associated with the significant price deflation that we anticipate in the battery market. We address this concern in the pricing section of this report.

Advanced lithium ion battery background

Of all metals available for battery chemistry, the battery industry has long considered chemistries based on lithium to be the most promising. Lithium is widely available, it is not toxic, it is the lightest metal on the periodic table, it has a high specific energy content, and it possesses other desirable electrochemical properties. For these reasons, the majority of portable electronic products (mobile phones, laptops, portable medical devices, cordless drills) have rapidly shifted to lithium ion batteries.

Figure 75: Comparison of battery families: Energy Density and Cost

Battery energy density and cost comparison

Energy Density	Cost	Charge Cycles
Lead Acid 30-40 wh/kg*	$/kWH 210	500-1000
NiCd 40+*	$/kWh 280	1000-2000
NiMH 71 WH/kg*	$/kWh 840	1000-2000
Li Ion 105-170 wh/kg**	$/kWh 650	2500+

Source:
*M. Keller and P. Birke, Continental Powertrain
**Deutsche Bank

Source: Continental Powertrain and Deutsche Bank

But traditional lithium ion batteries face challenges in more advanced applications

Although many batteries are generically referred to as lithium ion batteries, there is no generic standard. Consumer electronics batteries (i.e. laptops, cell phones) generally use Lithium Cobalt Oxide cathodes. These batteries are excellent for short lived (i.e. 2-3 year) applications, in which a significant amount of energy must be released over an extended period of time. But there are constraints in applying consumer electronics type batteries for higher end applications such as for Automobiles. These constraints include issues related to performance, safety, durability, and cost:

- Performance-Although consumer lithium ion batteries can store significant amounts of energy (kWh), they are not inherently powerful (it is difficult to release this energy quickly) because lithium is not inherently conductive. The consumer electronics battery industry has overcome the conductivity problem by adjusting the chemistry of these batteries through the addition of other materials (typically cobalt). This has made them practical for certain uses. But power still needs to be limited (or more batteries with sophisticated and expensive controls need to be added for high power applications) in order to ensure safety. Typically, more power is needed in advanced applications, such as accelerating an automobile. Moreover, most lithium ion cells have difficulty operating at very low/very high temperatures.
- Safety—Overcharging, charging in extremely cold weather, short circuits, and other abuse conditions could destroy the battery and potentially cause "thermal runaway", and fire (batteries contain combustible materials such as lithium, electrolyte solvents, and other gases).
- Durability—All batteries degrade over time. In conventional consumer lithium ion batteries, performance degrades by approximately 20% after 600-700charges (i.e. 2 years of cell phone charge and discharge cycling). Given the cost of large format batteries such as those required for automobiles, much greater durability is required: 300,000 charge/discharge cycles for HEVs, 2,500+ cycles for EVs, and 10+ year calendar lives are considered pre-requisites. Most automakers design extra margin into batteries in order to ensure that they still meet minimum performance levels after degradation

(GM's 16 kWh battery for the Volt only requires 8 kWh's of capacity). But this adds considerably to battery size, weight and cost.

- Cost—The U.S. Advanced Battery Consortium (USABC), a partially DOE funded consortium of U.S. Automakers involved in funding battery research, has established a price target of $500/system for HEV batteries, and $1,700-$3,400 for 10-mile and 40-mile PHEV batteries. Today's batteries systems are still far from achieving these goals.

Ener1's technology addresses these deficiencies…

Automakers, battery companies, and government/private sector research groups have been working on advanced batteries for automotive propulsion for nearly two decades. And these initiatives have accelerated over the past 5 years, as a result of an increased focus on fuel economy/CO2 reduction targets. While the industry's goals (i.e. goals established by the USABC) have not all been met, significant progress has been made in terms of durability, safety, power, energy density, and cost as a result of breakthroughs in battery chemistry and battery management. And there is a widely held expectation that battery technology will continue to improve at a rapid rate.

The batteries that will be used in the next generation of hybrid, plug-in hybrid, and electric vehicles are generically known as "Advanced Lithium Ion Batteries". As of today, industry participants in the Advanced Lithium Ion Battery industry group them into 4 broad categories, based on the formulation contained in the cathode: 1) NCA, or Nickel Cobalt Aluminum; 2) NMC, or Nickel Manganese Cobalt; 3) LMO, or Manganese Spinel, and; 4)LFP, or Iron Phosphate.

Ener1 tailors the design of its batteries to specific applications and therefore uses two different cathode materials: Manganese Spinel (LMO) for HEV applications and Nickel Manganese Cobalt (NMC) for EV applications. Most of Ener1's visible business is focused on PHEV's / EV's, which will use its NMC battery.

Figure 76: Lithium Ion Cathode Types – Advantages and Disadvantages

Chemistry	Wh/Kg	Positives	Negatives	Makers
Nickel / Cobalt / Alum (NCA)	160	Energy density Power	Safety Cost / commodity exposure Life Expectancy Range of Charge	JCI/Saft PEVE AESC
Manganese Spinel (LMO)	150	Cost Safety Power	Life Expectancy Usable energy	Hitachi, AESC, Sanyo GS Yuasa, LG Chem Samsung, Toshiba Ener1, SK Corp, Altairnano
Nickel Manganese Cobalt (NMC)	150	Energy density Range of Charge	Safety (better than NCA) Cost / commodity exposure	PEVE, Hitachi, Sanyo LG Chem, Samsung Ener1, Evonik, GS Yuasa
Lithium Iron Phosphate (LFP)	140	Safety Life Expectancy Range of Charge Material Cost	Low temp performance Processing costs	A123, BYD GS Yuasa, JCI/Saft Valence, Lishen

Source: AABC, DOE Merit Review

…through the innovative use of Anode materials

NMC's high charge density and voltage makes it very advantageous for high-energy applications like EV's. However, NMC is known to be relatively less stable (safety and and life expectancy testing has been somewhat inconclusive) and it also has a higher raw material cost than other chemistries). Ener1 has been successful in addressing several of these issues through the creative use of anode materials.

Nearly all of the automotive advanced lithium ion batteries that we've researched use a graphite anode because of graphite's high energy characteristics. Ener1 uses a hard carbon anode. For reasons discussed below, this substance improves safety and life expectancy significantly. Its key deficiency is that it is less energetic than graphite. One of Ener1's focuses has been to develop ways to combine its energetic cathode with safe anode materials, while maximizing the beneficial properties of each.

Safety: Besides NCA, the NMC cathode is the least stable thermally. The process that can result in fires in lithium-ion batteries is called Thermal Runaway, and NCA and NMC batteries are generally thought of as most susceptible. The process starts as the battery's internal temperature rises. Heat causes the negative electrode to react with the solvent, generating more heat, and causing a further increase in internal temperature. This leads to a chain reaction that eventually results in a reaction in the positive electrode that causes an internal short circuit and potentially a fire.

Since this reaction often begins in the negative electrode, Ener1's strategy has been to apply corrective measures on that side. They do this through the use of Hard Carbon, which is much less reactive than graphite due to its sponge-like structure and less pronounced SEI layer (the SEI layer is a coating that forms on the electrodes that plays a significant role in all lithium ion batteries). We've witnessed severe abuse tests on Ener1 batteries that have not resulted in fires or any reaction at all.

Life expectancy: Graphite experiences significant volumetric changes due to temperature and other variables (think of wood expanding and contracting due to temperature changes). This process leads to material degradation and reduced life. Hard Carbon is less crystalline, which makes it less susceptible to volumetric changes and thus leads to better life expectancy.

Cost: The strong safety performance of Ener1's battery leads to lower safety-management costs that at least offset the higher raw material cost of NMC. Due to improved safety and stability, Ener1 can air-cool their battery, in contrast to many other batteries which require an expensive cooling system. NMC and NCA are the highest-cost cathodes in terms of commodity cost (each are in the $20 / kWh range, compared to about $7 for LMO and $3 for LFP). While cathode commodity cost is currently a relatively minor issue (approximately 4% of total COGS), this could become a more significant disadvantage over time, as overall per unit cost comes down and the cost of cobalt potentially rises as this industry grows. However, we do believe that strong safety characteristics lead to cost-savings in other areas which provides a significant offset.

Ener1 is positioned well with early-entrant EV producers; near-term production provides opportunity to prove execution capabilities

We believe that the extensive manufacturing experience of Ener1 executives, and government-supported capacity plans position Ener1 to be a strong competitor in this industry. Furthermore, if Ener1 can prove production-readiness by executing early programs well, we believe they will be in a significantly better position to secure contracts with mainstream automakers.

We fully believe that Ener1's near-term programs will be successful. The Think City Electric vehicle will launch in late 2009, and the Fisker Karma will launch in 2H 2010. The company has already produced 100+ Think packs and were actually prepared to go into mass production nearly a year ago, prior to Think running into financial difficulties that delayed production for a year. The packs that were produced have gone through thousands of kilometers of real-world testing and are achieving two of the critical program requirements -- 100+ wh/kg and 100+ miles of range. Furthermore, the production delay has enabled Ener1 to further refine its manufacturing process.

Manufacturing process knowledge

We believe manufacturing experience will be one of the key differentiators in this industry, especially in the early stages, and particularly for energy batteries. There are many companies that can produce small experimental cells that have performance specs that, when extrapolated, can meet the life, cost, and safety performance required for an automobile. But scaling that cell up by 15-20x, and manufacturing it consistently, and in prismatic (flat as opposed to cylindrical) form is a major challenge. Manufacturing of large-format cells is much different than consumer cells, partly because the electrode material must be spread across a base foil with absolute precision in terms of consistency and uniformity. The fact that the foil is so much wider for a large-format battery makes this process much more difficult than for consumer cells. We believe that Ener1 fully understands this challenge and has a process in place to meet it (they've had a production line in place to supply Think for over a year now). Additionally, we believe the relatively slow ramp (Think in late 2009, Fisker in late 2010, Think NA in 2011, Volvo in 2012) will enable the company to improve its process.

We believe that Ener1 has assembled a very strong manufacturing team that can meet this challenge. Their acquisition of Enertech in Korea should not be underestimated. Enertech has significant experience in mass-producing lithium ion electrodes, as it is a supplier for large lithium-ion battery producers Samsung and LG Chem, as well as Li-Tec, the joint venture between Evonik and Daimler. Additionally, this company has produced large-format cells for grid storage applications and prototype automotive batteries over 10-years.

We also believe that automotive supply experience is a plus for Ener1, considering that much of their U.S. manufacturing team is composed of engineers from Delphi and other automotive suppliers.. Automotive suppliers must meet extremely rigorous quality standards. We believe that familiarity with the supplier qualification process, as well as familiarity with the automotive development process is important, particularly to the automakers.

Analysis of Revenue outlook / customer relationships

Ener1's current revenue is made up almost exclusively of revenue generated by Enertech, the Korean consumer battery-maker it acquired in late 2008. But this revenue, along with potentially significant revenue from grid storage applications, is likely to soon be dwarfed by automotive. In fact, in 2010 Ener1 is likely to be among the largest revenue generators in the automotive lithium-ion industry, because it is the supplier for two of the earliest EV entrants, Think and Fisker.

Automotive

As detailed in our November 2009 FITT report, we expect dramatic growth in the Automotive market for Advanced Lithium Ion batteries, as a result of several factors:

- We believe that government regulations/standards in the 2020 timeframe (in Europe, North America, and Japan) are unlikely to be achievable without significantly increased penetration of electric drive.
- We believe that China, which is rapidly becoming a venerable market force in the Global Auto Industry, is likely to adopt policies aimed at raising penetration rates for "Alternative Energy Vehicles", primarily consisting of PHEV's and EV's.
- We expect increasingly compelling financial incentives/penalties from governments—feebates, tax breaks, and congestion charges will become increasingly prevalent, providing an economic incentive for consumers to shift away from less efficient modes of transportation.
- Significant advances in battery technology/performance are likely to continue: Industry experts project a doubling of Advanced Lithium Ion battery performance over the next 7-years.
- We expect a steep cost reduction curve for batteries (50% decline over 10-years), and electric drive components.
- Deutsche Bank's Integrated Oil Research Team sees potential for oil prices to rise dramatically—including potential for a brief spike to $175 per barrel—given limited excess supply, rising demand, and chronic underinvestment in new oil production capacity. We see the convergence of alternative propulsion technology, combined with rising oil prices, as a major catalyst for consumer and government behavior.
- A very large market opportunity appears to be developing through the emergence of new business models based on the cost advantage of electricity versus gasoline driving. Combined with government incentives already in place, these business models have the potential to dramatically lower the entry price for electric vehicles—potentially making them cheaper to purchase and operate.
- Several new U.S., European, and Chinese ventures have been formed to challenge established automakers in the EV arena, where they believe that they can offer competitive and/or superior products. Several appear to be well capitalized, have experienced management (product development, procurement, and manufacturing experts that have come from other automakers), and credible plans to achieve commercial scale.
- We also believe that increased societal concern regarding environmental/climate risks can and will affect purchase decisions.

Automakers have begun to respond to these trends, and a barrage of hybrid, plug-in hybrid, and fully electric vehicles have been revealed. Based on our analysis of automakers' product disclosures, and discussions with global suppliers, we estimate that the world's Automakers will introduce at least 120 hybrid, plug-in hybrid, and electric vehicle models onto the market by 2012, compared with 29 (mostly hybrid) electrified vehicles on the market today. IHS

Global Insight estimates that the number of models will rise to at least 150 by 2014 and that at least 200 models will be available by 2019.

Based on our market by market forecast, which we detail in our November 2009 FITT Report, we project that the global automotive market for lithium ion batteries can grow to $66 billion by 2020, from virtually nothing today (<$50 million). This forecast is in-line with other projections, including a $74 billion projection by industry consultant A.T. Kearney. We would note that this projection only requires 20%-25% penetration of hybrids, plug-in hybrids, and fully electric vehicles in the developed markets, and it incorporates a ~50% price decrease for batteries through 2020.

Figure 77: Diagram of battery-maker / automaker relationships (HEV: Hybrid / PHEV: Plug-in Hybrid / BEV: Pure electric vehicle (no internal combustion engine)). Arrows denote Joint Venture investment.

Battery-maker		Joint Venture		OEM	Veh Type
Panasonic	→	PEVE	←	Toyota	HEV / PHEV
				Subaru	HEV
Sanyo				Ford	HEV
				Toyota	HEV / PHEV
				VW / Audi	HEV
A123				BMW	HEV
				Chrysler	BEV
				Daimler	HEV / Buses
				GM	???
				Magna / Volvo	Buses
				SAIC	BEV / HEV
GS Yuasa	→	Blue Energy	←	Honda	HEV
	→	Lithium Energy Japan	←	Mitsubishi	BEV
Hitachi	→	Hitachi Veh Energy		Isuzu	HEV
Shinkobe / Maxell	→			GM	HEV
LG Chem				GM	PHEV
				Hyundai / Kia	HEV / PHEV
NEC / NEC Tokin	→	AESC	←	Nissan	HEV / PHEV / BEV
				Renault	HEV / PHEV / BEV
				Subaru	BEV
Ener1				Think Global	BEV
				Volvo	PHEV / BEV
				Fisker	PHEV
				AC Transit	BEV
				Zero Sport / Japan Post	BEV
Evonik	→	Li-Tec	←	Daimler	HEV / BEV
JCI	→	JCI / SAFT		Azure Dynamics	HEV
				BMW	HEV
				Daimler	HEV
				Ford	PHEV
Saft	→			Jaguar / Land Rover	HEV
				Volkswagen	PHEV
Samsung SDI	→	SB LiMotive		PSA	HEV
				BMW	EV
Bosch	→			Ford	HEV / BEV
Toshiba				VW	BEV
BYD				BYD	PHEV / BEV

Source: Deutsche Bank, Company filings

Ener1 appears to have a strong position within the PHEV / EV space

Within the automotive space, Ener1 is focusing its efforts on the PHEV / EV market. We believe this is due to several reasons:

1) Their energy battery (suited for EV / PHEV applications) is production-ready and has performed well during thousands of kilometers of road-testing in Think test vehicles.

2) The cells and electronics used in the Think pack can be modified to power many different vehicle designs (including the Fisker and Volvo vehicles), leading to low development costs. Multiple hybrid programs would lead to significantly higher R&D costs, especially compared to the revenue that hybrid batteries generate (~$2,000 per vehicle, compared to $8k - $18k for a PHEV / EV battery).

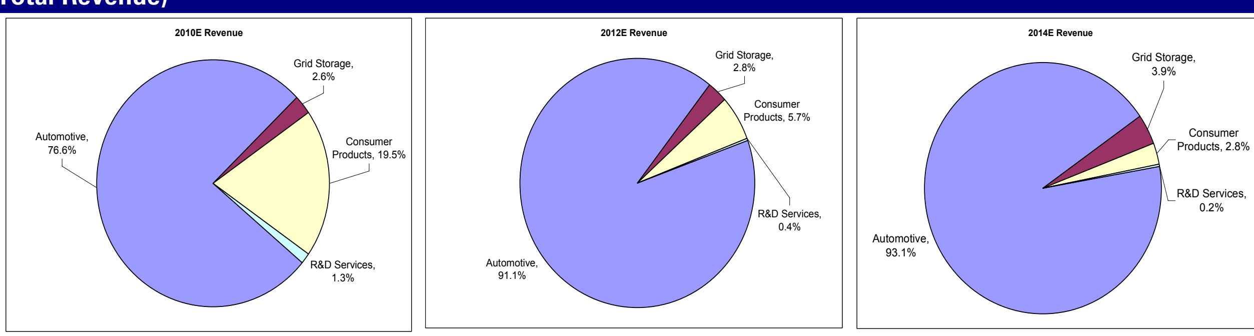
3) The PHEV / EV market is expected to drive the vast majority of the revenue in this industry. Of AT Kearney's $74billion estimate for lithium-ion battery revenue in 2020, 42% was for EV's, 45% was for PHEV's, and only 13% was for HEV's.

Figure 78: Revenue by business type ($ Millions)

	2009E	2010E	2011E	2012E	2013E	2014E
Automotive	2	120	302	487	884	1,012
Grid Storage	-	4	8	15	24	43
Consumer Products	30	31	31	31	31	31
R&D Services	1	2	2	2	2	2
Total Revenue	34	157	342	535	940	1,087

Source: Deutsche Bank

Figure 79: Automotive expected to drive the vast majority of revenue over time (Figure displays business type as % of Total Revenue)



Source: Deutsche Bank

DOE evaluation process reinforces our revenue estimates

Ener1 was recently awarded a $119 million grant from the U.S. Dept of Energy as part of the government's program to stimulate manufacturing of advanced technology vehicles in the U.S.. We also expect them to receive a $250million-$300million loan from the DOE. As part of the DOE's due diligence process, the company provided the DOE with details on what they saw as their bull case for Automotive battery revenue in 2012, 2013, and 2014. Those revenue projections were $1.4 billion, $2.1 billion, and $2.6 billion (note that these included a significant amount of revenue from contracts that have not yet been awarded). The company's base case still represented a very compelling growth trajectory : $596 million, $1.09 billion, and $1.15 billion in 2012, 2013, and 2014, respectively.

The DOE hired a consultant to validate these numbers by engaging in discussions with automakers, and forming their own opinions of the demand outlook for Ener1's batteries. Given Ener1's successful grant application, we believe it is likely that the DOE consultants broadly agreed with Ener1's base case revenues.

Figure 80: Revenue estimates – Ener1 Base / Bull Case and DB estimates ($million)

	2010E	2011E	2012E	2013E	2014E
Ener1 - Base Case - Auto Only	184	369	596	1,090	1,150
Ener1 - Bull Case - Auto Only	184	667	1,405	2,056	2,621
DB Estimate - Auto Only	120	302	487	884	1,012
DB Estimate - Total Revenue	157	342	535	940	1,087

Source: Company Filings, Deutsche Bank

We believe that the $1billion+ difference between Ener1's base / bull case is primarily 2 large OEM contracts for which Ener1 is competing. We believe the likelihood is no better than 50/50 for either program, but either one would add revenue in the hundreds of millions to our out-year estimates.

We've conducted our own bottom-up analysis based on our knowledge of OEM volume plans. As illustrated above, we project 2012 / 2013 / 2014 automotive revenue of $487 million / $884 million, and $1,012 million. We have been conservative in our analysis, which has resulted in significantly lower revenue numbers than Ener1's base case.

When we include our projections for Ener1's non-auto opportunities, we arrive at total revenue forecasts for 2012 / 2013 / 2014 of $535 million / $940 million / $1,087 million.

Ener1's revenue trajectory also appears to be reasonable when plotted against the industry volumes that we're expecting. As shown in figure 81, we estimate that Ener1 can potentially attain 6%-7% of the market for Automotive Lithium Ion batteries. Our revenue projections for 2012 / 2013 / 2014 incorporate 35k / 69k / 85k EV batteries.

Figure 81: Volume and Market share implied by DB's estimates of Ener1 automotive revenue

	2010E	2011E	2012E	2013E	2014E
Vehicle Units implied by Ener1 rev fcst					
Lt Duty EV's / PHEV's	7,501	20,268	35,208	68,672	84,572
Price per unit ($) (assume 7% annual decline in price / cost)					
Lt Duty EV's / PHEV's	16,000	14,880	13,838	12,870	11,969
Revenue ($MM)					
Lt Duty EV's / PHEV's	120	302	487	884	1,012
Ener1 Share of Global Auto Market for:					
Lt Duty EV's / PHEV's	7.3%	10.8%	6.5%	6.8%	6.3%

Source: Deutsche Bank

Modeling Ener1's revenue trajectory presents a number of challenges, given the nascent state of the Automotive Lithium Ion Battery market, given the fact that industry revenue won't accelerate until 2012 and beyond, and given the fact that Automakers typically award production contracts to suppliers 3-years in advance. Nonetheless, we are convinced that the industry is poised for dramatic growth, and we see Ener1 as well positioned within this market.

Revenue by customer

Figures 82 and 83 illustrate our volume and revenue estimates by customer for Ener1.

Figure 82: Battery volume estimates by customer

	2010	2011	2012	2013	2014
Th!nk Global	5,000	5,250	7,500	7,500	7,500
Th!nk NA	200	1,400	6,400	13,560	17,000
Fisker	1,500	6,400	7,000	7,500	7,500
Volvo	100	1,100	2,000	25,000	32,500
Japan Post	200	2,000	2,000	2,000	1,800
Other	26	4,720	11,250	15,900	16,650
Total Volume	7,026	20,870	36,150	71,460	82,950
Revenue / Battery	17,083	14,451	13,478	12,368	12,203

Source: Deutsche Bank

Figure 83: Revenue estimates by customer ($ millions)

	2010	2011	2012	2013	2014
Th!nk Global	85.0	89.3	105.0	105.0	105.0
Th!nk NA	3.4	23.8	89.6	189.8	238.0
Fisker	24.8	105.6	107.8	107.3	107.3
Volvo	1.8	17.1	24.1	272.5	336.8
Japan Post	3.4	34.0	28.0	28.0	25.2
Other	1.7	31.8	132.7	181.2	200.0
Total	120.0	301.6	487.2	883.8	1,012.2
Other as % of Total	1.4%	10.6%	27.2%	20.5%	19.8%

Source: Deutsche Bank

Think Automotive could provide growth above and beyond sales of the City vehicle itself

We believe that Ener1's partnership with Think Global is important for several reasons, including the fact that it can help Ener1 prove its technology and production readiness. We also believe that Think's growth strategy could present Ener1 with additional opportunities:

- Think City production in Europe: As the first pure electric vehicle to receive pan-European safety approval, with a relatively affordable ~$35k price tag (before gov't subsidies), and with substantial pre-orders from various European governments, we believe this vehicle can meet its 10,000 unit per year sales target (note that many countries in Europe offer massive incentives to promote pure EVs; For example, Denmark exempts EV's from VAT taxes ranging from 150-180%).
- Think City production in NA: Think has applied for a DOE loan to build a plant in the U.S. to produce the Think City. Volume estimates for this project are approximately 20k-30k units per year.
- Private label sales of Think drivetrains: Ener1 and Think recently signed a contract with Japan's Zero Sports, the company tapped by Japan Post to convert a quarter of its 22,000 vehicle fleet to EVs. The drivetrain used for the conversion will be an off-the-shelf Think City drivetrain. Think believes that their modular drivetrain can be sold as a turnkey solution to other automakers who prefer to purchase a fully-functional drivetrain (rather than design one themselves) or to vehicle conversion companies, similar to Zero Sports.

Think Global, a Norwegian company, has been designing electrified vehicles since 1991, and was owned by Ford from 1999-2003. Ford invested $150million to design a next-generation City model (the vehicle that is now set for production), but divested the company in 2003 when California's zero-emission requirements were delayed. The company appeared to be in hibernation until 2006, at which point it was sold for $15million to a group of Norwegian entrepreneurs who raised $78million in venture capital and continued the development process for an all-electric Think City, powered by a lithium-ion battery. In late 2008, only a few months before production was set to begin, Think filed for bankruptcy. After almost a year in court, a recapitalized Think emerged from bankruptcy, and it is now set to begin production in late 2009.

Figure 84: Think City – 100-mile range pure Electric Vehicle. Pricing expected in the mid-30k range before incentives / subsidies. Price is essentially half for the vehicle and half for the battery

Source: Ener1

Ener1 was involved in arranging the exit financing for the company. At emergence, Ener1 invested $8 million and it now owns 20.6% of the shares (24.1% including warrants). As part of the emergence plan, Ener1 is likely to invest an additional $10 million by 1Q10. At that point, it will own 29% of the company (32% including warrants) and have 37% voting power. Think will be accounted for as an unconsolidated subsidiary. We believe that the company will have a low breakeven point and any initial losses accruing to Ener1 will be non-cash and in the single-digit millions.

Think Europe

The Think City vehicle itself will be produced in Finland by Valmet, a contract assembler that also produces the Porsche Boxster and Cayman. It will be powered by a 26 kWh battery from Ener1 and it will have a 100 mile all-electric driving range. We believe the transaction price on the battery will be ~$17k ($650 / kWh) and that the vehicle will be priced to the consumer at around $35k before government subsidies. The vehicle is the first electric vehicle to receive Pan-European approval as "highway-safe", which allows the vehicle to be sold in all European countries.

Think is targeting production of 10k units per year. We are forecasting 7,500 per year, and an initial transaction price on the battery of $17,000. We believe that there is a plan to reduce the kWh's of the battery to 21 in the 2012 time-frame, which would likely reduce the transaction price on the battery to ~$14,000.

Think North America
The plan to produce Think vehicles in the U.S. is likely contingent on receipt of a DOE loan, which is currently in the DOE evaluation stage.

A Think vehicle plant would likely not require significant amounts of capital, as Think employs a modular assembly plan, essentially assembling a drivetrain (produced and designed by Think), a steel chassis shipped preassembled from Thailand, an aluminum frame produced in Denmark, and plastic body panels produced in Turkey. Due to the lean production technique, the company expects to breakeven at 5,000 units per year, with actual U.S. production expected to be in the 20k-30k unit range.

