Company

Global Markets Research

North America United States
Industrials Alternative Energy

21 January 2009

Solar Photovoltaic Industry

Looking through the storm

Steve O'Rourke
Research Analyst
(1) 212 250 8670
stephen.orourke@db.com

Peter Kim
Research Analyst
(1) 415 617 4246
peter-d.kim@db.com

Hari Polavarapu
Research Analyst
(1) 212 250 2076
hari.chandra@db.com

Deutsche Bank

FITT Research

Fundamental, Industry, Thematic, Thought Leading
Deutsche Bank Company Research's Research Product Committee has deemed this work F.I.T.T. for investors seeking differentiated ideas. In this piece we address the solar photovoltaic (PV) industry, and assess the potential impact of the ensuing shake-out on the solar PV industry and company business models, as well as provide an updated supply/demand forecast. We address price and cost dynamics through 2010, establishing a framework for analysis, and identifying what we believe will be the winning technologies and business models.

Fundamental: 1H09 below expectations; 2H09 may be better; 2010 better

Industry: the shake-out will be brutal; over-supply is inevitable

Thematic: the spoils go to the strong; CdTe and high efficiency Si will win

Thought Leading: business models are critical and are being tested

Deutsche Bank Securities Inc.

All prices are those current at the end of the previous trading session unless otherwise indicated. Prices are sourced from local exchanges via Reuters, Bloomberg and other vendors. Data is sourced from Deutsche Bank and subject companies. Deutsche Bank does and seeks to do business with companies covered in its research reports. Thus, investors should be aware that the firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision. Independent, third-party research (IR) on certain companies covered by DBSI's research is available to customers of DBSI in the United States at no cost. Customers can access IR at http://gm.db.com/IndependentResearch or by calling 1-877-208-6300. DISCLOSURES AND ANALYST CERTIFICATIONS ARE LOCATED IN APPENDIX 1.

Deutsche Bank

21 January 2009

Solar Photovoltaic Industry

Looking through the storm

Steve O'Rourke
Research Analyst
(1) 212 250-8670
stephen.orourke@db.com

Peter Kim
Research Analyst
(1) 415 617 4246
peter-d.kim@db.com

Hari Polavarapu
Research Analyst
(1) 212 250 2076
hari.chandra@db.com

Fundamental, Industry, Thematic, Thought Leading

Deutsche Bank Company Research's Research Product Committee has deemed this work F.I.T.T. for investors seeking differentiated ideas. In this piece we address the solar photovoltaic (PV) industry, and assess the potential impact of the ensuing shake-out on the solar PV industry and company business models, as well as provide an updated supply/demand forecast. We address price and cost dynamics through 2010, establishing a framework for analysis, and identifying what we believe will be the winning technologies and business models.

Fundamental: 1H09 below expectations; 2H09 may be better; 2010 better

We expect 1H09 fundamentals to be worse than already low expectations, with 2H09 potentially better than expectations should incremental lending return by mid-year; we anticipate a reacceleration of industry growth in 2010. We expect y/y demand growth (MWp installed) of 10% in 2009, well below our mid-08 forecast of 38%, and we are biased negatively; the year will be 2H09 weighted. We see the potential for conditions to return closer to supply/demand equilibrium in 2010.

Industry: the shake-out will be brutal; over-supply is inevitable

Even with much lower supply estimates, we expect acute credit tightness resulting in demand destruction to drive a vexing c-Si module oversupply at least through 1H09; this oversupply dynamic has already begun. We expect the shake-out to be brutal, with a strong balance sheet the potential key to survival. We expect differentiated industry leaders (i.e. via products yielding the lowest LCOEs) with strong balance sheets to fare best, less differentiated companies to struggle, and non-differentiated companies with weak balance sheets to become casualties. We expect significant reductions to 2009 consensus estimates.

Thematic: the spoils go to the strong; CdTe and high efficiency Si will win

We believe industry leaders are gaining market share, will gain market share through the shake-out, and will consolidate market share as industry growth accelerates at the expense of non-differentiated players with weaker balance sheets. Earlier in 2008 success seemed to primarily hinge on access to silicon, now it rests on access to projects and project financing. We believe CdTe will retain its LCOE advantage (albeit with a narrowing gap) as polysilicon costs decline; we believe that only high efficiency c-Si solutions can rival CdTe LCOE.

Thought Leading: business models are critical and are being tested

2009 will show winning and losing business models. Downstream integrated business models for c-Si, and low cost thin film business models are faring much better. High cost module makers (i.e. c-Si) will struggle unless the company's technology enables adequate cost to be extracted downstream, and the business model enables it to capitalize downstream. We view First Solar and SunPower as industry leaders with sustainable, technology based competitive advantages. We believe First Solar can retain industry leading margins through and after the shake-out, and SunPower has the most mature business model, addressing the industry's broadest markets and geographies, with a healthy long-term model. We expect these companies to benefit disproportionately as the industry recovers.

FITT Research

Companies featured			
SunPower (SPWRA.OQ),USD33.62			**Hold**
	2007A	2008E	2009E
EPS (USD)	1.00	1.67	2.25
P/E (x)	71.7	32.3	24.0
EV/EBITDA (x)	38.2	16.1	12.6
First Solar Inc. (FSLR.OQ),USD145.42			**Hold**
	2007A	2008E	2009E
EPS (USD)	1.34	3.89	6.45
P/E (x)	76.4	37.4	22.6
EV/EBITDA (x)	43.6	23.5	15.0
Energy Conversion Devices (ENER.OQ),USD26.05			**Hold**
	2008A	2009E	2010E
EPS (USD)	0.32	1.37	2.23
P/E (x)	104.1	19.1	11.7
EV/EBITDA (x)	42.6	11.9	7.1
Evergreen Solar (ESLR.OQ),USD2.88			**Hold**
	2007A	2008E	2009E
EPS (USD)	-0.19	-0.37	0.04
P/E (x)	–	–	70.2
EV/EBITDA (x)	–	–	7.0
Canadian Solar (CSIQ.OQ),USD5.29			**Hold**
	2007A	2008E	2009E
EPS (USD)	-0.03	1.34	-0.12
P/E (x)	–	4.0	–
EV/EBITDA (x)	–	2.6	15.9
Applied Materials (AMAT.OQ),USD10.18			**Hold**
	2008A	2009E	2010E
EPS (USD)	0.78	0.06	–
P/E (x)	23.1	158.7	–
EV/EBITDA (x)	11.5	28.6	–
MEMC Electronic Materials (WFR.N),USD14.76 Buy			
	2007A	2008E	2009E
EPS (USD)	3.24	3.23	2.30
P/E (x)	18.9	4.6	6.4
EV/EBITDA (x)	13.4	2.0	2.3

Related recent research	Date
Clouds are rolling in, downgrading to Hold *Stephen O'Rourke*	10 Nov 2008
Solar PV industry outlook and economics *Stephen O'Rourke*	27 May 2008
Technology and economics: thin films and crystalline silicon *Stephen O'Rourke*	9 Jul 2007

Deutsche Bank Securities Inc.

All prices are those current at the end of the previous trading session unless otherwise indicated. Prices are sourced from local exchanges via Reuters, Bloomberg and other vendors. Data is sourced from Deutsche Bank and subject companies. Deutsche Bank does and seeks to do business with companies covered in its research reports. Thus, investors should be aware that the firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision. Independent, third-party research (IR) on certain companies covered by DBSI's research is available to customers of DBSI in the United States at no cost. Customers can access IR at http://gm.db.com/IndependentResearch or by calling 1-877-208-6300. DISCLOSURES AND ANALYST CERTIFICATIONS ARE LOCATED IN APPENDIX 1.

Table of Contents

Investment thesis

The solar PV industry and the accelerating shake-out

Assessing the solar PV industry, companies and production technologies: this report assesses the potential impact of the ensuing shake-out on the solar PV industry and company business models, as well as provides an updated supply/demand forecast. We address price and cost dynamics through 2010, establishing a framework for analysis, and identifying what we believe will be the winning technologies, business models and companies.

Conclusions

Some companies will weather the storm well, some adequately, and some not at all.

Re-assessment of industry and company dynamics: we have assessed the effects of broader economic issues on the solar PV industry and companies, as well as industry dynamics on the competitiveness of production technologies and related companies. Whereas earlier in 2008 success seemed to hinge primarily on access to silicon, now it rests on access to projects and project financing. Over the near-term module ASP declines compounded by demand destruction will shackle revenue growth and company margin structures; some companies will weather the storm well, some adequately, and some not at all. A summary of our conclusions includes:

Industry related:

1H09 worse than expectations; 2H09 potentially better than expectations

- **1H09 worse than expectations; 2H09 possibly better than expectations; 2010 re-accelerating growth:** we expect 1H09 to be worse than most expect, 2H09 to be potentially better than most expect (with incremental lending returning by mid-year), and 2010 to bring accelerating growth in a more rationalized industry.
- **Demand growth will slow substantially in 2009:** we expect demand growth of 10% y/y in 2009 to ~4.6GWp installed, down from our mid-2008 estimate of 38% y/y growth. We would bracket a downside scenario with y/y growth of roughly flat.

A c-Si module oversupply is inevitable.

- **Module oversupply is inevitable:** we are forecasting ~6.4GWp available for installation (i.e. potential "sales") in 2009 (down ~18% from our mid-08 forecast), and a downside scenario of ~5.5GWp (down ~29% from our mid-08 forecast), pointing to the inevitability of a c-Si module oversupply situation.
- **Stimulus package to have little impact:** we do not expect the stimulus package to have a material impact on solar PV company outlooks in 2009. We do note President-elect Obama's 16 Jan 09 commentary, however, intending to double the output from renewable energy sources over the next three years; this could add upside to forecasts.

Industry leaders are gaining market share.

- **Industry leaders will gain market share at the expense of non-differentiated companies:** we believe industry leaders are gaining market share, will gain market share through the shake-out, and will consolidate market share as industry growth accelerates at the expense of non-differentiated companies with weaker balance sheets. We anticipate non-differentiated survivors could end up serving in subordinate capacities.

Many companies likely have inadequate balance sheets to effectively weather the storm.

- **Consolidation will accelerate; balance sheets could determine survivors:** the difference between a company that survives and one that may not could be historical balance sheet management. We expect industry consolidation to accelerate, and believe many companies likely have inadequate balance sheets to effectively weather the storm.
- **There will be ample opportunity for less differentiated companies that survive, but business will be less attractive:** for the less differentiated companies that survive the shake-out there will be ample opportunity as demand growth accelerates; however, we do not expect company operating structures to approach those of industry leaders.

Technology and company related:

c-Si will not effectively challenge CdTe.

- **c-Si cannot challenge CdTe at the module level:** although the gap will narrow, CdTe module cost and ASP leadership will not be effectively challenged by average conversion efficiency c-Si modules, even as c-Si module ASP begins to approach $2.00/Wp.
- **c-Si module manufacturers will suffer significant margin compression:** despite polysilicon cost reductions, most c-Si module manufacturers will suffer meaningful margin compression though 2009 and 2010.
- **Average c-Si LCOE will narrow the gap, but not catch CdTe LCOE:** c-Si will close the LCOE gap with CdTe, potentially offering some impetus for CdTe ASP declines in 2010; however, even if a c-Si installed system price approaches $4.00/Wp, CdTe would retain substantial margin latitude while c-Si would essentially have none.
- **CdTe module price declines will be driven more by First Solar:** we believe CdTe price declines in 2010 will more likely be driven by First Solar itself while opening new market segments (e.g. utility scale in the US).

High efficiency c-Si will be the only volume technology able to compete with CdTe at the LCOE level.

- **High efficiency c-Si (SunPower) LCOE will challenge CdTe (First Solar):** high efficiency c-Si will compete effectively with CdTe at the LCOE level, but average c-Si will struggle to even as the cost of silicon falls. CdTe will maintain industry leading margins.
- **First Solar and SunPower are clear industry leaders and have sustainable competitive advantages:** First Solar and SunPower have the most competitive LCOE offerings, and sustainable, technology based competitive advantages.
- **SunPower may have the best long-term business model:** we believe an integrated business model from the cell (i.e. where IP resides) through energy provisioning is best, (and critical for c-Si players). We believe SunPower can address the broadest markets and geographies in the industry, with a healthy long-term business model.
- **Downstream integration efforts will meet with little success:** we expect many upstream companies to frantically try to integrate downstream over the near-term to try to stem market share losses, and build a long-term business model. We expect most of these efforts to meet with little success.

Solar PV coverage companies

First Solar and SunPower are clear industry leaders and have sustainable competitive advantages.

Defining the industry going forward: we believe the companies that will do the most to define and advance the solar PV industry are the LCOE leaders. Over the next few years we believe this will fall to two production technologies from two companies within our coverage universe: First Solar – CdTe, and SunPower – high efficiency c-Si. This does not mean that other technologies and companies will be vanquished; they will not. There is hardly enough capacity from these two companies and technologies to satisfy demand over the next several years. We expect lower margin offerings driving trailing LCOE solutions will find a healthy place in the market as demand will require it, but there will likely be fewer of these companies one to two years from now.

When the severity of the shake-out is better discounted we would be overwhelmingly partial to industry leaders FSLR and SPWRA.

- **Positioning with solar PV company stocks:** if we are correct in our 2009 and 2010 assessment (i.e. 1H09 worse than expected, 2H09 possibly better, accelerating growth in 2010), then we believe the time to become more aggressive with key solar PV stocks would be later in 1H09. We anticipate near term downside to solar PV stocks as the severity of the shake-out is better discounted over the coming months.
  - **Industry leaders for the long-term:** we believe that owning long-tem winners (i.e. companies with sustainable competitive advantages, able to deliver the lowest LCOE, with solid balance sheets) is the best approach, and we would be overwhelmingly partial to FSLR and SPWRA. We expect First Solar and SunPower to benefit disproportionately as the industry rationalizes and recovers.

- **Differentiated companies playing to market niches with little direct near-term competition can also outperform:** we believe Energy Conversion Devices (ENER) could outperform through the shake-out and subsequently, but not to the degree of the industry leaders. We would be partial to ENER as the severity of the shake-out becomes better discounted, but note we anticipate more direct competition (e.g. light weight, flexible solar PV products) could emerge within two to three years.

We would remain very cautious on non-differentiated solar PV company stocks.

- **Non-differentiated companies will likely under-perform over the near-term and the long-term:** we would remain cautious on most other solar PV company stocks in our coverage universe, as the long-term impact of the shake-out on less-differentiated and non-differentiated companies will be more severe.

Figure 1: Summary of changes to coverage solar PV and solar PV related companies

	Rating	Price target ($)		C2009E DB Old	C2009E DB New	C2009E Consensus	C2010E DB New	C2010E Consensus
CSIQ	Hold	$7	Revenue ($M)	731	**621**	949	**910**	1,424
			EPS ($)	0.30	**(0.12)**	0.40	**1.00**	1.82
ENER	Hold	$35	Revenue ($M)	634	**479**	565	**726**	~800
			EPS ($)	2.48	**1.73**	2.18	**2.76**	~3.50
ESLR	Hold	$4	Revenue ($M)	364	**300**	384	**482**	587
			EPS ($)	0.07	**0.04**	0.20	**0.30**	0.51
FSLR	Hold	$160	Revenue ($M)	2,003	**1,868**	1,996	**2,561**	2,660
			EPS ($)	6.77	**6.45**	7.02	**8.15**	8.94
SPWR	Hold	$45	Revenue ($M)	1,900	**1,748**	1,946	**2,402**	2,775
			EPS ($)	2.45	**2.25**	2.82	**3.15**	3.73

Notes:

- **ENER:** we have adjusted our price target from $41 to $35. C2010 consensus estimates include estimates for C4Q10 numbers which are not included in First Call numbers.
- **ESLR:** we have adjusted our price target from $7 to $4.
- 2010 aggregate y/y revenue growth for solar PV coverage companies is 35% as per DB estimates versus 45% y/y MWp growth and a ~12% average annual y/y ASP decline in 2010. 2010 consensus growth off of more realistic 2009 numbers is too high.

Source: Deutsche Bank and First Call

With 10% MWp growth, and ~22% average annual ASP declines, while accounting for inventories, we believe flat to modestly declining aggregate revenue y/y is realistic. Consensus rolls up at 29% y/y aggregate growth in 2009.