We are forecasting production of 6,000 vehicles in 2012, ramping up to 17,000 in 2014.

Think drivetrain sales (Japan Post)
The Think drivetrain will be sold to Zero Sports and used in that company's conversion of Japanese postal vehicles from internal combustion to electric. The contract is for approximately 8,000 drivetrains over a 4-year period beginning late in 2010. Short-range, stop-and-go driving is an optimal application for electrification, and we believe that many local-delivery type fleets are investigating the potential for vehicle conversions / retro-fits. A fully-functional, off-the-shelf drivetrain module is compelling for a conversion company (JCI is supplying a similar system to Azure Dynamics, which is UPS and Fedex's conversion provider). Additionally, this contract provides an opportunity for both Ener1 and Think to prove themselves in a real-world application in Asia. These types of private label sales are critical to building scale beyond the Think vehicle itself (which likely has limited volume upside), with essentially no incremental R&D / Engineering expense associated with filling the contract.

Fisker Automotive

Fisker is a start-up automaker, led by renowned auto designer Henrik Fisker. Their first vehicle, the Fisker Karma, will start production in 2H 2010, and will be produced by auto assembler Valmet, in Finland (at the same facility as Think). The Karma will be a PHEV, priced in the $85k range, before subsidies. The company recently received a $528 million DOE loan to assist in both completing development of the Karma and to partially fund a U.S. plant to produce several lower-priced PHEV models (<$40k) beginning in 2012. Production target for the Karma is 15k per year. The production target for the group of lower-priced vehicles is 75,000-100,000 vehicles per year.

Ener1 has a Letter of Intent to produce batteries for the Fisker Karma. This is expected to be a 22 kWh battery, priced at approximately $16.5k per unit at the start of the program (we estimate a reduction to ~$14k by 2014). Although the Karma is a stunning vehicle that has won several prestigious awards, we have conservatively assumed that the high price point results in volume of approximately 7,500 per year. Although we would expect Ener1 to be a strong candidate for the battery supply contract for the lower-priced vehicles, this contract has not been awarded as of yet, and we are not explicitly including any revenue in our forecast from these vehicles.

While we believe it will be very challenging for a start-up automaker to gain traction in the market, we consider Fisker a legitimate company with significant automotive experience and a strong, low-cost business model. We believe the DOE loan awarded to Fisker provides an additional level of validation to the company, and that this increases Fisker's chances of achieving commercial milestones.

Figure 85: Fisker Karma – Production to begin in mid-2010

Source: Ener1

Volvo contract could be high-profile / high-volume

Volvo appears to be one of the more aggressive automakers in terms of electrification, indicating that its portfolio will include several electric models in the near-term. Ener1 is the battery supplier for prototype versions of the C30 pure electric vehicle (production expected to begin in 2012) and the V70 PHEV (production expected to begin in 2013). While Ener1 does not hold production supply contracts yet (a production contract this far in advance would be unusual), we believe that it is highly likely that Ener1 will be the supplier on at least one of these vehicles. The September 2009 announcement of the C30 collaboration supported that belief, for two reasons:

1) The unveiling of a 2nd vehicle, particularly as Volvo is being marketed for sale by Ford, is a strong sign that development work continues on Volvo's electrification plans.

2) Most importantly, the announcement of Ener1's involvement in the C30 development program was a strong indication that Volvo was satisfied with the company's V70 batteries, which were delivered back in February 2009.

Regarding volumes, overall C30 volume peaked at 40k units per year in 2007 (about 9% of Volvo's 460k unit volume in that year). The S70 / V70 (sedan / wagon) is Volvo's high-volume vehicle and represents approximately 25% of the company's volume. We believe that volume projections for this product imply that Volvo expects, by the 2015 / 2016 period, that the electrified versions of these vehicles could be a standard feature, rather than a low – penetration version of the ICE vehicle. We forecast 25k units in 2013 and 32.5k units in 2014.

With respect to a prospective sale of Volvo by Ford, we don't see this as a big risk to Volvo's ongoing electrification program. Volvo has a world-class product development program, having developed some of Ford's most successful vehicle platforms. We believe that the ultimate buyer (if Ford in fact sells the company) will see Volvo engineering as one of the core assets and will continue to support the company's development programs.

Other Programs

As can be seen in Figure 83, ~20% of our 2012-2014 revenue estimates rely on contracts that are not yet identified. We believe that Ener1 is competing for two very high-volume programs that would more than close this gap (each of these programs would bring expected annual volume of 50k-100k units). There are also many other programs still in play for the 2012-2014 time-frame, including Fisker's high-volume sedan program, as well as the potential for additional sales of the Think drivetrain and/or higher-than-expected volume at Volvo

Grid applications expected to bring significant Lithium-Ion revenue over the medium-term

There are two main areas in which lithium-ion batteries can add value to the electrical generation / distribution business:

1) Bulk Energy storage: In these types of applications, energy is stored in a lithium-ion battery for future use. This is particularly useful where the generation source is unpredictable, or tends to be strongest during periods of low demand (i.e. such as wind or solar). Although this market is potentially very large, there are competing technologies (such as Sodium Sulfur batteries) which are competitive with Lithium-Ion in terms of performance, but at a price per kWh that is currently lower.

2) Ancillary Services: Utilities need to generate a steady supply of energy based on demand, but commonly experience brief rises and declines in supply or demand. Most utilities currently manage this variability by keeping up to 7% of their generation capacity off-line, and spooling this excess capacity up or down as necessary. Large arrays of lithium-ion batteries called Ancillary Power Units can also be used for this purpose. As the grid experiences a spike, the APU delivers power into the system (happens in milliseconds). Using a battery to level out these fluctuations enables the power producer to operate power plants at a relatively steady, optimally efficient level (i.e. the power plant operates like a hybrid, with the battery supplementing the combustion system as needed). Adding an APU also allows a utility to add capacity (reserve capacity is not needed) without having to add generation assets, and often without any permitting. We believe that as wind and solar become more prevalent power sources, electricity supply will become somewhat more volatile, and the value of APU's will be further enhanced.

Although Ener1 has no current revenue from grid storage, we believe that the company is focused on this revenue opportunity and that its core energy battery is well-suited to these applications. Ener1 has 3 applications in under the DOE's Funding Opportunity Announcement 36. This FOA falls under the ARRA's (stimulus bill) $4.5billion allocation of funds for smart-grid demonstration projects, one section of which is specifically directed to utility-scale energy storage demonstrations.

In addition to the DOE opportunity, Ener1's other near-term opportunity is to provide Ancillary Power Units for its strategic partner (and shareholder), Itochu, a large Japanese trading house that manages 130 megawatt's of solar power generation facilities in the U.S. Itochu currently keeps capacity off-line to meet peaks in demand. Assuming that Itochu keeps 10% of capacity off-line to handle peaks in demand or troughs in supply, this could be a 13 MW ($26 million at $2 million per MW) opportunity. Although this is a relatively small number, it would provide Ener1 with an opportunity to demonstrate their capabilities in this field. In terms of the overall electrical grid storage market, we've seen estimates for this market as high as $100billion in annual revenue by 2020.

ENERTECH CONSUMER BATTERY VOLUME EXPECTED TO REMAIN STABLE

The bulk of Ener1's current revenue comes from its Enertech subsidiary in South Korea, a lithium-ion battery-maker that Ener1 acquired in 4Q09. From 2006 – 2008, Enertech generated revenue in the low $40 million range annually. Due to the weakening of the Korean Won and weakening demand for consumer products, 2009 revenue is expected to be approximately $32 million. Enertech's business is focused on mature consumer battery markets, and we are forecasting flat revenue (in the low $30million range) through our forecast period.

Enertech's core business is selling fully-assembled batteries into the consumer electronics market. In periods of high demand, they have also been a supplier of raw electrodes to LG Chem and Samsung when those companies experience tight capacity. The loss of that "overflow" business is the primary reason (besides currency) for the recent revenue decline.

Ener1 bought this business (for stock) for the company's electrode coating capacity and its manufacturing expertise. As we will discuss below in the Capacity section, one of the positives that we see in this industry is the ability to add capacity in small increments, so as to avoid underutilization. Having the use of Enertech's facility should further enhance Ener1's ability to cautiously add capacity, as Enertech can handle overflow demand.

Pricing and Cost outlook

We believe that Ener1 has a clear path to mid-teen EBITDA margins by 2013 / 2014, on conservative volume expectations and despite relatively steep expected price declines. At ~$1billion of revenue we believe the company can achieve 25% gross margins and 14.5% EBITDA margins. We believe that a lean operating expense structure will result in Ener1's EBITDA margin outperforming AONE's by 150bp's – 200bp's on lower revenue. Our expectation for strong operating leverage is based on the fact that most Ener1 battery programs are expected to be based on the core Think cell, and thus require low levels of additional engineering. AONE's broad mix of products, while favorable from a diversification perspective, leads to relatively high engineering expense.

We expect that Ener1's EBITDA will turn positive at approximately $300million of revenue (the equivalent of approximately 17.5k EV packs), and that its gross margins can reach 20%+ slightly after this point ($350million / 20k packs), both occurring in the 2011 time-frame. This scenario is based on current battery pricing (approximately $650 / kWh), and our belief that at 20k units of volume, Ener1's COGS per unit will be approximately $525 / kWh.

Figure 86: Estimated Ener1 margins at-a-glance

	2009E	2010E	2011E	2012E	2013E	2014E
Gross Margin	14.3%	16.6%	21.8%	23.7%	24.4%	25.0%
SG&A	-52.7%	-15.3%	-9.1%	-8.9%	-7.9%	-7.7%
R&D	-99.3%	-23.1%	-10.9%	-8.9%	-6.8%	-6.7%
EBIT Margin	-137.7%	-21.8%	1.9%	6.0%	9.7%	10.5%
D&A	19.2%	4.3%	2.2%	4.1%	3.4%	4.1%
EBITDA Margin	-118.5%	-17.5%	4.1%	10.1%	13.1%	14.6%

Source: Deutsche Bank

We believe that these margins can be sustained despite expected price deflation
Importantly, we believe Ener1 can generate these margins while also reducing battery pricing significantly. We believe that beginning in the 2012 time-frame, average battery pricing will start to fall by approximately 5%-8% per year. This would imply a price per kWh for an energy battery of approximately $500 by 2015 (vs approximately $650 today).

Based on the following analysis, we believe Ener1 can reduce cost by ~$150 / kWh to $375 / kWh. This level of savings would enable Ener1 to maintain margins in the 25% range on battery pricing of $470 / kWh, well in-line with expected battery pricing by mid-decade. Importantly, we do not believe that this level of cost reduction requires any technology breakthroughs.

Near-term cost reductions are expected in the following areas:

1. Cell Material (59% of cost of total battery pack): By 2015, we believe this cost can be reduced to $190 / kWh from $315 / kWh currently.

- Manufacturing yield – as factory processes evolve and become more automated, wasted material will be reduced, which should lower overall material cost. We believe the company can raise their yield on manufactured material to 95% from 85%. In other words, the company currently wastes 15% of the $315 / kWh, but will likely reduce that to 5%, a $31 savings, which brings the cost down to $284 / kWh.
- Bulk purchasing – Based on our research, we believe that cell material cost can be reduced by 30%, purely based on scale, assuming volume of ~100k EV packs annually (approximately $1.25billion in revenue at mid-decade pricing). This $86 savings, should bring total cost down to $198 / kWh.
- Localized sourcing – lithium-ion companies are currently spending significant amounts on freight and duties by having to purchase material from wherever it's available. We believe that a U.S. domestic material supply network will develop to support manufacturing plants planned by AONE, Dow Kokam, Enerdel, JCI / Saft, LG Chem, and Nissan/NEC. This should lead to scale in the supply chain, as well as lower freight / duty costs for the cell manufacturers. We assume that freight / duty costs of approximately $20 / kWh can be cut in half. This $10 savings would reduce the cell material cost to ~$190 / kWh.

2. Pack material (26% of the battery pack). By 2015, we believe this cost can be reduced to $108 from $138.

- Mechanical parts make up 55% of the pack cost. We assume a 5% decline per year, which will yield a $17 / kWh cost decline by 2015.
- Connectors make up 8% of the pack cost. We assume a 2% decline per year, which will yield a $1 / kWh cost decline by 2015.
- Electrical / electronic parts make up 37% of the pack cost. We assume a 5% decline per year, which will yield a $12 / kWh cost decline by 2015.

Long-term technology / process improvements can also help battery companies maintain strong margins. We do not expect advanced Lithium Ion batteries to become commoditized in the near to intermediate term, for a number of reasons:

- We believe that automakers will place a high priority on safety, durability, and performance; particularly at the outset of vehicle electrification strategies. The ability to produce a battery that mitigates safety concerns (even under vehicle crash conditions) and can perform up-to-spec for 10 years is a difficult task. And Ener1 appears to have a head-start in this area.
- Ener1 continues to improve the performance of its products in terms of specific energy (energy storage capability (watt-hour) for a given mass (kg) of battery). Lower mass will deliver lower cost, better vehicle performance, and better vehicle integration, all of which are highly valued by automakers.

DOE funding could put Ener1 on equal footing to A123 and JCI/Saft with respect to capacity

Depending on the final resolution of DOE funding (Ener1 has received a grant but is still awaiting decision on a loan package), we expect Ener1 to undertake one of two capex plans. Either plan would result in a capacity level that is sufficient through at least 2014 and the larger plan would put Ener1's U.S. capacity in-line with the capacity levels of its two main U.S.-based competitors, JCI/Saft and A123. We'd also point out that Ener1 appears to be highly capital efficient (its ~$600million capex plan appears to yield more incremental capacity than A123's ~$800million plan).

Figure 87: Comparison of Capacity Build-out Plans

	Total Capex ($MM)	DOE portion	Company Portion	Incremental Capacity (000 kWh's)	Thousand EV units (at 25kWh / unit)	Revenue potential	Enough capacity through?
HEV - Plan 1	240	50%	50%	1,300	64	$1.1bn	2014
HEV - Plan 2	581	68%	32%	3,100	136	$2.0bn	2015-2016
AONE	800	61%	39%	3,000	120		
JCI/Saft	600	50%	50%	3,500	140		

Source: Company Filings / Deutsche Bank

Capacity in the battery industry is generally measured in terms of kWh's. Ener1 currently has capacity of 300k kWh's at its U.S. facility, enough to produce the equivalent of approximately 12,000 electrical vehicle battery packs (at 25kWh's per battery) or 150,000 hybrid battery packs (at 2kWh's per pack). The capacity plans noted above are primarily for an additional U.S. plant (as well as some build-out to its current facility in Indianapolis). The total DOE funding picture for Ener1 remains unclear at this point. We have assumed the following:

- Ener1 was awarded a $118.5million stimulus grant from the DOE. The company was one of 5 battery-makers to receive a grant, in addition to JCI / Saft ($299million), A123 ($249million), Dow Kokam ($161million), and LG Chem ($151million). The grant money must be matched 1 for 1 by Ener1. Plan 1 in Figure 87 above represents the scenario where grant funding is all that is available to Ener1.
- We believe that, in addition to the awarded grant, Ener1 has requested a loan of $250MM - $300MM from the DOE's $25 billion Advanced Technology Vehicle Manufacturing loan pool. We base this on Ener1's original request of $480mm which, given the program's 80% / 20% cost share requirement, implies a ~$600 million capital plan. As can be seen in figure 88, we assume the midpoint, $275 million, with Ener1 funding the remainder (the company will be able to net approximately $30million of capex they've already spent against the match requirement). This ~$600 million plan represents Plan 2 in Figure 87 above.
- We believe it is more likely than not that Ener1 will receive both a loan and a grant, and we have modeled the company under that assumption.

Figure 88: Ener1 government-supported capex plan ($ millions)

CAPEX PLAN	
DOE Loan (DB estimate)	275
HEV Match - Loan (80%/20%)	69
Total, excluding grant	344
DOE Grant	119
HEV Match - Grant (50% / 50%)	119
Total Capex Plan	581

HEV FUNDING	
Loan match	69
Grant match	119
Already spent	(33)
Total Funding Requirements	154

Source: Company Filings and Deutsche Bank

The total ~$600 million capex plan above would result in total U.S. capacity of 3.4million kWh's, enough to build approximately 135k EV units per year. At 100% capacity, total revenue potential from this capacity would be approximately $2billion. We believe that revenue in that range is unlikely prior to 2016.

If Ener1 did not receive a loan, ~$240million capex plan (grant + match) would result in total U.S. capacity of 1.6million kWh's, enough to build approximately 65k EV units per year, and to generate approximately $1.1 billion in revenue. We believe this level of capacity would meet production requirements through 2014.

Importantly, despite having the capital available, Ener1 can carefully add capacity incrementally. We believe that production capacity can be added relatively efficiently in ~5k EV unit increments. Lithium-ion cell production equipment does not require large amounts of throughput to be economical. In fact, the biggest-ticket items in battery cell manufacturing are the coating machines, each of which has an approximate capacity for 10,000 EV units per year, and costs $3.5 - $4.0 million (about 6% of the capex cost is for coating machines). Based on our research, all other equipment can be purchased and installed with capacities of less than 5,000 units.

Additionally, the coating machines are also the longest lead-time item at approximately one year. All other equipment can be ordered and installed in approximately 6 months, which will also be helpful in attempting to match capacity with production.

Finally, Ener1 will be able to make use of Enertech's capacity, if demand temporarily outstrips their U.S. capacity.

Figure 89 illustrates our projections for Ener1's capacity and required capex funding (based on 80% utilization rates, because we assume that capacity is in place approximately 6 months before they are necessary).

Figure 89: Forecast of capacity needs, capital spending, and funding sources

	2010E	2011E	2012E	2013E	2014E	
US Capacity (000 kWh's)	455	650	915	1,353	1,713	
US Shipments (000 kWh's)	171	392	732	1,217	1,370	
Capacity Utilization - Autos Only	38%	60%	80%	90%	80%	
U.S. Plant Capacity (EV's)	20,682	29,545	41,571	61,488	77,866	
Total Revenue ($ MM)	157	342	535	940	1,087	
Capex Forecast (all in $ millions)	2010E	2011E	2012E	2013E	2014E	
Capex - U.S. ($MM)	45	60	100	82	103	
Capex - Korea ($20mm to get to 15k EV capacity)	4	16	-	-	-	
Capex - Maintenance / Other	8	8	10	12	14	
Total Capex	57	84	110	94	117	
Funding Forecast (all in $ millions)	2010E	2011E	2012E	2013E	2014E	Total
DOE Grant	8	20	20	15	25	88
Ener1 Match - Grant	8	20	20	15	25	88
DOE Loan	29	20	60	45	43	196
Ener1 Match - Loan	-	-	-	7	11	18
Ener1 Funded - Other	12	24	10	12	14	72
Total	57	84	110	94	117	462
Remaining Grant balance	111.0	91.0	71.0	56.0	31.0	
Remaining Loan balance	246.0	225.8	166.2	121.6	78.9	

Source: Deutsche Bank

Ener1's capital needs to meet revenue targets appear manageable

We believe that Ener1 will require approximately $170 million of external capital through FY2010 to fund operations and capacity-building (this assumes the larger, $600million capex plan described above). Assuming that the company is successful in raising $180million through FY2010, we believe its remaining cash needs can be funded through cash flow from operations. Our estimate of Ener1's likely capital plan is below:

Figure 90: DB Forecast of Ener1 capital-raising requirements

3Q09 sale of shares	34
Working Capital Financing	11
Future equity raise	50
Remaining Capital requirements	75
Total	170

Source: Deutsche Bank

3Q09 sale of shares: Ener1 has been selling shares in the open market since late May under an Open Market Sales Agreement that allows up to $40million in shares to be sold. In the company's 2Q09 10-q, it was disclosed that through August 6th, the company had raised $19.6million through open market sales at an average price of $6.38 ($6million of the proceeds were included in the 2Q09-end balance sheet). We assume that Ener1 completed the maximum $40million in sale proceeds during 3Q09, which would result in $34million in total proceeds during 3Q09.

Working Capital Financing: We believe that Ener1 should be able to arrange an Accounts Receivable factoring agreement. We assume that the company will be able to finance 50% of its A/R balances. This would result in a capital inflow of $11million by 2010YE.

Additional Capital: Ener1's remaining $125million in capital needs is likely to be funded through equity and some type of equity-linked debt such as a convertible debt issue. We assume an approximate split of 40% straight equity ($50million) and 60% convertible debt ($85million).

Assuming Ener1 issues convertible debt of $75million in 2010, which matures and is converted to equity in 2014, below is our estimate of Ener1 debt levels through the forecast period.

Figure 91: DB Forecast of Ener1 future debt levels ($000's)

	FY2009E	FY2010E	FY2011E	FY2012E	FY2013E	FY2014E
Current debt instruments as of 2Q09	30,997	30,297	18,837	18,337	17,837	17,337
A/R Financing (assume 50% of A/R balance)	-	11,682	20,864	34,010	56,405	77,531
ATVM Loan	-	29,000	49,156	108,788	153,423	196,052
Convertible debt	-	75,000	75,000	75,000	75,000	0
Total Debt	30,997	145,979	163,857	236,136	302,666	290,919
Total Debt (ex ATVM)	30,997	116,979	114,701	127,347	149,242	94,868
1 year forward EBITDA	(27,467)	14,726	53,785	122,906	158,840	207,404
Total Debt to 1yr forward EBITDA		9.9	3.0	1.9	1.9	1.4

Source: Deutsche Bank

On a fully-diluted basis, we believe that Ener1's share count could increase to 136million shares, which represents 18.5% dilution from total shares of 114.7million as of June 30, 2009.

Figure 92: Projected share count after prospective capital raising activity

	Proceeds ($MM)	Est Price per share	Shares
Current Shares: As of Qtr End 2Q09			114.7
3Q09 Equity Raise	34	6.0	5.7
Assumed new equity raise (late '09 / early '10)	50	7.5	6.7
Convert Ener1 Group $11mm LOC to equity (2011)	11	8.5	1.3
Remaining cash needs (assume $75mm convert)	75	10	7.5
Total Proforma Shares	170		136

Source: Deutsche Bank

Cash Flow projections

In the figure below, we look at free cash flow, with capex that is funded by DOE funds excluded (as this capex is essentially pass-through). We assume that the DOE loan funds and grant funds are used in an approximate ratio of 2:1, as we believe Ener1 will prefer to spend the loan funds, in order to delay matching fund needs. The major cash use in 2010 – 2014 is the DOE match and working capital needs.

Importantly, we believe the company will be free cash flow-positive beginning in 2013.

Working capital will likely be a drain on cash as long as the company continues to grow rapidly. We'd expect that growth in A/R and Inventory (both forecasted at approx 45 days) will outpace that of A/P and Accrued Liabilities (mostly warranty). We expect overall working capital as % of sales to be approximately 4% beginning in 2014.

Figure: Cash Flow and Debt projections

Figure 93: DB estimate of Ener1 Cash Flow

	2H09	2010	2011	2012	2013	2014
Cash Balance, Start of Year	8,256	25,782	71,209	27,087	45,641	114,797
OCF through 2011 ex W/Cap	(21,947)	(17,965)	5,164	43,060	95,239	108,278
Working Capital	(2,527)	(21,589)	(14,008)	(7,153)	(13,681)	(362)
Th!nk Investment	(12,000)	(6,000)	-	-	-	-
Capex: DOE Match	-	(8,000)	(20,000)	(20,000)	(22,297)	(35,657)
Capex: Other	(5,000)	(12,000)	(24,000)	(10,000)	(12,000)	(14,000)
Cash Flow, ex DOE Capex and Funding	(41,474)	(65,555)	(52,844)	5,907	47,261	58,259
Financing: Capital Raise / (Debt Paydown)	59,000	110,982	8,722	12,647	21,895	20,625
Cash Balance, End of Year	25,782	71,209	27,087	45,641	114,797	193,681

Source: Deutsche Bank

Valuation

Our equity valuation of $1.3billion ($11 per share) is based on a DCF analysis, which uses the following assumptions:

- Terminal growth year of 2020. We use our detailed earnings model to populate the years through 2014, and then use the growth rate of our global automotive lithium-ion battery revenue model as a proxy for Ener1's growth rate through 2020.
- We assume a terminal growth rate of 8.0%. Given our projection that only 20% of global sales will be electrified in 2020 (9% HEV and 11% PHEV / EV), we believe that an 8% terminal growth rate is reasonable.
- Terminal EBITDA margin of 13.3%, including 9% EBIT margin.
- WACC of 12.0%
- In the terminal growth year, Capex of 5.0% of sales remains above D&A of 4.4% of sales. We believe this level of capex is enough to fund capex required for 8% terminal growth as well as maintenance.

In figure 94, we present the analysis we used to predict capex requirements in the terminal year. We project the new capacity required to fund 8% annual growth (using $400 / kWh pricing). Then we use the company's Capex $ per kWh from their current plan, assuming a 25% decline in capital equipment costs (from industry scale), to calculate capex required to fund growth. We assume that maintenance capex is 50% of D&A, noting that that capital equipment is expected to last far longer than the 8 year depreciation period.

Figure 94: Analysis of the capex requirement to fund 8% terminal growth (all in $ million except New Capacity Req'd is in thousands of kWh's)

	2020E Revenue	8% growth	New Capacity Req'd, assuming $400 / kWh of revenue (000 kWh)	$ per kWh (assume 25% reduction)	Growth Capex req'd	Maint Capex (assume 50% of D&A)	Total Capex Req'd	% of Sales
Ener1	4,713	377	943	142	134	101	235	5.0%

Source: Deutsche Bank

Given the ramp in revenue and profitability that we expect in 2012 and beyond, we believe that a DCF model represents he most meaningful way to value this company. Using our target equity / enterprise value, we arrive at the following Market Cap / Sales, EV / EBITDA, P/E ratios:

Figure 95: Implied forward ratios, using DCF-derived EV of $1.3billion and Equity Value of $1.3billion, and comparing to DB-modeled Revenue, EBITDA, and EPS in 2010-2014

	FY2010E	FY2011E	FY2012E	FY2013E	FY2014E
Target Price / Sales	8.4	3.8	2.4	1.4	1.2
Target EV / EBITDA	NM	NM	24.8	10.8	8.4
Target Price / Earnings	NM	NM	113.7	31.4	24.4

Source: Deutsche Bank

Figure 96: Discounted Cash Flow Model ($ millions)

	2009E	2010E	2011E	2012E	2013E	2014E	2015E	2016E	2017E	2018E	2019E	2020E
Revenues	33.5	156.6	342.2	534.8	940.4	1,087.3	1,375.6	2,114.4	2,953.2	3,619.8	4,102.0	4,484.3
Revenue Growth		367.1%	118.5%	56.3%	75.8%	15.6%	26.5%	53.7%	39.7%	22.6%	13.3%	9.3%
Operating Expenses	79.7	190.8	335.1	503.0	849.6	972.8	1,224.3	1,903.0	2,687.4	3,330.2	3,773.9	4,125.6
Operating Income	($46)	($34)	$7	$32	$91	$115	$151	$211	$266	$290	$328	$359
Operating Margin	-137.7%	-21.8%	2.1%	6.0%	9.7%	10.5%	11.0%	10.0%	9.0%	8.0%	8.0%	8.0%
Depreciation and Amortization	$6	$7	$8	$22	$32	$44	$56	$87	$124	$154	$178	$198
EBITDA	($40)	($27)	$15	$54	$123	$159	$207	$299	$389	$444	$506	$557
EBITDA Margin	-118.5%	-17.5%	4.3%	10.1%	13.1%	14.6%	15.1%	14.1%	13.2%	12.3%	12.3%	12.4%
EBITDA Growth		30.9%	153.6%	265.2%	128.5%	29.2%	30.6%	44.1%	30.4%	13.9%	14.0%	10.0%
Taxes	($0)	$15	$1	($7)	($27)	($34)	($53)	($74)	($93)	($101)	($115)	($126)
Working Capital	$4	$21	$30	$37	$50	$51	$62	$95	$133	$163	$185	$202
WC to Sales	11.9%	13.1%	8.6%	6.9%	5.4%	4.7%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Change \Working Capital	($4)	($17)	($9)	($7)	($14)	($0)	($11)	($33)	($38)	($30)	($22)	($17)
Capex to Sales %	37.0%	31.3%	18.7%	16.8%	8.4%	8.5%	13.1%	10.5%	8.5%	6.5%	5.5%	5.0%
CAPEX	($12)	($49)	($64)	($90)	($79)	($92)	($181)	($222)	($251)	($235)	($226)	($224)
Incremental Investment	($16)	($66)	($73)	($97)	($93)	($93)	($192)	($255)	($289)	($265)	($247)	($241)
Free Cash Flow	($56)	($78)	($57)	($50)	$4	$32	($37)	($30)	$8	$77	$144	$190
Terminal Value												$4,740
Total Value	**($56)**	**($78)**	**($57)**	**($50)**	**$4**	**$32**	**($37)**	**($30)**	**$8**	**$77**	**$144**	**$4,930**
Present Value		($69)	($46)	($36)	$2	$18	($19)	($14)	$3	$28	$46	$1,417

Enterprise value	**$1,331**
Cash	($8)
Total Debt	$31
Shareholder Value	$1,309
Shares Outstanding	113.8
Per Share Value	$11

Normalized Assumptions			
Sales Growth	8.0%	Terminal Value	
Operating Margin	8.0%	WACC - g	4.0%
Tax Rate	35.0%	WACC	12.0%
W/C % Revenue	4.5%		
CAPEX % Rev.	5.0%		

Source: Deutsche Bank

Ener1 Group maintains significant ownership stake

Ener1 Group is an investment company that is primarily owned by Boris Zingarevich and Peter Novak, a co-founder of Ener1 Inc. Boris Zingarevich is part of the ownership group of Ilim Pulp, a Russian paper company, half of which was sold to International Paper in 2007. Ener1 Inc.'s CEO Charles Gassenheimer owns 3% of Ener1 Group.

Ener1 Group owns 56% of the common shares of Ener1 Inc. as of 6/30/09. Bzinfin LLC, another company controlled by Zingarevich owns an additional 2%. Other substantial ownership stakes (as of the last reporting period) are held by Morgan Stanley (6.5%), Anchorage Advisors (5.3%), and Alpha Class Investments (4.4%), former owner of Enertech.

Figure 97: Ownership as of June 30, 2009

	Shares	Ownership
Ener1 Group / Bzinfin	68,233	59.5%
Morgan Stanley	7,400	6.5%
Anchorage Advisors	6,126	5.3%
Alpha Class Investments	5,000	4.4%
Other	27,958	24.4%
Total Shares (6/30/09)	114,717	

Source: Company Filings, Capital IQ

Ener1 Inc. is 100% owner of its 3 divisions: Enerdel, NanoEner, and Enerfuel. It has a 90% ownership stake in Enertech, its South Korean subsidiary (the other 10% is owned by Korea Investment Bank, among others).

Ener1 Inc. currently owns 20.6% (24.1% including warrants) of Think Technology AS, the Norwegian electric vehicle maker. Assuming the planned $12million additional investment in tranche 2 and tranche 3 of Think's bankruptcy financing, Ener1 Inc. will hold 29% of common shares (32% including warrants). The total exit financing package is $43million, with Ener1 contributing $18million. Other announced investors are Valmet (the company that will be assembling the vehicles) and Investinor (the Norwegian state investment fund).

Risks

Current revenue projections rely on a limited number of customers, some of whom have selected Ener1 as a supplier, but have not signed production contracts (such as Volvo). If Ener1 fails to achieve production contracts with significant customers, our revenue forecast could be at risk.

A portion of current revenue projections rely on customers that are essentially start-up automakers. If these companies fail to achieve conservative volume assumptions, potentially due to production issues, or lack of consumer interest, our revenue forecast could be at risk.

Ener1's products will carry warranties in most cases, for which an expense is accrued based on reliability estimates. A significant unforeseen warranty / recall issue could impact the company's balance sheet.

Prototype to production scaling risk. There is a risk that Ener1 could encounter problems scaling to commercial production. We believe this risk is significantly mitigated by Ener1's operations team, which has significant experience with other industrial manufacturing companies.

Our demand estimates rely on a belief that government regulatory actions will continue to favor low-emission vehicles and that the cost of lithium ion batteries will continue to decline. If either of these assumptions fail to materialize, our total market estimates could be lower than forecasted.

Significant competition from other battery-makers could force Ener1 to lower prices faster than its costs are declining. We expect, however, that demand will outstrip the supply of batteries for some time, mitigating this risk for the near term.

Figure 98: Ener1 Earnings Model (all in $000's except per-share data)

	2009E										
	Mar	**June**	**SeptE**	**DecE**	**2008PF**	**2009E**	**2010E**	**2011E**	**2012E**	**2013E**	**2014E**
Revenue	8,192	7,537	7,800	10,000	38,583	33,529	156,623	342,189	534,824	940,394	1,087,327
Cost of Sales	6,803	6,360	6,795	8,760	33,339	28,718	130,577	267,438	408,011	711,281	815,822
Gross profit	1,389	1,177	1,005	1,240	5,244	4,811	26,046	74,752	126,814	229,114	271,505
Gross margin	**17.0%**	**15.6%**	**12.9%**	**12.4%**	**13.6%**	**14.3%**	**16.6%**	**21.8%**	**23.7%**	**24.4%**	**25.0%**
SG&A	4,617	3,741	4,000	4,000	15,557	16,358	22,314	28,402	44,390	70,530	78,288
Reseach and Development	6,262	7,452	7,800	7,800	22,200	29,314	31,200	31,624	38,507	51,722	56,541
Depreciation / Amortization	1,108	1,354	1,401	1,448	2,419	5,310	6,680	7,662	12,062	16,043	22,164
Other Operating Expense / (Income)	-	-	-	-	800		-	-	-	-	-
Operating Income	(10,598)	(11,370)	(12,196)	(12,008)	(35,732)	(46,171)	(34,147)	7,065	31,854	90,819	114,512
Operating Margin	**-129.4%**	**-150.9%**	**-156.4%**	**-120.1%**	**-92.6%**	**-137.7%**	**-21.8%**	**2.1%**	**6.0%**	**9.7%**	**10.5%**
Net Interest expense (income)	1,317	1,419	1,162	930	11,822	4,828	7,922	8,908	10,725	14,271	16,128
Equity (Income) / Loss	39	(129)	-	500	968	410	2,000	2,000	-	-	-
Other expense (income)	(4,683)	236	-	-	(2,789)	(4,447)	-	-	-	-	-
Pre-tax income	(7,271)	(12,896)	(13,358)	(13,438)	(45,733)	(46,963)	(44,070)	(3,843)	21,129.0	76,548.5	98,384.0
Tax provision	37	(35)	-	-	84	2	(15,424)	(1,345)	7,395.2	26,792.0	34,434.4
Tax rate	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**-0.2%**	**0.0%**	**35.0%**	**35.0%**	**35.0%**	**35.0%**	**35.0%**
Net income from operations	(7,308)	(12,861)	(13,358)	(13,438)	(12,402)	(46,965)	(28,645)	(2,498)	13,733.9	49,756.5	63,949.6
Net margin	**-89.2%**	**-170.6%**	**-171.3%**	**-134.4%**	**-32.1%**	**-140.1%**	**-18.3%**	**-0.7%**	**2.6%**	**5.3%**	**5.9%**
EPS from Continuing Op's	**(0.06)**	**(0.11)**	**(0.11)**	**(0.11)**	**(0.12)**	**(0.40)**	**(0.23)**	**(0.02)**	**0.10**	**0.37**	**0.47**
Basic shares outstanding	113,470	113,803	117,549	122,049	103,382	116,718	126,633	127,858	128,343	128,343	132,593
Dilluted shares outstanding	113,470	113,803	117,549	122,049	103,382	116,718	126,633	127,858	135,843	135,843	135,843
YOY Growth											
Sales Growth	10.0%	10.0%	10.0%	10.0%		-13.1%	367.1%	118.5%	56.3%	75.8%	15.6%
Operating Income Growth	87.3%	55.4%	40.3%	-1.9%					350.9%	185.1%	26.1%
Net Income Growth	-46.8%	64.4%	48.4%	8.4%							
EBITDA	(8,827.0)	(9,548.0)	(10,795.0)	(10,560.0)	(34,120)	(39,730)	(27,467)	14,726	53,785	122,906	158,840
EBITDA Margin	-107.8%	-126.7%	-138.4%	-105.6%	-88.4%	-118.5%	-17.5%	4.3%	10.1%	13.1%	14.6%
Expense Analysis											
SG&A	56.4%	49.6%	51.3%	40.0%	40.3%	48.8%	14.2%	8.5%	8.3%	7.5%	7.2%
R&D	76.4%	98.9%	100.0%	78.0%	57.5%	87.4%	19.9%	9.2%	7.2%	5.5%	5.2%
Interest Expense	16.1%	18.8%	14.9%	9.3%	30.6%	14.4%	5.1%	2.6%	2.0%	1.5%	1.5%

Source: Deutsche Bank

Figure 99: Ener1 Cash Flow and Balance Sheet Model (all in $000's)

	2009E Mar	2009E June	2009E SeptE	2009E DecE	2008PF	2009E	2010E	2011E	2012E	2013E	2014E
Operations											
Reported net income	(7,308)	(12,861)	(13,358)	(13,438)	(42,955)	(46,965)	(28,645)	(2,498)	13,734	49,757	63,950
Depreciation and amortization	1,771	1,822	1,401	1,448	1,612	6,441	6,680	7,662	21,931	32,086	44,328
Other operating	(1,823)	3,178	1,000	1,000	12,330	3,355	4,000	-	7,395	13,396	-
Change in working capital	(4,389)	1,559	(1,173)	(1,354)	1,284	(5,357)	(21,589)	(14,008)	(7,153)	(13,681)	(362)
Operating cash flow	**(11,749)**	**(6,302)**	**(12,130)**	**(12,344)**	**(27,729)**	**(42,525)**	**(39,555)**	**(8,844)**	**35,907**	**81,558**	**107,916**
Investing											
Capital expenditures	(5,844)	(1,563)	(2,500)	(2,500)	(8,787)	(12,407)	(49,000)	(64,156)	(89,632)	(78,932)	(92,286)
Free cash flow	**(17,593)**	**(7,865)**	**(14,630)**	**(14,844)**	**(36,516)**	**(54,932)**	**(88,555)**	**(73,001)**	**(53,724)**	**2,626**	**15,630**
Cash used in acquisitions					-	-	-	-	-	-	-
Other investing	-	19	(8,000)	(4,000)	(2,044)	(11,981)	(6,000)	-	-	-	-
Dividends					-	-	-	-	-	-	-
Discretionary cash flow	**(17,593)**	**(7,846)**	**(22,630)**	**(18,844)**	**(38,560)**	**(66,913)**	**(94,555)**	**(73,001)**	**(53,724)**	**2,626**	**15,630**
Financing											
Increase (decrease) in borrowings	9,968	3,617	-	-	(315)	13,585	85,982	(2,278)	12,647	21,895	(54,375)
ATVM Borrowings						-	29,000	20,156	59,632	44,635	42,629
Equity issuance	40	6,415	34,000	25,000	30,302	65,455	25,000	11,000	-	-	75,000
Other					(8,000)	-	2,260	-	-	-	-
Net Financing flow	**10,008**	**10,032**	**34,000**	**25,000**	**21,987**	**79,040**	**142,242**	**28,878**	**72,279**	**66,530**	**63,254**
Effect of foreign currency	(120)	286	-	-	(50)	166	-	-			
Net change in cash position	**(7,705)**	**2,472**	**11,370**	**6,156**	**(16,623)**	**12,293**	**47,687**	**(44,122)**	**18,554**	**69,156**	**78,884**
Interest Expense	1,317	1,419	1,162	930	11,921	4,828	7,922	8,908	10,725	14,271	16,128
Total Debt (ex ATVM)	18,942	25,734	30,997	30,997		26,668	131,725	158,304	236,136	302,666	290,919
Interest Rate (qtrly) %	27.8%	22.1%	15.0%	12.0%					5.4%	5.3%	5.4%

Ener1 Consolidated balance sheet ($MM)

	2009E Mar	2009E June	2009E SeptE	2009E DecE	2008PF	2009E	2010E	2011E	2012E	2013E	2014E
Assets											
Cash and cash equivalents	4,267	5,996	17,366	23,522	11,229	23,522	71,209	27,087	45,641	114,797	193,681
Receivables, net	6,572	4,685	4,800	6,154	7,006	6,154	23,364	41,727	62,921	110,635	127,921
Inventory	9,199	8,689	9,060	10,011	10,202	10,011	20,390	27,715	38,858	67,741	77,697
Prepaid expenses					-	-	5,000	10,000	10,000	10,000	10,000
Other	1,464	1,116			1,199	-	-	-			
Current assets	**21,502**	**20,486**	**31,226**	**39,687**	**29,636**	**39,687**	**119,963**	**106,529**	**157,420**	**303,173**	**409,299**
PP&E	43,767	45,243	46,342	47,395	39,513	47,395	89,715	146,210	213,910	260,755	308,713
Equipment Deposits / Restricted Cash	2,233	2,260	2,260	2,260	2,976	2,260	-	-	-	-	-
Deferred Debt and Note Costs	4,241	3,393	-	-	5,088	-	-	-	-	-	-
Other	61,176	62,758	65,606	68,606	64,518	68,606	70,606	70,606	63,211	49,815	(25,185)
Total assets	**132,919**	**134,140**	**145,434**	**157,948**	**141,731**	**157,948**	**280,283**	**323,344**	**434,541**	**613,743**	**692,826**
Liabilities											
Short-term Debt	11,721	9,981	9,981	9,981	11,417	9,981	9,981	9,981	9,981	9,981	9,981
Capital Leases	2,045	2,177	2,177	2,177	-	2,177	2,177	2,177	2,177	2,177	2,177
Accounts payable	12,138	9,747	9,060	10,011	16,376	10,011	16,312	27,715	45,335	88,910	101,978
Accrued Liabilities (prim warranty)							4,699	9,976	17,540	36,880	50,693
Due to Related parties		1,500			-	-	-	-			
Other	279	299			-	-	-	-			
Total current liabilities	**26,183**	**23,704**	**21,218**	**22,169**	**27,793**	**22,169**	**33,168**	**49,849**	**75,033**	**137,949**	**164,829**
Deferred income taxes	324	313						-			
Long-term Debt	14,013	18,839	18,839	18,839	7,525	18,839	104,821	102,543	115,189	137,084	82,710
ATVM Debt					-	-	29,000	49,156	108,788	153,423	196,052
Preferred Stock / Minority Int	-	-	-	-	3,517	-	-	-	-	-	-
Other	6,621	6,549			-	-	-	-			
Total liabilities	**47,141**	**49,405**	**40,057**	**41,008**	**38,835**	**41,008**	**166,989**	**201,548**	**299,010**	**428,456**	**443,590**
Shareholders equity	85,778	84,735	105,377	116,939	102,896	116,939	113,294	121,796	135,530	185,287	249,236
Total liabilities and S.E.	**132,919**	**134,140**	**145,434**	**157,948**	**141,731**	**157,948**	**280,283**	**323,344**	**434,541**	**613,743**	**692,826**

Source: Deutsche Bank

North America United States
Consumer Autos & Auto Parts

3 November 2009

A123 Systems Inc.

Reuters: **AONE.OQ** Bloomberg: **AONE UQ**

Initiating coverage with Hold recommendation

A123 Systems' proprietary battery materials have broad applicability...
...in a number of growing segments, including consumer products, grid services, and automotive, which we believe will be the largest, by far. And the company's commercial success in this arena so far has been very impressive—particularly considering the fact that A123 competes against a number of large and well-established competitors. Co's including BMW, Daimler, SAIC, BetterPlace, Magna, BAE Systems, GM and Chrysler have all recognized A123's innovation. We initiate with a $17 price target and a Hold rating based on valuation.

The momentum behind vehicle electrification is growing
Based on our analysis of automakers' product disclosures, and discussions with global suppliers, we estimate the world's automakers will introduce at least 120 hybrid, plug-in hybrid, and electric vehicle models onto the market by 2012, compared with 29 (mostly hybrid) vehicles today. Overall, we believe that by 2020, HEVs, PHEVs, and EVs will comprise 20% of the global automobile market, and we project the market for advanced lithium ion batteries supporting this segment could rise to $66 billion in that timeframe. We estimate A123 should be able to achieve close to $700 million/$1.2 billion/$2.1 billion in revenue in 2012/2013/2014 just from automotive opportunities.

And there are other large applications for A123's products
We believe A123 has reasonably good visibility of $45-$65 million per year from the ancillary services market for electric utilities in the near term (through 2011), and we believe this market opportunity can climb to over $200 million per year for A123 over the next few years. There are also high-end applications of batteries for consumer and portable power that could become very significant.

Our $17 price target ($1.5 billion equity value) is based on a DCF analysis
Valuing A123 Systems presents a unique set of challenges, given the fact that revenue from the automotive industry revenue won't accelerate until 2012 and beyond. Nonetheless, we believe A123's technologies position them to play a significant role in this industry over time. We derive our $17 target price based on our DCF analysis (terminal EBIT margin of 8.0%, weighted average cost of capital of 12.0%). Revenue estimates projected by DOE consultants could suggest even more upside, up to approximately $30. Risks to our outlook center around A123s revenue trajectory. Particularly given that many of the revenue opportunities incorporated into our model are not yet under contract.

Forecasts and ratios

Year End Dec 31	2008A	**2009E**	2010E
FY EPS (USD)	-0.71	**-0.73**	-0.65
DPS (USD)	0.00	**0.00**	0.00
Revenue (USDm)	68.5	**85.5**	149.6

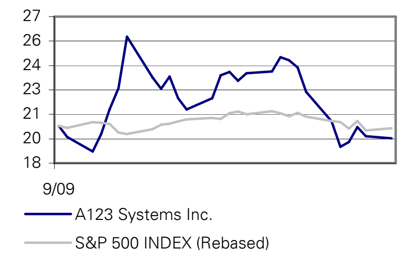
Source: Deutsche Bank estimates, company data

[1] Includes the impact of FAS123R requiring the expensing of stock options.

Hold

Price at 2 Nov 2009 (USD)	**19.54**
Price target	**17.00**
52-week range	**25.77 - 18.73**

Price/price relative

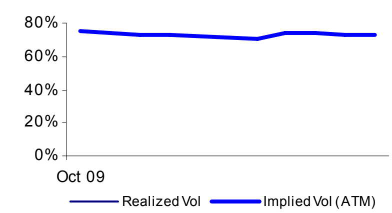


Performance (%)	1m	3m	12m
Absolute	*-24.2*	*–*	*–*
S&P 500 INDEX	*1.7*	*5.6*	*7.7*

Stock & option liquidity data

Market Cap (USDm)	2,093.8
Shares outstanding (m)	107.2
Free float (%)	100
Volume (2 Nov 2009)	290,554
Option volume (und. shrs., 1M avg.)	476,600

Implied & Realized Volatility (3M)



Model updated:01 November 2009

Running the numbers

North America

United States

Autos & Auto Parts

A123 Systems Inc.

Reuters: AONE.OQ Bloomberg: AONE UQ

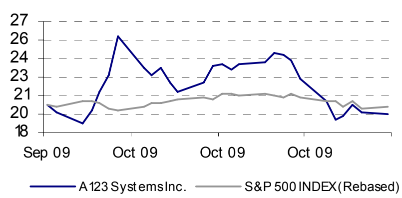
Hold

Price (2 Nov 09)	USD 19.54
Target price	USD 17.00
52-week Range	USD 18.73 - 25.77
Market Cap (m)	USDm 2,094 EURm 1,413

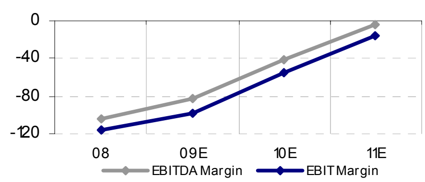
Company Profile

A123 Systems, Inc. designs, develops, manufactures, and sells rechargeable lithium-ion batteries and battery systems. Its batteries and battery systems, based on its proprietary nanophosphate chemistry, provide a combination of power, safety, and life. The company principally serves the transportation, electric grid services, and portable power markets in North America, Asia, and Europe

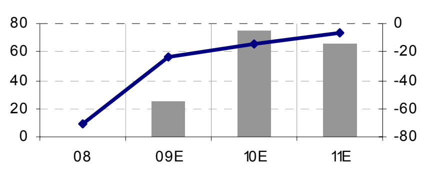
Price Performance



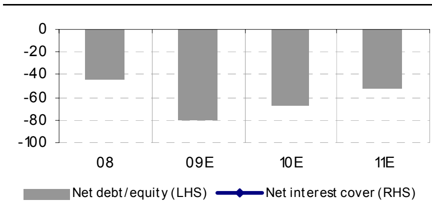
Margin Trends



Growth & Profitability



Solvency



Dan Galves
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Fiscal year end 31-Dec	2008	2009E	2010E	2011E
Financial Summary				
DB EPS (USD)	-0.71	-0.73	-0.65	-0.29
Reported EPS (USD)	-0.71	-0.73	-0.65	-0.29
DPS (USD)	0.00	0.00	0.00	0.00
BVPS (USD)	1.06	5.34	4.65	4.34
Valuation Metrics				
Price/Sales (x)	nm	24.5	14.0	8.4
P/E (DB) (x)	nm	nm	nm	nm
P/E (Reported) (x)	nm	nm	nm	nm
P/BV (x)	0.0	3.7	4.2	4.5
FCF yield (%)	na	nm	nm	nm
Dividend yield (%)	na	0.0	0.0	0.0
EV/Sales	nm	19.1	11.7	7.4
EV/EBITDA	nm	nm	nm	nm
EV/EBIT	nm	nm	nm	nm
Income Statement (USDm)				
Sales	69	85	150	248
EBITDA	-71	-71	-60	-12
EBIT	-80	-84	-81	-39
Pre-tax profit	-80	-83	-74	-31
Net income	**-80**	**-83**	**-74**	**-33**
Cash Flow (USDm)				
Cash flow from operations	**-44**	**-41**	**-39**	**1**
Net Capex	-32	-43	-96	-97
Free cash flow	**-76**	**-84**	**-135**	**-96**
Equity raised/(bought back)	115	484	0	0
Dividends paid	0	0	0	0
Net inc/(dec) in borrowings	8	9	4	-6
Other investing/financing cash flows	1	-2	0	0
Net cash flow	**48**	**407**	**-131**	**-101**
Change in working capital	*19*	*20*	*4*	*-6*
Balance Sheet (USDm)				
Cash and cash equivalents	71	477	346	245
Property, plant & equipment	53	85	160	229
Goodwill	10	10	10	10
Other assets	76	106	116	130
Total assets	**209**	**678**	**631**	**613**
Debt	19	22	8	2
Other liabilities	76	85	125	147
Total liabilities	**95**	**106**	**133**	**149**
Total shareholders' equity	**114**	**572**	**498**	**465**
Net debt	*-51*	*-456*	*-338*	*-243*
Key Company Metrics				
Sales growth (%)	nm	24.7	75.0	66.1
DB EPS growth (%)	na	-2.5	10.6	54.7
Payout ratio (%)	nm	nm	nm	nm
EBITDA Margin (%)	-104.2	-82.7	-40.4	-4.8
EBIT Margin (%)	-116.2	-98.6	-54.3	-15.9
ROE (%)	-70.7	-24.1	-13.8	-6.9
Net debt/equity (%)	-45.0	-79.7	-68.0	-52.2
Net interest cover (x)	nm	nm	nm	nm
DuPont Analysis				
EBIT margin (%)	-116.2	-98.6	-54.3	-15.9
x Asset turnover (x)	0.3	0.2	0.2	0.4
x Financial cost ratio (x)	1.0	1.0	0.9	0.8
x Tax and other effects (x)	1.0	1.0	1.0	1.1
= ROA (post tax) (%)	**-38.5**	**-18.6**	**-11.3**	**-5.4**
x Financial leverage (x)	1.8	1.3	1.2	1.3
= ROE (%)	**-70.7**	**-24.1**	**-13.8**	**-6.9**
annual growth (%)	*na*	*65.9*	*42.7*	*49.7*
x NTA/share (avg) (x)	1.0	3.0	4.7	4.2
= Reported EPS	**-0.71**	**-0.73**	**-0.65**	**-0.29**
annual growth (%)	*na*	*-2.5*	*10.6*	*54.7*

Source: Company data, Deutsche Bank estimates

From the labs of MIT, to the shelves of Home Depot

We are initiating coverage of A123 Systems with a Hold recommendation and a $17 target. A123 Systems was founded in 2001 with plans to commercialize new battery materials and technologies, including a proprietary Lithium Iron Phosphate battery technology that delivers considerably more power and energy than many competitors, while maintaining this chemistry's characteristic safety/stability, life expectancy, and cost advantages.

The company's commercial success so far has been impressive, particularly considering the fact that A123 competes against a number of large and well-established competitors.

Black & Decker was among the first to recognize the advantage of A123's innovation, as A123 displaced the company's incumbent Japanese battery supplier in 2005 with a battery that had 4x the power and 10x the life span. Since then, A123 has built an impressive book of business in each of its three key markets:

- Consumer Products,
- Grid Services, and
- Automotive

While we see potential for dramatic growth in all three business segments, we believe the market for automotive lithium ion batteries will be the largest, by far. As discussed in our June 2008 and November 2009 Electric Vehicle FITT reports, we believe a combination of factors including tightening fuel economy regulation, government incentives, increased concern about oil dependence, and significant advances in battery technology have converged to drive profound changes for the global auto industry over the next 5-10 years.