Consensus estimates are much too high: while hardly a surprise, we believe consensus estimates of ~29% aggregate (i.e. 20 publicly traded companies) revenue growth y/y in 2009 for module related companies is clearly too high. With 10% MWp growth, and ~22% average annual ASP declines (we note that this new forecast is substantially more modest than it otherwise would have been due to the significant q/q ASP decline expected in 4Q08), while accounting for inventories, we believe flat to modestly declining aggregate revenue is more realistic. With a smaller sample size biased toward industry leaders (i.e. market share gainers), we believe modest aggregate revenue growth y/y in 2009 is possible. (We also note that we expect a peak to trough c-Si ASP decline of >30% from 3Q08 to 4Q09.)

Valuation

For solar PV companies, earnings power is less of an issue than what the market is willing to pay for earnings. We have seen significant multiple compression over the past several quarters, and will likely see more in 2009. Our price targets and views on stocks reflect this. While we are strong advocates of companies we believe will be long-term solar PV industry leaders (e.g. First Solar and SunPower), we acknowledge the clear reality of lower valuation multiples driven by (1) anticipated slower growth, (2) industry headwinds that are difficult or impossible to quantify now (e.g. access to capital), (3) an accelerating industry shake-out, and (4) broader macro-economic concerns. We believe solar PV company stocks should trade in an earnings multiple range of (1) potentially high single digits for non-differentiated companies and (2) up to a ~20 range for clearly differentiated industry leaders.

Risks

Risks include but are not limited to: (1) rapidly changing market conditions, (2) changes to government subsidization policies, (3) the impact of many competing technologies, (4) the emergence of disruptive technologies, (5) material supply constraints, (6) large capital investment requirements, (7) increasing competition with many new entrants, (8) a relatively immature industry infrastructure (9) competition from other renewable energy sources, (10) long warranty periods for solar panels, (11) geopolitical risk, and (12) general economic risk.

Macroeconomic backdrop

Deutsche Bank's macroeconomic outlook

We first offer the Deutsche Bank global economics team's 2009 macroeconomic view as a backdrop for Solar PV industry growth, which can be directly impacted by several macro-level interactions related to currency, capital flows, government policy, commodity (e.g. oil/natural gas) prices, and the overall health of the global economy. Again, this section is a distillation of much more extensive work done by DB's global economics team.

Global growth is forecast to be barely above zero in 2009, with downturns in all major regions setting records not seen in the past 50 years.

The gloom thickens: First, Deutsche Bank's global economics team expects global growth to be barely above zero in 2009, with downturns in all major regions setting records not seen in the past 50 years. The intensification of the global credit crisis and asset price deflation in recent months has reset Deutsche Bank's relatively pessimistic view even lower, with DB's current forecast calling for a deep and unprecedented downturn (i.e. at least since the Great Depression), driven in part by a weaker US outlook, and in part by weaker domestic fundamentals in all major regions; the theory of global economic decoupling is clearly dead. Consumer spending is now expected to decline at record levels and last longer, and business spending on plant and equipment is expected to fall more sharply, with inventory runoff continuing at a rapid pace through 1H09. The deeper downturn does not beget a stronger recovery, with global growth now set at just above zero in 2009, nearly two percentage points below a "mild recession" level of 2%. Beyond 2009, DB's outlook for a sluggish pickup in 2010 has not changed appreciably. Nor have projections of aggressive fiscal policy action changed. However, inflation will likely fall further, and central bank policy rates remain lower for longer, thanks in part to the lower trajectory of oil/commodity prices that the growth forecast yields. Oil prices are expected to remain in the neighborhood of $50 per barrel through 2009, rising in 2010. Headline inflation is expected to be temporarily negative in the US in 2009, but rise again as oil/commodity prices stabilize at a low level. Deflation is not a serious risk now due to aggressive monetary and fiscal policy actions being taken.

The US sub-prime crisis of 2007 signaled the endpoint of a credit-driven consumption boom that had begun twenty five years earlier.

A watershed event: Second, this deep recession marks the end of a long-term expansion that was characterized by a few key industrial countries assuming the role of the global net consumer, and all other countries the role of the net producer. This international "division of labor" was made possible by trade and financial globalization, and the availability of cheap credit. Trade integration allowed the shipping of goods, and increasingly services through the internet around the world, while financial integration allowed the funding of ever larger trade imbalances. With inflation running fairly low, central banks kept monetary policy relatively accommodative while financial engineering was ever reducing apparent credit risk. In this construct, the national accounting equality of savings and investments became irrelevant at the national level. No imbalance seemed to be too big not to be funded by the international capital markets. However, as countless merchants supplying customers on credit have found out since the advent of commerce, business turns sour when customers cannot repay their debts. But finally, it was the US sub-prime crisis of 2007 that signaled the endpoint of a credit-driven consumption boom that had begun twenty five years earlier.

Consumer demand in major industrial countries should be depressed for some time to come.

Averting deflation via economic policy: Third, consumer demand in major industrial countries should be depressed for some time to come by tremendous losses in household wealth and a severe credit crunch with offsets to deflation from economic policy. The experience of the 1930s shows that mass destruction of debt through bankruptcy will cause deflation and depression when the resolution is left to the private sector alone. US economic policy is now directed to prevent such a deflationary scenario

from unfolding whereby banks have been recapitalized and the Fed is funding potentially impaired assets. Monetary policy has been eased very aggressively and a big fiscal policy impulse can be expected for 2009 after a more moderate program earlier in 2008. However, European economic policy has not risen to the occasion. Bank recapitalization programs have been launched, but the take-up has been slower than in the US (in part because of tough conditions attached, and in part because of deficiencies via national implementation). Monetary policy was too tight until the threat of a global financial meltdown forced a policy U-turn in October. More powerful fiscal policy action is further undermined by dithering government(s). Hence, recession will likely be more severe in Europe than in the US. Still, thanks to some spill-over effects from the US, some local economic policy support, a lesser sensitivity to oil price declines, and a greater degree of wage stickiness, deflation is less likely in Europe as well. Indeed, for these reasons, inflation in Europe will remain noticeably positive next year despite a dip into negative territory in the US.

Fiscal stimulus should fill a good deal of the gap in aggregate demand, enough to avert serious risk of deflation, but not enough to ensure a self-sustaining recovery any time soon.

Growth stability at lower levels: Fourth, massive fiscal stimulus, especially in the US should fill a good deal of the gap in aggregate demand, enough to avert serious risk of deflation, but not enough to ensure a self-sustaining expansion of global growth for some time to come. In addition to policy actions, private demand downturns have some self-limiting features that help to bring recessions to an end. Cyclical swings in demand are dominated by shifts in purchases of durable goods (most importantly autos), houses, and business plant and equipment. In the US these components of demand account for roughly one-third of total GDP. In a deep recession, they fall sharply, and as they reach a bottom, growth stabilizes. Already, U.S. home building has fallen sharply over the past 2-1/2 years and has already reached levels that are well below the demographic growth in demand, meaning it will not be too long before this sector begins to make a positive contribution to growth. Likewise, while indicators of business spending are now plunging, that spending was relatively low to begin with going into this downturn, and it too is unlikely to be an important drag on growth past mid-2009. The major uncertainty, however, is how far spending on consumer durables and even non-durables will fall. Prior to the current downturn, tracked data since 1947 shows real consumer spending had never declined more than two quarters in a row. This time, DB's forecast calls for consumer spending to decline four quarters in a row, through mid-2009. More importantly, that spending will likely face significant headwinds even after it has bottomed as households strive to cut debt levels and rebuild very low saving rates.

A new engine of private demand growth will be needed to fuel the next global expansion.

A new source of global demand growth: Fifth, a new engine of private demand growth will be needed, and a likely possibly candidate is in the still largely untapped consumption potential of the rapidly expanding middle classes in large emerging market countries. Although help from fiscal policy and natural spending stabilizers is essential to averting deflation and limiting the extent of the recession, a new self-sustaining expansion cannot be based on fiscal expansion alone. The industrial economies may be too stretched financially (as in the U.S. consumer), and in some cases too reluctant to take needed policy actions (as in unsuccessful efforts to translate high national savings in Japan and Germany into stronger consumption) to contribute their traditional share to global economic expansion ahead. Fortunately, a new and potentially powerful source of global demand may be waiting in the wings: the still largely untapped consumption potential of the growing middle classes in the big emerging market countries. The needs and tastes of Chinese, Indian and Brazilian middle class families may have to take over from the US consumer and its associates in spearheading the stimulation of global production in the future. And those who until recently have benefited from cheap goods produced in these countries will in the future turn into their suppliers.

The initial expansion to come after the sharp downturn now underway looks likely to be unusually sluggish.

Bridging the gap with sluggish growth: Sixth, any restructuring of the global economy will take some time, and the initial expansion to come after the sharp downturn now underway looks likely to be unusually sluggish overall, with fits and starts of growth driven primarily by policy stimulus over the next couple years. A modest recovery in the second half of 2009, as presently envisaged by many forecasters, DB included, could well be followed by a renewed weakening several quarters later. And, the Bush fiscal stimulus program of 2008 is already slated to be followed by more than one Obama stimulus program in 2009 and in later years. DB's forecast sees a period of some volatility in growth, that overall is fairly sluggish by historical standards, with relatively slow progress made in bringing down high rates of unemployment until the new driver of the next global expansion is finally in place.

The drag of fiscal burden: Seventh, taking over bad debt from the private sector now, and incurring new debt in the fight against recession is likely to leave the public sector with a very high debt burden in most industrial countries. In fact, expected future tax revenues may not be enough to cover debt service and all other government expenses, especially when public pension liabilities are taken into account. Additionally, a reduced global savings glut means that growth in individual countries will in the future probably be more constrained by their ability to fund investments through their own savings rather than from abroad. With less capital having to be shipped around the world to fund national saving (investment imbalances), the global financial sector can be smaller than it was in the past. Hence, while "trade globalization" (and the benefits from international trade integration) is likely to stay, "financial globalization" will probably retreat as more investment will be financed by savings at home.

"Monetization" of excessive government debt should eventually fuel inflation.

Inflation risk from monetization: Eighth, an oversupply of liquidity caused by central bank funding of government debt should lower exchange rates against the currencies of the faster growing emerging market economies and encourage wage and price increases. Additionally, with the fiscal costs associated with retiring baby boomers drawing nearer, there is an increased risk of "monetization" of excessive government debt, which should eventually fuel inflation. Higher inflation should erode the claims of nominal debt holders to real values that are eventually consistent with the debt service capacity of the governments. But the eventual rise in inflation is likely to still be several years off.

Conclusions

In the future, consumers in the industrial world will have to settle for lower growth and higher inflation than they experienced in the last two decades.

Broadly: as the U.S. enters the third year of the financial crisis, the outlook has worsened further. The U.S is likely to avoid deflation, but a deep and potentially long recession seems inevitable. Thereafter, the over-indebted consumers in the industrial world will probably have to settle for lower growth and higher inflation than they experienced in the last two decades. Following a possibly extended period of sluggish global recovery, a key driver of the next self-sustaining global expansion is likely to be increased consumer spending by the growing middle classes in major emerging market countries.

Distressed economic conditions caused an accelerated destabilization of the solar PV industry value chain, promising a more violent shake-out.

Translating to discrete industries (e.g. the Solar PV industry): a deterioration in solar PV industry operating conditions was already anticipated in stocks by 3Q08, reflecting weakening global macroeconomic conditions centered on the credit market malaise. Our expectation at that time was for an industry shakeout likely materializing by mid-09, driven largely by an adequate supply of polysilicon reversing the supply constrained imbalance of the past few years. Clearly the operating environment for the broader global economy, and more specifically for the solar PV industry, has changed dramatically since mid-September following the credit market freeze and ensuing dislocations across the capital markets involving every asset class. The distressed economic conditions caused an accelerated destabilization of the solar PV industry value chain pulling in the timing of an industry shake-out by roughly two quarters (i.e. beginning in 4Q08). When assessing the Solar PV industry in

light of macroeconomic events and the impact on individual companies, key consideration should be given to:

- **Macroeconomic factors:** (1) an aggressively strengthening dollar versus the euro, and ongoing currency exchange rate volatility, (2) capital markets dislocations, (3) a broad economic slowdown, and (4) declining oil/natural gas prices.
- **Industry factors:** (1) demand destruction, (2) the emergence of excess supply along the value chain, (3) significant ASP declines (currency and supply driven), (4) restricted access to and/or a higher cost of capital for project financing, and (5) a potential delay in reaching grid parity from prior expectations due to a slower grid electricity price CAGR.
- **Company impact:** (1) significant ASP declines (particularly in the upstream portion of the value chain), (2) adverse currency fluctuations, (3) revenue declines (due to currency effects, the emergence/anticipation of over-supply, and reduced production targets), (4) margin compression, (5) working capital constraints, (6) earnings risk, (7) capacity risk, (8) liquidity risk, and (9) the specter of consolidation.
- **Stock/debt impact:** (1) risk re-pricing (i.e. significantly lower), (2) multiple compression (accelerated trend more in-line with the broader market), (3) capital access constraints, and (4) forced liquidation.
- **Potentially offsetting catalysts:** (1) accelerated decline in Solar PV industry cost curves, (2) price induced elasticity of demand, (3) ITC extension in the U.S., (4) Obama administration initiatives on alternate energy (e.g. $15B per year spend for 10 years), and (5) new solar PV market growth (e.g. France, Italy, Greece, South Korea, new markets).

The macroeconomic outlook promises no near-term relief.

Negatives overwhelm potential catalysts: while the first four elements have received substantial recognition, the last (industry catalysts) continues to be overwhelmed by capital markets uncertainty, demand destruction, and the timeline involved.

The shakeout has begun

A solar PV industry shakeout was accelerated by the credit crisis

The credit crisis, which became acute in Sep-08, accelerated our shake-out timeline by roughly two quarters. Rather than a shakeout beginning in 2Q09, it began in 4Q08.

The solar PV industry shakeout has been accelerated by roughly two quarters.
Revisiting our shakeout scenario: in May 08 we detailed our outlook for the solar PV industry in our piece "*Solar PV industry outlook and economics*," forecasting the onset of a solar PV industry shakeout by mid-2009, induced by an adequate supply of silicon and crystalline silicon solar PV modules, precipitating an oversupply dynamic in the middle of the value chain (i.e. at the module level) where there are few, if any, price support mechanisms. The credit crisis, which became acute in Sep-08, accelerated this timeline by roughly two quarters. Rather than a shakeout beginning in 2Q09, it began in 4Q08.

The credit crisis added the previously unanticipated variable of significant near term demand destruction, accelerating the specter of oversupply, and all its attendant difficulties. Module ASPs are declining precipitously, driven by industry and macroeconomic (e.g. currency exchange rates, capital constraints) forces; industry and company margin structures are shrinking; valuations are compressing; balance sheets are becoming challenged, and many business models are being assailed, assessed and modified.

Revisiting our industry shakeout scenario

First Solar and SunPower are two of very few companies with long-term, competitive differentiation.

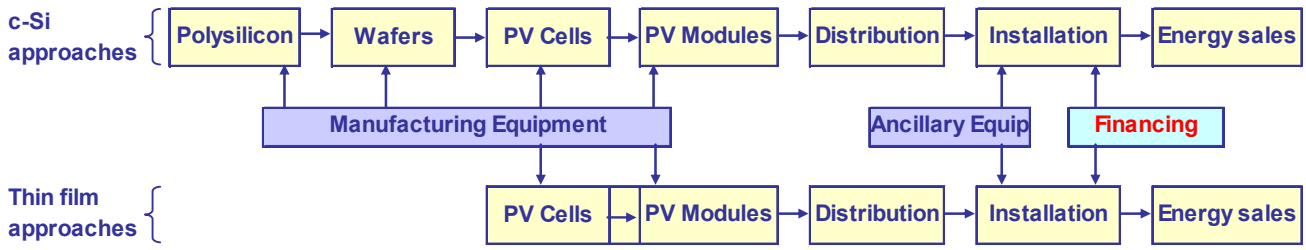
Who gets hurt in the shakeout, and who fares best?
Our investment preference: our investment preference in the solar PV industry has centered on companies with long term competitive differentiation with business models sophisticated enough to adapt to rapidly changing industry conditions. Such companies will be better insulated from the effects of an industry shakeout, and will likely emerge as industry leaders and consolidators. There are very few of these companies, and those in our coverage universe that best exemplify this are First Solar and SunPower.

Our shakeout thesis is playing out: our solar PV industry shakeout thesis is playing out, albeit more rapidly, and with greater severity than originally expected. Our forecast had called for an oversupply condition to manifest at the crystalline silicon module level of the value chain, with effects first and most markedly felt by crystalline silicon module manufacturers due to rapid, significant module prices declines. This is clearly playing out, with ASP declines exacerbated by foreign currency effects.

System integrator/installers with end market ownership and access to capital are being less impacted, as are companies with downstream integrated business models.