Automakers have begun to respond to these trends, and a barrage of hybrid, plug-in hybrid, and fully electric vehicles have been revealed. Based on our analysis of automakers' product disclosures, and discussions with global suppliers, we estimate the world's automakers will introduce at least 120 hybrid, plug-in hybrid, and electric vehicle models onto the market by 2012, compared with 13 (mostly hybrid) electrified vehicles in 2008 and 29 in 2009. IHS Global Insight estimates the number of models will rise to at least 150 by 2014 and that at least 200 models will be available by 2019.

Based on our market by market forecast, which we detail in our November 2009 EV FITT report, we project the global automotive market for lithium ion batteries can grow to $66 billion by 2020, from virtually nothing today (<$50 million). This forecast is in line with other projections, including a $74 billion projection by industry consultant A.T. Kearney. We would note that this projection only requires ~25% penetration of hybrids, plug-in hybrids, and fully electric vehicles in the developed markets, and it incorporates a ~50% price decrease for batteries through 2020.

A123 Systems has distinguished itself as a leader in this burgeoning market, with an impressive list of companies including BMW, Daimler, SAIC, BetterPlace, Magna, BAE Systems, GM, and Chrysler in various stages of discussions or deployment of the company's products. Based on the company's win rate to date, we believe A123 systems could potentially achieve 10% or more of this market.

Figure 100: Hybrid (HEV), Plug-in Hybrid (PHEV), and Electric (EV) Models by year (HEV unless otherwise indicated)

2008 (13 Models)	2009 (29 Models)	2010 (61 Models)	2011 (98 Models)		2012 (119 Models)	
Ford Escape	Ford Escape	Ford Escape	Ford Escape	BMW 3 Series	Ford Escape	BMW 3 Series
GM Lg SUV's	GM Lg SUV's	GM Lg SUV's	GM Lg SUV's	BMW 5 Series	GM Lg SUV's	BMW 5 Series
GM Malibu	GM Malibu	GM Malibu	GM Malibu	Daimler C-Class	GM Malibu	Daimler C-Class
Honda Civic	Honda Civic	Honda Civic	Honda Civic	Daimler B-Class [EV]	Honda Civic	Daimler B-Class [EV]
Nissan Altima	Nissan Altima	Nissan Altima	Nissan Altima	Dongfeng Aeolus	Nissan Altima	Dongfeng Aeolus
Toyota Prius	Toyota Prius	Toyota Prius	Toyota Prius	Ford Flex	Toyota Prius	Ford Flex
Toyota Camry	Toyota Camry	Toyota Camry	Toyota Camry	Ford Focus [EV]	Toyota Camry	Ford Focus [EV]
Toyota Highlander	Toyota Highlander	Toyota Highlander	Toyota Highlander	GM Mid CUV's	Toyota Highlander	GM Mid CUV's
Toyota Estima	Toyota Estima	Toyota Estima	Toyota Estima	GM Sm CUV's	Toyota Estima	GM Sm CUV's
Toyota Crown	Toyota Crown	Toyota Crown	Toyota Crown	GM Lg Sedan	Toyota Crown	GM Lg Sedan
Toyota Lexus GS	Toyota Lexus GS	Toyota Lexus GS	Toyota Lexus GS	GM Volt [PHEV]	Toyota Lexus GS	GM Volt [PHEV]
Toyota Lexus RX	Toyota Lexus RX	Toyota Lexus RX	Toyota Lexus RX	GM Small CUV [PHEV]	Toyota Lexus RX	GM Small CUV [PHEV]
Toyota Lexus LS	Toyota Lexus LS	Toyota Lexus LS	Toyota Lexus LS	Honda Acura RL	Toyota Lexus LS	Honda Acura RL
	BYD E6 [EV]	BYD E6 [EV]	BYD E6 [EV]	Honda Odyssey	BYD E6 [EV]	Honda Odyssey
	BYD F3DM	BYD F3DM	BYD F3DM	Hyundai Tucson	BYD F3DM	Hyundai Tucson
	Changan Jiexun	Changan Jiexun	Changan Jiexun	Mitsubishi Colt	Changan Jiexun	Mitsubishi Colt
	Daimler S-Class	Daimler S-Class	Daimler S-Class	Nissan Serena	Daimler S-Class	Nissan Serena
	Ford Fusion	Ford Fusion	Ford Fusion	Nissan Infiniti M	Ford Fusion	Nissan Infiniti M
	Honda Insight	Honda Insight	Honda Insight	Nissan Fuga	Honda Insight	Nissan Fuga
	Hyundai Elantra	Hyundai Elantra	Hyundai Elantra	Nissan Van [EV]	Hyundai Elantra	Nissan Van [EV]
	Jianhuai Yuebin	Jianhuai Yuebin	Jianhuai Yuebin	Peugeot 3008	Jianhuai Yuebin	Peugeot 3008
	Mitsubishi iMiEV [EV]	Mitsubishi iMiEV [EV]	Mitsubishi iMiEV [EV]	Peugeot 408	Mitsubishi iMiEV [EV]	Peugeot 408
	Subaru Stella [PHEV]	Subaru Stella [PHEV]	Subaru Stella [PHEV]	Renault Kangoo [EV]	Subaru Stella [PHEV]	Renault Kangoo [EV]
	Tata Indica [EV]	Tata Indica [EV]	Tata Indica [EV]	SAIC Roewe 750	Tata Indica [EV]	SAIC Roewe 750
	Tesla Roadster [EV]	Tesla Roadster [EV]	Tesla Roadster [EV]	Subaru Legacy	Tesla Roadster [EV]	Subaru Legacy
	Tianjin Messenger [EV]	Tianjin Messenger [EV]	Tianjin Messenger [EV]	Th!nk Ox [EV]	Tianjin Messenger [EV]	Th!nk Ox [EV]
	Th!nk City [EV]	Th!nk City [EV]	Th!nk City [EV]	Toyota Avalon	Th!nk City [EV]	Toyota Avalon
	Toyota Lexus H	Toyota Lexus H	Toyota Lexus H	Toyota Tundra	Toyota Lexus H	Toyota Tundra
	Zotye Auto [EV]	Zotye Auto [EV]	Zotye Auto [EV]	Toyota Sequoia	Zotye Auto [EV]	Toyota Sequoia
		Bestrun B50	Bestrun B50	Toyota RAV4	Bestrun B50	Toyota RAV4
		BMW X6	BMW X6	Toyota Yaris	BMW X6	Toyota Yaris
		BMW 7-Series	BMW 7-Series	Toyota Lexus ES	BMW 7-Series	Toyota Lexus ES
		BMW Mini-E [EV]	BMW Mini-E [EV]	Toyota [PHEV]	BMW Mini-E [EV]	Toyota [PHEV]
		BYD F6DM [PHEV]	BYD F6DM [PHEV]	VW Polo	BYD F6DM [PHEV]	VW Polo
		Chery Qilin M1	Chery Qilin M1	VW Touareg	Chery Qilin M1	VW Touareg
		Chrysler Ram	Chrysler Ram	Volvo C30 [EV]	Chrysler Ram	Volvo C30 [EV]
		Chrysler Mid SUV	Chrysler Mid SUV		Chrysler Mid SUV	BMW MegaCity [EV]
		Chrysler / Fiat [EV]	Chrysler / Fiat [EV]		Chrysler / Fiat [EV]	Changan EV [EV]
		Coda Sedan [EV]	Coda Sedan [EV]		Coda Sedan [EV]	Chery ZC7050A [EV]
		Daimler M-Class	Daimler M-Class		Daimler M-Class	Chrysler / Fiat [EV]
		Daimler E-Class	Daimler E-Class		Daimler E-Class	Daimler Smart Fortwo [EV]
		Fisker Karma [PHEV]	Fisker Karma		Fisker Karma	Fisker Nina [PHEV]
		Ford Taurus	Ford Taurus		Ford Taurus	Ford Escape [PHEV]
		Ford Edge	Ford Edge		Ford Edge	GM / Reva JV [EV]
		Ford Transit Connect [EV	Ford Transit Connect [EV]		Ford Transit Connect [EV]	Hyundai [PHEV]
		Geely EK-1 [EV]	Geely EK-1 [EV]		Geely EK-1 [EV]	Nissan Infiniti [EV]
		Great Wall Oula [EV]	Great Wall Oula [EV]		Great Wall Oula [EV]	Peugeot [PHEV]
		Honda CR-z	Honda CR-z		Honda CR-z	Renault City [EV]
		Honda Fit	Honda Fit		Honda Fit	SAIC Roewe [PHEV]
		Hyundai Sonata	Hyundai Sonata		Hyundai Sonata	Tesla Model S [EV]
		Hyundai Accent	Hyundai Accent		Hyundai Accent	Toyota [EV]
		Kia Lotze	Kia Lotze		Kia Lotze	VW Porsche Cayenne
		Lifan 320 [EV]	Lifan 320 [EV]		Lifan 320 [EV]	VW Porsche Panamera
		Nissan Leaf [EV]	Nissan Leaf [EV]		Nissan Leaf [EV]	VW Passat
		Peugeot Ion [EV]	Peugeot Ion [EV]		Peugeot Ion [EV]	VW Up [EV]
		Peugeot Berlingo [EV]	Peugeot Berlingo [EV]		Peugeot Berlingo [EV]	VW Audi Sport [PHEV]
		Renault Fluence [EV]	Renault Fluence [EV]		Renault Fluence [EV]	Volvo V70 [PHEV]
		Tata Nano [EV]	Tata Nano [EV]		Tata Nano [EV]	
		Tianjin Siabao [EV]	Tianjin Siabao [EV]		Tianjin Siabao [EV]	
		Toyota Corolla	Toyota Corolla		Toyota Corolla	
		Toyota Auris	Toyota Auris		Toyota Auris	
		Toyota Sienna	Toyota Sienna		Toyota Sienna	
		VW Golf [PHEV]	VW Golf [PHEV]		VW Golf [PHEV]	

Source: Deutsche *Bank compilation from various news sources, company press releases, JD Power, Ward's Automotive, just-auto.com*

We are launching coverage with a Hold based on valuation. Valuing A123 Systems presents a unique set of challenges, given the nascent state of the automotive lithium ion battery market, given the fact that industry revenue won't accelerate until 2012 and beyond, and given the fact that automakers typically award production contracts to suppliers 3 years in advance. In other words, while we are convinced that the industry is poised for dramatic growth, and we see A123 as well positioned within this market, we acknowledge some uncertainty regarding the composition and trajectory of this growth.

Our DCF model arrives at a $17 target for A123's shares, but we can arrive at higher valuation targets based on revenue projections produced by third-party consultants. The US Department of Energy hired consultants to perform due diligence on A123's automotive battery products, and their commercial business prospects as part of their assessment of A123's Advanced Technology Vehicle Loan and Grant applications. As part of this process, the company provided the DOE and its consultants with a detailed business outlook, including business opportunities that were characterized as "Early Discussion", "Bidding", "Negotiating", and "Under Contract". The DOE consultants assigned probability weightings to each of these opportunities, with a relatively low weighting assigned to contracts in early discussion, and the highest probability assigned to contracts sourced for production. Figure 101 summarizes the outcome of this analysis: A $1.2 billion automotive revenue projection for 2012, $1.9 billion for 2013, and $2.8 billion for 2014. Adding this to our revenue expectations for other markets, one could derive a $1.5 billion revenue forecast for 2012, $2.3 billion for 2013, and $3.3 billion for 2014. Our financial model, from which we derive a $17 DCF-based target, incorporates a further haircut to these numbers, as noted below. Nonetheless, we note that incorporating the DOE consultant's targets could imply a DCF-derived target of approximately $30.

A "Blue Sky" scenario could theoretically get A123 to $100 by 2020, a 17% CAGR from current levels. This scenario is based on the following high level assumptions:

- A123 achieves $7 billion of automotive revenue in 2020, representing 10% of the $66 billion market for automotive lithium ion batteries in that year.
- We assume that A123 achieves an additional $3 billion of revenue from non-automotive sources (i.e. Grid Storage, Consumer).
- Applying a 9% operating margin would imply $900 million EBIT/$1.4 billion EBITDA.
- A 35% tax rate, and the company's current share count would imply EPS of approximately $5.00.
- At 20x earnings, this could imply a $100 stock late in the decade, implying 17% compound annual appreciation for the stock from current levels. In other words, today's stock price implies a 17% discount rate to a theoretical blue sky scenario.

Figure 101: Revenue by total opportunity / DOE-weighted / DB estimate

		2012			2013			2014		
		Total Bidding	DOE Wtd	DB Est	Total Bidding	DOE Wtd	DB Est	Total Bidding	DOE Wtd	DB Est
Automotive		2,605	1,227	592	4,380	1,939	955	6,486	2,834	1,586
Grid Storage	*	140	140	126	196	196	157	274	274	220
Consumer	*	115	115	69	132	132	93	152	152	122
Other	*	20	20	20	20	20	20	20	20	20
Total Revenue		**2,880**	**1,502**	**807**	**4,728**	**2,287**	**1,225**	**6,932**	**3,281**	**1,947**

* Total Bidding #'s were only provided for Automotive. Grid, Consumer, and Other figures displayed are A123 projections.

Source: Company Filings, Deutsche Bank

Valuation

Our $17 price target is based on a DCF analysis. We assume 8% terminal growth beginning in 2020 (given our projection that only 20% of global sales will be electrified in 2020, we believe that an 8% growth rate is reasonable). We assume a terminal EBIT margin of 8.0% and a weighted average cost of capital of 12.0%. See page 22 for full details.

Risks

As noted above, we believe that our assessment of A123's revenue/earnings prospects are reasonably conservative. Nonetheless, we acknowledge that it is not yet possible to model the company's growth trajectory with precision, particularly in the 2012+ timeframe, which is most critical to A123's valuation. Uncertainty regarding the product pipelines of certain high-profile customers, including Chrysler, adds to uncertainty, and has also led us to build a sizeable cushion into our estimates. Additional risks include the potential for margin pressure associated with the significant price deflation that we anticipate in the battery market. We address this concern in the pricing section of this report.

Advanced lithium ion battery background

Of all metals available for battery chemistry, the battery industry has long considered chemistries based on lithium to be the most promising. Lithium is widely available, it is not toxic, it is the lightest metal on the periodic table, it has a high specific energy content, and it possesses other desirable electrochemical properties. For these reasons, the majority of portable electronic products (mobile phones, laptops, portable medical devices, cordless drills) have rapidly shifted to lithium ion batteries.

Figure 102: Comparison of battery families – energy density and cost

Battery energy density and cost comparison

Energy Density	Cost	Charge Cycles
Lead Acid 30-40 wh/kg*	$/kWH 210	500-1000
NiCd 40+*	$/kWh 280	1000-2000
NiMH 71 WH/kg*	$/kWh 840	1000-2000
Li Ion 105-170 wh/kg**	$/kWh 650	2500+

Source:
*M. Keller and P. Birke, Continental Powertrain
**Deutsche Bank

Source: Continental Powertrain, Deutsche Bank

But traditional lithium ion batteries face challenges in more advanced applications

Although many batteries are generically referred to as lithium ion batteries, there is no generic standard. Consumer electronics batteries (i.e., laptops, cell phones) generally use lithium cobalt oxide cathodes. These batteries are excellent for short-lived (2-3 years) applications, in which a significant amount of energy must be released over an extended period of time. But there are constraints in applying consumer electronics type batteries for higher end applications such as automobiles. These constraints include issues related to performance, safety, durability, and cost:

- Performance: Although consumer lithium ion batteries can store significant amounts of energy (kWh), they are not inherently powerful (it is difficult to release this energy quickly) because lithium is not inherently conductive. The consumer electronics battery industry has overcome the conductivity problem by adjusting the chemistry of these batteries through the addition of other materials (typically cobalt). This has made them practical for certain uses. But power still needs to be limited (or more batteries with sophisticated and expensive controls need to be added for high power applications) in order to ensure safety. Typically, more power is needed in advanced applications, such as accelerating an automobile. Moreover, most lithium ion cells have difficulty operating at very low/very high temperatures.
- Safety: Overcharging, charging in extremely cold weather, short circuits, and other abuse conditions could destroy the battery and potentially cause “thermal runaway”, and fire (batteries contain combustible materials such as lithium, electrolyte solvents, and other gases).
- Durability: All batteries degrade over time. In conventional consumer lithium ion batteries, performance degrades by approximately 20% after 600-700charges—e.g., 2

years of cell phone charge and discharge cycling. Given the cost of large format batteries such as those required for automobiles, much greater durability is required: 300,000 charge/discharge cycles for HEVs, 2,500+ cycles for EVs, and 10+ year calendar lives are considered pre-requisites. Most automakers design extra margin into batteries in order to ensure they still meet minimum performance levels after degradation (GM's 16 kWh battery for the Volt only requires 8 kWh of capacity). But this adds considerably to battery size, weight and cost.

- Cost: The US Advanced Battery Consortium (USABC), a partially DOE-funded consortium of US automakers involved in funding battery research, has established a price target of $500/system for HEV batteries, and $1,700-$3,400 for 10-mile and 40-mile PHEV batteries. Today's batteries systems are still far from achieving these goals.

A123's technology addresses these deficiencies

Automakers, battery companies, and government/private sector research groups have been working on advanced batteries for automotive propulsion for nearly two decades. And these initiatives have accelerated over the past 5 years, as a result of an increased focus on fuel economy/CO2 reduction targets. While the industry's goals (i.e., goals established by the USABC) have not all been met, significant progress has been made in terms of durability, safety, power, energy density, and cost as a result of breakthroughs in battery chemistry and battery management. And there is a widely held expectation that battery technology will continue to improve at a rapid rate.

The advantage of iron phosphate

As of today, industry participants in the advanced lithium ion battery industry are often grouped into 4 broad categories, based on the formulation contained in the cathode: 1) NCA, or nickel cobalt aluminum; 2) NMC, or nickel manganese cobalt; 3) LMO, or manganese spinel, and; 4) LFP, or iron phosphate. **A123's technology falls within the LFP category.**

Figure 103: Lithium Ion Cathode Types – Advantages and Disadvantages

Chemistry	Wh/Kg	Positives	Negatives	Makers
Nickel / Cobalt / Alum (NCA)	160	Energy density Power	Safety Cost / commodity exposure Life Expectancy Range of Charge	JCI/Saft PEVE AESC
Manganese Spinel (LMO)	150	Cost Safety Power	Life Expectancy Usable energy	Hitachi, AESC, Sanyo GS Yuasa, LG Chem Samsung, Toshiba Ener1, SK Corp, Altairnano
Nickel Manganese Cobalt (NMC)	150	Energy density Range of Charge	Safety (better than NCA) Cost / commodity exposure	PEVE, Hitachi, Sanyo LG Chem, Samsung Ener1, Evonik, GS Yuasa
Lithium Iron Phosphate (LFP)	140	Safety Life Expectancy Range of Charge Material Cost	Low temp performance Processing costs	A123, BYD GS Yuasa, JCI/Saft Valence, Lishen

Source: AABC, DOE Merit Review

LFP had long been known as an inherently safe, stable, long lasting, and inexpensive material, but it has also been known to have deficiencies related to power and energy density. A123's innovations have been largely related to overcoming these deficiencies. Through nanotechnology, and through a proprietary niobium doping process, the company has produced batteries that are far more conductive (i.e., increased power), and which hold far more energy than many competitive products. These innovations have opened the door to a large number of high-end applications, as validated by A123's growing customer list.

Safety

LFP is generally regarded as the one of the safest chemistries for lithium batteries, because of the stability of the iron phosphate cathode. Auto companies are likely to be particularly attracted to this aspect of the company's technology given reputational risk as well as the financial risk associated with the launch of new technology (a manufacturing defect is less likely to necessitate a broad recall if the safety risk is minimal).

Cost

Although the processing cost of A123's nanophosphate chemistry appears to be high, we still believe LFP-based chemistries are likely to provide a cost advantage over time given the relative abundance and low cost of iron and phosphorus (see Figure 104). This cost advantage could become more pronounced if cobalt prices rise, owing to increased demand from the battery industry. We believe this cost advantage could become an increasingly important competitive factor as battery prices decline.

Figure 104: Cathode Raw Material Costs ($ per kWh)

	Cost/kWh (incl Li)	Cost/kWh (ex Li)
NCA	30.1	26.2
LFP	4.1	0.2
LMO	17.3	13.4
NMC	29.3	25.4

Source: Deutsche Bank

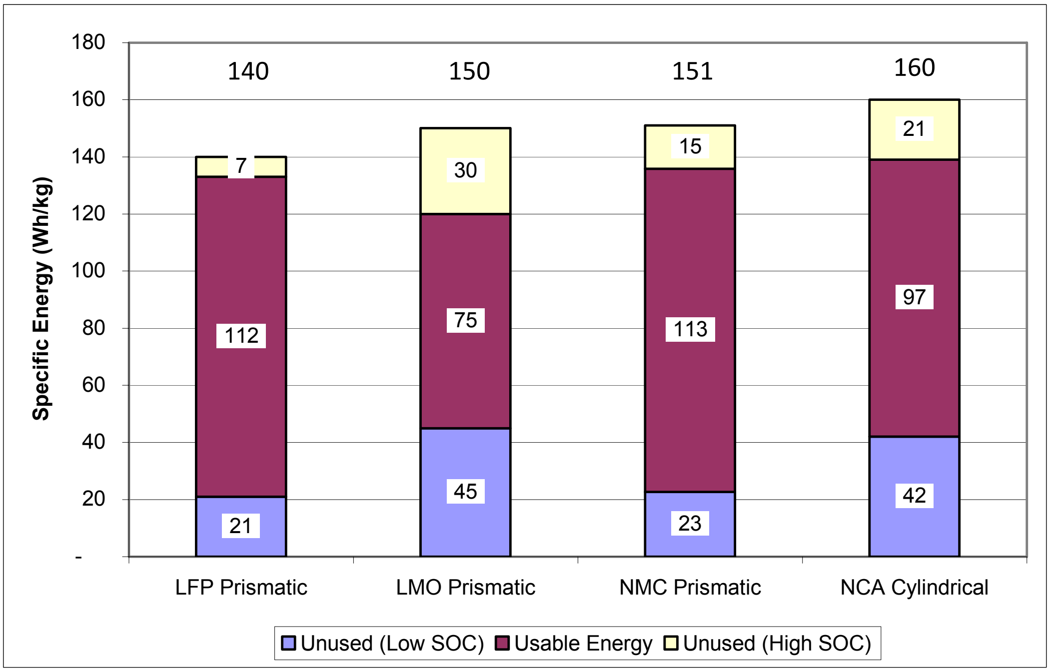
Life expectancy

LFP's attractive thermal characteristics and stability appear to facilitate longer life expectancy. While advanced lithium ion batteries are currently expected to achieve 2500+ full charge/discharge cycles, we have noted that the company is now achieving 7,000+ charge/discharge cycles in simulations (implies 19 years of life expectancy if a battery is charged and discharged fully every day). That compares with 700 charge/discharge cycles for consumer electronics batteries.

Energy density and useable energy

A123's prismatic battery cells are currently quoted as achieving 140 wh/kg of specific energy; somewhat lower than the 150-170 that we have seen for other chemistries, but significantly higher than the 110 wh/kg achieved by other LFP manufacturers. Importantly, however, LFP appears to be able to achieve a broader range of useable energy (a larger proportion of its total energy can be used), due to the battery's inherent stability at high state of charge (SOC) levels, and relatively flat voltage down to a low SOC (see Figure 105).

Figure 105: Energy Density, Nominal and Useable - Comparison of Cathode Types (figures at top are total Nominal Energy; figures in Red denote Useable Energy)



Source: Company Filings, DOE

Analysis of revenue outlook/customer relationships

A123 has focused on three key growth markets:

- Automotive (light-duty passenger vehicles and heavy duty trucks/buses)
- Electrical grid storage
- Consumer/portable power

While we see potential for dramatic growth in all three business segments, we believe the market for automotive lithium ion batteries will be the largest, by far.

Automotive

As detailed in our EV FITT report, we expect dramatic growth in the automotive market for advanced lithium ion batteries, as a result of several factors:

- We believe that government regulations/standards in the 2020 timeframe (in Europe, North America, and Japan) are unlikely to be achievable without significantly increased penetration of electric drive.
- We believe China, which is rapidly becoming a venerable market force in the global auto industry, is likely to adopt policies aimed at raising penetration rates for "Alternative Energy Vehicles", primarily consisting of PHEVs and EVs.
- We expect increasingly compelling financial incentives/penalties from governments—feebates, tax breaks, and congestion charges will become increasingly prevalent, providing an economic incentive for consumers to shift away from less efficient modes of transportation.

- Significant advances in battery technology/performance are likely to continue: Industry experts project a doubling of advanced lithium ion battery performance over the next 7 years.
- We expect a steep cost reduction curve for batteries (50% decline over 10 years), and electric drive components.
- Deutsche Bank's Integrated Oil Research Team sees potential for oil prices to rise dramatically—including potential for a brief spike to $175 per barrel—given limited excess supply, rising demand, and chronic underinvestment in new oil production capacity. We see the convergence of alternative propulsion technology, combined with rising oil prices, as a major catalyst for consumer and government behavior.
- A very large market opportunity appears to be developing through the emergence of new business models based on the cost advantage of electricity versus gasoline driving. Combined with government incentives already in place, these business models have the potential to dramatically lower the entry price for electric vehicles, potentially making them cheaper to purchase and operate.
- Several new US, European, and Chinese ventures have been formed to challenge established automakers in the EV arena, where they believe they can offer competitive and/or superior products. Several appear to be well capitalized, have experienced management (product development, procurement, and manufacturing experts from other automakers), and credible plans to achieve commercial scale.
- We also believe increased societal concern regarding environmental/climate risks can and will affect purchase decisions.

Figure 106: Diagram of battery-maker / automaker relationships (HEV: Hybrid / PHEV: Plug-in Hybrid / BEV: Pure electric vehicle (no internal combustion engine)). Note: Arrows represent investments in battery-making joint ventures.