As anticipated, module manufacturers upstream to ingot manufacturers are being impacted severely, with silicon manufacturers better insulated, but certainly not immune. System integrator/installers with end market ownership and access to capital are being less impacted, as are companies with integrated business models (i.e. deeper ownership of the value chain that extends well downstream). Figure 2 details the major components of the value chain; we address key elements of the value chain below.

Figure 2: Solar PV value chain (crystalline silicon and thin film)



- **An oversupply dynamic begins at the module level:** an oversupply situation will manifest at the crystalline silicon module level, and matriculate up and down the value chain with varying degrees of severity.

Source: Deutsche Bank

Six months ago if a company had silicon it could largely dictate its fortunes.

Now, if a company has access to capital and projects it can largely dictate its fortunes.

The focus has shifted from one end of the value chain to the other: significant capacity expansion severely exacerbated by the credit crisis has shifted focus and fortune from the upstream end of the value chain to the downstream end. Six months ago the mantra was one of silicon availability: if a company had silicon it could dictate its fortunes. Now the mantra is ownership of projects and access to capital: if a company has access to capital and projects it can largely dictate its fortunes. This has clear implications on business models.

- **Silicon sourcing AND channel management:** with near term demand destruction, downstream channel ownership and management enables a market share grab of sorts. Companies with historically strong silicon sourcing strategies (or no need for silicon) and downstream ownership of the value chain will likely see much less company specific demand destruction. We do believe that existing demand will preferentially gravitate to the higher quality companies with better integrated and more resilient business models. While no company is immune from present industry and market gyrations, some are far better positioned than others.
- **Strong management of the ends of the value chain complement LCOE:** it cannot be overemphasized that the solar PV industry is fundamentally about selling energy, and the levelized cost of electricity (LCOE) that a company can deliver is the most critical, differentiating metric, and the final arbiter of success. Module manufacturing costs and system installation costs are critical inputs to LCOE, but in the long run are secondary inputs to competitiveness and ultimate success. Controlling input costs (e.g. silicon price) and module production latitude (e.g. quantity of silicon available) helps to lower LCOE; controlling sales channels and access to capital helps to compete with a low LCOE.

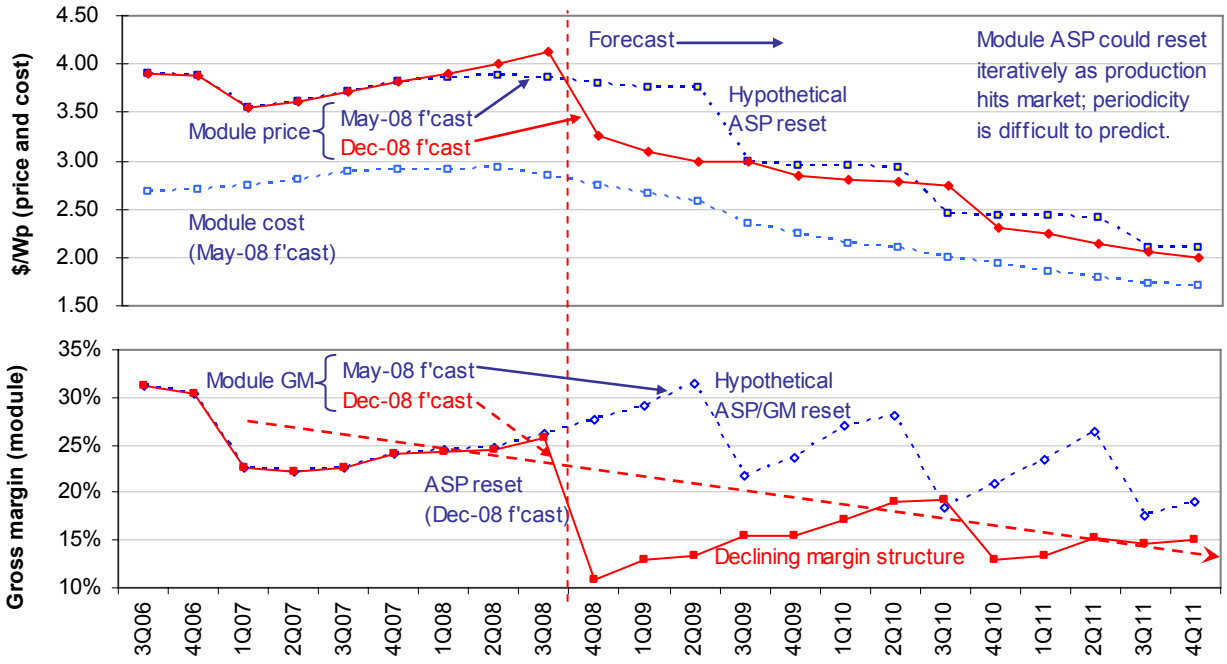
Several factors are impacting upstream players

- ***module overcapacity,***
- ***adequate silicon,***
- ***lag in silicon price drops,***
- ***demand destruction,***
- ***credit constraints,***
- ***closed capital markets,***
- ***liquidity concerns,***
- ***market share shifts.***

The upstream half of the value chain: raw material to the module

Crystalline silicon module and cell manufacturers: several factors have conspired to relegate most module and cell manufacturers to frustrating near-term operational performance to include (1) overcapacity, (2) adequate silicon, (3) a corresponding lag in silicon input price declines, (4) demand destruction due to credit constraints, (5) credit constraints for company balance sheets, (6) severe capital market restrictions, (7) the specter of potential liquidity concerns in 2009, (7) loss of investor confidence, and (8) what we believe is an ongoing bifurcation between higher and lower quality companies manifesting as market share shifts. We had always been of the mind that the sooner a shakeout materialized, the more severe it would be; this would appear to have been a valid concern. Figure 3 details prior (i.e. May-08 in blue) and present ASP and gross margin forecasts for crystalline silicon cell/module manufacturing companies.

Figure 3: Polysilicon based solar PV module price, cost and gross margin (May-08 versus present forecast)



- **Currency assumptions:** for the modeling purposes of this exercise we have assumed an exchange rate of $1.30/€ in the above graph. However, we note significant exchange rate volatility, and point out that between 13 Nov 08 and 14 Jan 09 the exchange rate has moved from a low of $1.25/€ to $1.44/€, then back to $1.32/€. Should we use a lower dollar valuation, the ASP curve would shift upward.

Source: Deutsche Bank

- **Crystalline silicon module ASP:** Figure 3 details our updated view of average c-Si module ASPs (i.e. red line in upper graph) versus our prior forecast of May 08 (which was arguably more academic to illustrate how an industry shakeout might proceed). Key differences are (1) the magnitude of the initial ASP decline, and (2) the timing. Demand destruction due to the credit crisis, substantial new capacity, and adequate silicon availability to drive production accelerated an industry shakeout, precipitating substantial module ASP declines and meaningful near-term overcapacity beginning in 4Q08 rather than by mid-09.

We have recently heard of c-Si module ASPs as low as ~$3.05/Wp, with a more realistic ASP of ~$3.30/Wp.

- **Quantifying c-Si module ASPs:** we recently heard of c-Si module ASPs of €2.30/Wp (i.e. $3.05/Wp at an exchange rate of $1.32/€, and note that this would equate to <$3.00/Wp when the exchange rate was recently <$1.30/€) from a large Chinese manufacturer, with a better average ASP estimate at ~€2.50/Wp (i.e. ~$3.30/Wp at an exchange rate of $1.32/€ as). A 3Q08 ASP of ~$4.20 would mark a ~21% q/q decline in 4Q08. Exchange rate fluctuations through the end of the year will likely make this q/q percentage decline a bit more modest.

Curtailed module production by many companies sounds a clear near-term overcapacity alarm.

- **Is it all currency?** Some would argue that the significant majority of module ASP declines is currency related (i.e. due to the strengthening of the US$ with respect to the Euro). In 4Q08 this may well be true; however, concurrent demand destruction which is prompting many companies to curtail module production sounds a clear near-term overcapacity alarm. This has also exacerbated anticipated module price declines looking into 2009. We note the Euro has spanned a range of $1.25/€ on 13 Nov 08 to $1.44/€ on 17 Dec 08 to $1.32/€ on 14 Jan 09 after having peaked at $1.59/€ on 15 Jul 08. (We address currency effects in greater detail later in this piece.) For present modeling purposes we have used Deutsche Bank's FX forecast of late 2008 (Figure 4).

Figure 4: DB Equity Strategist US$/Euro forecast (late-2008 forecast)

Exchange rate	Actual 16 Dec 08	2008 Year-end	End Mar-09	End Jun-09	End Sep-09	2009 Year end	2010 Year end
US$/Euro	1.38	1.23	1.30	1.27	1.23	1.20	1.15

- **Note:** when Deutsche Bank's strategist Binky Chadha published "The remarkable rebound of the dollar: where to from here?" on 24 Oct 08 the exchange rate was $1.27/€. Since then the exchange rate has fluctuated substantially. We will continue to assess exchange rate volatility with respect our company and industry forecasts.

Source: Deutsche Bank "The remarkable rebound of the dollar: where to from here?" Binky Chadha, 24 Oct 08, from Figure 11

We are forecasting c-Si module quarterly ASP to decline ~31% from 3Q08 to 4Q09.

We are forecasting c-Si module average annual ASP to decline ~22% y/y in 2009, and note this forecast would have been substantially higher had we not seen such a significant q/q ASP decline in 4Q08.

- **Forecasting ASPs in 2009:** in our May-08 piece we had forecasted a c-Si module ASP decline of ~22% between 4Q08 and 4Q09; we are now forecasting a decline of ~31% between 3Q08 and 4Q09. In our prior forecast we had estimated an average annual c-Si module y/y ASP decline of ~15%; we are now forecasting an average annual y/y decline of ~22% and note that this new forecast is significantly more modest than it otherwise would have been due to the significant q/q ASP decline expected in 4Q08. We are hardly apt to place much credence in longer term module contracts as we believe most contracts with durations of more than one to two quarters have market pricing clauses, such that if "market" pricing changes by a "certain" percentage, contract pricing will adjust commensurately.
- **Seasonal effects:** the solar PV industry does exhibit seasonal patterns with demand waning toward year-end and waxing beginning in C2Q; this is also somewhat weather dependent as the largest PV markets are in more northern latitudes. Additionally, contracts often reset pricing early in the year, impacting pricing in C1Q. This is reflected in our module ASP forecast with greater ASP drops in C4Q/C1Q with stabilizing ASPs in C2Q/C3Q. As geographies shift, so could this seasonal pattern. However, when considering macroeconomic trends and anticipated new markets, we do expect this pattern to hold, at least through 2010.

- **c-Si module company gross margin:** Figure 3 details our updated view of module/cell manufacturer gross margin (i.e. red line in lower graph) versus our prior forecast of May 08 (which was arguably more academic to illustrate how an industry shakeout might proceed). Key differences are (1) the magnitude of the initial margin decline, and (2) the timing. Demand destruction due to the credit crisis, substantial new capacity, a lag in input cost reductions, and in many cases idled capacity are driving significant near-term (C4Q08) gross margin resets.
  - **Gross margin spans a wide range in 4Q08 and should improve in 1Q09:** we expect most c-Si module manufacturing companies will post 4Q08 gross margins of <0% to potentially 20%, although we are quite skeptical of higher guidance levels. Some companies have chosen to (1) idle significant capacity, reflecting near term demand destruction (this is a very significant factor with several companies – e.g. Canadian Solar), and (2) consume high cost inventory in 4Q08. These same companies will likely (1) write down high cost inventory with lower cost purchases beginning to accrue, and (2) begin to benefit from more meaningful input cost reductions setting the stage for improved gross margin in 1Q09.

c-Si manufacturer GM trend will be down, and could settle at <15% over the long term.

  - **Forecasting gross margin:** our prior forecast (i.e. May-08 in the lower graph of Figure 3) depicted an iterative process in which gross margin would reset lower as module ASPs periodically dropped faster than costs; the interim periods of expanding gross margin would be insufficient to overcome the periodic drops resulting in a declining long term gross margin structure. We still believe this general trend is correct; however, with recent real inputs, we can better quantify the near term trend and extrapolate a longer term trend (i.e. the red line in the lower graph of Figure 3). While the graph shows an increasing gross margin structure through 2009 and well into 2010 before another periodic reset, it is entirely possible that ASP

declines will be more pronounced over the period, or cost declines will be less pronounced, or both, resulting in a dampened gross margin profile that could peak in a mid-teens percentage range, and then modestly decline. This would be consistent with a commodity type industry, which we believe would be an appropriate assumption for the c-Si module segment of the industry. What is most important to note, however, is that we believe the overall gross margin trend will be down over the coming several years.

- **Non-differentiated c-Si cell/module manufacturers will be hurt the most:** we continue to believe that non-differentiated companies that only participate in c-Si module manufacturing are likely to be hurt the most. Such companies have little in the way of competitive differentiation, participate in the upstream segment of the value chain with relatively low barriers to entry, and will likely have the most difficulty in defending margins.

Ingot and wafer manufacturers: most ingot/cell companies have begun to integrate either up or down the value chain. We view ingot/wafer manufacturing as a lower value add segment of the supply chain, and would view integration to include polysilicon manufacturing and/or downstream elements of the value chain as critical to the longer-term health of the business model.

- **Near term expectations:** we believe supplying wafers will be a commodity business. The silicon shortage over the past few years has offered strong margin performance for ingot/wafer manufacturers. We do not expect this to continue, and anticipate ASP and gross margin retracement potentially similar to c-Si cell/module manufacturers over the near term. We have been very skeptical of ingot/wafer companies that were projecting relatively modest ASP and gross margin declines in 4Q08. Recent revisions to 4Q08 guidance have helped to rectify this, but we anticipate further downside in 1Q09. Furthermore, when considering 4Q08 guidance from companies like SunTech and Canadian Solar, significantly lower production would portend lower volume purchases of wafers, for example; we expect this dynamic to continue through 1Q09.

c-Si wafer pricing must decline to well below $2.00/Wp in 2009 to enable a functioning value chain.

- **c-Si wafer pricing:** LDK Solar stated that solar wafer pricing in 3Q08 averaged $2.48/Wp. We believe forward contracts exist with wafer pricing <$2.00/Wp, and would anticipate that wafer pricing must decline to well below $2.00/Wp in 2009 to enable a functioning value chain (i.e. customers) at the cell/module level.

Polysilicon manufacturers are better insulated, but certainly not immune: we believe long term (e.g. typically ≥5yrs) polysilicon contract pricing has remained largely intact, declining annually as per predetermined schedules. We have heard of intermediate term (e.g. typically one to two years) contract renegotiations as the contracts were signed with what are comparably high prices today, and note that polysilicon spot prices have declined substantially from a recent peak. We do not expect a collapse in silicon pricing, but would expect convergence of intermediate term contract and spot pricing toward long term contract pricing through 2009 and 2010. Semiconductor industry wafer pricing has dropped substantially, and will likely suffer further declines in 2009 both in ASP and units.

We estimate 2009 long term polysilicon contract pricing will range from ~$65/kg to ~$90/kg with some re-negotiation of contracts at or above the high end of the range.

- **Polysilicon contract pricing:** most solar PV silicon is sold under long term agreements with near-term prices that likely range from as low as $60/kg to $65/kg for companies yet to produce silicon, but needing to secure financing from customers, to roughly $75/kg to $90/kg for established players. Broadly speaking, we estimate 2009 long-term polysilicon contract pricing will range from ~$65/kg to ~$90/kg. We believe there may be selective long term contract price renegotiations in progress, and would anticipate that long-term contracts with pricing >$90/kg in 2009 could be revised downward within the range. We have heard of intermediate term (e.g. one to two years) contract price renegotiations in which the original contract was signed with a contract price as high as $240/kg; we would expect such contracts to be renegotiated, or to be broken by customers depending on the price of alternatively available silicon and contract penalties. This would help drive intermediate term contract pricing toward long-term contract pricing.

Polysilicion spot pricing is ≥$150/kg for meaningful quantities.

- **Polysilicon spot pricing:** we believe polysilicon spot pricing is roughly $150/kg to $175/kg, down substantially from the $400/kg or more of a few months ago. We have heard anecdotally of polysilicon spot pricing as low as $100/kg, but believe this is for very small quantities, and is not representative of the broader spot market. When considering the marginal cost of new polysilicon producers, we anticipate polysilcon spot prices could begin to gravitate toward long-term contract prices through 2009 and 2010. Even with potential long term contract cancellations (or more likely defaults), and the availability of more silicon in the short term market, we do not expect spot prices to drop below the long term contract price range. We believe overall silicon pricing at such levels offers a compelling value proposition for leading cell/module manufacturers (detailed later in this piece), and anticipate demand at such prices will become be adequate to consume supply.
- **Marginal producers' cost:** we have already seen newcomers to the polysilicon manufacturing sector push out capacity expansion plans due to capital restrictions. Furthermore, we believe that some of the more capable of the Chinese would-be polysilicon suppliers expect to reach a production cost of ~$45/kg when fully ramped and at yield; this compares to ~$32/kg for incumbent suppliers using a typical Siemens process. Realistically speaking, these new suppliers will not likely be fully ramped and at long term targeted yields within the next year, and consequently, manufacturing costs will likely be meaningfully higher than $45/kg. Commentary on anticipated manufacturing costs related to new polysilicon suppliers has ranged from $50/kg to as much as $100/kg. Even at the lower end of this range, pricing below present long term contract prices would likely result in a loss. We believe this dynamic will help to keep spot pricing at or above long term contract prices through 2009 and 2010.

Contract defaults could periodically saddle the spot market with substantial supply, driving spot prices toward the low end of long-term contract pricing.

- **Incumbent polysilicon suppliers:** we believe incumbent polysilicon suppliers have largely pre-sold anticipated production in long term contracts. However, we also anticipate that not all long-term contracts will survive the solar PV industry shake-out, and it is quite possible that several customers could default on long-term contracts as early as 2009. In a worst case situation this could saddle the spot market with substantial supply, driving spot prices toward the low end of long-term contract pricing. We believe it is appropriate to conservatively model the solar PV businesses of polysilicon producers at the low end of contract prices through 2009 as one plausible, albeit conservative scenario. Conversely, we believe the specter of significant incremental supply within the next one to two years from new manufacturers has waned significantly, mitigating what may have been previously anticipated competitive pressures through 2009 and 2010.
  - **Margin structure of silicon producers:** we expect margin contraction among the silicon producers, albeit not nearly as pronounced as among the ingot to module manufacturers. Considering that many silicon and silicon wafer manufacturers serve the semiconductor industry as well, we believe margin compression could be more pronounced. For example, we are modeling gross margin at MEMC Electronics to decline to 40% by mid-09 from a high of >53% in 2Q08.
- **UMG-Si – anticipated impact:** we are increasingly of the belief that UMG-Si (i.e. upgraded metallurgical grade – purified to at least six nines (6N) of purity – 99.9999% – at least three orders of magnitude less pure than electronics grade silicon) can drive a solid product in the solar PV industry over the near-term. The claims we have heard from companies like Canadian Solar and Q-Cells indicate cell conversion efficiencies within a percent of cells based upon electronics grade silicon. We believe that with incremental improvement in crystallization techniques in ingot formation, and cell structure, UMG-Si based modules may be able to maintain a 1% or less conversion efficiency deficit to industry average (e.g. not SunPower) crystalline silicon modules made from electronics grade silicon. Accelerated life testing does not seem to indicate inordinate degradation early in life. Furthermore, we believe companies like PhotoWatt have been selling UMG-Si based modules for well over a year, with solid field performance. Should efficiency assumptions prove out, we estimate that a "middle" tier (i.e. not the technology leader)

manufacturer could produce a competitive UMG-Si based module as long as the cost of electronics grade silicon remains >$80/kg; with conversion efficiency improvements from efforts indicated above, this number could decline to roughly >$70/kg indicating a potentially healthy life for such products. We expect 2009 and 2010 to be the defining years for acceptance (or rejection) of UMG-Si based modules in the industry.

- **Long-term dynamic could well favor producers:** when the cost of solar PV generated electricity is less than grid supplied electricity, with an increasingly favorable spread, and solar PV demand increases dramatically, we anticipate another potential silicon shortage could emerge, driving prices higher, benefiting silicon producers. We believe this could begin within four to five years.

We believe leading thin film module manufacturers will be less impacted than c-Si module manufacturers through the shake-out.

Thin film module manufacturers: although certainly not immune, we continue to believe that leading thin film module manufacturers will be less impacted than c-Si module manufacturers. Despite ongoing capital constraints for projects, we anticipate less of an impact on thin film module demand than on c-Si module demand as (1) thin film modules are a much smaller segment of the market, that is (2) concentrated in the industry's largest market (i.e. Germany), which is (3) more conducive to thin film technologies. Furthermore, the largest thin film module manufacturer (i.e. First Solar) offers the most competitive product in the industry (i.e. can deliver the lowest LCOE), driving better project ROI's, securing more reliable funding, and offering a greater degree of insulation from demand destruction. This assessment runs the risk of being branded exclusive to First Solar, rather than applicable to the entire thin film segment of the industry, and there is some truth to such an assessment.

- **Pricing pressure among thin film modules:** we expect First Solar to experience less pricing pressure than c-Si module manufacturers as the company (1) priced below market to begin with, and (2) offers the most compelling value proposition in the industry. We expect a-Si companies that did not price below market (e.g. UniSolar) to experience more pricing pressure as pressure mounts on the c-Si manufacturers; however, we believe companies like UniSolar that focus more on integrated BIPV markets could resist pricing pressure more effectively. We believe pricing pressure on new thin film entrants later in 2009 will come largely from the bar set by First Solar.
- **Private thin film module/cell companies will shake-out as well:** we expect the shake-out to affect private thin film module companies driving consolidation under a sanguine scenario, and liquidation under a less favorable scenario. Some private thin film companies appear to have managed cash well, but even with the rich funding of recent capital raising rounds, we believe some private companies that raised hundreds of millions of dollars over the past year or two could well encounter liquidity issues in 2009. We believe many early investors have picked their horses for the coming race, and will not likely invest additional money in all their previously funded solar PV start-ups. We expect the CIGS and a-Si segments of the thin film space to struggle the most, largely because of the sheer volume of companies pursuing these technologies.

The downstream half of the value chain: systems and energy, and end market demand

Downstream companies with strong customer ownership and access to capital will benefit disproportionately over the near-term.

Integrater/installers – capital constraints overshadow module price reductions in the short term – it is now a question of quantifying demand destruction and assessing company positioning: an oversupply dynamic at the module level is clearly beneficial to integrator/installers. There are essentially no price support mechanisms at the module level when an oversupply dynamic emerges at that point in the value chain; however, there are price support mechanisms at the system level – regional incentive structures – provided the integrator/installer has access to projects and capital. Unfortunately for the integrator/installers, the near-term environment of severe capital constraints will likely overshadow the potential near-term benefit of lower input costs. As mentioned previously, the mantra is now access to projects and project financing; those downstream companies with strong customer ownership and access to capital will benefit disproportionately over the

near-term. Several factors will impact near-term demand and downstream players; we address some in more detail in a subsequent section.

- **Rising cost of capital:** we calculate that a 1% increase in the cost of capital for a commercial scale project would require a ~7% decline in the system price to maintain an ROI constant. This varies by region, and will drive demand destruction, or greater price declines at the module and system levels with varying impact up the value chain. (More on this in the next section.)

The biggest near term impact to demand is reduced access to capital. This is very difficult to quantify.

- **Reduced access to capital – impact on demand:** this is the primary question related to third party financing, and potential demand destruction looking out into 2009. Projects with third party financing, rather than internally financed, are at the greatest risk of being delayed or cancelled. We have heard of delays of projects that were to date unfunded, and have observed slowing bookings of new projects as many integrator/installer/financiers have put new (i.e. unfinanced) projects on hold until the credit situation improves. This issue is currently unquantifiable; however, our rough calculations indicate that the potential for demand destruction of >30% in 2009 from recent expectations could be discounted into solar PV stocks (i.e. we calculate demand destruction from forecasted aggregate industry revenue levels extrapolated to MWp installed, not y/y decline).
- **Project delays versus cancellations versus new bookings:** we have heard of unfinanced projects put on hold until credit eases, and believe projects have been delayed. We anticipate a significantly negative impact through 1H09, and believe not all of this may be discounted into stocks yet. We also believe that reality could be less than what may be discounted in some stocks (i.e. stocks of the surviving companies) over the next year or more, as these relatively secure investments (i.e. often government backed (via incentive programs), comparably low risk investments) may offer a safer haven for bank lending, should incremental lending resume in 2H09.
- **Declining fossil fuel costs and grid parity projections:** declining fossil fuel costs, particularly natural gas, mitigates grid electricity price increases, and the CAGR of average grid electricity prices could slow and/or be less than present "convergence" forecasts assume. This constitutes a perceptive threat to incentive programs, and could demand a faster cost reduction curve for solar PV LCOE, potentially pressuring company margin structures.
- **An incentive driven industry:** without incentives the solar PV industry would be significantly smaller, and demand is largely a function of regional incentive programs. We believe most of the uncertainty regarding 2009 regional incentive programs has been removed. However, a worsening macro-economic environment could cause governments to frequently reassess programs. Our 2009 outlook is based upon what we believe are currently stable programs out through 2009.

We do not expect much concrete benefit for solar PV demand in the US in 2009 from an Obama administration stimulus package; however, there is clearly upside potential.

  - **The US market under an Obama administration:** we anticipate that the promised economic stimulus package of 2009 (which apparently will be quite large) will contain some provisions for renewable energy investment; however, we do not expect a material impact to 2009 US solar PV market demand or company estimates. We are more inclined to believe that climate change legislation which could become law by the end of 2009 will more likely be a catalyst for renewable energy projects beginning in 2010. We do note, however, President-elect Obama's commentary during a 16 Jan 09 speech on the stimulus package that "we" intend to double the output from renewable energy sources over the next three years. Specifics and related funding could offer upside to our expectations over the coming two years.

- **Market segmentation; company positioning:** in the present environment, the market needs to be segmented not just traditionally (e.g. residential vs commercial vs industrial;

rooftop vs ground mount; region and incentive programs), but also by financing type (e.g. internally vs third party; higher vs lower quality companies). We believe that a further bifurcation between higher and lower quality companies will become more apparent over the near term.

We believe fully integrated system providers with long term competitive advantages are best positioned overall.

Integrator installers – larger is better: we anticipate larger integrator/installers with multiple market exposure, and the deepest ownership of sales channels and projects to fare best. We expect all to be adversely impacted by near-term demand destruction, but also believe that a bifurcation in higher versus lower quality companies will become more pronounced as the shake-out deepens. We believe that fully integrated system providers with long term competitive advantages are best positioned overall.

- **Fully integrated system providers:** there are very few "fully" integrated system integrator/installers, and even fewer with long term technology based competitive advantages. Module price declines should help fully integrated companies as (1) internally produced modules can be directed toward the company's systems business, (2) externally sourced modules will be less expensive, (3) the company will be in the best position to engineer lower cost BOS solutions, and (4) ownership of sales channels should offer preferential access to projects. We view this business model, particularly among crystalline silicon technology companies, as the most insulated.

Capital markets and consolidation

The financing window has narrowed considerably for virtually all companies, and has closed for many.

Funding and consolidation: the financing window has narrowed considerably for virtually all companies, and we believe has closed for many. This will help accelerate a shake-out and rationalization of the industry as we expect many companies, public and private, to face liquidity issues beginning in 2009.

- **Private company consolidation:** there are dozens and dozens of private companies that span the value chain using both crystalline silicon and thin film technologies. Many of these companies are private; some have amassed liquidity that could carry them through the shake-out of the next couple years, and some have spent war chests that should have been able to carry them through the shake-out of the next couple years. We expect the shakeout to be severe among the private thin film companies for several reasons: (1) there are many private thin film companies, very few of which are close to volume production, (2) few thin film companies have solid, technology based competitive differentiation (i.e. with respect to each other, particularly in the amorphous silicon segment), (3) larger companies will likely acquire promising technology based, next generation companies, and (4) the financing window has largely closed, except for next generation companies. We expect many private companies, predominantly amorphous silicon based, CIGS based, and smaller downstream players to encounter liquidity issues beginning as early as 1H09. Again, we have anecdotally heard of several venture investors that have "picked their horses," and will not likely support all investments should additional funding become needed. This will likely lead to liquidity issues at several companies.

Who is best positioned among our coverage universe?

For particular market segments (e.g. commercial scale) we believe selling energy rather than modules and systems will likely offer the best long term returns.

Selling energy should be the most attractive long term segment of the industry: for particular market segments (e.g. commercial scale) we believe selling energy rather than modules and systems will likely offer the best long term returns. Our general belief is that over time the return on selling modules and systems (i.e. commodity parts) will become less attractive, and the return on selling energy under a distributed model will become more attractive. We believe the most strategic minded companies are positioning themselves to be able to sell energy in various markets as economics become favorable to do so. This has involved integrating to the end customer (i.e. becoming an integrator/installer), building internal expertise in structured finance, and leveraging cell technology (if a company has it) to

offer a more competitive levelized cost of electricity with which to win energy provisioning contracts.

The lowest LCOE enables a company to address the broadest market with the greatest potential return.

- **Energy provisioning – a good bet for the long term:** when the cost of solar PV generated electricity drops below the price of grid electricity, selling energy in a distributed utility model will become increasingly attractive. As the delta between solar PV cost and grid prices increases, each successive power purchase agreements (PPA) signed will become increasingly profitable (assuming consistent terms). With the upstream portion of the value chain becoming increasingly commoditized, we believe this energy pricing dynamic will offer the best economic opportunity in the entire value chain. Those companies with a technology based competitive advantage (and this typically manifests at the cell level) will be able to offer the lowest levelized cost of electricity (LCOE), making them the most competitive. The lowest LCOE enables a company to address the broadest market with the greatest potential return.

SunPower and First Solar are the best positioned companies in our coverage universe, and stand to suffer least in the near-term, and benefit most over the long term.

The natural conclusion is that SunPower and First Solar are best positioned in our solar PV coverage universe: if the above is true, then SunPower and First Solar are the best positioned companies in our coverage universe, and stand to benefit most over the long term.

- **First Solar** can offer the most competitive solar PV based LCOE solution, while maintaining an industry leading operating model, in our opinion. And, while the company's business model may be somewhat less sophisticated than SunPower's (e.g. less geographic penetration and latitude, shallower penetration in some market segments, a less mature downstream component), we believe the company has the latitude of time like no other company in the industry, and will inevitably become a "fully integrated" industry leader in appropriate markets. Furthermore, we believe the company has a multi-year time advantage over any potential thin film competitor.
- **SunPower** has the most sophisticated business model (i.e. integrated from wafers to energy), is structured to address the broadest market (i.e. market segments and geographies), and can offer one of the two most competitive solar PV based LCOE solutions while maintaining a solid operating model. Furthermore, we believe the company's technology (which drives its LCOE solution) is not likely to be replicated by other companies any time soon.

Supply/demand update

Update on supply and demand

The uncertainty of unfolding events, particularly in the credit markets, has made quantification of supply and demand problematic at best.

Supply and demand: in our 27 May 08 piece "*Solar PV industry outlook and economics*," we presented a detailed supply and demand model through 2010, with the principle aim of (1) defining a rational supply and demand forecasting methodology that could be refined as data dictated, and (2) predicting when an oversupply dynamic would emerge. Our belief was that this oversupply dynamic would usher in a shake-out period for the industry. The credit crisis, which became acute in Sep-08, has clearly accelerated this dynamic, precipitating the beginnings of a shake-out in 4Q08. This has clear implications on supply and demand, both of which will be lower than we had previously forecasted. Furthermore, the uncertainty of unfolding events, particularly in the credit markets, has made quantification of supply and demand problematic at best. In this section we present our preliminary assessment of 2009 and 2010 supply and demand, understanding that variance error is high, and frequent re-assessments will be required as company actions and needs, and credit availability become clearer in 1H09.

- **An interim assessment:** we employ our supply and demand model developed earlier in 2008, but note that variance error is significant both in our demand calculation and in our supply calculation. While the methodology is as rigorous, our estimation is that exogenous factors are far more uncertain. Consequently, we will provide an "interim" assessment of supply and demand for 2009, with the expectations that it will be revised frequently over the coming months as more data becomes available.

Near-term demand re-assessment

Several factors have tempered 2009 demand growth expectations, with the primary ones being

(1) a rising cost of capital, (2) access to capital.

Demand growth expectations have declined

2009 demand growth has been tempered: several factors have tempered 2009 demand growth expectations, with the primary factors being (1) a rising cost of capital, and (2) access to capital.

A rising cost of capital: the present environment will increase the cost of capital. In Figures 5, 6, and 7 we assess the impact on regional ROIs on a rising cost of capital over the next couple years; our focus is clearly on 2009. We use our base case scenario detailed in our 27 May 08 piece "*Solar PV industry outlook and economics*," which offers a basic framework for sensitivity analyses; we have adjusted that model for what we believe are current inputs.