Battery-maker	Joint Venture	OEM	Veh Type
Panasonic →	PEVE ←	Toyota	HEV / PHEV
		Subaru	HEV
Sanyo		Ford	HEV
		Toyota	HEV / PHEV
		VW / Audi	HEV
A123		BMW	HEV
		Chrysler	BEV
		Daimler	HEV / Buses
		GM	???
		Magna / Volvo	Buses
		SAIC	BEV / HEV
GS Yuasa →	Blue Energy ←	Honda	HEV
GS Yuasa →	Lithium Energy Japan ←	Mitsubishi	BEV
Hitachi →	Hitachi Veh Energy	Isuzu	HEV
Shinkobe / Maxell →		GM	HEV
LG Chem		GM	PHEV
		Hyundai / Kia	HEV / PHEV
NEC / NEC Tokin →	AESC ←	Nissan	HEV / PHEV / BEV
		Renault	HEV / PHEV / BEV
		Subaru	BEV
Ener1		Think Global	BEV
		Volvo	PHEV / BEV
		Fisker	PHEV
		AC Transit	BEV
		Zero Sport / Japan Post	BEV
Evonik →	Li-Tec ←	Daimler	HEV / BEV
JCI →	JCI / SAFT	Azure Dynamics	HEV
		BMW	HEV
		Daimler	HEV
		Ford	PHEV
Saft →		Jaguar / Land Rover	HEV
		Volkswagen	PHEV
Samsung SDI →	SB LiMotive	PSA	HEV
		BMW	EV
Bosch →		Ford	HEV / BEV
Toshiba		VW	BEV
BYD		BYD	PHEV / BEV

Source: Company Filings, Deutsche Bank

A123 has developed one of the most diverse customer lists within this market

Based on our review of business opportunities that are being discussed, being negotiated, or already awarded, it is our opinion that A123 has already positioned itself as a leader in the burgeoning market for automotive lithium ion batteries. We have noted for example that A123 already appears to have one of the broadest lists of OEM customers, a list that is characterized by:

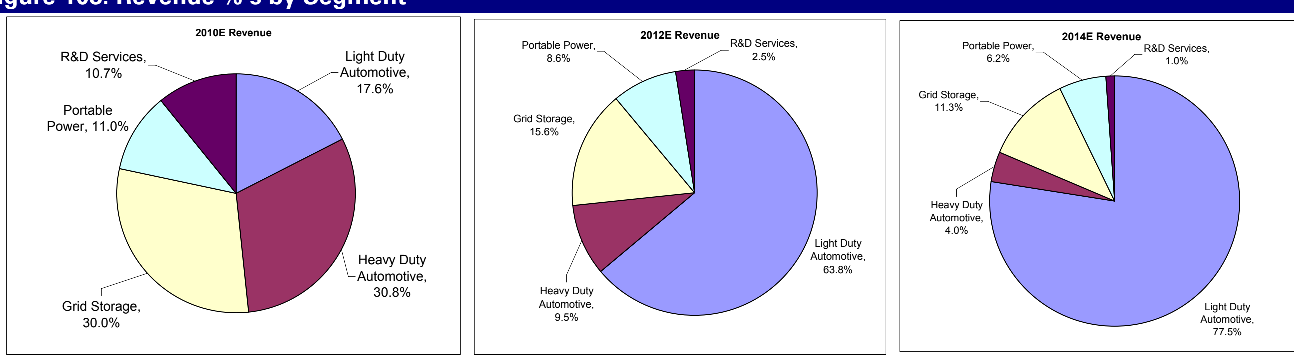
- Geographic diversification: A123's customers include several of the largest automotive OEMs in NA, Europe, and China.
- Vehicle diversification: Early contract wins have come from heavy duty vehicle manufacturers (mainly hybrid buses), which provide a steady, but manageable revenue ramp until large light vehicle contracts begin to launch in 2012 and beyond.
- Product diversification: A123 is one of the few battery-makers that appears to have business on all types of xEVs, ranging from mild hybrids to pure EVs. We view this as an indication of the strength of A123's technology. In addition, we believe this breadth should provide the company with a natural hedge, in case one type of vehicle achieves faster market uptake than another.

Figure 107: Revenue by business type ($ million)

	2008	2009E	2010E	2011E	2012E	2013E	2014E
Light Duty Automotive	6	12	26	102	515	878	1,509
Heavy Duty Automotive	4	35	46	58	77	77	77
Grid Storage	3	8	45	64	126	157	220
Portable Power	40	18	17	14	69	93	122
R&D Services	15	11	16	10	20	20	20
Total Revenue	69	85	150	248	807	1,225	1,947

Source: Company Filings and Deutsche Bank

Figure 108: Revenue %'s by Segment



Source: Deutsche Bank

Our analysis of A123's automotive opportunity set suggests the company should experience a significant increase in automotive revenue around 2012, at which time the company's automotive segments ($592 million) are likely to dwarf revenue from the consumer and grid markets ($195 million). Importantly, we reiterate that automotive supply contracts of this type are typically awarded 3 years in advance. In other words, there is still uncertainty regarding the ultimate magnitude of A123's revenue ramp. Nonetheless, we have confidence that our revenue forecast for A123 is likely conservative, based on positive feedback that we have received from potential automotive customers, and based on the relatively conservative volume assumptions underlying our forecast. **On this latter note, we**

point out that given relatively high average transaction prices for batteries, volumes do not need to be very high (by automotive standards) in order to achieve a significant revenue ramp. Even in 2012, we forecast average transaction prices approaching $14,000 for a light duty EV/PHEV, $20,000 for a hybrid bus, and $1,400 for a light duty HEV. Based on our analysis, A123 should be able to achieve our $800 million revenue projection ($600 million from automotive) with only 31,500 EV batteries, 57,000 hybrid batteries, and 3,900 bus batteries.

Figure 109 breaks down our automotive revenue projections for A123 by xEV type. This analysis also includes a 7% annual reduction in average transaction prices.

Figure 109: Volume and Market Share implications of DB's revenue forecast

	2010E	2011E	2012E	2013E	2014E
Vehicle Units implied by A123 rev fcst					
Lt Duty EV's / PHEV's	1,266	5,435	31,525	57,568	108,140
Lt Duty HEV's	3,750	14,382	56,726	106,646	179,320
Hybrid Buses	2,000	2,721	3,871	4,162	4,475
Price per unit ($) (assume 7% annual decline in price / cost)					
Lt Duty EV's / PHEV's	16,000	14,880	13,838	12,870	11,969
Lt Duty HEV's	1,600	1,488	1,384	1,287	1,197
Hybrid Buses	23,000	21,390	19,893	18,500	17,205
Revenue ($MM)					
Lt Duty EV's / PHEV's	20	81	436	741	1,294
Lt Duty HEV's	6	21	79	137	215
Hybrid Buses	46	58	77	77	77
Total Automotive	**72**	**160**	**592**	**955**	**1,586**
Grid / Consumer	77	88	215	269	361
Total Company Revenue	**150**	**248**	**807**	**1,225**	**1,947**
A123 Share of Global Auto Market for:					
Lt Duty EV's / PHEV's	1.2%	2.9%	5.8%	5.7%	8.1%
Lt Duty Hybrids	0.3%	0.9%	2.8%	4.3%	5.9%
Hybrid Buses	12.5%	10.9%	10.5%	9.2%	9.9%

Source: Deutsche Bank

Modeling A123 Systems revenue trajectory presents a number of challenges, given the nascent state of the automotive lithium ion battery market, given our view that industry revenue won't accelerate until 2012 and beyond, and given automakers typically award production contracts to suppliers 2-3 years in advance. Nonetheless, we are convinced that the industry is poised for dramatic growth, and we see A123 as well positioned within this market. Moreover, our industry checks suggest that the volume assumptions summarized in Figure 109 are likely conservative.

Automotive Contract A:

A123 was selected to be the battery supplier for SAIC's first hybrid, the Roewe 750, which launches in 2010. And given this position, we believe A123 is likely in a strong position to participate in follow-on contracts, including EVs and PHEVs that we expect from SAIC in the 2012 and 2013 timeframe. SAIC is China's largest domestic automaker, with close to 25% market share on its own and through its partners. And as we noted in the China section of our electric vehicle report, we believe China is likely to become one of the largest players in the world when it comes to electric vehicles. Consequently, we view A123's exposure to this domestic Chinese automakers as a key positive.

Automotive Contract B:
In April 2009 Chrysler announced that A123 would be the battery supplier for Chrysler's electric vehicles. This formalized a three-year relationship in which A123 had supplied prototype batteries to Chrysler's ENVI engineering group, and followed Chrysler's unveiling of 5 EV concept vehicles at the Detroit Auto Show in January 2009. At the time Chrysler indicated that they planned to bring one model to market in 2010, and that at least three additional models will follow by 2013. In addition, Chrysler indicated that their goal was to have 500k electric vehicles on the road by 2013 (including its GEM neighborhood vehicle division, which currently has 50k vehicles on the road).

While there is some uncertainty regarding the specific models that will be selected by Chrysler for electrification, and the volumes associated with those plans, we do not see a high risk of cancellation for Chrysler's electric vehicle strategy. In fact, we believe there is potential for Chrysler's electric vehicle platform to play a larger role with Fiat (Chrysler's new owner), a scenario that would further diversify A123's customer mix. Electrified vehicles appear to be central to Chrysler's product portfolio, as they facilitate the dramatic improvement in fuel economy that Chrysler has to achieve to meet increasingly aggressive corporate average fuel economy rules in the US.

Figure 110: The impact of EV's is enhanced by EPA's recent decision to assign 0 emissions to electric driving, as well as its decision to count each EV as more than 1 vehicle (they are considering 1.2x – 2.0x) in a company's fleet weighted average calculation. Chrysler must reduce its fleet average by ~20% by 2016. We have calculated that if 5% of Chrysler's sales are EV in 2016, it would enable the rest of their vehicles to only improve by 10%, instead of the 20% target.

	Current		2016	
	ICE	ICE	EV	Total
Volume (15mm unit mkt @ 7.5% share)	1,120,000	1,058,400	61,600	
Volume (incl 2x multiplier for EV's)			123,200	1,181,600
Average CO2 Emission (g/km)	243	221	0	198
Target				198

Source: Deutsche Bank

The revenue potential from a Chrysler contract could be significant, even if volumes are low by automotive standards (we assume volume of ~1,000 units in 2010, ~4,500 units in 2011, and 10k-15k units in 2012). Assuming that A123 sells full battery packs for approximately $15k-$20k per unit, A123 could potentially achieve $15 million revenue in 2010, $70 million in 2011, and approximately $200 million in 2012 on those volumes. We have assumed Chrysler's overall US market share could be in the 7%-8% range going forward, which would imply 900k – 1,200k units per year (based on a 15 million unit normalized market). If 5% of Chrysler's volume was EV's, this could translate to $700-$800 million of annual revenue for battery suppliers (note that this estimate incorporates a 25% battery price decline over this timeframe).

Automotive Contract C:
We believe A123 Systems holds production contracts to supply lithium ion batteries to power hybrid versions of a high-volume product from a mainstream European luxury OEM. These vehicles are expected to begin production in 2011. Production of the ICE versions of these products have ranged between 500,000-850,000 units per year over the last five years. We believe the battery will likely be sized at about 2 kWh, with an average transaction price

of $1,500 per battery. Assuming 5%-10% eventual penetration of the hybrid version, volume potential could reach the 35k-70k range, with associated revenue of $50-$100 million.

Automotive Contract D:
Micro-Hybrids are vehicles that save fuel by allowing the vehicle's ICE to completely shut down when idle, and instantly turn on when needed to propel the vehicle. These systems generally improve emissions performance by 5%-10%, are relatively cheap (<$500 per unit in most cases), do not require massive vehicle re-engineering (particularly in manual transmission applications), and thus are expected to become a significant contributor to meeting near-term emissions requirements. But they do require more advanced energy storage systems in order to power the vehicle's components (AC, lights, etc.) during idle, capture energy from regenerative braking, and restart the engine instantly when needed.

We believe the European market for micro hybrids has already achieved 5%-10% penetration, and many industry experts project a 50%+ penetration by 2015. Most of these systems are expected to use enhanced lead-acid batteries (such as valve-regulated lead acid batteries). However, these batteries have power/durability tradeoffs—durability is impacted when these batteries are used in power intensive vehicles, and/or support regenerative braking systems. In these cases, ultracapacitors and lithium ion batteries are being considered.

We assume A123 has potential to win at least one European micro-hybrid contract. The revenue per unit at only $350 per unit is low. However, volumes could be enormous, as these systems can potentially be implemented across an automakers' entire line. We believe that volumes of 150k-300k units are achievable, which would drive revenue of $50-$100 million per year.

Automotive Contracts E, F, G:
A123 currently has a relationships with BAE Systems for the Orion Bus (3,000+ sales, the highest selling hybrid bus in the world), Daimler for the Citaro Bus, and Magna for the Volvo 7700 bus program, providing it with close to 50% market share of all battery electric hybrid buses produced worldwide. We estimate these contracts collectively contributed $35 million of revenue in 2009, that they can increase to over $60 million by 2011, and nearly $80 million by 2014.

Contract H:
We are not explicitly projecting any A123 revenue from GM, or other global automakers, but we would point out that A123's batteries appear to be regarded highly by the industry (GM has had very positive comments regarding three battery suppliers: LG Chem, Hitachi, and A123). Thus, we are comfortable incorporating an assumption of at least one additional contract in 2012 and beyond. For modeling purposes, we assume $70 million revenue in 2012, ramping up to $360 million by 2014. We would note that this revenue assumption equates to only 29,000 EV batteries in 2014 (at $12,500 each).

Grid storage

There are two major applications for lithium ion batteries in the electrical generation/ distribution business:

- Bulk Energy storage: In these types of applications, energy is stored in a lithium ion battery for future use. This is particularly useful where the generation source is unpredictable, or tends to be strongest during periods of low demand (i.e., such as wind or solar). Although this market is potentially very large, there are competing technologies (such as sodium sulfur batteries) which are competitive with lithium ion in terms of performance, but at a price per kWh that is currently lower.

- Ancillary services: Utilities need to generate a steady supply of energy based on demand, but commonly experience brief rises and declines in supply or demand. Most utilities currently manage this variability by keeping up to 7% of their generation capacity off-line, and spooling this excess capacity up or down as necessary. Large arrays of lithium ion batteries called ancillary power units (APUs) can also be used for this purpose. As the grid experiences a spike, the APU delivers power into the system (happens in milliseconds). Using a battery to level out these fluctuations enables the power producer to operate power plants at a relatively steady, optimally efficient level (i.e., the power plant operates like a hybrid, with the battery supplementing the combustion system as needed). Adding an APU also allows a utility to add capacity (reserve capacity is not needed) without having to add generation assets, and often without any permitting. We believe that as wind and solar become more prevalent power sources, electricity supply will become somewhat more volatile, and the value of APUs will be further enhanced.

We believe A123 has reasonably good visibility on 2009 / 2010 / 2011 revenue of $8.4 million / $44.8 million / $64.0 million from the ancillary services market. We believe this is partly based on the company's relationship with AES, a global power company with generation, distribution, and service businesses. AES has already purchased 18 megawatts A123 batteries for APUs. And per AES's 10Q, we believe the company currently has an additional 500 MWs of APU projects in their capex pipeline (implies revenue potential of $1 billion for battery suppliers, assuming $2 million per megawatt). We assume AES sources half of its APUs from A123. In terms of the overall electrical grid storage market, we've seen estimates for this market as high as $100 billion in annual revenue by 2020.

Competitors in the APU market include Altairnano (using lithium ion) and NGK (using sodium sulfur batteries). We believe other lithium ion battery producers could be competitive with A123 in the ancillary services market. Sodium sulfur appears to have broad applicability in bulk storage, but it does not appear to have a sufficiently high C Rate (speed of charge / discharge) or round-trip efficiency to be effective in the ancillary services area.

Portable power/consumer products

A123 has supplied Black & Decker with batteries for cordless power tool products since 2005. Over that period, the company has shipped 10 million batteries, with an impressive quality performance (less than 10 battery-related defects). Revenue from sales to Black & Decker peaked at $30 million in 2008, but will decline in 2009 and future years, as A123 has decided to exit from their supply of 18650 batteries. There were essentially two types of batteries being supplied under this relationship: 1) A low-end, 18650-sized battery for run-of-the-mill consumer tools, and; 2) a high-end, 26650-sized battery for use in high-end contractor tools. While the 18650-powered tools have sold well, this is a commoditized battery type (similar to a laptop battery), and margins are not high enough to warrant continuing the program. A123 prefers to focus on higher-end applications and has licensed its 18650 technology to Lishen (a Chinese manufacturer). The 26650-powered tools, on the other hand, did not sell particularly well, due to a non-battery related issue that hindered the tools' ability to command the premium price required. A123 will continue to supply batteries for these products, but does not expect meaningful revenue growth.

We expect the portable power segment to be a mid-teen million revenue business through 2011. At that point, the company expects the business to grow substantially (to $100 million+ per year), driven by uninterrupted power supply (UPS) applications. The main source of revenue for this application is expected to come from internally embedded backup power units within IT-system servers. Currently, UPS units for servers are external to the servers and require AC/DC converters. They need to be external because the batteries have to be replaced often. Advanced lithium ion batteries are expected to have the calendar life capability to eliminate the need for replacement; therefore, the batteries can be placed inside the units, and the need for external batteries and AC/DC converters is eliminated.

We believe there are meaningful growth opportunities in this segment, but we have limited visibility and have therefore substantially discounted revenue expectations from this market in our projections.

Margin outlook

A123 is currently targeting a 25%-26% gross margin (vs. negative margins currently) by 2011. And with additional scale, the company believes its gross margin and operating margin could approach 30% and 10%-12%, respectively (includes R&D of 7%-9% of revenue and SG&A of 7%-9% of revenue). Incremental margins in this industry will likely be in the 30%-35% range, given that 65% of the cost of the battery is believed to be material, with the remaining 35% made up of labor (5%-10%) and overhead (25%-30%).

We have assessed these objectives against our understanding of A123's pricing and cost trajectory, and come up with somewhat more conservative assumptions: 25%-26% gross margin by 2012 (remaining relatively flat thereafter), and an operating margin in the high-6% range, rising to 9.5% by 2014. Factors that we have taken into account include:

- A123's steep revenue ramp, and our expectation of manufacturing inefficiency over this ramp-up period. We anticipate an 80% capacity utilization level during this ramp-up period, as the company prepares for growth, and we believe 3-4 points of margin could be subtracted due to under-absorbed overhead.
- Although we believe manufacturing capacity can be added in fairly small increments (explained in capacity section below), we see potential for significant variances from planned production in the near term, until the company builds a more diversified revenue base.
- Large automotive OEMs are notorious for squeezing the margins of their vendors, with the most successful suppliers (with strong organic growth and proprietary technology) achieving operating margins of 8%-9%.

Figure 111: Estimated AONE margins at a glance

	2009E	2010E	2011E	2012E	2013E	2014E
Gross Margin	-6.8%	9.7%	23.0%	26.2%	26.4%	26.7%
SG&A	-39.8%	-29.6%	-17.2%	-10.9%	-10.2%	-9.2%
R&D	-52.0%	-34.4%	-21.7%	-9.5%	-8.7%	-8.0%
EBIT Margin	-98.6%	-54.3%	-15.9%	5.8%	7.5%	9.5%
D&A	15.9%	14.0%	11.1%	4.1%	3.4%	3.3%
EBITDA Margin	-82.7%	-40.4%	-4.8%	9.8%	10.9%	12.8%

Source: Deutsche Bank

We believe that these margins can be sustained despite expected price deflation. Importantly, we believe A123 can generate these margins while also reducing their battery pricing significantly. We estimate current pricing for energy cells at approximately $450 / kWh, and $650-$750 / kWh for a full 25kWh battery system. This includes a gross margin (at scale) of approximately 30%, and a warranty of approximately 5 years (we estimate 2%-3% accrual revenue). A123 has acknowledged that negative pricing of 6%-7% per year is possible, which would lead to cell/system pricing of ~$300/$500/ kWh by 2014. Importantly, we do not believe that this level of cost reduction requires any technology breakthroughs.

Near-term cost reductions are expected in the following areas:

- Material supplier economies of scale: We believe purchasing economies of scale and reduce purchased component costs by 20%-30% over the next several years.
- Internal economies of scale—as factory processes become more automated, and utilization rates increase.
- Localized sourcing—lithium ion battery companies are spending significant amounts on freight/duty on materials sourced from Asia. We believe a US domestic material supply network will likely develop to support a growing manufacturing base in North America (A123, Dow Kokam, Enerdel, JCI / Saft, LG Chem, and Nissan/NEC. This will lead to scale in the supply chain, as well as lower freight / duty costs for the cell manufacturers).
- Design changes that remove components, and increase energy density.

There are literally hundreds of innovations being developed by battery companies aimed at achieving cost reduction at the cell level and at the pack level.

One way to convey the cost opportunity is to point out that battery industry engineers believe they are on a path to doubling the energy density of their batteries, which implies that half of the material (by weight) would go away for the same amount of storage capacity. A123's batteries, for example, currently use just 25% of the space inside of their cells to store energy. In 2001 their cells were only using 10% for energy storage. The rest of the material inside of the cell consists of binders, additives used to enhance conductivity, separators, electrolyte, etc. Many similar innovations have already been applied over the past 20 years in the consumer electronics battery market. For reference, laptop type (18650) lithium cobalt oxide batteries introduced by Matsushita in 1990 were achieving energy density of 90 wh/kg. Today's batteries typically achieve 232 wh/kg.

One specific example of cost reduction opportunity at the cell level has involved reducing the cost of separators (separators are membranes that are placed between the anode and cathode, but which still allow lithium ions to flow through them). These separators cost battery companies approximately $2 per square meter, and they account for 12%-16% of the material cost of a cell. The material cost involved in manufacturing these membranes is estimated at $0.20 per square meter, implying a significant cost reduction opportunity. In fact, over time many battery companies believe that it will be possible to remove the separator entirely, through the use of laminated electrodes.

Another cost reduction opportunity can be found at the pack level. Battery packs, which can cost up to $4,000 today for a large, 25 kwh system (20%-35% of the cost of a battery system), consist of mechanical systems (55% of the cost of the pack, including the cooling systems, fasteners, etc.), electrical connectors (8% of the cost of the pack), and electronics (37% of the cost of the pack is related to the battery management system, or bms). At low volumes, many of the functions within the BMS are carried out using discrete chipsets. Manufacturing of discrete chipsets involves relatively low tooling costs. But the cost of the system is higher. At higher volume, battery manufacturers will begin using application-specific integrated circuits, or ASICs, which are designed to manage many functions within the battery system. The tooling cost for ASICs is higher, but the overall cost of chipsets could decline by 80%.

Long-term technology/process improvements can also help battery companies maintain strong margins. We believe commoditization of advanced lithium ion batteries is not likely in the near to intermediate term, for a number of reasons:

- We believe that automakers will place a high priority on safety, durability, and performance; particularly at the outset of vehicle electrification strategies. The ability to produce a battery that mitigates safety concerns (even under vehicle crash conditions) and can perform up-to-spec for 10 years is a difficult task. And A123 appears to have a headstart in this area.

- A123 continues to improve the performance of its products in terms of specific energy (energy storage capability [watt-hour] for a given mass [kg] of battery). Lower mass will deliver lower cost, better vehicle performance, and better vehicle integration, all of which are highly valued by automakers.

Capacity planning

Capacity in the battery industry is generally measured in terms of kilowatt hours (kWh). A123 currently has capacity for 169,000 kWh, enough to produce the equivalent of approximately 7,000 electrical vehicle battery packs (at 25kWh per battery) or 85,000 hybrid battery packs (at 2kWh per pack). The company is planning a large, 3 million kwh US plant ($813 million capex plan) that will be funded primarily through a $249 million grant from the US Dept of Energy, an assumed $235 million US DOE loan, $22 million of grants from state and local governments, and $308 million of internal company funding.

Figure 112: A123 government-supported capex plan

DOE Grant	249
AONE Match - Grant (50%/50%)	249
DOE Loan	235
AONE Match - Loan (80%/20%)	59
Other Grants	22
Total	814
Memo: AONE contribution	308

Source: Company Filings and Deutsche Bank

We estimate A123's 3 million kwh plant will have a capacity to produce 120,000 EV battery packs or 1.5 million HEV packs per year. And we estimate this capacity will be able to produce revenue of $2.25 - $2.75 billion per year, depending on the mix of products (average transaction prices / kWh differ significantly), which would support our revenue projections through the 2014 timeframe.

Importantly, despite having plenty of capital available, A123 does not need to build-out this entire plant at once. We believe production capacity can be added relatively efficiently in 5,000 (EV equivalent) unit increments. This is due to the fact that battery cell production does not require large amounts of throughput to be economical. In fact, the biggest ticket items in battery cell manufacturing are the coating machines, each of which has an approximate capacity for 10,000 EV units per year, and costs $3.5-$4.0 million (about 6% of the capex cost is for coating machines).

Additionally, the coating machines are also the longest lead time items. All other equipment can be ordered and installed within approximately 6 months, which will also be helpful in attempting to match capacity with production.

Figure 113 illustrates our projections for A123 capacity and required capex funding (based on 80% utilization rates, because we assume capacity is in place approximately 6 months before they are necessary). We note that the revenue per kWh shipped looks high relative to our expected EV price per kWh of ~$500 in 2015. This is due to mix – we estimate grid revenue comes in at $2,000 / kWh and HEV battery revenue comes in at $800 - $1,000 / kWh.

Figure 113: Forecast of capacity needs, capital spending, and funding sources

	2010E	2011E	2012E	2013E	2014E	
US Capacity Needed (000 kWh's)	143	262	1,012	1,707	2,810	
US Shipments (000 kWh's)	107	209	810	1,366	2,388	
Capacity Utilization - Autos Only	75%	80%	80%	80%	85%	
U.S. Plant Capacity (EV Units @ 25kWh's)	5,490	10,066	40,498	68,295	112,389	
Total Revenue ($ millions)	150	248	807	1,225	1,947	
Revenue per kWh	1,248	1,139	971	882	807	
Capex Forecast (all in $ millions)	2010E	2011E	2012E	2013E	2014E	
Capex - New Facilities	109	167	154	220	164	
Capex - Maintenance / IT	33	13	20	20	30	
Total Capex	141	180	174	240	194	
Capex - % of Sales	94.5%	72.5%	21.6%	19.6%	10.0%	
Funding Forecast (all in $ millions)	2010E	2011E	2012E	2013E	2014E	Total
ABMI Grant	46	83	77	43	-	249
AONE Match - Grant (50%/50%)	46	83	77	43	-	249
ATVM Loan	-	-	-	108	127	235
AONE Match - Loan (80%/20%)	-	-	-	27	32	59
Other Grants	18					
AONE Funded - Other	33	13	20	20	35	121
Total	141	180	174	240	194	913
Grant Available	203	120	43	-	-	
ATVM Available	235	235	235	127	-	

Source: Deutsche Bank

Current cash levels appear sufficient through 2014

We believe the combination of funds raised through its IPO (~$385 million net) and expected DOE funding availability (~$483 million) should be sufficient to fund A123's operations and capex through 2014. Importantly, we also believe that once DOE funding is exhausted in 2013, A123 will be free cashflow positive, even assuming a relatively high (10% of sales) capex level to support growth in 2014.

In Figure 114, we look at free cash flow, with capex that is funded by DOE funds excluded (as this capex is essentially passthrough). We include capex funded by the DOE matching requirements, as obviously that is true cash out-the-door. We assume the grant funds are used first (exhausted in 2013) and then the loan is used to essentially fund 2013 / 2014 capex. The major cash use in 2010 – 2014 is the DOE match and working capital.

Working capital will likely be a drain on cash as long as the company continues to grow rapidly. We'd expect that growth in A/R and inventory (both forecasted at about 45 days) will outpace that of A/P and accrued liabilities (mostly warranty). We expect overall working capital as a percentage of sales to be approximately 5% beginning in 2014.