- **Impact of a rising cost of capital:** using a 20 year project financing time horizon, and 100% financing, for a 1MWp project excluding land costs, we estimate that a 1% increase in the cost of capital would require a ~7% decline in an installed system price to maintain a constant project ROI. By region these required price declines range from just below 6% (South Korea) to over 9% (Japan) (see Figure 7).
- **Defining regional cost of capital in 2009:** in assessing the cost of capital for solar PV project financing for 2009 and 2010 in a credit contraction environment, we note a lack of credit velocity despite trillions in liquidity injections globally in recent months. For base reference purposes, we use a 12-month Libor rate or a similar rate in most markets, and layer in corporate credit spreads as well as expected credit spreads to approximate the cost of capital. Furthermore, we have made minor adjustments for specific markets to account for industry size, maturity, and government supported financing programs.

- **Corporate credit instruments as a check:** in as much as solar PV financing costs would vary depending on project viability and the credit quality of participants, we do note that corporate credit instruments in various industries in various geographies have come into the market over the last several months within +/- 0bps to 200bps tolerances of what we have assessed as the cost of capital for specific geographies. Accordingly, we use the cost of capital mentioned for specific regions as good reference points, as well as for solar PV project sanity checks to ensure they make sense after adjusting for all other variables impacted by industry dynamics.

- **Modifying our base case:** in our 28 May 08 piece we detailed base case scenarios by region for project financing costs and project (e.g. 1MWp size) ROIs; we have adjusted our base case scenario (Figure 5). All the underlying assumptions for the base case model and inputs are detailed in that piece; we present results and what has changed in Figure 5.

Figure 5: Solar PV project financing costs and ROIs by region – base case

	Solar PV project financing costs (%)				Solar PV project ROIs (%)			
	2007	2008	2009	2010	2007	2008	2009	2010
Germany - Ground	6.6%	6.4%	7.6%	6.9%	8.5%	9.8%	7.6%	10.0%
Germany - Roof	6.6%	6.4%	7.6%	6.9%	8.2%	9.5%	8.0%	10.9%
Spain	6.8%	6.7%	7.6%	6.9%	12.0%	15.7%	9.2%	20.4%
Italy - Ground	6.6%	6.4%	7.6%	7.4%	3.5%	11.4%	12.2%	16.9%
Italy - Roof	6.6%	6.4%	7.6%	7.4%	5.4%	13.5%	14.3%	19.2%
France	6.6%	6.4%	7.6%	7.4%	2.7%	11.6%	13.4%	20.3%
France - Overseas	6.8%	6.7%	7.8%	7.6%	8.4%	18.2%	20.1%	27.9%
Greece - Mainland	6.8%	6.7%	7.8%	7.6%	3.2%	11.5%	15.2%	22.4%
Greece - Islands	6.8%	6.7%	7.8%	7.6%	6.7%	15.3%	19.1%	26.5%
Japan	2.0%	2.5%	3.5%	3.3%	2.8%	3.6%	5.5%	11.4%
South Korea	8.3%	8.5%	9.5%	9.5%	12.6%	16.3%	17.5%	21.5%
U.S.A	7.3%	6.3%	7.8%	6.4%	8.4%	8.2%	3.5%	13.0%

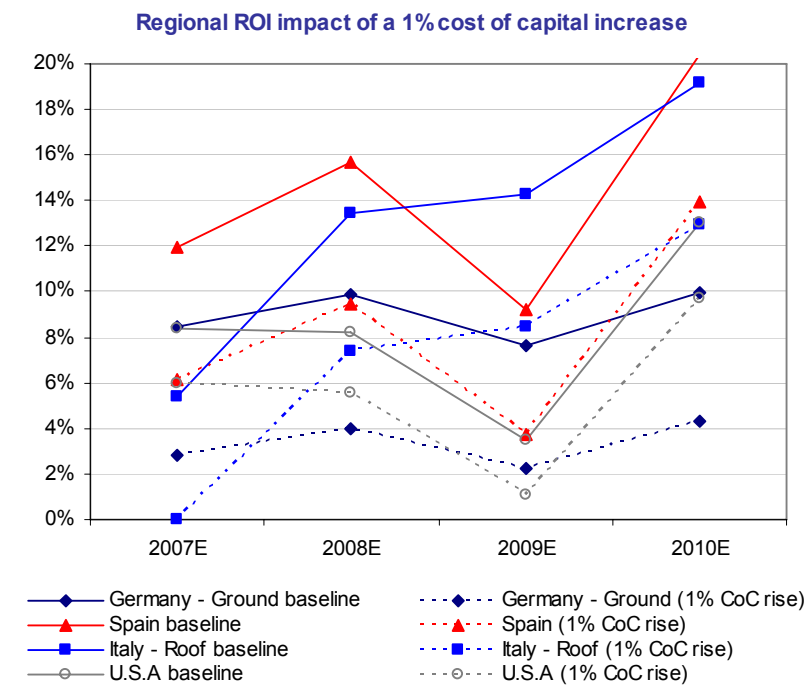
Notes:

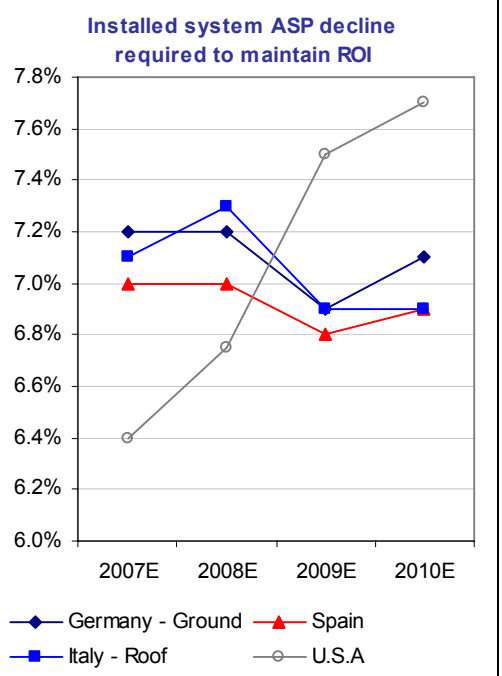
- **Cost of capital estimates:** our 2009 cost of capital estimates are rougly 100bps higher than our mid-08 baseline estimates; this varies by region.
- **Average regional project ROI estimates:** our 2009 average project ROI estimates are rouhgly 50bps to 90bps lower than our mid-08 baseline estimates; this varies by region.
- **Average regional system costs used in our ROI estimates:** in our 2009 regional demand ROI calculations we have reduced installed system price ($/Wp) forecasts by rougly another 5% to 7%; this is on top of the rouhgly 10% system price reduction we had originally forecasted for 2009. This varies by region.

Source: Deutsche Bank

- **Cost of capital impact on ROIs in primary markets:** Figure 6 graphs the impact to average project ROIs for a 1% increase in the cost of capital in four primary markets, as well as the installed system price decline required to maintain baseline ROIs with a 1% cost of capital increase. The right graph indicates that an installed system price must decline by approximately 7% to compensate for a 1% increase in the cost of capital.

Figure 6: Impact of a cost of capital increase on project ROIs, and required system ASP declines to compensate





Source: Deutsche Bank

- **Cost of capital impact on ROIs in all relevant near-term markets:** Figure 7 details the impact to average project ROIs for a 1% increase in the cost of capital in all relevant markets over the next couple years, as well as the installed system price decline required to maintain baseline ROIs with a 1% cost of capital increase. This offers a more complete picture and enables a more broad based sensitivity analysis.

Figure 7: Impact of a cost of capital increase on project ROIs, and required system ASP declines to compensate

	Solar PV project ROIs (%) with a 1% increase in the cost of capital				Installed system ASP decline (%) required to maintain project ROI			
	2007	2008	2009	2010	2007	2008	2009	2010
Germany - Ground	2.8%	4.0%	2.2%	4.3%	7.2%	7.2%	6.9%	7.1%
Germany - Roof	2.5%	3.7%	2.6%	5.1%	7.2%	7.2%	6.9%	7.1%
Spain	6.1%	9.5%	3.7%	14.0%	7.0%	7.0%	6.8%	6.9%
Italy - Ground	-1.8%	5.5%	6.5%	10.9%	7.1%	7.2%	6.9%	6.9%
Italy - Roof	0.0%	7.4%	8.4%	12.9%	7.1%	7.3%	6.9%	6.9%
France	-1.4%	6.9%	8.7%	15.1%	6.9%	6.9%	6.8%	6.8%
France - Overseas	4.0%	13.0%	15.0%	22.2%	6.8%	7.0%	6.7%	6.7%
Greece - Mainland	-1.7%	6.0%	9.8%	16.4%	6.6%	6.6%	6.3%	6.4%
Greece - Islands	1.6%	9.6%	13.4%	20.3%	6.6%	6.6%	6.4%	6.4%
Japan	-4.2%	-3.4%	-1.4%	4.0%	9.6%	9.4%	9.1%	9.1%
South Korea	7.8%	11.2%	12.5%	16.4%	5.8%	5.8%	5.6%	5.6%
U.S.A	6.0%	5.6%	1.1%	9.7%	6.4%	6.8%	7.5%	7.7%

Source: Deutsche Bank

The biggest issue impacting near-term demand is access to capital, and we do not believe there is a reliable way to accurately estimate the impact of this effect yet.

Access to capital: the biggest issue impacting near-term demand is access to capital, and we do not believe there is a reliable way to accurately estimate the impact of this effect. Present information compels us to assume a substantially negative impact on broad based demand in 2009, weighted toward 1H09. This has significant implications throughout the value chain, but quantifying this is very difficult, and may not be possible at the present juncture considering changing industry and macro-economic conditions, and little more than anecdotal inputs from which to draw conclusions.

- **Third party financing:** the greatest risk lies with third party financed projects (i.e. not internally financed). This is a difficult percentage of the industry to assess. We estimate that in regions with large sized projects (e.g. Spain) the percentage of projects that are third party financed has been well over 50%; we also believe that in Germany, the percentage could be well over 50% considering bank financing and project size profiles. In the US we believe this percentage is also quite high. This raises the specter of meaningful risk to aggregate project installation in 2009 if the credit markets remain less than favorable. If we assume if internally financed projects with reasonable ROIs remain largely intact over the next year, we could see a modest decline in internally financed projects and a more substantial decline in third party financed projects.

Expectations are for weak near term new business, ongoing progress with financed business, and the anticipation that project growth will accelerate in 2H09 as credit restrictions ease.

- **Anecdotal commentary:** we have spoken with several solar PV value chain companies to include integrator/installers, project management/finance companies, and integrated manufacturing/system companies recently. Expectations continue to be for a near-term hiatus in new business, ongoing progress with financed business, and a great deal of uncertainty looking through 2009. Most seem to anticipate that project growth will accelerate in 2H09 as incremental lending ensues; there is little concrete data to provide a high level of confidence in this, however.
  - **Potential delays of funded projects:** discussions with solar PV project management/finance companies indicate that while they generally believe that funded projects will proceed, there could be potential delays. And, while there seems to be relative confidence in booked (i.e. financed) business, this does not preclude the possibility that funded projects may begin to see delays. This presents risk for a 2009 demand forecast.
  - **New business on hold:** several integrator/installers we spoke with indicated that projects for which financing has not been secured are still largely on hold for review in the near future should the credit markets ease. We believe this largely impacts third party financed projects, which we believe is a majority of overall projects.
  - **US based integrator/installers and the ITC:** recent discussions we have had with some smaller integrator/installers in the US indicated that with the passage of the ITC extension late last year, projects that had been on hold, but for which financing had been arranged, have moved forward. We anticipate increased activity through 1H09 in the US due to the passage of the ITC for what was booked/financed business. This presents a modest positive for the near-term demand environment in the US. Nonetheless, a dearth of tax equity investors, and a great deal of uncertainty remains for yet to be financed projects through 2009, easily countering the near term positive from earlier passage of the ITC extension bill.
  - **Regional commentary:** we believe that markets like Spain will likely be able to fulfill the 2009 cap of 500MWp of installations. We also note that in markets like Spain and Greece, for example, renewable energy investments (i.e. more reliable cash generating assets) may be being viewed as more defensive, and downside demand risk may be more limited. Regardless, inputs indicate higher costs of capital for projects, and we do see a slowdown in bookings as future projects come under scrutiny, and access to capital remains restricted.

Incentive programs: we have reassessed incentive program inputs to our demand model with particular focus on countries in which incentive programs have changed dramatically from our May-08 understanding or expectation. Incrementally negative impacts from Spain could have been offset by lower prices in the uncapped German market (spurring increased demand), positive changes for the US market, and emerging markets in broader Europe. Unfortunately, what could have been viewed as a potentially neutral outcome among these demand drivers has been overshadowed by demand destruction due to capital constraints for project finance.

- **Spain's incentive program instates an annual cap of 500MWp:** Spain, the second largest market in 2008 at >1GWp of installations, adopted a new law in 4Q08 that cut the solar PV electricity feed-in tariff by an average of ~25%, and instated an annual solar PV installation cap of 500MWp. This will cut Spain's 2008 market by more than half in 2009.
- **US ITC passes in expanded form:** though rejected numerous times in the past, an expansion and extension of the US investment tax credit (ITC) passed as part of the $700B TARP package (HR 1424) in Oct-08. The approved ITC package is more favorable than the previous package, and should stimulate growth in all US market segments (i.e. residential, commercial, and industrial) assuming project financing is available. We expect this to have a positive impact on the US market in 2009 and beyond.
- **Changes to German feed-in tariffs:** Germany, the single largest market for solar PV installations, adopted a new accelerated feed-in tariff digression schedule in 2008, which took effect in 2009. The new digression schedule (i.e. a nearly 10% decline in feed-in tariffs versus the original schedule of a 6.5% per year decline) was long anticipated, and expected module and system price declines, offset by cost of capital increases should enable the market to continue to grow, albeit at a much lower rate than in 2008, assuming adequate project financing is available in 2009.

What reinitiates accelerated demand growth and when?

Incremental lending and tax equity investment for project finance will instigate accelerated demand growth. Our best estimate as to when this begins to return in a meaningful way is mid-2009.

Incremental lending is the primary catalyst needed to revive demand growth: incremental lending and tax equity investment for project finance will instigate accelerated demand growth. Our best estimate as to when this may begin to return in a meaningful way is mid-009; an optimistic estimate would be sometime in 2Q09. If traditional "incremental" lenders and tax equity partners like the large multinational banks and investment banks have completed balance sheet deleveraging plans by the end of 1Q09, which we believe is a reasonable timing target, then incremental project finance activity could begin again in 2Q09. If we assume a more conservative time horizon, then mid-2009 may be a more realistic estimate, and solar PV project demand growth could reaccelerate in 2H09.

Revising our global demand forecast over the next couple years

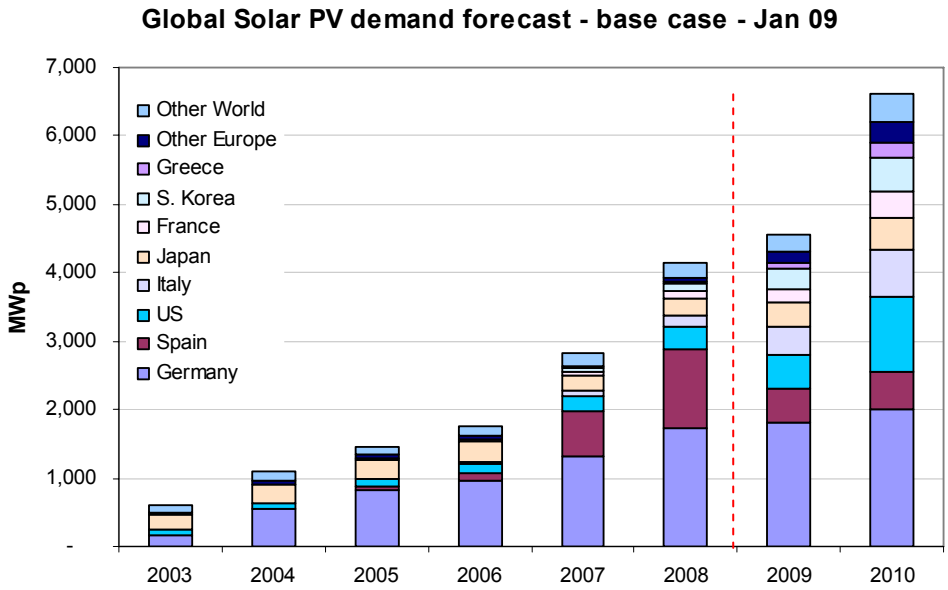
Global demand roll-up: we continue to use our ROI based demand model, but have tried to account for exogenous factors to include (1) near term credit availability, and (2) a near term dearth of tax equity investors. This has lowered our outlook, with the most pronounced effect in 2009. The data presented in Figure 8 constitutes our base case demand scenario through 2010 by region. The data assumes component price declines consistent with our system ASP assumptions and consequent project return calculations, tempered by credit induced demand destruction. (For a detailed explanation of our demand forecasting methodology please refer to our 27 May 08 piece "*Solar PV industry outlook and economics.*")

We are now forecasting 2009 demand growth of ~10% y/y, down from our May-08 forecast of ~38% growth y/y.

- **Demand forecast:** we are now forecasting 2009 demand of ~4.6GWp (i.e. MWp installed), up ~10% y/y from ~4.1GWp in 2008. Our prior forecast estimated ~6.0GWp in 2009, which would have been up 38% y/y from ~4.3GWp in 2008. Our 2010 forecast now stands at 6.6GWp installed, up 45% y/y versus our prior forecast of ~9.4GWp installed. (Furthermore, for comparison's sake, our new 2009 demand forecast would mark y/y growth of ~6% from our old 2008 demand forecast.)

- **Variance error:** we cannot overemphasize the uncertainty associated with present credit restrictions, and our outlook on credit and tax equity investment available in 2009. We offer this forecast as a best estimate in light of present (and scant) data, and expect we will be refining our demand outlook frequently over the coming months.

Figure 8: Global solar PV demand through 2010 – base case – Jan-09 revision



New Forecast

MWp installed (Dec-08 forecast)	1,087	1,460	1,744	2,826	4,137	4,565	6,624
% growth y/y	82%	34%	19%	62%	46%	10%	45%

Old Forecast

MWp installed (May-08 forecast)	1,087	1,460	1,744	2,826	4,307	5,948	9,434
% growth y/y	82%	34%	19%	62%	52%	38%	59%

- **Upside and downside 2009 demand growth scenarios:** our downside demand growth scenario calls for roughly flat MWp y/y in 2009 (i.e. ~0% growth), and our upside scenario calls for ~19% MWp growth y/y in 2009.
- **Note:** we note a great deal of variability in demand forecasts We present our base case demand forecast here, and believe it provides an adequate revised basis from which to run scenario analyses in the coming months as data becomes clearer. Obviously, 2009 is most relevant, and variance error in any 2010 forecast is compounded by 2009 forecasting uncertainty.

Source: Deutsche Bank

Our new demand forecast predicts a global market with only one regional market >1GWp in 2009.

- **Markets and demand growth:** this baseline demand assessment creates a global market with only one regional market >1GWp in 2009 (Germany), and two in 2010 (Germany and the US), down from two in 2008 (Germany and Spain). We are not terribly enthusiastic about incremental demand growth in the US in 2009, despite a President Obama administration; we believe US federal "cleantech" policy will not likely drive accelerated demand growth until 2010. Although tempered from our prior estimate, growth remains strong in 2008 as incentive programs and the present demand environment can be comprehensively assessed. Growth slows substantially in 2009 as (1) tight credit continues, (2) the cost of capital rises, while (3) incentive program digressions take effect early in the year, and meaningful cost reductions begin to take effect later in the year. Subsequently, we anticipate a reacceleration of demand growth in 2010.

Near-term supply re-assessment

Primary factors tempering 2009 supply growth are:

(1) lowered c-Si module production due to credit induced demand destruction, and

(2) less ability to expand production due to balance sheet constraints.

Supply growth expectations have declined - summary

2009 supply growth has been tempered: several factors have tempered 2009 supply growth expectations, with the primary factors being (1) lowered c-Si module production due to credit induced demand destruction, and (2) less ability to expand production due to balance sheet constraints. Assessing the impact of these factors introduces a more subjective component to the supply equation, increasing variance error. As a result, we anticipate our forecast will require frequent revisions as data becomes available, particularly through 1H09.

- **Our methodology has not changed, but input variables have expanded:** in determining supply, we employed the same bottom up methodology as in our piece of May-08. However, supply of polysilicon can no longer be the defining determinant of crystalline silicon solar PV module supply. Polysilicon supply will be tempered, at least in the near-term, by company decisions to lower output, as well as company inability to proceed with prior production plans.
- **Our supply forecast declines meaningfully over the next couple years:** Figure 9 summarizes our new solar PV module forecast through 2010. We estimate that solar PV module supply will decline ~4% from our prior (May-08) estimate in 2008 as many crystalline silicon solar PV cell/module companies cut back on 4Q08 production. We estimate that solar PV module production will decline by ~18% in 2009 from our prior forecast as many companies rationalize production output, and some companies encounter working capital issues that will invariably limit production output capability. We estimate solar PV module production will decline by ~23% in 2010 from our prior forecast as the industry rationalizes production and output with some companies gone (either via acquisition or an inability to continue as an ongoing concern), and other companies consolidating the industry.

Figure 9: Production forecast (MWp) – Base case (New and Old)

New Production Forecast (Jan-09)		2007	2008	2009	2010
Crystalline Si	Production (MWp)	2,520	3,630	5,633	9,131
CdTe	Production (MWp)	208	420	975	1,590
Amorphous Si	Production (MWp)	144	323	688	1,252
CIGS	Production (MWp)	9	34	94	240
Total	Production (MWp)	**2,881**	**4,407**	**7,390**	**12,213**
y/y growth			***53%***	***67%***	***65%***

Reduction from our prior forecast (%)		**3%**	**18%**	**23%**

Old Production Forecast (May 08)		2007	2008	2009	2010
Crystalline Si	Production (MWp)	2,520	3,782	7,023	11,964
CdTe	Production (MWp)	208	364	845	1,596
Amorphous Si	Production (MWp)	144	361	949	1,887
CIGS	Production (MWp)	9	46	146	343
Total	Production (MWp)	**2,881**	**4,553**	**8,963**	**15,790**

Notes

- CdTe is the only category in which our production estimate will increase in 2009 from our prior forecast; this is almost entirely due to our First Solar forecast.
- Our "downside" c-Si supply scenario results in a 32% y/y decline in supply from our prior forecast.

Source: Deutsche Bank

Revisiting our forecasting methodology

Reviewing supply inputs and methodology: the primary considerations in determining and refining our supply forecast over the next couple years are (1) crystalline silicon module production (driven by (i) polysilicon availability, (ii) silicon usage efficiency, (iii) conversion efficiency, and (iv) manufacturing yield), tempered by company decisions/needs to reduce output from prior plans, (2) thin film module production, tempered by planned production reductions due to near-term demand and slower/scrapped ramp plans, and (3) the duration of present credit constraints, and the dearth of tax equity investors.

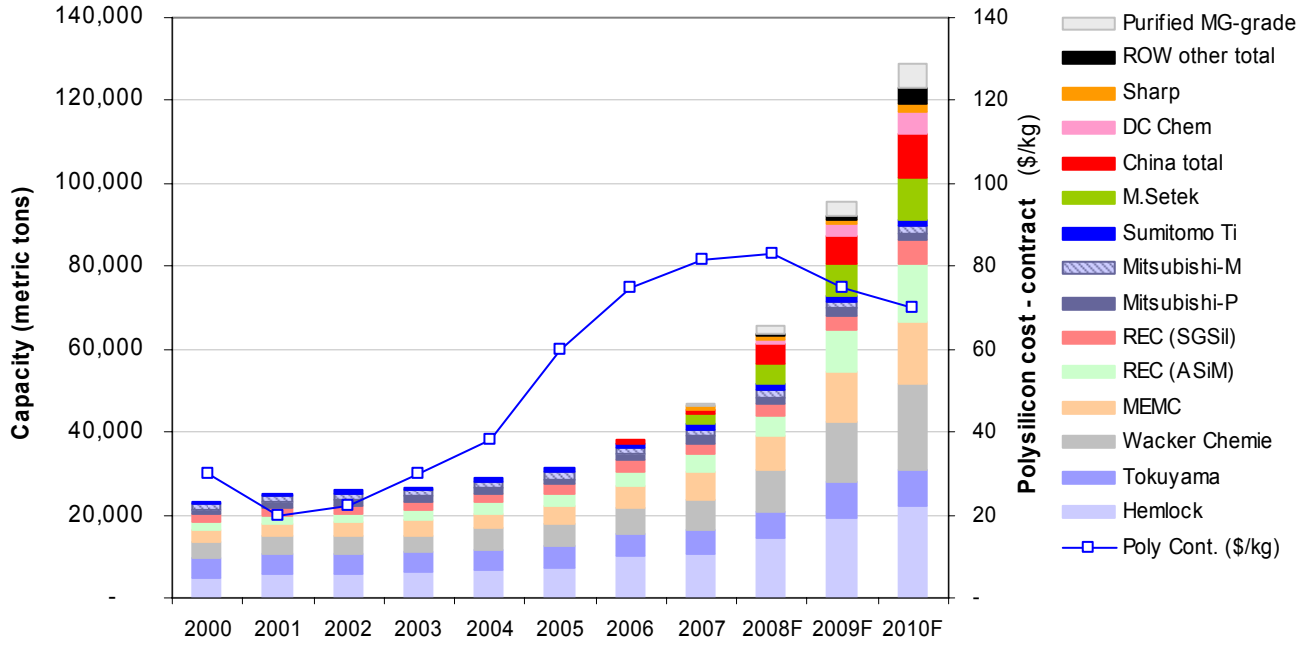
Polysilicon capacity and production expectations: we have tempered our already conservative outlook for polysilicon capacity expansions and production in 2009 and 2010. We are less concerned with this dynamic with respect to forecasting solar PV module supply since we believe module supply will be end demand driven in 2009 rather than polysilicon supply driven as it was in 2007 and largely in 2008.

- **Polysilicon supply:** Figure 10 details our updated polysilicon capacity and production estimates through 2010. The primary capacity and production reductions from our prior (May-08) forecast reside with Chinese and Rest of World manufacturers, although we have modeled modest reductions by some incumbents. Due to capital constraints we are aware of capacity expansion delays among would be Chinese manufacturers, and anticipate that the percentage of capacity and production deriving from Chinese and other than incumbents will be less in 2010 than previously forecast. We believe this conservatism in capacity and production estimates from new suppliers is appropriate.
- **Polysilicon producers – the overwhelming majority of capacity and production comes from the "incumbents:"** we have identified ten "low risk" producers (i.e. Hemlock, Wacker, REC, MEMC Electronics, Tokuyama, Mitsubishi, Sumitomo, M-Setek, DC Chemical and Sharp) that we estimate will account for ~89% of capacity in 2008 and ~84% of capacity in 2010 (previously we had forecast ~77% in 2010). While we are still tracking upwards of 95 present and would-be silicon producers; our expectation is that the majority of these would-be producers will likely never make it to meaningful volume production. We were purposefully conservative in estimating capacity and production from new silicon producers in our prior forecast, and are more so now. We believe our polysilicon capacity and production forecasts are adequately conservative over the near term, even considering the present environment.

We are forecasting production growth for solar PV polysilicon of 63% in 2009 and 52% in 2010 versus our prior forecast of 71% and 60% in 2009 and 2010 respectively.

- **Capacity and production growth:** we are now forecasting total polysilicon capacity growth of 45% in 2009 and 35% in 2010 versus our prior forecast of 53% and 40% in 2009 and 2010 respectively. We are forecasting production growth for solar PV polysilicon of 63% in 2009 and 52% in 2010 versus our prior forecast of 71% and 60% in 2009 and 2010 respectively.
- **Where is the greatest variance error in polysilicon production?** We believe the greatest potential variance error in our polysilicon forecast is with incumbent manufacturers' 2009 production. Should incremental lending not return by mid-09, it is quite possible that incumbent manufacturers could further throttle back utilization, producing less silicon in 2009. Additionally, we would highlight a potential supply impact that upgraded metallurgical grade (UMG) silicon could begin to have in 2009; we have become more sanguine on prospects for UMG-Si based modules, and believe that 2009 will be a defining year for product acceptability. Should UMG-Si modules carve out an industry toehold in 2009, we believe polysilion supply for solar PV use could increase by thousands of metric tons above our present forecast. However, should demand dictate, we believe potential production cutbacks from electronics grade silicon producers could compensate. We are less concerned with these eventualities with respect to forecasting solar PV module supply since we believe module supply will be end demand driven in 2009 rather than polysilicon supply driven as it was in 2007 and largely in 2008. And, should these eventualities begin to evolve in a more pronounced fashion we will update our polysilicon supply forecast and implications on polysilicon producers.

Figure 10: Polysilicon capacity and production forecast



Capacity forecast (Metric Tons – MT)	2008	2009	2010
New solar PV polysilicon capacity forecast (MT)	**66k**	**96k**	**130k**
Old (May-08) solar PV polysilicon capacity forecast (MT)	66k	101k	141k

Production forecast (Metric Tons – MT)	2008	2009	2010
New solar PV polysilicon production forecast (MT)	**35k**	**57k**	**87k**
Old (May-08) solar PV polysilicon production forecast (MT)	35k	60k	96k

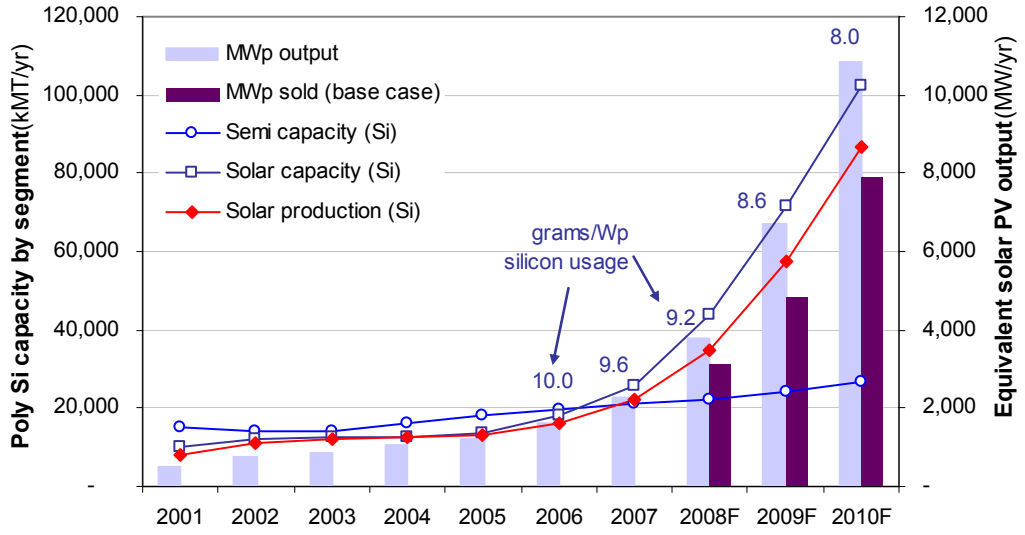
Notes

- **Capacity assessment:** our prior capacity assessment (i.e. May-08) was conservative, with little capacity expected from new industry players. Our present capacity forecast declines modestly (i.e. ~5% in 2009 and ~8% in 2010) as we expect incumbents to largely stick to capacity expansion plans, while marginal producers slow expansion plans or scrap them altogether.
- **Production assessment:** our prior production assessment (i.e. May-08) was conservative, with little production expected from new industry players. We maintain this view, albeit more conservatively, in our new forecast. We expect incumbents to largely continue production plans with modest reductions in 2009 and 2010. Our prior discussion on near-term pricing should support business models for incumbent producers through the solar PV industry shake-out period.
- **Semiconductor industry component, utilization and yield:** the largest difference in the capacity and production numbers in the above tables is the quantity of polysilicon used for the semiconductor industry. The second largest contributing factor is utilization rates (e.g. we have modeled ~85% to 88% utilization rates for low risk silicon producers through 2010). If the vast majority of silicon is coming from incumbent producers, we believe normalized industry utilization rates and yields in polysilicon manufacturing are appropriate assumptions (i.e. not significantly impacted by new producers which will likely have lower yields and lower utilization rates) However, lower incumbent utilization could result from dampened demand conditions which would bias our production assessment lower.

Source: Deutsche Bank

Crystalline silicon module production expectations: several variables govern module production output. Primary inputs include silicon usage efficiency which incorporates conversion efficiency (e.g. cell and module design and materials), and wafer manufacturing efficiency (e.g. crop loss from cutting the ingot, kerf loss from cutting the wafers, and wafer yield), and demand, which we expect will drive some underutilization of silicon at least in 2009. Figure 11 details our c-Si solar PV module production forecast, the difference from our prior (i.e. May 08) forecast, with downside and an upside scenarios as well.