Figure 114: Cash flow projections ($ millions)

	2H09E	2010E	2011E	2012E	2013E	2014E
Cash Balance, beginning of year	114.9	477.3	345.9	244.5	205.4	234.6
OCF through 2011 ex W/Cap	(31.0)	(42.9)	6.9	94.5	150.3	239.8
Working Capital	32.2	3.7	(6.0)	(34.5)	(31.4)	(33.3)
Capex - DOE Match	-	(45.6)	(83.4)	(77.2)	(69.7)	(31.7)
Capex - Other	(20.7)	(32.6)	(13.2)	(20.0)	(20.0)	(35.5)
Cash Flow, ex DOE-funded Capex	(19.5)	(117.4)	(95.7)	(37.2)	29.1	139.3
Capital Raise / Debt Paydown	381.9	(14.0)	(5.7)	(1.9)	-	-
Cash Balance, End of Year	477.3	345.9	244.5	205.4	234.6	373.9
Total Non-ATVM Debt	21.5	7.6	1.9	-	-	-
Total ATVM Debt	-	-	-	-	108.0	235.0

Source: Deutsche Bank

Balance sheet

A123 had $25 million of debt as of 2Q09, and this is expected to be paid down to $0 by the end of 2011. We believe that the assumed $235 million DOE loan will begin to be drawn in 2012, and that it will be fully drawn by 2014. We believe the company will end 2014 with a total of $235 million of debt, accruing interest at approximately 4% (rate will likely be based on the 20-year treasury bond yield plus 0% spread).

A123's balance sheet, overall, is quite clean, with only ~$10 million of intangible assets/goodwill and no pension/OPEB liabilities. Net working capital is expected to be approximately 5% of sales. There is also a deferred revenue line ($26 million). This represents products shipped to customers for which revenue has not been recognized due to the company's inability to estimate a warranty cost.

Proforma capital structure

Pre-IPO owners hold approximately 70% of A123's 107 million basic shares, and shares sold through the IPO represent the remaining 30%. The pre-IPO ownership piece includes 9% insider ownership, and approximately 25% owned by 4 significant shareholders (Northbridge, GE, Qualcomm, and Motorola).

Figure 115: Estimated ownership structure, post-IPO

	# of Shares (ex options)	Ownership %
Northbridge Venture Partners	8,859,619	8.3%
General Electric	8,280,622	7.7%
Qualcomm Inc.	5,351,864	5.0%
Motorola Inc.	4,844,914	4.5%
Directors / Officers / Other assoc'd persons (ex options)	9,822,678	9.2%
Other Current Owners (< 5% ownership each)	37,585,851	35.1%
Total Current Ownership	74,745,548	69.8%
IPO Shares - Primary	31,727,075	29.6%
IPO Shares - Secondary	680,501	0.6%
Total Common Stock - Basic	107,153,124	100.0%
Dilution from Options and Warrants (TSM at IPO Price)	6,421,937	
Total Common Stock Equivalents (Fully Diluted)	113,575,061	

Source: Capital IQ, Company Filings, Deutsche Bank

Valuation

Our equity valuation of $1.9 billion ($17 per share) is based on a DCF analysis, which uses the following assumptions:

- Terminal growth year of 2020. We use our detailed earnings model to populate the years through 2014, and then use the growth projected by our global automotive lithium ion battery revenue model as a proxy for A123's growth rate through 2020.
- We assume a terminal growth rate of 8.0%. Given our projection that only 20% of global sales will be electrified in 2016 (9% HEV and 11% PHEV / EV), we believe an 8% terminal growth rate is reasonable.
- Terminal EBIT margin of 8%, and EBITDA margin of 11.7%.
- WACC of 12.0%
- In the terminal growth year, we estimate capex of 5.6% of sales; well above D&A of 3.7% of sales, which accounts for the spending required to support 8% terminal growth.

In the figure below, we go through an analysis to predict capex requirements in the terminal year. We project the new capacity in kWh required to fund 8% in annual growth (using $400 / kWh pricing). Then we use the company's capex $ per kWh from their current plan, assuming a 30% decline in capital equipment costs (from industry scale), to calculate capex required to fund growth. We assume maintenance capex is 50% of D&A, noting that capital equipment is expected to last far longer than the 8-year depreciation period. Additionally, capex required to maintain stable revenue is expected to be much lower than in the automotive business. In automotive, new vehicle programs often require new tooling. In the battery industry, changes to battery design do not generally require significant new machinery.

Figure 116: Analysis of the capex requirement to fund 8% terminal growth (all in $ million except New Capacity Req'd is in thousands of kWh's)

	2020E Revenue	8% growth	New Capacity Req'd (kWh)	$ per kWh (assume 30% reduction)	Growth Capex req'd	Maint Capex (assume 50% of D&A)	Total Capex Req'd	% of Sales
AONE	8,086	647	1,617	187	302	150	452	5.6%

Source: Deutsche Bank

DCF analyses are based on many assumptions, but we believe this is the most meaningful way to value this company given the ramp in revenue and profitability that we expect in 2012 and beyond. Using our target equity/enterprise value, we arrive at the following market cap/sales, EV/EBITDA, and P/E ratios:

Figure 117: Implied forward ratios, using DCF-derived EV of $1.4billion and Equity Value of $1.9billion, and comparing to DB-modeled Revenue, EBITDA, and EPS in 2010-2014

	FY2010E	FY2011E	FY2012E	FY2013E	FY2014E
Target Price / Sales	12.6	7.6	2.3	1.5	1.0
Target EV / EBITDA	NM	NM	17.9	10.6	5.7
Target Price / Earnings	NM	NM	59.6	32.7	16.7

Source: Deutsche Bank

Figure 118: Discounted Cash Flow Analysis ($ millions)

	2009E	2010E	2011E	2012E	2013E	2014E	2015E	2016E	2017E	2018E	2019E	2020E
Revenues	85.5	149.6	248.5	806.8	1,224.5	1,947.1	2,463.4	3,749.5	5,180.5	6,272.2	7,139.2	7,911.6
Revenue Growth		75.0%	66.1%	224.7%	51.8%	59.0%	26.5%	52.2%	38.2%	21.1%	13.8%	10.8%
Operating Expenses	169.7	230.8	287.9	760.3	1,132.4	1,762.8	2,230.2	3,394.5	4,766.1	5,770.5	6,568.0	7,278.7
Operating Income	($84)	($81)	($39)	$46	$92	$184	$233	$355	$414	$502	$571	$633
Operating Margin	-98.6%	-54.3%	-15.9%	5.8%	7.5%	9.5%	9.5%	9.5%	8.0%	8.0%	8.0%	8.0%
Depreciation and Amortizatic	$14	$21	$28	$33	$42	$64	$81	$126	$178	$221	$258	$293
EBITDA	($71)	($60)	($12)	$79	$134	$249	$314	$481	$592	$722	$829	$926
EBITDA Margin	-82.7%	-40.4%	-4.8%	9.8%	10.9%	12.8%	12.8%	12.8%	11.4%	11.5%	11.6%	11.7%
Taxes	($0)	$0	($2)	($17)	($31)	($62)	($82)	($124)	($145)	($176)	($200)	($222)
Working Capital	$3	($1)	$5	$40	$71	$104	$123	$187	$233	$263	$286	$309
WC to Sales	3.2%	-0.6%	2.0%	4.9%	5.8%	5.4%	5.0%	5.0%	4.5%	4.2%	4.0%	3.9%
Change \Working Capital	($7)	($20)	($6)	($34)	($31)	($33)	($19)	($64)	($46)	($30)	($22)	($23)
Capex to Sales %	50.4%	64.0%	38.9%	12.0%	16.1%	10.0%	10.0%	9.5%	8.5%	7.0%	6.0%	5.6%
CAPEX	($43)	($96)	($97)	($97)	($198)	($194)	($245)	($356)	($440)	($439)	($428)	($442)
Incremental Investment	($51)	($115)	($103)	($132)	($229)	($227)	($264)	($421)	($486)	($469)	($450)	($465)
Free Cash Flow	($121)	($176)	($117)	($70)	($127)	($41)	($32)	($64)	($39)	$77	$179	$240
Terminal Value												$5,994
Total Value	**($121)**	**($176)**	**($117)**	**($70)**	**($127)**	**($41)**	**($32)**	**($64)**	**($39)**	**$77**	**$179**	**$6,234**
Present Value		($157)	($93)	($50)	($80)	($23)	($16)	($29)	($16)	$28	$57	$1,792
Sum of PVs		**$1,414**										

Enterprise value	**$1,414**
Cash	($496)
Total Debt	$25
Shareholder Value	$1,885
Shares Outstanding	113.6
Per Share Value	$17

Normalized Assumptions			
Sales Growth	8.0%	Terminal Value	
Operating Margin	8.0%	WACC - g	4.0%
Tax Rate	35.0%	WACC	12.0%
W/C % Revenue	3.5%		
CAPEX % Rev.	5.6%		

Source: Deutsche Bank

Risks

We believe that our assessment of A123's revenue/earnings prospects are reasonably conservative. Nonetheless, we acknowledge that it is not yet possible to model the company's growth trajectory with precision,particularly in the 2012+ timeframe, which is most critical to A123's valuation. Uncertainty regarding the product pipelines of certain high profile customers, including Chrysler, adds to uncertainty, and has also led us to build a sizeable cushion into our estimates. Additional risks include the potential for margin pressure associated with the significant price deflation that we anticipate in the battery market. We address this concern in the pricing section of this report.

Downside Risks:

Current revenue projections rely on a limited number of customers, some of whom have selected A123 as a supplier, but have not signed production contracts. If A123 fails to achieve production contracts with significant customers, our revenue forecast could be at risk.

A123's products carry 3-5 year warranties in most cases, for which an expense is accrued based on reliability estimates. A123 holds product liability insurance up to an aggregate limit of $102 million. And A123 does not have product recall insurance.

Prototype to production scaling risk. There is a risk that A123 could encounter problems scaling to commercial production. We believe this risk is significantly mitigated by the company's experience in meeting production schedules for current customer Black & Decker and by key employees that A123 has hired who have experience working for other high growth companies.

Patent litigation / IP risk. Hydro-Quebec / Univ. of Texas has asserted that A123 has infringed on its patents. An unfavorable outcome of this case could impact gross margin estimates by 2%-3%. There is also the possibility that A123's manufacturing operations in China could put the company's IP at risk.

Our demand estimates rely on a belief that government regulatory actions will continue to favor low-emission vehicles and that the cost of lithium ion batteries will continue to decline. If either of these assumptions fail to materialize, our total market estimates could be lower than forecasted.

Significant competition from other battery-makers could force A123 to lower prices faster than its costs are declining. We expect, however, that demand will outstrip the supply of batteries for some time, mitigating the risk of negative pricing.

Upside Risks:

The primary upside risk is related to A123 achieving a higher win rate than we project. A123's total revenue opportunity appears to represents an approximate three-fold increase versus our estimates in 2012 –2014.

There could be potential for upside for the stock from existing business wins, as investors gain additional clarity / detail on them. We believe that our estimates for the grid and consumer markets are particularly conservative, and could experience upside.

Upside could also be derived from higher-than-expected consumer demand for vehicles on which A123 is the battery supplier.

Figure 119: AONE Earnings Model (all in $ thousands except per-share data)

	2009E										
	Mar	June	SeptE	DecE	2008	2009E	2010E	2011E	2012E	2013E	2014E
Product Revenue	20,121	16,517	20,065	17,486	53,514	74,189	133,557	238,480	786,750	1,204,513	1,927,127
R&D Services	3,099	3,185	2,500	2,500	15,011	11,284	16,000	10,000	20,000	20,000	20,000
Total Revenue	23,220	19,702	22,565	19,986	68,525	85,473	149,557	248,480	806,750	1,224,513	1,947,127
Cost of Sales - Product	19,570	19,616	23,272	19,795	70,474	82,253	120,681	182,208	577,695	882,986	1,409,866
Cost of Sales - R&D	1,844	2,661	2,250	2,250	10,295	9,005	14,400	9,000	18,000	18,000	18,000
Total Cost of Sales	21,414	22,277	25,522	22,045	80,769	91,258	135,081	191,208	595,695	900,986	1,427,866
Gross profit	**1,806**	**(2,575)**	**(2,957)**	**(2,059)**	**(12,244)**	**(5,785)**	**14,475**	**57,272**	**211,055**	**323,526**	**519,261**
Gross margin - Total	**7.8%**	**-13.1%**	**-13.1%**	**-10.3%**	**-17.9%**	**-6.8%**	**9.7%**	**23.0%**	**26.2%**	**26.4%**	**26.7%**
R&D Expenses	11,227	11,587	10,217	11,413	36,953	44,444	51,500	54,000	76,641	106,533	155,770
Sales & Mktg Expenses	1,982	2,245	2,025	2,163	8,851	8,415	9,700	10,400	33,884	48,981	73,991
General & Admin Expenses	6,283	5,999	6,140	5,712	21,544	24,134	24,000	24,400	54,052	75,920	105,145
Ramp-up Expenses		170	500	800		1,470	10,500	7,867	-	-	-
Total Operating Expenses	19,492	20,001	18,882	20,088	67,348	78,463	95,700	96,667	164,577	231,433	334,906
Operating Income	**(17,686)**	**(22,576)**	**(21,839)**	**(22,147)**	**(79,592)**	**(84,248)**	**(81,225)**	**(39,395)**	**46,478**	**92,093**	**184,355**
Operating Margin	**-76.2%**	**-114.6%**	**-96.8%**	**-110.8%**	**-116.2%**	**-98.6%**	**-54.3%**	**-15.9%**	**5.8%**	**7.5%**	**9.5%**
Interest Income	26	36	574	2,356	1,258	2,992	8,426	8,472	2,445	2,054	2,346
Interest Expense	(244)	(328)	(381)	(421)	(812)	(1,373)	(964)	(366)	-	(4,321)	(9,400)
Gain (loss) on F/X	(788)	673	-	-	(724)	(115)	-	-	-	-	
Unrealized loss on pref stock warrants	(48)	(22)	-	-	(286)	(70)	-	-	-	-	-
Pre-tax income	(18,740.0)	(22,217.0)	(21,645.9)	(20,211.4)	(80,156)	(82,814)	(73,762)	(31,289)	48,923	89,827	177,301
Tax provision	144	123	-	-	275	267	-	2,114	17,123	31,439	62,055
Tax rate	0.0%	0.0%	0.0%	0.0%				**-6.8%**	**35.0%**	**35.0%**	**35.0%**
Net income from operations	(18,884.0)	(22,340.0)	(21,645.9)	(20,211.4)	(80,431)	(83,081)	(73,762)	(33,403)	31,800	58,387	115,246
Minority Interest	147	427	-	-	(39)	574	-	-			
Net income to common holders	**(18,737)**	**(21,913)**	**(21,646)**	**(20,211)**	**(80,470)**	**(82,507)**	**(73,762)**	**(33,403)**	**31,800**	**58,387**	**115,246**
EPS from Continuing Op's	**(0.16)**	**(0.19)**	**(0.19)**	**(0.18)**	**(0.71)**	**(0.73)**	**(0.65)**	**(0.29)**	**0.28**	**0.51**	**0.99**
Basic shares	107,153	107,153	107,153	107,153	107,153	107,153	107,153	107,153	107,153	107,153	107,153
Dilluted shares outstanding	113,563	113,563	113,563	113,563	113,563	113,563	113,563	113,563	114,143	114,932	115,943

Source: Deutsche Bank

Figure 120: AONE Cash Flow Model (all in $ thousands except per-share data)

	2009E										
	Mar	**June**	**SeptE**	**DecE**	**2008**	**2009E**	**2010E**	**2011E**	**2012E**	**2013E**	**2014E**
Operations											
Reported net income	(18,884.0)	(22,340.0)	(21,645.9)	(20,211.4)	(80,432)	(83,081)	(73,762)	(33,403)	31,800	58,387	115,246
Depreciation and amortization	2,792	3,512	3,507	3,744	8,156	13,556	20,865	27,508	32,679	41,898	64,163
Other operating	807	(661)	(1,020)		4,356	(874)	-	1,691	13,698	25,152	24,822
Stock-based Comp	1,209	2,825	2,302	2,356	4,508	8,692	10,027	11,084	16,300	24,824	35,609
Change in working capital	(12,121)	88	21,121	11,118	19,210	20,206	3,679	(5,996)	(34,500)	(31,388)	(33,281)
Operating cash flow	**(26,197)**	**(16,576)**	**4,264**	**(2,993)**	**(44,202)**	**(41,502)**	**(39,192)**	**884**	**59,979**	**118,873**	**206,559**
Investing											
Capital expenditures (Net of DOE / Other G	(8,474)	(8,733)	(7,986)	(17,858)	(32,180)	(43,050)	(95,749)	(96,614)	(97,213)	(197,749)	(194,205)
Free cash flow	**(34,671)**	**(25,309)**	**(3,722)**	**(20,851)**	**(76,382)**	**(84,552)**	**(134,941)**	**(95,730)**	**(37,235)**	**(78,876)**	**12,353**
Cash used in acquisitions					476	-	-	-	-	-	-
Other investing	(2,664)	419	-	-	(167)	(2,245)	-	-	-	-	-
Dividends					-	-	-	-	-	-	-
Discretionary cash flow	**(37,335)**	**(24,890)**	**(3,722)**	**(20,851)**	**(76,073)**	**(86,797)**	**(134,941)**	**(95,730)**	**(37,235)**	**(78,876)**	**12,353**
Financing											
Increase (decrease) in borrowings	(601)	5,538	(1,458)	(1,458)	5,152	2,021	(13,832)	(5,630)	(1,860)	-	-
Increase (decrease) in cap leases	(123)	(155)	(619)	(30)	3,049	(927)	(120)	(61)	-	-	-
Increase (decrease) in gov't borrowings			-	-				-	-	108,020	126,980
Governmental Grants	3,000		1,370	3,739	-	8,109	17,500	-	-	-	-
Equity Issuances	(642)	99,500	385,484	-	114,817	484,342	-	-	-	-	-
Other					-	-	-	-	-	-	-
Net Financing flow	**1,634**	**104,883**	**384,777**	**2,251**	**123,018**	**493,545**	**3,548**	**(5,691)**	**(1,860)**	**108,020**	**126,980**
Effect of foreign currency	98	(22)	-	-	682	76	-	-	-	-	-
Net change in cash position	**(35,603)**	**79,971**	**381,055**	**(18,600)**	**47,627**	**406,824**	**(131,393)**	**(101,421)**	**(39,095)**	**29,144**	**139,333**

Source: Deutsche Bank

Figure 121: AONE Balance Sheet model (all in $ thousands except per-share data)

	2009E										
	Mar	June	SeptE	DecE	2008	2009E	2010E	2011E	2012E	2013E	2014E
Assets											
Cash and cash equivalents	34,907	114,877	495,932	477,333	70,510	477,333	345,940	244,519	205,424	234,568	373,901
Restricted Cash	3,361	2,976	2,976	2,976	766	2,976	2,976	2,976	2,976	2,976	2,976
Receivables, net	20,716	15,769	14,838	13,142	17,734	13,142	25,528	33,664	98,344	150,564	240,891
Inventory	43,127	41,663	47,212	34,972	35,724	34,972	45,150	40,747	96,283	126,141	176,233
Notes Receivable	-	-			-	-	-	-			
Prepaid Expenses and Other	3,299	2,745	2,882	3,026	5,101	3,026	3,679	4,471	10,000	15,000	20,000
Current assets	**105,410**	**178,030**	**563,840**	**531,449**	**129,835**	**531,449**	**423,272**	**326,376**	**413,026**	**529,249**	**814,001**
PP&E	60,454	66,172	70,650	84,763	52,705	84,763	159,648	228,754	293,288	449,139	579,181
Goodwill	9,581	9,581	9,581	9,581	9,581	9,581	9,581	9,581	9,581	9,581	9,581
Intangible Assets - Net	2,197	2,005	1,777	1,549	2,389	1,549	637	-	-	-	-
Deferred offering costs					-	-	-	-	-	-	-
Other Assets	14,043	13,405	54,840	50,239	14,232	50,239	37,320	48,453	48,453	48,453	48,453
Restricted Cash	217	215	215	215	216	215	215	-	-	-	-
Total assets	**191,902**	**269,408**	**700,904**	**677,797**	**208,958**	**677,797**	**630,673**	**613,164**	**764,348**	**1,036,422**	**1,451,217**
Liabilities					-	-	-	-			
Revolving credit lines	8,000	8,000	8,000	8,000	8,000	8,000	-	-	-	-	-
Curr portion of LT debt	4,590	7,058	7,058	7,058	4,629	7,058	7,058	1,860	-	-	-
Curr portion of Cap Leases	446	568	211	181	393	181	61	-	-	-	-
Accounts payable	20,351	11,466	23,272	21,994	19,472	21,994	31,766	31,104	82,528	110,373	176,233
Accrued expenses	13,684	13,719	27,788	26,393	14,381	26,393	43,515	42,706	82,528	110,373	156,652
Deferred Income Taxes									13,698	38,850	63,672
Deferred Revenue	11,152	11,050	4,513	5,596	13,051	5,596	17,519	21,463	55,073	60,226	57,814
Other Curr Liabilities (incl Def Rent)	474	363	530	470	566	470	1,144	2,475	1,611	21,281	59,302
Total current liabilities	**58,697**	**52,224**	**71,373**	**69,692**	**60,492**	**69,692**	**101,063**	**116,054**	**235,438**	**341,103**	**513,673**
Long-term Debt - Other	5,142	9,180	7,722	6,264	5,892	6,264	432	-	-	-	-
Long-term Debt - Gov't									-	108,020	235,000
Capital Leases	270	262	-	-	291	-	-	-	-	-	-
Deferred revenue	26,025	26,000	25,000	25,000	26,028	25,000	25,000	25,000	25,000	25,000	25,000
Other LT Liabilties	4,382	4,625	4,856	5,099	1,410	5,099	6,198	7,534	7,534	7,534	7,534
Preferred Stock Warrants	998	1,020	-	-	950	-	-	-	-	-	-
Total liabilities	**95,514**	**93,311**	**108,951**	**106,055**	**95,063**	**106,055**	**132,693**	**148,588**	**267,972**	**481,658**	**781,207**
Redeemable Preferred	255,832	357,475				-	-	-			
Redeemable Common	11,500	11,500				-	-	-			
Accum Deficit, Minority Interest, and AOCI	(170,944)	(192,878)	591,953	571,742	(152,216)	571,742	497,980	464,576	496,376	554,764	670,010
Total liabilities and S.E.	**191,902**	**269,408**	**700,904**	**677,797**	**208,958**	**677,797**	**630,673**	**613,164**	**764,348**	**1,036,422**	**1,451,217**

Source: Deutsche Bank

Company briefs: Automakers and battery-makers

US automakers

Chrysler

Chrysler's only hybrid entry is the Dodge Durango hybrid, a vehicle that uses a two-mode hybrid systems jointly developed with GM and BMW (similar hybrid system to GM's SUV and pickup hybrids). This vehicle, however, was only produced from August 2008 to December 2008, as all Durango production was shut down by Chrysler at 2008YE. We have no visibility on future Chrysler hybrid products.

In January 2009 Chrysler unveiled 5 EV/PHEV concept vehicles. At the time Chrysler indicated that they are planned to bring one model to market in 2010, and that at least three additional models will follow by 2013 (stated goal was to have 500k electric vehicles on the road by 2013 (including its GEM neighborhood vehicle division, which currently has 50k vehicles on the road)). The "E-Drive" system that was developed to power these vehicles was developed by an internal Chrysler engineering group called ENVI that was formed in 2005, when the company was still part of Daimler Chrysler. The E-Drive system is intended to be scalable across a variety of models / segments and the announced lithium ion battery supplier is A123 Systems.

While Fiat's purchase of Chrysler has brought significant uncertainty regarding specific EV models, volumes, and production timing, we do not see a high risk of the cancellation of Chrysler's electric vehicle strategy. In fact, we believe there is potential for Chrysler's electric vehicle platform to play a larger role with Fiat, potentially being used on Fiat vehicles, which would give the technology a larger geographic distribution. For example, there have been recent news reports stating that Fiat / Chrysler are jointly developing an electric vehicle, with Chrysler leading the development of the electric propulsion system.

Electrified vehicles appear to be central to Chrysler's product portfolio, as they facilitate the dramatic improvement in fuel economy that Chrysler has to achieve in order to meet increasingly aggressive corporate average fuel economy rules in the U.S. Chrysler must reduce its fleet average by ~20% by 2016. We have calculated that if 5% of Chrysler's sales are EV in 2016, it would enable the rest of their vehicles to only improve by 10%, instead of the 20% target.

Ford Motor Company

Ford has a very strong franchise in hybrid vehicles currently. The hybrid version of the Ford Escape / Mercury Mariner small crossover vehicle has been produced since 2004 and the Ford Fusion / Mercury Milan midsize sedan hybrid has been produced since March 2009. The combination of Toyota, Honda, and Ford control 90% of the US hybrid market, with Toyota generally running in the 65%-70% range, and Honda and Ford both in the 10%-15% range. Ford's hybrids are considered Full Hybrids (Honda's are mild, Toyota's are full). The Escape hybrid achieves 32mpg fuel economy (39% improvement over the non-hybrid version) and the Fusion achieves 39mpg (56% improvement over the non-hybrid version). We expect Ford to broaden its hybrid lineup with potentially a Taurus hybrid and Edge hybrid in 2010 and a Flex hybrid in 2011. Ford's hybrids use Nickel Metal Hydride batteries produced by Sanyo. We believe the company is strongly considering lithium-ion batteries for the next-generation versions of current hybrids, but are likely to be somewhat cautious about switching technologies given their strong current performance with NiMH-powered hybrids.

In terms of PHEV / EV, Ford announced plans more than a year ago for 3 PHEV / EV vehicles:

- Transit Connect EV: a light commercial all-electric vehicle intended to begin production in 2011 (potentially late 2010). Smith Electric Vehicles will be the battery system integrator. No lithium-ion cell / pack supplier has been announced as yet.
- Focus EV: a small sedan all-electric vehicle intended to begin production in 2011. Tier 1 supplier Magna will be the battery system integrator. No lithium-ion cell / pack supplier has been announced as yet.
- PHEV (likely the Escape): Ford currently has a demonstration fleet of Escape plug-in hybrids, which leads us to believe that Escape will be the vehicle type. JCI / Saft has been announced as the lithium-ion battery system supplier for this vehicle.

Ford has been cautious in terms of production targets for these vehicles, and we expect early production on each will be less than 10k vehicles per year.

General Motors

GM currently produces full hybrid versions of their large SUVs and large pickups. They also produce a mild hybrid version of the Chevy Malibu. GM's share of the U.S. hybrid market has been in the 4%-8% range in 2009. GM's plans for future hybrid models is unclear, but we do believe they will produce a range of mild hybrids using a belt alternator starter system (BAS), powered by lithium-ion batteries supplied by Hitachi. The BAS system is capable of providing modest power assist during launch and acceleration and provides approximately 15%-20% fuel. This system is currently used on the Malibu and was used on the Saturn VUE and AURA hybrids, prior to those vehicles ending production.

The Chevrolet Volt extended range electric vehicle (similar to a PHEV) is expected to begin production in late 2010. We believe the production target on this vehicle is approximately 50k-60k units per year. The Volt will have a 16 kWh battery produced by LG Chem. GM's system is expected to enable 40 miles of all-electric driving, with the range extended beyond 40 miles through a small ICE-powered generator which is used to recharge the battery during driving. We believe GM is planning additional vehicles using this system, but no plans have been announced as of yet.

US Battery suppliers

A123 Systems

A123 produces lithium iron phosphate (LFP) batteries for customers such as BAE Systems, Black & Decker, AES, and Daimler. The company appears to be an early leader in the hybrid bus market (its batteries are on approximately 50% of the hybrid buses produced to date) and electrical grid storage (AONE has shipped 18 mw's of Ancillary Power Units to its customer AES at $2 million per mw). It also has an impressive list of potential customers, including BMW, Daimler, SAIC, Better Place, Magna, and Chrysler. The company's commercial success so far has been impressive—particularly considering the fact that A123 competes against a number of large and well established competitors. Based on the company's win rate to date, we believe that A123 systems could potentially achieve 10% or more of the automotive lithium-ion battery market.

The company was recently awarded a $249 millon DOE grant and believes it will likely receive a $235 million low-interest loan from the DOE. With this funding (along with matching requirements), the company intends to spend ~$800mm to build a battery manufacturing plant in the U.S., likely to have the capacity to produce 3mm kWh's of batteries (120k EV-equivalent units per year). Given ~$380mm in proceeds from its recent IPO, we believe the company has enough capital to fund operations and its capacity plan through 2014, at which point we expect AONE to be approaching $2 billion in revenue.

For additional analysis on A123, please see our initiation report which is included in its entirety at the end of this report.

Ener1 Inc.

Ener1 produces NMC batteries for high-energy applications (such as EVs) and LMO batteries for high-power applications (such as HEV's). Ener1 will be amongst the first to achieve commercial production of EV and PHEV products (note that we expect the EV and PHEV markets to be significantly larger revenue opportunities), given its contracts with Fisker, Think, Volvo, and Japan Post (through Zero Sports), which will be ramping up in 2010 and 2011. In fact, we estimate that the company's contracts position them to secure a ~7% share of global PHEV / EV battery production through mid-decade.

Ener1 is currently the only lithium-ion battery company with meaningful production capacity in the US. And with recently awarded DOE grant funding ($119mm), and assuming additional loan funding (Ener1 has asked for $290mm), we expect the company could achieve 3.4 million kWh's of production capacity sometime after mid-decade (depending on supply requirements); enough to build approximately 135,000 EV units per year—on par with its two major US-based competitors: A123 and Johnson Controls. We expect Ener1 to reach capacity of approximately 1.7mm kWh by 2014, which should be sufficient to drive revenue of nearly $1.1 billion in that year.

For additional analysis on Ener1, please see our initiation report which is included in its entirety at the end of this report.

Johnson Controls / Saft

JCI / Saft is a 51% / 49% joint venture between Johnson Controls and Saft to produce lithium-ion cells and systems. The JV has a plant in France (opened in 2008 with a Euro 15 million investment) that currently produces battery systems for the Mercedes S400 and BMW 7-series hybrids, the first lithium-ion powered production vehicles from mainstream automakers. MB and BMW collaborated on these vehicles. The company's original cathode chemistry was NCA, but it has recently developed batteries using NMC and LFP cathodes.

The JV was recently awarded a $299mm grant under the DOE's ABMI program, which, along with $299mm in matching funds from the JV, will fund two U.S. facilities, each with an annual production capacity of approximately 70k EV-equivalent batteries (total of 140k). In addition to the MB / BMW vehicles (likely about 10k units per year total), JCI has been named the supplier to Ford for its Escape PHEV (start of production 2012), to Azure Dynamics, a converter of delivery vehicles for UPS and Fedex, and the partner to Jaguar / Land Rover on its first production HEV.

JCI / Saft is targeting revenue of $1bn per year and double-digit EBIT margins, time-frame to be determined by production plans of the automakers. The JV believes it can reduce battery cost to $500 / kWh in the relative near-term, with 75k systems per plant being the tipping point for economies of scale.

Valence Technologies

Valence is a producer of Lithium Iron Phosphate (LFP) cells and systems. The technology is similar to that of A123, but Valence adds Magnesium in their current battery and is working on developing a proprietary Lithium Iron Vanadium Phosphate technology. Although Valence's technology is promising, we believe the company is at a disadvantage to other US battery-makers, as it did not receive a DOE grant and it is not a participant in the USABC. Valence has a DOE loan application pending. The company produces its battery systems at two wholly-owned facilities in China.

The company's primary current revenue sources are sales of battery systems that power the Segway scooter (46% of $26mm revenue in FY2009) and Tanfield Group's Smith Electric Vehicles (16% of $26mm revenue in FY2009). The company appears to be focusing its strategy on commercial vehicle applications as well as opportunities to directly sell or license its proprietary cathode material to other battery-makers. To this end, the company is producing cathode materials for Lishen in China. At this time, we do not have significant visibility on Valence's future revenue trajectory.

Japan: Overview of products & projects

We can point to few tangible business models that have reached a stage of economic relevance and scalability without relying implicitly on taxpayer subsidies or need a significant increase in fuel prices to justify the consumer economics. We see Toyota and Honda's hybrid operations as at or close to this level after 10-12 years of development. The first Prius was launched in 1997, while the Honda Insight debuted in 1999.

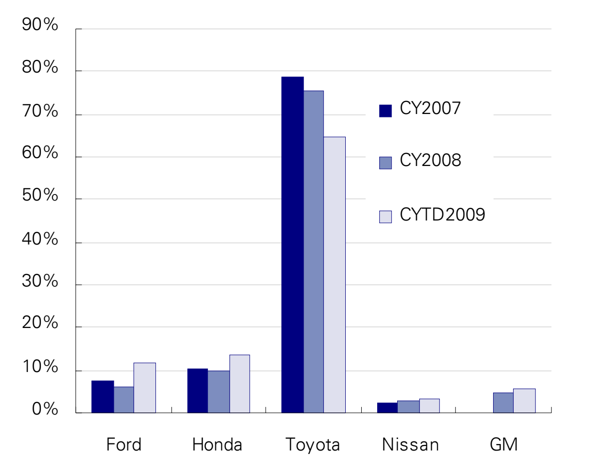
Toyota is the clear global leader in hybrid vehicle sales with Honda really only starting its volume push. Volume targets over the next several years are for 1 million units for Toyota, and 500k units for Honda. Overall volumes are getting a lift from strong demand in Japan in 2009 where we estimate hybrids will account for 10% of the market. This was helped by new models (mainly from the 3rd generation Prius and Honda Insight), as well as government support for fuel efficient vehicles. In 2008, hybrid penetration was a mere 2% of the Japan market. This shows how long it took for hybrids to come this far since the initial release of the 1st generation of Prius. Perhaps the experience of Japanese consumers with the adoption of a new technology is a good case study, as conservative consumers slowly overcame concerns with safety, reliability, and higher prices. 2009 also showed that government policy can help facilitate this transition.

Figure 122: J3: Global hybrid sales by model 2008

	Model	Global	Japan	US	Europe
Toyota	Prius	285,700	73,100	158,900	125
	Harrier/RX	35,100	3,800	15,200	107
	Highlander	21,000	-	19,000	-
	GS450h	5,070	1,310	680	134
	LS600h	8,410	4,300	980	81
	Camry	-	-	46,000	-
	Estima	10,900	10,900	-	123
	Alfard	1,440	1,440	-	40
	Crown	8,460	8,460	-	3,384
	Dina	480	480	-	466
	Toyo Ace	40	40	-	154
	Quick Delivery	620	620	-	81
	Total	**429,700**	**104,400**	**241,400**	**127**
Honda	Insight	2	1	-	25
	Civic	56,718	5,121	31,297	117
	Accord	211	-	198	-
	Total	**56,931**	**5,122**	**31,495**	**117**
Nissan	Altima	9,070	-	8,827	-

Source: Nikkan Jidosha Shimbun, Deutsche Securities

Figure 123: US hybrid vehicle sales market share



Source: Deutsche Bank

Both Toyota and Honda brought new hybrids (Toyota Prius and the new Honda Insight) to market in 2009. The way we view it is that the focus of gen-3 hybrid systems for each company was not to make major breakthroughs on hybrid performance, but rather to focus on cost. Part of the process was a concentration on reducing system size, while improving the output of each component of the system. We believe Toyota's and Honda's experience with electrification, gained over 10+ years of on-road testing, and the IP that has gone into both system design and system optimization, should not be underestimated. Given their current lead with hybrid technology, neither Honda nor Toyota appear eager to be at the leading edge of the latest EV push. Nonetheless, they believe they can react quickly with EV products if the market supports this product strategy.

Figure 124: Prius specs – Gen 1 to Gen 3

Feature		Generation 1st gen	1st gen	2nd gen	3rd gen
Body style		4-door Sedan	4-door Sedan	5-door Hatchback	5-door Hatchback
First sales		1997	2000	2003	2009
Battery	Modules	40	38	28	28
	Cells per module	6	6	6	6
	Total cells	240	228	168	168
	Volts per cell	1.2	1.2	1.2	1.2
	Total volts (nominal)	288	273.6	201.6	201.6
	Capacity amp-hours	6	6.5	6.5	6.5
	Capacity watt-hours	1728	1778.4	1310.4	1310
	Weight kilograms (kg)	57	50	45	NA
Gasoline Engine	Power kW/HP	43/58	52/70	57/77	73/99
	Max rpm	4,000	4,500	5,000	5,200
Electric Motor	Operating Voltage	288	273	500	650
	Power kW/HP	30/41	33/44	50/68	60/82
Combined	Power kW/HP	NA	73/98	82/111	100/136

Source: Company data, Deutsche Securities

This focus on cost shifts the debate to how profitable they are versus how big the losses were on previous generations. Given its focus on simplicity and cost perhaps at the expense of incremental fuel economy improvements, we believe the Honda Insight project is profitable. Indeed, in Japan the company claims higher margins on the Insight than the Fitt subcompact given the availability of a cheap, low-end version of the latter in the domestic market. The hybrid system for the Insight is assumed to cost $2,200, of which we estimate roughly $700 is the battery while the remainder includes the motor, inverter, ECU and other components. Honda claims to have reduced the cost of the system from the Civic Hybrid by 50%. For instance the Insight battery reduced its modules from 11 to 7 from the Civic Hybrid while increasing output and durability by 30%.

Toyota says that the progression from gen1 to gen2 was a 50% cut, while gen2 to gen3 achieved a 30% cut. While Toyota is less forthcoming about the cost of its system, local media reports have put it at twice the cost of the Honda Insight. The battery and motor components alone support this view with the Prius using two motors and a battery with twice the size (in kWh) of the Insight. While Toyota claims about average profitability for the Prius, we know that the supplier base continues to be in the red with annual volume of 1m units a critical target for the entire project. Indeed, it is our experience with the supplier base that makes us cautious on assuming quick profits for EV as each generation of the Prius required significant redesign of components as the hybrid system progressed.

In Figure 125, we compare the Prius to the Insight. Both systems use NiMH batteries. The Prius uses 168 cells of their NiMH battery against Honda Insight using 84 cells. The capacity of a single NiMH battery cell used for the Prius is slightly higher than the Insight and total battery energy per vehicle calculates to 1.3kWh for the Prius while it is roughly half at 0.6kWh for the Insight. We estimate that the battery for the Prius system comprises about 45% of the cost of the system, while for Honda that ratio is closer to 35%.

Figure 125: Toyota Prius and Honda Insight specification

	Prius	Insight
Basic Spec		
Weight	1310kg	1190kg
Passenger	5	5
Transmission	Electronic CVT	CVT
Fuel Efficiency		
10.15mode (mpg)	38km/l (50mpg)	30km/l (41mpg)
Battery		
Type	NiMH	NiMH
Modules	28	7
Voltage	201.6V	100V
Capacity	6.5Ah	5.75Ah
Estimated battery energy (kWh)	1.3	0.6

	Prius	Insight
Engine		
Type	4cyl DOHC	4cyl SOHC
Displacement	1,797cc	1,339cc
Max output	99hp/5200rpm	88hp/5800rpm
Max torque	142Nm/4000rpm	121Nm/4500rpm
Motor		
No. of Motors	2	1
Output	82hp	14hp/1500rpm
Torque	207Nm	78Nm/1000rpm
Combined output	134 hps	98 hps

Source: Company homepage, Deutsche Securities

While Toyota and Honda are the only makers to reach critical scale, other Japanese manufacturers have also progressed with vehicles. Here we see a similar trend as in other markets where brands that have lagged in hybrid development are putting effort into EV. Nissan is the most ambitious in this area in volume terms while Mitsubishi is actually the first to market Honda and Toyota will not be quick to follow on this path. However, we do expect to see the Toyota PHEV by year-end.

Figure 126: Major current EV, PHEV model specifications

Automaker	MMC	FHI	Nissan	Toyota
Model	iMiEV	Plug-in Stella	Leaf	PHEV (1.8l engine)
Dimension (mm)	3395X1475X1610	3395X1475X1660	4445X1770X1550	4460X1745X1490
Vehicle weight (kg)	1100	1010	NA	NA
No. of passengers	4	4	5	5
Drive system	Rear	Front	Front	Front
Max Speed (km/h)	130 (81mph)	100 (62mph)	over 140 (87mph)	NM
Travel distance (10.15 mode)	160km/charge	90km/charge	160km+/charge (USLA4 mode)	20km/charge** on electricity only
Motor	permanent magnet synchronous motor			
max output (kW)	47	47	80	60 (Engine=73kW)
max torque (Nm)	180	170	280	207 (Engine=142Nm)
Battery	Li-ion	Laminate type Li-ion	Laminate type Li-ion	Li-ion
Cathode Chemistry	LMO	LMO	LMO	NCA
Anode Chemistry	Hard Carbon	Hard Carbon	Hard Carbon	Carbon
Total Capacity (kWh)	16	9	24	NA
Total Voltage (V)	330	346	345	NA
No. of cells	88	192	192	NA
Charge time	14hr (AC100V)	8hr (AC100V)	16/8hr (AC100V/200V)	3 / 1hr40m (AC100V/200V)**
Quick charge time	30min, 80% (200V 50kW)	15min, 80% (200V)	30min, 80% (200V)	NA
Price (ex subsidies)	¥4.60mn	¥4.73mn	NA (battery to be leased)	NA
Price with subsidies***	¥3.20mn	¥3.33mn	NA (battery to be leased)	NA

* Production model expected to have a li-ion battery
** Target property
*** Not including eco tax reductions.

Source: Company, Various news sources, Deutsche Securities

Japan: Cost structure for Li-ion – view and targets from Japan

In order to make most of the above projects profitable realities, it is a widely held view that the cost of the battery must be lowered considerably. The New Energy and Industrial Technology Development Organization (NEDO) in Japan has a working group for next generation batteries targeting auto aimed battery cost to decline to $330/kWh (¥30k/kWh) by 2015 which seem very competitive compared to US battery maker estimated pricing even if it does not reach as low as the actual target.

Automotive battery cost in Japan is reported to be roughly $1,100/kWh (¥100k/kWh) in 2010 while 100k units of production is assumed to be necessary to bring down the cost by half, according to GS Yuasa. Current price quotes to customer from US makers is closer to $650/kWh, we understand. The difference appears to be quotes based on actually current cost for GS Yuasa versus competitive price bids to get new business at other makers. Looking at the 2015, GS Yuasa targets costs of $550/kWh (¥50k/kWh) at 100k unit production level, which is more in line with estimated price levels of US companies at approximately $500/kWh, suggesting with volume these various makers see similar potential.

Japan: Automakers

Toyota Motor (7203) – High volume business model in place

Toyota is ramping up a high-volume strategy for alternative powertrain vehicles based on its existing (NiMH battery based) hybrid system. This puts it in a position to make an economic return on fuel efficient vehicles at the same time it is developing next-generation products, a rarified position. The company will have capacity to build 1mn hybrid units by mid-2010 in advance of offering its first plug-in hybrid to individual buyers. When it comes to proliferation of lithium-ion based propulsion systems the company is more cautious. Toyota does not believe that lithium ion batteries offer a critical enough breakthrough regarding the balance of cost and performance for mass-market hybrids like the Prius, while it is exercising its traditional degree of caution assessing the suitability of lithium for mass market PHEVs and EVs. Whether or not Toyota has fallen behind others in the development of next generation batteries is currently a source of debate. Clearly, Toyota is in the position of having to defend its sizeable investment in its existing (hybrid) technology, so there is reason to view Toyota's public statements regarding EVs and lithium batteries with healthy skepticism.

Figure 127: Toyota HEV/PHEV/EV product plans

2009	- new Prius in May - Sale start of the Lexus HS250h hybrid (Domestic: July release 500units/month sales target, US: Sept release 2400 units/month target) - PHV model start fleet sales. Initial lot 500 units total (breakdown: JP 200 units, US 150 units, Eu 150units) - Release of the SAI model in Japan
2010	- Start production of the Auris hybrid in UK from mid 2010 (20-30k units initially) - Reach 1mn units worth of hybrid NiMH battery capacity at PEVE
2011	- Support FHI to release hybrid variant of FHI car models. - Release of the Yaris hybrid in US and Japan - Release of a hybrid only mini-van
2012	- Release of an EV model - Small SUV hybrid - Start mass production of PHEV 20k-30k target to begin with
2013	- Possible supply of HV system parts to Mazda
Other	- Set up a Hybrid variant for all models by early 2010s

Source: Fourin, Various news sources, Deutsche Securities

Toyota's accumulated sales of hybrid models though Aug 31 has reached over 2 million units (since 1997). The company currently sells 13 hybrid models in approximately 50 countries. We expect Toyota's annual sales of its base NiMH battery system hybrids to top 1m by 2012. Toyota is also developing a plug-in hybrids using a lithium-ion battery system, a product we expect to see in small fleet volume from early 2010, and sold to the public by 2012. The company is reportedly testing the lower limit of the battery-only driving range necessary for PHEVs, to understand the best balance between battery capacity and cost. It showed the latest iteration of its Prius PHEV at the Frankfurt Motor Show. The model will drive in full EV mode up to 20km before reverting to a base hybrid system while emitting less than 60g/km of CO_2. Toyota claims a full charge will take less than 1.5hrs (at 230V). The company is also viewing EVs for a possible 2012 release.

Honda Motor (7267) – Lead in ICE, hybrid, fuel cell; follow in EV

With the release of the Insight in February, Honda has started on its strategy to expand in low-cost mild hybrids. We estimate the system cost for the new Insight is approximately $2,200, with about 30-35% of that accounted for by the battery cost. New models in 2010 will include the CR-Z sports coupe and the Fitt hybrid, both based on the existing Insight system using a NiMH battery. Honda's mid-term target is for 500,000 units of its current IMA hybrid system. The Blue Energy battery JV with GS Yuasa is planned to start lithium-ion battery production at the end of 2010. Output is expected to start slowly and ramp up to HEV capacity of 200-300k units by an unspecified time. What is clear is that Honda feels that sufficient durability testing must be undertaken before substituting these new products for the proven NiMH batteries. Speculation on which product it could be offered in includes the Fitt, the next generation Civic hybrid or a mid-large car system. Honda's strategy is clearly to develop various areas of electrification including HEV, EV, and fuel cell while waiting for the regulatory environment to become clearer. To its benefit it has strong brand recognition in its key N. American market.

Honda believes the ultimate environmentally friendly car is a fuel cell car, but it is pragmatic enough to realize a lack of infrastructure development will be an impediment considering the lack of advancement by other automakers. As such it is advancing the developing of its EV with a targeted US launch reportedly in 2015. In an attempt to meet California regulations, Honda was one of the first with an EV in the 1990s with the EV1 (133 units in 1998, behind GM EV1's 264 units). Based on customer feedback, Honda is skeptical that lithium-ion batteries present enough of an advancement to meet consumer demands for driving distance and charge time. Because of this, we believe Honda does not see merit in trying to be a segment leader before sufficient infrastructure is in place and potential advancements are clearer. It does not seem concerned about being locked out of the market by patents and it considers its own advancements in electric motors as a core future technology. In the meantime, Honda will use its existing strengths in key markets using improvement in ICE (direct injection, 6-speed AT, etc) and proliferation of its hybrid system as its core strategy. Indeed, Honda is already in compliance with US2012 targets and believes it can clear US 2016 regulations with ICE improvements and a hybrid penetration rate around 10%. In some ways we see Honda's hybrid strategy as ahead of its time with a focus on cost, rather than maximizing fuel economy. To us this system fits an era where cars have to have the system to meet fuel economy/emission standards so cost becomes critical, more so than in the current era where hybrid purchases are generally volitional, centered on well-off buyers who are not as price sensitive. Honda's challenge will be to develop a system for large cars, a challenge all makers face.

Figure 128: Honda HEV/PHEV/EV product plans

2009	- Release of the Insight HV
2010	- Release of the CR-Z hybrid in Feb - Release of the Fit/Jazz hybrid(Autumn) - Start-up of Blue energy battery JV production in Autumn
2011	- Renewal of the Civic hybrid
2012	-
2013	-
Other	- Release of a Freed based hybrid, timing unknown - Clean diesel release delay - Considering an Acura brand HV - Considering a 2 motor hybrid system development for mid large size hybrid - Reported to be planning an EV model for release in the early 2010s to the US mark

Source: Fourin, Various news sources, Deutsche Securities

Nissan Motor (7201) – Bullish on EVs

Nissan believes the future is big for EVs, having performed a similar cost analysis to our own, we suspect. Nissan believes the cost curve will bring the price of batteries down sharply and improve the economics for the auto buyer. While Nissan is very vocal on its EV plans, it lags its peers in hybrid technology. Its only existing model is the Nissan Altima based on Toyota technology with only limited availability in the US market. Some progress is being made with a rear-wheel drive hybrid system expected to be available on the new Infiniti M in 2010. The company has also reportedly been planning a front-wheel drive hybrid system for midsized cars, but has not been clear on its strategy in this area. In comparison neither of these programs is as clear as Nissan's target of 200k units for the Leaf EV.

Nissan is the most aggressive in its EV strategy amongst its peers. In terms of marketing strategy, Nissan is considering a business model where the customer buys the car but leases the battery. This would make the vehicle more affordable while making the monthly battery lease payments commensurate with monthly fuel costs. The plan is to release their Leaf model by the end of 2010 in the US, Europe and Japan targeting initial production of 50k units. Beyond this, Nissan aims to produce EV in at least four global locations and targets a 200k units/year by 2012. Based on an all-new platform, the Leaf needs to achieve sufficient volume to offset development costs. There are potential benefits for the entire model range. Modest progress towards its US goals should help the company meet its emission mandates, especially if EVs are afforded a multiplier as we discuss in the US regulatory section.

While we are not sure that Nissan is more technically advanced in EVs than other automakers, the company does appear to be ahead of the curve politically and strategically. Strategically it has begun to lay out a very ambitious capex plan for battery supply in Japan, the US, and Europe. The plans for overseas expansion are supported by low cost loans including $1.6bn from the US Department of Energy, of which $1.1bn alone is for tooling. Politically, it has a growing list of cooperative agreements with countries and cities. It is our understanding that none of these agreements offer guarantees on exclusivity. Rather, Nissan sees efforts to develop infrastructure as beneficial to the growth of the segment, and for Nissan.

Figure 129: Nissan HEV/PHEV/EV product plans

2009	-
2010	- FR hybrid release based on the Fuga - EV release in JP, US, Europe (50k units/year start)
2011	- Considering a FF(possibly Serena) hybrid
2012	- EV global release - Start production of EV in US Smyrna plant 150k units capacity with 200k units battery capacity - Start production of EV batteries and EVs in UK and Portugal (60k units worth of batteries in each plant)
2013	-
Other	- Clean diesel plan delay from initial plan of FY3/11 (US, China) - Zero emission mobility cooperation agreement with Singapore, Yokohama, Israel, Denmark, Portugal, Monaco, UK, France, Switzerland, Ireland, China, Hong Kong and US(Tennessee, Oregon, California-Sonoma, San diego, Arizona, Pheonix, Seattle, North Carolina) - Renault to stop developing Fuel cell and Li-ion batteries and rely on Nissan for development. - Nissan to set HV variant for most FR models.

Source: Fourin, Various news sources, Deutsche Securities

Figure 130: Nissan Leaf EV

Source: Deutsche Bank

Figure 131: Nissan Leaf EV

Nissan revealed the production model of its Li-ion battery based EV called the "Leaf" on 2 August 09. The Leaf allows up to five passengers and has a driving range of 160km/charge. The battery charger is in the nose of the car and takes roughly 8/16hours using a 200V/100V household charger for a full charge. Alternatively, through a rapid charger it can be charged up to 80% of capacity in 30-minutes. But such rapid charges seem to be prohibitive for household use due to cost (estimated installation cost reported at $45k) and infrastructure issues.

Source: Deutsche Bank

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Suzuki Motor (7269) – Moving on without GM

Suzuki is a major manufacturer of mini vehicles (vehicles with under 660cc engines) which are on average more environmentally friendly than non-minis due to their smaller size and small 660cc engines. Unlike Mitsubishi motors and Fuji Heavy Industries, which recently released a mini vehicle-based EV model, the company has recently announced instead their non-mini Swift-based plug in hybrid concept at the Tokyo Motor show. The model can be seen to be using both the company's know how in mini as well as non mini vehicles since this series plug-in hybrid system is reported to have a mini vehicle based 660cc engine as the generator after the initial 20km EV range is used up. This hybrid system has been reported as being self developed, and does not use the hybrid system being developed by their long-term partner GM. Going forward, another environmental task for the company other than hybrid models may be the further improvement of their mini vehicle fuel efficiency as their segment competitor aims to pull up mini vehicle efficiency to hybrid standards in the near future. Overall, scale is a challenge for Suzuki and we suspect it will need to seek a development alliance or a new partner in pursuit of next generation technology.

Mazda Motor (7261) – Advancements concentrated on ICE

Under Mazda's plan to improve vehicle fuel efficiency 30% by 2015, the company has shown progress in developing environmental technologies mainly on their own. The company has recently developed their own start-stop system installed in the new Mazda 3. They have also shown two next generation engines at the Tokyo Motor Show (one gasoline and one diesel based). The gasoline-based engine will improve the fuel efficiency of a conventional 2.0l by 15% using technologies such as direct injection and reduced friction for the engine block while the diesel engine improves fuel efficiency of a conventional 2.2liter diesel engine by 20% by methods such as applying better fuel injectors and two-stage turbo chargers. While there is high importance to improve conventional ICE fuel efficiency, the company has also been reported to release from 2013 future hybrid vehicles in which the hybrid system will be supplied by Toyota. Indeed, one official cause for a recent equity issuance was to have funds for hybrid vehicle investment.