Figure 11: Crystalline silicon solar PV module production output forecast (MWp)



Modeling assumption:

- MWp output is the calculated output assuming all available solar PV silicon is converted to modules.
- MWp sold adjusts for company module production reductions and FGI.
- Grams/Wp: we assume 9.2g/Wp silicon usage efficiency in 2008 declining to 8.0g/Wp in 2010. This incorporates average efficiency and wafer manufacturing assumptions.

Crystalline silicon solar PV module production (base case)	2008	2009	2010
Old c-Si module production forecast (MWp) – May 08 base case	**3.8**	**7.0**	**12.0**
Less due to estimated polysilicon production output reductions (%)	0%	5%	9%
Less due to estimated module production output reductions (%)	4%	16%	15%
New c-Si module production forecast (MWp) – Jan-09 base case	**3.6**	**5.6**	**9.2**
Total forecast reduction due to primary factors (%)	4%	20%	23%
Silicon usage efficiency (g/Wp)	*9.2*	*8.6*	*8.0*

Downside scenario module production forecast (MWp)	3.4	4.8	7.4
Silicon usage efficiency (g/Wp)	*9.4*	*9.0*	*8.6*
Production change from base case (solar Si production - MT)	*-2%*	*-7%*	*-10%*

Upside scenario module production forecast (MWp)	3.9	6.6	11.5
Silicon usage efficiency (g/Wp)	*8.8*	*8.2*	*7.6*
Production change from base case (solar Si production - MT)	*2%*	*7%*	*10%*

Notes

- **Downside and upside cases:** in our downside and upside scenarios we adjust silicon usage efficiency and silicon production from our base case scenario as indicated in the tables above and apply to our new c-Si module production forecast (base case). Please note that our new base case forecast already incorporates silicon production declines as indicated previously in this section (indicated in table). We include these scenarios for 2008 for completeness.
- **Production estimates:** the "production" estimates in the above table assume that not all solar PV silicon is converted into solar PV modules (i.e. cell/module manufacturers reduce previously planned production over the near term). Our production forecast assumes solar PV modules company production cuts that are independent of silicon availability (i.e. the quantity of silicon no longer defines solar PV module production).
- **Conversion efficiency when translating to modules:** MWp is at the module level. Often, g/Wp is quoted at the cell level. We have incorporated the conversion efficiency degradation when translating from MWp of cells to MWp of modules into our silicon usage efficiency estimates.
- **Rounding error:** apparent discrepancies between total forecast reduction and the sum of component forecast reductions is rounding error.

Source: Deutsche Bank

Our new 2009 c-Si solar PV module base forecast is 20% lower than our prior forecast. Our downside scenario is 32% lower.

- **c-Si base case forecast revision:** we have reduced our 2009 and 2010 c-Si solar PV module base forecast to 5.6GWp and 9.2GWp, declines of 20% and 23% respectively from our prior forecast (May-08). As indicated in the above table, primary factors are a forecasted reduction in silicon availability, and more importantly, estimated reductions in c-Si solar PV module production output. The production output decline in 2010 also assumes more substantial industry consolidation, and consequent rationalization of c-Si cell/module production capacity.

Thin film solar PV module production expectations: thin film solar PV module production will be gated by thin film module capacity and utilization, tempered by near-term demand dynamics and capital constraints (for both projects and planned company capacity expansions). We anticipate less of an impact on thin film module demand than on c-Si module demand as (1) thin film modules are a much smaller segment of the market, that is (2) concentrated in the industry's largest market (i.e. Germany), which is (3) more conducive to thin film technologies. Furthermore, the largest thin film module manufacturer (i.e. First Solar) offers the most competitive product in the industry (i.e. can deliver the lowest LCOE), driving better project ROI's, securing more reliable funding, and offering a greater degree of insulation from demand destruction; the company is hardly immune, but is certainly much better positioned.

Our new 2009 thin film solar PV module base forecast is 10% lower than our prior forecast.

- **Base case forecast:** due primarily to capital constraints (both for project finance and company investment/expansion) we are lowering our overall thin film module production forecast in 2009 and 2010 to 1.75GWp and 3.1GWp from our prior forecast of 1.94GWp and 3.8GWp previously (i.e. reductions of 10% in 2009 and 19% in 2010). Figure 12 details our new and old thin film module production forecasts by technology.
  - **CdTe:** the CdTe segment of the thin film solar PV module space is the only segment for which our forecast is increasing (see Figure 12). This is due to increased production from First Solar in 2008, and our expectation of higher production than our prior forecast in 2009. We actually are forecasting less production in 2008, 2009 and 2010 from new CdTe entrants like Q-Cells (i.e. Calyxo project), AVA Technologies, and Primestar Solar (majority owned by General Electric) due to conservatism, and our view of the status of volume production activities at these companies. A more complete list of CdTe companies can be found in our May-08 report "*Solar PV industry outlook and economics.*"

We have reduced our 2009 amorphous-Si solar PV module production forecast by 28%.

  - **a-Si:** our amorphous silicon forecast had the greatest variance error due to (1) the large number of participants, (2) the immaturity of the next generation product (i.e. micro-morph), and (3) the degree of private funding which created a virtual stew of incubating companies many of which have yet to install a single piece of production equipment. The credit crisis and a slower ramp in the availability of a production worthy "micro-morph" product have caused us to reduce our production forecast by ~28% in 2009 and ~34% in 2010 from our prior forecast (see Figure 12). We expect established companies like UniSolar (a subsidiary of Energy Conversion Devices) and Kaneka to produce in line or modestly above prior expectations. We expect new producers (e.g. Sharp, Mitsubishi Heavy Industries, Signet Solar, Auria Solar, Moser Baer) to proceed according to modest ramp plans through 2009. We expect companies conducting initial line start-ups (e.g. SunWays AG, T-Solar, Schott AG, Q-Cells subsidiaries) to commence small volume production in 2009, tempering ramp plans commensurate with the business and financing environment. We expect previously ambitious players with grand plans (e.g. Best Solar, QS Solar, API Petrochemische) to significantly curtail capacity expansion plans, at least through 2009, meaningfully reducing equipment sales from prior expectations in the coming year. Lastly, we expect potential new entrants (e.g. Samsung, Chi Mei, AU Optronics) will likely bide their time as the industry lurches through a shake-out, entering the market when conditions seem best (i.e. not likely in 2009 in any

meaningful way). A more complete list of a-Si companies can be found in our May-08 report "*Solar PV industry outlook and economics.*"

We are optimistic that select CIGS companies may be able to enter initial volume production by 2H09.

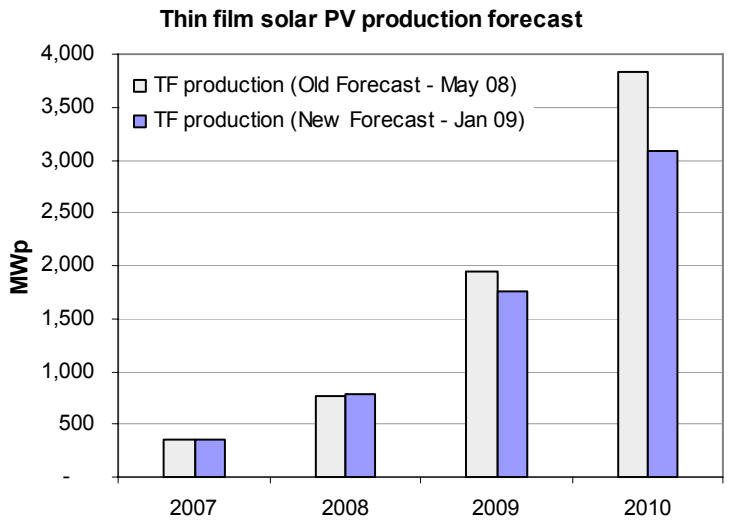
- **CIGS:** CIGS is the least mature of the three thin film segments, but holds great potential. As with the a-Si segment, our CIGS segment forecast has significant variance error due to (1) a large number of participants, (2) the immaturity of the technology, and (3) the degree of private funding which has created a slew of incubating companies many of which are still designing absorber layer deposition equipment. The credit crisis and the status of production processes has caused us to reduce our production forecast by ~36% in 2009 and ~30% in 2010 from our prior forecast (see Figure 12); it is important to note that these new forecast reductions are off a relatively small base. Nonetheless, we have been encouraged by the progress toward production at some CIGS companies and discouraged by others, and we are optimistic that select CIGS companies may be able to enter initial volume production by 2H09. Some companies (e.g. Global Solar, Showa Shell, Wurth Solar) have demonstrated the ability to produce multiple MW's of annual production; however, ramp plans in 2009 appear to be modest. A more complete list of CIGS companies can be found in our May-08 report "*Solar PV industry outlook and economics.*"

We expect some private, thin film companies to potentially run into liquidity issues in 2009 as funding windows close and production processes are not yet proven.

- **Private companies will see a shake-out as well:** the ensuing shake-out is another factor reducing our thin film production forecast over the next few years. We expect many private, thin film companies to potentially run into liquidity issues as funding windows close and production processes are not yet proven. We expect this to be most pronounced in the CIGS and a-Si sub-segments. Again, we believe several venture capital firms have already made a decision on which solar PV investments will be eligible for additional investment and which will not; we believe this will drive some private companies to liquidity crises by as early as 1H09.

- **Our methodology has not changed but we chose not to reproduce it here:** we have identified well over 100 thin film solar PV companies in various stages of development, from initial R&D work to high volume production. We have included stated, implied and estimated capacity and production ramp plans for what we believe is the significant majority of thin film companies that could meaningfully impact supply through 2010. We have adjusted those plans based upon our assessment of realistic production estimates considering technology maturity, capital constraints, and end demand dynamics. We have not included a company by company assessment as we did in our prior piece of May-08 ("*Solar PV industry outlook and economics*"), but note our forecasting methodology has not changed.

Figure 12: Thin film solar PV module production forecast



	2008	2009	2010
New forecast (MWp)			
CdTe	420	975	1,590
Amorphous Si	323	688	1,252
CIGS	34	94	240
Total thin films	**777**	**1,757**	**3,082**
Decline from prior forecast (%)		10%	19%
Old forecast (MWp)			
CdTe	364	845	1,596
Amorphous Si	361	949	1,887
CIGS	46	146	343
Total thin films	**771**	**1,939**	**3,826**

Notes

- **CdTe:** based upon forecast projections primarily associated with industry leader First Solar, our CdTe module production forecast through 2009 has increased (i.e. up ~15% in 2009 and flat in 2010 from our prior forecast).
- **a-Si:** based upon capital constraints (i.e. limiting capacity expansion plans), and the relative immaturity of a dual junction uc-Si/a-Si product, we have lowered our production forecast for overall a-Si module production through 2010 (i.e. down ~28% in 2009 and ~34% in 2010 from our prior forecast). This may seem overly conservative for an emerging technology, but we view conservatism as appropriate considering substantial plans that have been either delayed, curtailed, or are unlikely to move forward at all.
- **CIGS:** based upon the maturity of the technology, and potential capital constraints among private companies (e.g. most CIGS companies are private) we have lowered our CIGS module production forecast through 2010 (i.e. down ~36% in 2009 and ~30% in 2010 from our prior forecast). It is important to note that these new forecast reductions are off a relatively small base, and should the technology be introduced to reasonable volume production by 2H09, our 2010 forecast could climb.

Source: Deutsche Bank

For 2009 we believe downside scenarios are more probable than upside scenarios.

- **Upside and downside scenarios:** we have conducted sensitivity analyses for thin film production as we did with c-Si production to offer a potential range of production outcomes over the next couple years. While we have included both upside and downside scenarios, we believe a downside scenario is more likely, and to that end we have tempered our forecast both in production numbers (i.e. utilization) and in capacity ramp plans (particularly for ambitious companies without any production running yet). Add ongoing financing difficulties that will exacerbating an industry shakeout, and we could easily see capacity and production numbers more than 10% below our updated forecast over the next year.

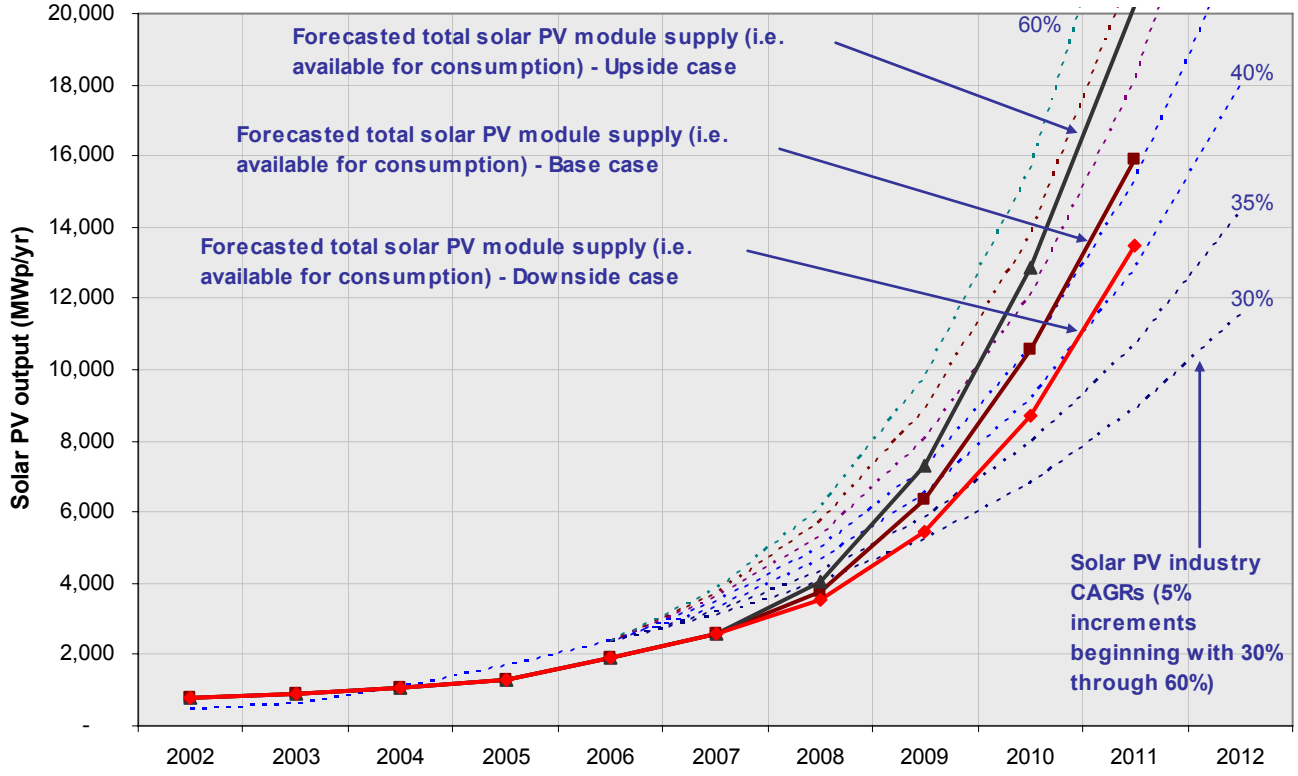
Total supply re-assessment – sales forecast

Sales forecast: Figure 13 details our total solar PV module sales forecast in MWp, with our base case scenario as well as upside and downside scenarios. It is important to note that this is a sales forecast and not a production forecast.

Our total modules sales (MWp) forecast for 2009 is 18% lower than our prior forecast. Our downside scenario is 29% lower.

- **Production forecast versus sales forecast (i.e. adjusting for WIP and FGI):** the most relevant number is MWp sold, meaning production numbers must be adjusted to account for finished goods inventory and work in process (i.e. product to be sold early in the subsequent year). This better represents end consumption, and effective supply. We are now forecasting ~6.4GWp of potential module sales in 2009, and ~10.6GWp in 2010 (reductions of ~18% in 2009 and ~29% in 2010). We have bracketed this baseline forecast with a downside scenario that projects ~5.5GWp of total module sales in 2009, and ~8.7GWp in 2010, and an upside scenario that projects ~7.3GWp in 2009, and ~12.9GWp in 2010. In addition to the variables toggled in the "production" forecast, we have adjusted for FGI and WIP with a roughly 14% reduction to arrive at MWp sold.