Fuji Heavy Industries (7270) – Relationship with Toyota critical

FHI's main specialty is in their sporty all wheel drive models which cradles their unique boxer engines. In terms of environmental vehicles the company has released a mini vehicle-based EV model called plug-in stella to the Japanese market in 2009. The company uses AESC (the Nissan-NEC battery JV) as their li-ion battery supplier for the model which achieves a 90km driving range. As the company concentrates its resources on main product improvements, its intention seems to be to tap their major shareholder Toyota for support on the development of future environmentally friendly vehicles including a compact vehicle EV reported to be released in early 2010s to replace the Stella. The co-developed model is expected to use batteries from PEVE. The company is also reported to be planning a hybrid variant of their product for a planned 2011 release. At the Tokyo Motor Show the company showed their Hybrid Tourer Concept which is a two-motor hybrid system based on their boxer engine.

Daihatsu Motor (7262) – Upside potential for frugal ICE

Daihatsu is a major mini vehicle producer holding top market share in the segment in Japan. Mini vehicles are size limited sub 660cc engine vehicles and their products currently have an average CO_2 emission of roughly 124g/km in Japan due to their small size. While hybrids are fuel efficient, the most fuel efficient version of a Daihatsu Mira can achieve as high as 27km/l in its idle stop CVT variant, with a low-end model closer to 21km/l.

At the Tokyo Motor Show, Daihatsu unveiled a future mini vehicle model with equivalent fuel efficiency as the current Honda Insight of 30km/l. The concept model uses an internally developed fuel combustion control system and idle-stop technology, together with reduced weight (10-15% reduction, to 700kg). A model using these technologies is reported to be planned for release in FY3/11 at pricing close to ¥1mn yen, no more expensive than current mini vehicles. This possible improvement in mini vehicle fuel efficiency should continue to support the mini vehicle market.

Figure 132: Major Li-ion battery/EV parts suppliers and potential suppliers

Lithium Suppliers	Separator	Cathode	Anode
SQM	Asahi Kasei (JP-3407)	Toda Kogyo	NEC Tokin (to AESC)
Rockwood Holdings (Chemetall)	Polypore (PPO)	Mitsubishi Chemical	Hitachi Chemical
FMC	Exxon Mobil Chemical	NEC Tokin (to AESC)	Nippon Carbon
Citic Guoan	Sumitomo Chemical	Nippon Denko	Showa Denko
Western Lithium	Mitsubishi Plastic/Chemical	Tanaka Chemical	Tokai Carbon
	Ube Industries	Mitsui Engineering and Ship building	Kureha Chemical
		Sumitomo Chemical	JFE Chemical
		JFE Mineral	
		Sumitomo Cement	
		Showa Denko	
		Tosoh	

Electrolyte	Electric Motors	Inverter	DC-DC converter
Ube industries	Siemens	Meidensha (to MMC)	TDK (to Honda)
Cheil Industries	General Electric	Toyota	Toyota Industries (to Toyota)
Mitsubishi Chemicals	Denso	Mitsubishi Electric (to Honda)	Nichicon (to MMC and Subaru)
Stella Chemifa	Bosch	Nichicon (to Subaru)	
Central Glass	Meidensha (to MMC)		
	Toyota		
	Honda		
	Remy		
	UQM		
	Enova		

Other Li-Ion Battery Mfs	Integrators (Software, Pack electronics)
BYD	Continental (integrator on MB / BMW hybrid)
Tesla	Magna (integrator on Ford EV)
Valence	Bosch
Alees	Denso
Altairnano	
Electrovaya	

*includes makers targetting entry of parts production for Auto aimed batteries or Electrified vehicles itself.

Source: Company, Various News sources, Deutsche Bank Group Estimates

Japan: Battery Suppliers

Many battery manufacturers and JVs have recently announced their investment plans on automotive li-ion battery plants. Including some plants that have already been set up, the total investment by 2015 is estimated to be roughly $7bn. Below illustrates some of the plans revealed by each company/JV.

Panasonic EV Energy (not listed) (Panasonic, 6752.T, Buy, TP ¥1760, DB Analyst: Yasuo Nakane)

PEVE is a 60:40 JV between Toyota and Panasonic to produce and supply batteries for electrified vehicles. It currently produces NiMH batteries with capacity for 800k HV units/year. PEVE is reported to be planning to add another 300k units in late 2010 by setting up a new plant domestically under an approximate $330mn investment. This would bring total hybrid battery capacity for to 1.1mn HV units/year. PEVE also plans to start producing Li-ion batteries in 2009 to power Toyota's PHEV model which is expected to be released by the end of the year. The company reached 2mn units' worth of NiMH battery production in December 2008 showing their extensive experience in auto battery production though on a NiMH battery.

Sanyo (6764.T, Sell, TP ¥100, DB Analyst: Yasuo Nakane)

Sanyo is a producer of NiMH batteries for automotive use and supplies Honda and Ford's hybrid vehicles projects. The company has also been reported to provide Bosch with NiMH batteries to be used in the Porsche Cayenne hybrid. The company has a current capacity of

60k HEV units/year but within FY3/10 is expected to invest approximately $30 million to set up a new plant with 150k units/year capacity. Sanyo also has a 20k HEV units/year of production capacity for Li-ion batteries and will invest approximately $315mn to add a new plant with 100k units/year capacity by FY3/12. The pending merger of Panasonic and Sanyo could raise the competitiveness of both makers. Due to this concern, customers from outside the Toyota group have sought to build supply relationship with alternative makers.

Automotive Energy Supply Corporation (not listed) (NEC, 6701.T, Sell, TP ¥250, DB Analyst: Takeo Miyamoto)

AESC is a 51:49 JV between Nissan and NEC/NEC Tokin to produce lithium-ion batteries mainly for Nissan/Renault HEVs & EVs. The company is the current supplier of batteries used in Subaru's Plug-in Stella minicar while it will also supply Nissan's EV planned for release in 2010. AESC will start initial production in Japan (50k EV units) but plans to set up production from 2012 at Nissan's Smyrna US plant (200k units), UK (60k EV units/year), Portugal (60k EV units/year) and possibly China. We estimate that total investment into these projects add up to $1.8bn including the $1bn for the US plant.

GS Yuasa (6674.T, unrated)

GS Yuasa is a major lead acid battery supplier for automotive and industrial applications. In terms of lithium-ion batteries, the company has two JVs for development and production, one with Mitsubishi Motors (JV name: Lithium Energy Japan) and the other more recently with Honda Motors (JV name: Blue Energy). The company owns a 51% majority stake in both JVs and seems to be leaving its options open to supply a wider range of customers going forward. They have developed separate chemistry batteries for different uses. GS Yuasa has mainly three types of batteries, LMO cathode based EV battery called LEV50, NMC cathode based batteries EH6 for hybrid vehicles and also an iron phosphate -based battery to provide solutions to customers who are more concerned about safety versus performance. The current production cost of the battery is ¥100k ($1,100)/1kWh while the company sees volume as being the major factor to reducing cost going forward. The cost of batteries is expected to fall to half if production reaches 100k units on a MMC iMiEV units' basis but can vary depending on the degree of further investments made for further expansion. Details on each JV follow.

- Blue Energy (unlisted): Blue Energy is a 51:49 JV between GS Yuasa and Honda to develop and produce lithium-ion batteries for their future hybrid vehicles and possibly EVs. Blue energy is currently constructing their lithium-ion battery plant under an approximately $260 million investment to start operation in autumn 2010. The initial production capacity is expected to be 200k to 300k HEV units. GS Yuasa has developed an HEV aimed lithium-ion battery (NMC cathode) separate from their EV aimed lithium-ion battery (LMO cathode-based battery used in the MMC iMiEV) which may be the base battery used for the company's HEV project.
- Lithium Energy Japan (unlisted): Lithium Energy Japan is a 51:34:15 JV between GS Yuasa, Mitsubishi Corp and Mitsubishi Motors. The lithium-ion battery is already in production at their plant in Japan for the MMC iMiEV model. The company is reported to be investing approximately $25 million to set up a new 15k unit/year production facility at their headquarters. The company is targeting 55k EV units' worth of battery production by end of FY3/14 including 25k units for their EV supply agreement with PSA.

Hitachi Vehicle Energy (not listed) (Hitachi, 6501.T, Hold, TP ¥300, DB Analyst: Takeo Miyamoto)

Hitachi Vehicle Energy has a track record of producing 600k lithium ion cells. While its current revenue from the business is ¥20bn ($222mn), the company targets ¥100bn ($1.1bn) by 2015. There are plans to increase its battery production capacity by 70 times to 700k HV units/year worth of batteries by 2015 through an investment of $334mn. The company has an agreement with GM to supply 100k HEV batteries from 2010 but has no fixed relationship with a specific automaker.

Toshiba (6502.T, Buy, TP ¥650, DB Analyst: Takeo Miyamoto)
Toshiba plans to start production of their lithium-ion battery at their new plant expected to start operation by autumn 2010 under an approximate ¥25bn ($278mn) investment. The company targets the batteries to be used in electrified vehicles, forklifts and elevators. Their target revenue in 2015 is ¥200bn ($2.2bn) by which time the company targets capacity to be 120mn cells. This from a rough battery property calculation translates into roughly 60,000 EV units worth of batteries, we estimate. There are no fixed partnerships with car makers though the company is in development of an EV aimed battery with VW while reported to be testing batteries on line buses with Isuzu and Keio University in Japan.

Japan: Non-battery component suppliers

Toyota Industries (6201.T, unrated)
Toyota Industries is one of the major suppliers of EV parts to Toyota Motors. The third generation Prius has its DC-DC converter, PCU cooling unit, electric compressor, and inverter supplied by Toyota Industries. The company has already gained some significant know-how from Toyota's hybrid parts development and production. One example is the 30% reduction in size of the DC-DC converter used in the new Prius relative to the previous model. These improvements increase the competitiveness of Toyota's electrified products as well as Toyota Industries' competitiveness.

Toyota Industries has also developed (together with Nitto Kogyo) a rapid recharge unit for EVs/PHEVs. This unit is not a super-fast charger but a 200V household based charger. The unit is priced at ¥450k ($5,000), and is reported to be able to charge a Prius PHEV in 2-3 hours.

Denso (6902.T, unrated)
Denso is the main supplier for Toyota's Hybrid Control Unit (ECU), Battery Monitoring Unit, Battery Cooling Unit and the special air-conditioning system. Like Toyota, the company has experience in development and production of hybrid vehicle parts through its cooperation with Toyota. Recent advancements include an air conditioning system that needs 25% less electric compressor power for operation relative to its' predecessor, and which is 20% lighter. The company also co-developed (with Fujitsu Ten) an 8% smaller ECU for the new Prius. As hybrid vehicles are still an expanding business, there will be continued investments neeed in terms of production capacity, which we believe will continue to put pressure on profitability. We currently assume their hybrid related business is loss making, and that the company will need over 1 million units per year to achieve breakeven levels.

Denso is currently developing hybrid-related parts on their own, including inverters which they aim to supply for the next generation of Toyota hybrid vehicles. Current inverters are developed and produced in-house by Toyota.

Japan: Battery component suppliers

Asahi Kasei (3407.T, Buy, TP ¥550, DB Analyst: Takato Watabe)
Asahi Kasei holds about 50% global share for consumer lithium-ion battery separators. The company has a production capacity of 120million square meters/year, which they plan to expand to approximately 200mn sqm/year by spring 2010. The company is planning to invest a total of ¥9bn ($100mn) in two plants in Japan to reach the target production capacity. The company has so far produced mainly wet-process products for lithium-ion batteries used for mobile devices. It is possible that some of Asahi Kasei's wet process products will be used in automobiles, but the company claims it has technology to market dry-process products as

well. The company does not disclose its revenue target for auto battery products or its production capacity. Most of its products are for use in consumer products. We think its FY09/3 separator sales were a little over ¥20bn ($223mn) and it enjoyed a relatively high margin.

Sumitomo Chemical (4005.T, Buy, TP ¥520, DB Analyst: Takato Watabe)
Sumitomo Chemical is a producer of separators for lithium-ion batteries. The company's annual separator production capacity is expected to increase to 25 million square meters from previously capacity of 16 million square meters. The company is also said to be developing a new cathode material for lithium-ion batteries. It is said that FY10/3 separator sales will total some ¥3 billion ($33 million), and that the company will aim for an annual sales of about ¥10 billion ($111 million) in 2011 or 12. We believe the company's automobile use battery materials are at the R&D stage.

Mitsubishi Chemical (4188.T, Hold, TP ¥430, DB Analyst: Takato Watabe)
The strength of Mitsubishi Chemical HD is that it manufactures all four key lithium-ion battery materials, the separator, cathode, anode and the electrolyte. The auto battery specific materials are currently in the R&D stage. The company is second in the global electrolyte market (20% share) after Ube Industries, and plans to expand annual production capacity from current 6,000 tons to 8,500 tons by January 2010. The company is believed to have over 10% share of the anode electrode market, and is expected to have raised its annual capacity from 3,000 tons to 5,000 tons by Sept 09. They are also said to have recently added a separator capacity of an annual 12mn sqm, while planning to start operating a facility for cathode production with an annual capacity of 600tons. The market share for separators and cathodes are low since the company just entered the business. Its current sales target for automotive battery materials is ¥100bn ($1.11bn) in 2015. Combined sales for all of battery materials division was ¥9.3bn ($103mn) in FY3/09 (¥8.5bn or $94mn in FY3/08), of which ¥7.2bn ($80mn) was from electrolytes (¥7.0bn or $78mn FY3/08).

Hitachi Chemical (4217.T, Buy, TP ¥2,300, DB Analyst: Takato Watabe)
Hitachi Chemical, which mainly produces anode material for consumer batteries such as those for mobile phones, is believed to hold top share globally of about 45%. The company plans a 50% boost to its current capacity by autumn 2009, though it discloses neither their current capacity nor the expected absolute increase. We believe the anode material for automotive batteries is currently in development by the company. Hitachi group JV Hitachi Vehicle Energy has received orders for lithium-ion batteries from GM to be used in their hybrid car planned for 2010, and we believe there is good chance Hitachi Chemical's anode material will be used in these batteries.

Korea: Automakers

Hyundai's plan
Hyundai Motor Group has been active in hybrid car development since 1995, and the company released its first mass produced model, the Avante LPI hybrid, in July 2009. The group announced that it plans to invest W4.1tn ($3.5 bn) through 2013 in the development of green cars, including W2.2tn ($1.9 bn) to develop hybrid and hydrogen fuel cell propelled vehicles. Hyundai has outlined commercialization plans for 3 different types of hybrids:

- Soft Type HEV (LPG Hybrid), such as the Avante LPI Hybrid.
- Hard Type HEV (Gasoline Hybrid): Hyundai will launch its hybrid system with the Sonata Hybrid in 2010. It is looking to sell this model in the US starting 2010.
- Plug-in HEV (Plug-in electric vehicle): Hyundai is currently developing a plug-in HEV for commercial production (and sales in the U.S.) starting in 2013.

Hyundai has also been experimenting with fuel cell vehicles (FCEV) for the past six years. It has participated in a number of fuel-cell verification programs, including a Tucson (crossover FCEV), which achieved an equivalent fuel economy of 24 km/l compared to the internal-combustion-engine Tucson's less than 12 km/l. The company currently believes that commercial production of this type of vehicle could be feasible by 2018.

Avante LPI Hybrid

Hyundai Motor's first hybrid car, the Avante LPI Hybrid, was released in July 8, 2009. Development took 43 months and cost W250bn ($210 MM). The company is targeting 7,500 units of the Avante LPI Hybrid for this year and 15,000 units for next year. This vehicle is the world`s first hybrid electric car that uses a combination of LPG engine and electric motor. It is also the world`s first commercially available hybrid car that uses lithium-ion polymer batteries (sourced by LG Chem). The price of the battery accounts for about 10 percent of the car`s price. Fuel economy comes in at 17.8 kilometers/liter, and the vehicle emits 99 grams of carbon dioxide per kilometer, making the car the cleanest Korean-made vehicle. This equates to 55% lower fuel expense than the comparable gasoline vehicle.

The car is available in three trim levels, priced between W22.2m and W23.2m. The prices include the reduced tax rates applied to hybrid electric vehicles. Although more expensive that a conventional powertrain vehicle, Hyundai estimates that the price gap can be recovered in three years.

Korea: Battery suppliers

SB LiMotive (not listed) (Samsung SDI, 006400.KS, Buy, TP=KRW190,000, DB Analyst: Sc Bae)

In June 2008, Samsung SDI (006400.KS), the world's No.2 lithium-Ion battery maker (around 17% M/S), and Bosch, a leading global supplier of technology and services, signed an agreement to form a fifty-fifty joint venture, SB LiMotive, to supply lithium-Ion batteries for xEVs. Through this JV, SDI will be in charge of R&D and manufacturing, and Bosch will take charge in global sales by using its global customer base in auto industry. Cell development and manufacturing will take place in Korea, while system and package development will take place in Germany. The JV started its operations in September 2008, and the company is planning to start manufacturing lithium ion battery systems customized for automotive requirements in 2011. SB LiMotive is expected to be a leader in the battery market, and Bosch's technology and customer base in the auto market should provide synergy to Samsung SDI. SB LiMotive has already signed a contract with BMW in Aug 2009 to supply Li-Ion batteries for BMW's Megacity project. Under the deal, the company will supply batteries for BMW's test vehicles starting in 2010, and exclusively supply batteries for all PHEVs and EVs starting in 2013. The company is expecting to expand its customer base going forward and plans to invest $500 million through 2013 with a goal of achieving 30% market share of the global lithium ion based car battery market by 2015.

LG Chem (051910.KS, Buy, TP=KRW277,000, DB Analyst: Peter Lee)

In January 2009, LG Chem, the world's No.4 lithium-Ion battery maker with about 8% market share, signed an agreement to supply lithium ion batteries to GM's first PHEV, the Volt, starting in 2H 2010. The company has already started providing batteries for mild hybrid cars, including the Hyundai Avante Hybrid (called Accent in the U.S) and Kia Forte Hybrid, since July 2009. LG Chem can provide just battery cells or the whole pack/complete system, depending on customers' preference. LG Chem is also competing with SK Energy for the Hyundai Sonata HEV and Kia Lotze HEV models, which are scheduled to be launched in 2H 2010. Similar to Samsung SDI, LG Chem is also a global leader in small-sized lithium-Ion batteries for IT products. LG Chem is aggressively positioning itself in the xEV battery market based on the technological know-how it has built through the conventional lithium ion battery business. The company is building two plants, one in Korea and the other in the US (total investment expected to be $300mn with 50% coming as grants from the US government). The company also plans to expand its customer base and plans to invest $1bn by 2013 with a goal of achieving $2bn in revenue from its xEV battery business by 2015.

SK Energy (096770.KS, Hold, TP=KRW140,000, DB Analyst Peter Lee)
In September 2009, SK Energy announced an imminent entry into the xEV battery business, and that it is currently negotiating with an overseas automaker for its first battery contract. It is also competing with LG Chem for the Hyundai Sonata HEV and Kia Lotze HEV which are scheduled to be launched in 2H 2010. The company has not disclosed any details regarding capex, target volume, or timeline for mass production. The company is Korea's leading oil refiner, holding roughly 40% market share. SK Energy's entry into the rechargeable battery business started with the development of lithium-ion battery separators in 2006 (only one of 4 companies in the world with this technology). SK Energy currently garners about 12% M/S in separators, supplying to LG Chem and SDI.

Europe: Automakers

Daimler
Daimler has most recently been very active in the field of green technology. While initially being surprised management steered R&D efforts into this direction in all major product lines. Currently the company offers S-Class and M-Class as hybrid versions to the consumer, with the S-Class using lithium ion based batteries. Initial reception of the vehicle has surprised on the upside, as the S400 hybrid currently stands for approximately 20% of total S-Class sales. On the small car side Daimler has introduced its Smart EV which still runs on traditional NmH batteries for now. While being only in small scale, Daimler aims to find key takeaways on the average day usage of EVs. Daimler will accelerate its Mercedes product offering in the field of hybrids PHEVs and EVs and we estimate that the company will offer a hybrid version in any major product range by 2012.

Furthermore the company has been highly active in stepping into the field of battery manufacturing themselves, having acquired a 49% stake in Litec (90% stake in the car battery production) and a small 10% stake in Tesla.

BMW
While initially counting substantially on hydrogen powered cars, BMW has most recently shifted strategy and focus. With the launch of the BMW 7 series hybrid the company operates the first (together with the MB S-Class) lithium ion based hybrid on the road. Furthermore the company introduced its X6 hybrid just recently, completing its current hybrid range.

On the EV side we note that BMW currently has 500 Mini-e on the road, which are designed to provide information on customer habits. Around 2014 BMW aims to launch a full EV (Project I).

With its efficient dynamics strategy the company has proven to be at the forefront of technological development and Co2 reduction. We thus believe that BMW will also launch hybridized versions of its main products 3- and 5-series. At the Frankfurt Motorshow BMW presented its “Vision EfficientDynamics” which included separate electric motors at both front and rear axle, a technology which we believe might be introduced around 2012-13 in its main product lines.

Renault
The company is counting most on a fast market penetration of EV, believing that market penetration rates will rise to 5% of world demand already by 2015 and 10% by 2020. The

company has developed a specific EV lineup with the first vehicle (Zoe) to be launched in Q42011. This vehicle will be manufactured in a dedicated plant on a vehicle-specific platform underlying that management is expecting to sell at least 100k units of this model. The second vehicle to be introduced is going to be the Fluence, which will be sold via Better Place in Israel and Denmark (20k per annum company target).

At the last auto show in Frankfurt Renault had further 2 EV demo cars (Tweezy and Kangoo) at display, highlighting the dedication of Renault management towards the concept.

Similar to Daimler, Renault will invest in battery manufacturing using the technology of the Nissan joint venture partner NEC.

Peugeot

The company is not dedicating its focus on one specific technology. Therefore PSA is not developing its own EV, rather decided to use an existing Mitsubishi platform (MiEV). PSA targets to sell 25k units from 2012 onwards.

On the hybrid side PSA is counting on diesel hybrids (full hybrid) which will be limited volume in our view. Given that Diesel engines are already E2k more expensive than gasoline, on top of which the additional cost of the battery will bring this version to at leats E5k more expensive than an equivalent gasoline version.

Fiat

Fiat has only most recently announced that it aims to develop its own EV vehicle range. However, we note that likely projects will use upcoming Chrysler technology as part of the upcoming alliance. To understand Fiat’s technological ambition is therefore hard at current, given that CEO Marchionne is currently just developing his strategic alliance ambitions with a new partner.

Appendix 1

Important Disclosures

Additional information available upon request

Disclosure checklist			
Company	**Ticker**	**Recent price***	**Disclosure**
Ford Motor	F.N	7.00 (USD) 30 Oct 09	1,2,6,7,8,14,15,17

*Prices are sourced from local exchanges via Reuters, Bloomberg and other vendors. Data is sourced from Deutsche Bank and subject companies.

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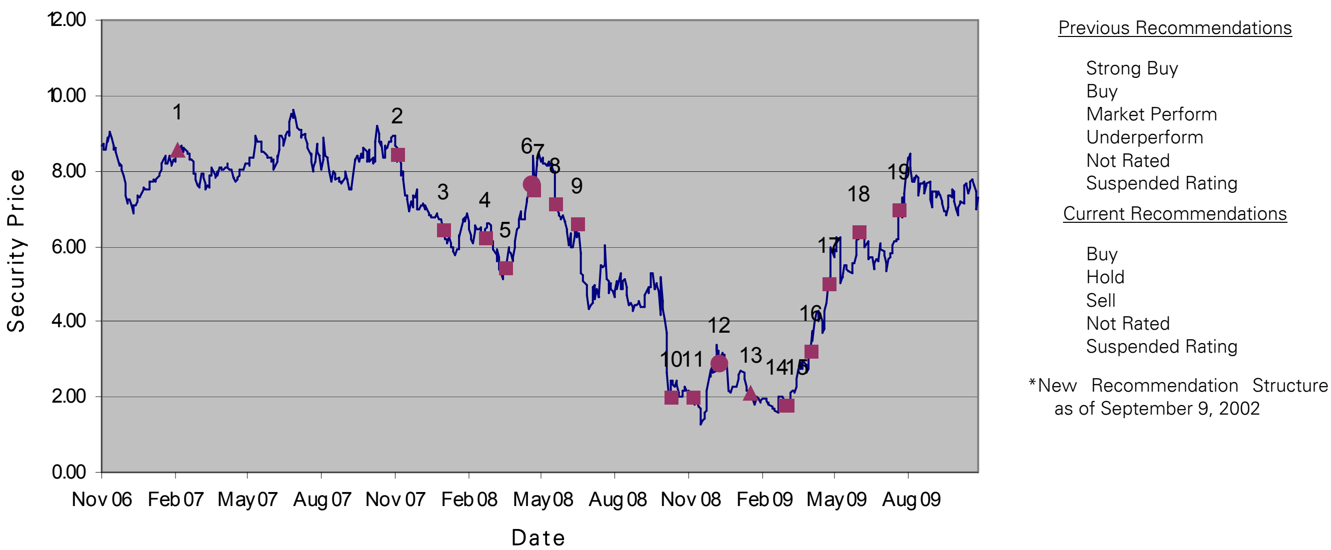
Historical recommendations and target price: Ford Motor (F.N)

(as of 30/10/2009)



1.	2/9/2007:	Upgrade to Buy, Target Price Change USD11.00	11.	11/10/2008:	Hold, Target Price Change USD1.70
2.	11/9/2007:	Buy, Target Price Change USD14.50	12.	12/12/2008:	Downgrade to Sell, USD1.70
3.	1/3/2008:	Buy, Target Price Change USD13.00	13.	1/21/2009:	Upgrade to Hold, USD1.70
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5.	3/20/2008:	Buy, Target Price Change USD11.00	15.	3/5/2009:	Hold, Target Price Change USD2.00
6.	4/23/2008:	Downgrade to Hold, Target Price Change USD7.50	16.	4/6/2009:	Hold, Target Price Change USD3.00
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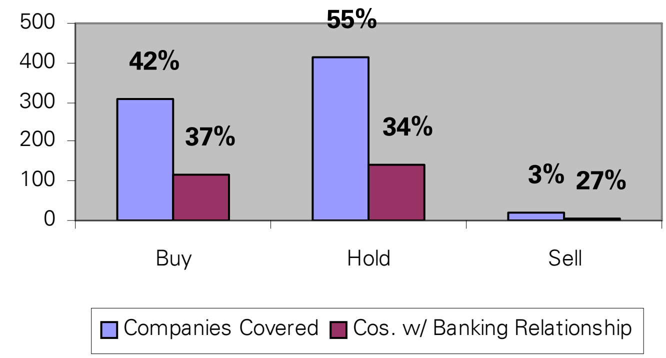
Equity rating dispersion and banking relationships



North American Universe

Regulatory Disclosures

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