Figure 13: Total solar PV module sales forecast (MWp) – base case, upside and downside scenarios



New Sales Forecast (Dec 08)		2008	2009	2010
Base case scenario	c-Si module sales (GWp)	3.1	4.8	7.9
	Thin film module sales (GWp)	0.8	1.5	2.7
	Total solar PV module sales (GWp)	**3.8**	**6.4**	**10.6**
Downside scenario	c-Si module sales (GWp)	2.9	4.1	6.3
	Thin film module sales (GWp)	0.8	1.4	2.4
	Total solar PV module sales (GWp)	**3.6**	**5.5**	**8.7**
Upside scenario	c-Si module sales (GWp)	3.3	5.7	9.9
	Thin film module sales (GWp)	0.8	1.6	3.0
	Total solar PV module sales (GWp)	**4.0**	**7.3**	**12.9**

Note

- **"Sales" versus "production:"** our "sales forecast" numbers account for finished goods inventory and work in process not sold until the following year. This sales forecast number is more descriptive of MWp installed, and better represents end consumption, or effective supply. Our "production forecast" numbers, from which our "sales forecast" numbers are directly derived, are based upon polysilicon actually converted to modules plus our thin film module production estimates.

Old Sales Forecast (May 08) for comparison		2008	2009	2010
Base case	Total solar PV module sales (GWp)	3.9	7.7	13.6
Downside	Total solar PV module sales (GWp)	3.6	6.8	11.6
Upside	Total solar PV module sales (GWp)	4.2	8.8	16.3

Source: Deutsche Bank

Supply and demand – updated forecast

We expect an oversupply dynamic to dominate in 2009.

Supply will outstrip demand in 2009: using our updated supply and demand scenarios we expect an oversupply dynamic to dominate in 2009 (Figure 14). We believe this oversupply dynamic already began in 4Q08, precipitated earlier than previously forecasted by the onset of an acute phase of the credit crisis in Sep-08. Along with substantial currency volatility, the industry is beginning to see significant module price declines that will matriculate up the value chain with greater severity than down the value chain. We are concerned about a persistent near-term oversupply, but believe with an easing of credit (the time of which is yet to be determined), price elasticity of demand could alleviate such a condition driving a supply/demand environment closer to equilibrium.

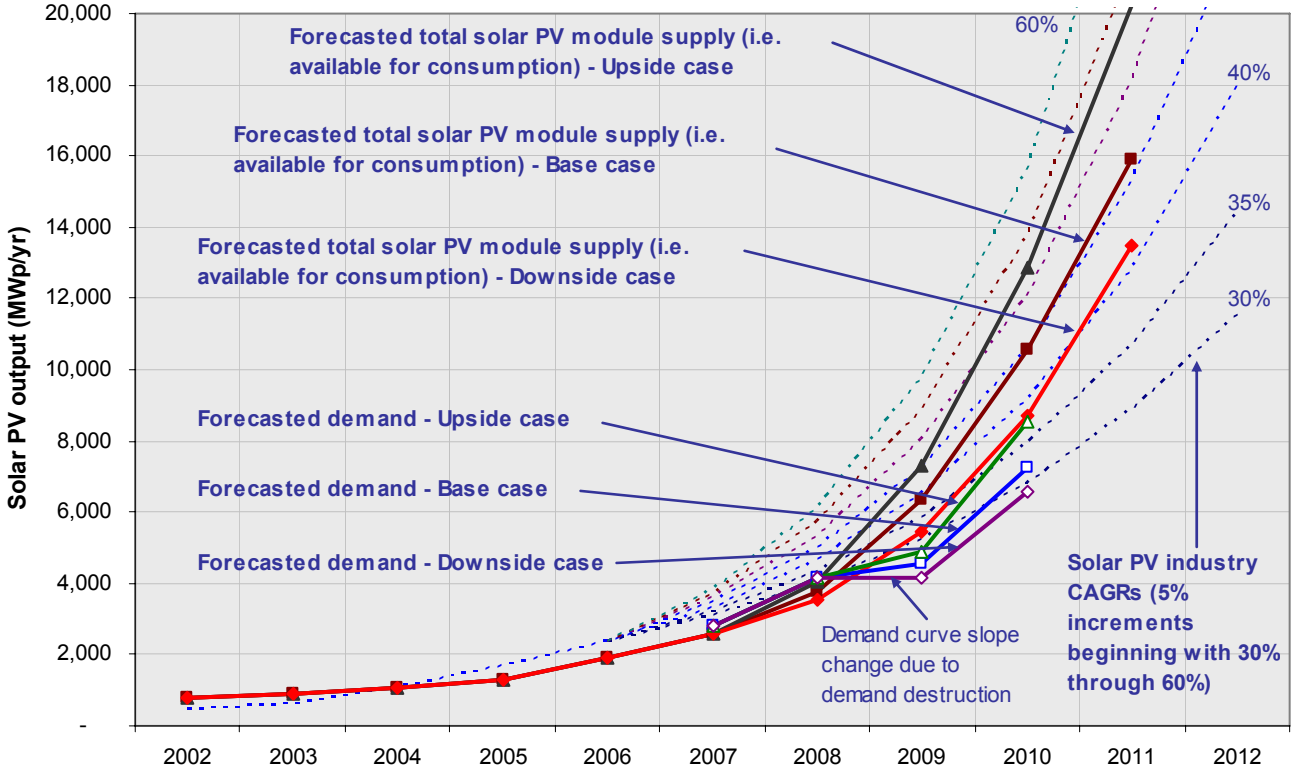
Pent up demand may well exist, but project finance to release that demand may not over the near-term.

- **Elasticity of demand in the very near-term will be significantly dampened:** the near term concern (i.e. 1H09) is that price declines will not result in previously expected elasticity of demand due to project financing constraints (i.e. pent up demand may well exist, but project finance to release that demand may not).
- **Supply sensitivities:** it is conceivable that our supply scenario could still overstate supply considering (1) potentially persistent project finance restrictions causing more severe production cutbacks (e.g.. lowered production, inability to ramp capacity/production), (2) the percentage of FGI and work in process at year end (could be greater than we assume), and/or (3) one or more of the many variables we use to forecast supply could be in error (e.g. silicon usage efficiency, conversion efficiency, silicon production ramps, cell and module production ramps, etc.). Furthermore, we believe a potential understatement of supply could derive from (1) credit easing, driving utilization of idle capacity and resumption of capacity/production expansion, (2) exaggerated inventory build estimates, and/or (3) a miscalculation of one or more of the many variables used in calculating supply.
- **Demand sensitivities:** we have forecasted baseline demand based fundamentally upon project return rates in various regions. These return rates have changed, and coupled with capital restrictions for project financing, near-term demand destruction has been significant. A project ROI based demand forecasting methodology is still valid to establish an empirical baseline; however, exogenous factors like credit induced demand destruction are not easily quantified. We have done our best to estimate the impact of these exogenous factors and apply to our project ROI based demand model. It is important to point out, however, that this is imperfect as scant data shows substantial dispersion. It is entirely possible that potentially persistent project finance restrictions (i.e. lack of credit, lack of tax equity, higher cost of capital) could well dampen 2009 and 2010 demand further. Should credit normalize other factors would become more dominant as demand determinants, such as (1) price declines that could spark demand in excess of our forecast, (2) system price declines that may be too conservative through 2010, (3) assumptions on government induced demand constraint may be incorrect (it is very important to remember that until the solar PV industry becomes economically self-sustaining government incentives will be primary demand drivers), and (4) assumptions on new market development over the next few years may develop differently.

1H09 will be worst, with 2H09 better, driven by (1) a rationalizing industry, (2) credit markets easing, (3) more financing partners, (4) lower pricing, (5) a more efficient industry, (6) a better 2010 outlook..

- **Our best estimates:** we expect the emerging oversupply dynamic to worsen in 1H09, and improve in 2H09 as credit easing enables project finance to reaccelerate; this is our best estimate on timing for demand improvement. Our three illustrated demand cases track closely through 2008, with 2009 marking a significant divergence (Figure 14). The quarterly dynamic of a supply/demand imbalance cannot be accurately depicted in an annual supply/demand forecast, but with supplemental data, as offered in this piece, it can be implied. We expect 1H09 to be worst, with improvement beginning in 2H09 driven by (1) a rationalizing industry, (2) potential easing in the credit markets, (3) the potential emergence of tax equity investors, (4) much lower supply chain pricing, (5) a more efficient industry, and (6) better prospects looking into 2010.

Figure 14: Supply versus demand through 2010 – updated forecast



	2008	2009	2010
New forecast (Jan-09) – base case			
Supply (sales MWp)	3.8	6.4	10.6
Demand (MWp)	4.1	4.6	6.6
Over- / (Under-) supply (%)	**(~8%)**	**~28%**	**~38%**

Old forecast (May-08) – base case

Supply (sales MWp)	3.9	7.7	13.6
Demand (MWp)	4.3	6.0	9.4
Over- / (Under-) supply (%)	**(~9%)**	**~23%**	**~30%**

Notes

- **Oversupply dynamic – timing:** our quantification of oversupply in 2009 and 2010 has become worse in our new forecast, despite our lower supply forecast. A significant difference in our adjusted forecast is timing. Rather than more of a 2H09 phenomenon as with our old forecast, the oversupply dynamic will impact all of 2009, and will do so most significantly in 1H09, driven by the acute nature of the credit crisis.
- **Oversupply dynamic - demand:** should credit markets ease by 2H09, it is quite possible that 2H09 and 2010 demand could exceed our present forecast due to elasticity of demand. Price elasticity of demand is governed by an algorithm that is quite difficult to define; we simply know that elasticity of demand is strong provided other demand gating items are not dominant.
- **Oversupply dynamic – supply:** should industry rationalization proceed through 2009 and 2010, we expect capacity growth to slow further from present expectations, helping to limit the oversupply condition reflected in our supply/demand scenario analyses presented.
- **Variance error:** we offer our baseline scenario as our best estimate on a near term supply/demand dynamic, understanding that quantifying the impact of exogenous factors introduces a significant degree of variance error in both supply and demand estimates. We view this present forecast as an interim supply/demand forecast – an update – and anticipate that we will revise this forecast frequently over the coming months.

Source: Deutsche Bank

A final word on supply/demand forecasts and our near-term outlook

Our view of a solar PV industry shake-out has remained fundamentally intact: we initially began writing about a solar PV industry shakeout in our July-07 report "*Solar photovoltaics technology and economics: thin films and crystalline silicon.*" We elaborated on this shake-out scenario in great detail in our May-08 report "*Solar PV industry outlook and economics.*" The first sections of this report offer an update to our shake-out thesis, and the industry dynamic driving it as macro-economic forces have pulled in the timing of our original scenario. Our view has remained fundamentally intact and we had always believed that the sooner a shake-out happened, the more severe it would be; we believe present data further supports this view. We will continue to offer updates to our near-term (i.e. the next two years) industry outlook as our thoughts on how this shakeout will evolve continue to crystallize with a constant flow of industry data.

Our prior piece contains explanatory detail that we have chosen not to include here: while the analysis in this piece is intended to stand on its own, we would encourage a review of our May-08 piece "*Solar PV industry outlook and economics*" for further explanation on detailed points that we have chosen not to replicate in this piece (e.g. a justification for utilization rates of polysilicon manufacturers, etc.). While there are updates to some of the underlying assumptions we have chosen to include the key ones in this report, and would use our May-08 piece as a supplemental reference.

Price and cost dynamics

The near term environment has changed substantially

Near-term growth has come in substantially: as detailed previously, we have lowered our forecasted 2009 y/y demand (MWp installed) growth to 10% from 38%, and our 10% y/y growth forecast is off a base that is ~3% lower than our prior 2008 expectation. Effectively (i.e. holding our 2008 forecast steady) we have lowered our 2009 anticipated growth to ~7% y/y from 38% previously. We note that several months ago, implied (i.e. an aggregate of industry company revenue forecasts) consensus growth expectations were well over 50% y/y in 2009.

Price declines will exert mild to extreme pressure on companies throughout the value chain over the near term.

Supply will exceed demand and the industry will struggle through a shake-out period: we have already established that an oversupply dynamic at the module level has begun, which, along with currency volatility will drive significant ASP declines beginning in 4Q08. While price declines through the value chain are clearly good for the long-term health of the industry, they will exert mild to extreme pressure on companies throughout the value chain over the near term.

- **Module pricing will decline substantially in the coming quarters:** stable or rising module ASPs, overarching conditions of the past few years, are clearly no longer sustainable. Currency volatility with an industry end market concentrated in Europe, regional incentive digressions, and varying degrees of an oversupply condition from polysilicon through the module are conspiring to collapse c-Si module pricing over the next year.
- **Quantifying module price declines:** we estimate that c-Si module ASPs at the end of 2Q08 averaged just over $4.05/Wp, up from an average of ~$3.65/Wp a year previously. Given the present environment, recent trends, and our outlook, we believe spot c-Si module ASPs could potentially decline to <$2.50/Wp (e.g. hopefully equating to a manufacturing cost of ~$1.70/Wp with a ~25% gross margin) by early 2010. Given longer term supply agreements, broader based market pricing clauses, and a reporting lag, we estimate reported c-Si module ASPs will likely be in a range of ~$2.80/Wp to $3.00/Wp by the end of 2009. These numbers reflect our assessment of the present environment and our c-Si module forecast presented earlier in this report (see Figure 3).
- **Assessing module cost structures:** we estimated general module price and module company margin declines in Figure 3 earlier in this report. Consistent with those figures, we now present a more detailed breakdown of module cost structures and the potential for cost reduction in fully burdened module COGs, evaluating the factors that are likely to have the greatest influence on module price and cost over the next one to two years.

Module ASP declines compounded by demand destruction will impact the industry greatly. Some companies will weather the storm well, some adequately, and some not at all.

Solar PV module company impact: module ASP declines compounded by demand destruction will have an immediate effect on revenue growth and company margin structures; some companies will weather the storm well, some adequately, and some not at all. Significant ASP declines will likely outpace cost declines over the short term, and unit output would have to increase enormously to maintain flat revenue on what would likely be lower margins for most, if not all companies. Frighteningly for some companies, demand destruction is forcing a reduction in output, idling substantial capacity over at least the short term, offering no latitude at all to improve near-term operating performance. This initial surprise will lay bare business model inadequacies, and effectively begin the industry shake-out with individual companies struggling greatly. While we have spoken thus far of an impact to operating performance (i.e. we have concentrated on the income statement), the difference between a company that may survive and one that may not could well be historical balance sheet management (i.e. a healthy cash cushion to absorb operational shocks, insure

against fundamental industry shifts like present credit induced demand destruction, enable rational capacity expansion for future competitiveness, and allow for the implementation of necessary business model adjustments). We believe there are many companies that may not have an adequate balance sheet to effectively weather the growing storm.

A framework for future analysis: the following analysis forms a framework for assessing company business models at the module level. We subsequently address system level price and cost issues, and LCOE to offer a more complete picture.

Primary factors influencing module ASP and costs

Several primary factors drive module ASP and cost dynamics: solar PV module pricing has largely climbed over the past few years driven by a supply shortage. The dynamic looking into 2009 involves interplays between the same variables that drove industry dynamics over the past few years, although now the variables have changed rather substantially.

Supply and demand will conspire to drop ASPs, a reversal of the dynamic of the past several years.

- **Supply:** as detailed in the prior section, the supply of solar PV modules has grown dramatically over the past couple years, and will eclipse demand in 2009; this is a primary contributing effect on industry dynamics.
  - **New solar PV module technologies:** production of one type of thin film technology (CdTe) modules has grown dramatically over the past year, and has gained acceptance as the most competitive product in the market; this will continue in 2009. We also expect amorphous silicon (α-Si) based modules to ramp production more meaningfully in 2009, offered impetus by companies like Applied Materials, Oerlikon, Ulvac, and Anwell Solar, and produced by companies like Sharp, Kaneka, and Signet Solar to name just a few. We expect initial volume production of CIGS modules to begin in 2H09 from companies like MiaSole, Global Solar, Wurth Solar and Showa Shell but do not expect a significant contribution until 2010.
  - **Consolidation:** current capital market conditions will accelerate the industry shake-out, and could drive consolidation beginning in 2009. We anticipate some capacity could be shuttered, and some acquired inexpensively by stronger industry players later in the year. Consolidation among solar PV module manufacturers could impact equipment manufacturers like Applied Materials, Oerlikon, Ulvac, Centrotherm, GT Solar, and many others as secondary market equipment could become available, dampening primary equipment manufacturers' outlooks. This dynamic could help rationalize capacity, and lower costs.
- **Demand:** as detailed in the prior section, demand growth will fall off substantially in 2009 due largely to credit constraints, limiting funding availability for system installations. Again, this is a primary contributing effect on industry dynamics.
  - **Cost reduction driving elasticity of demand:** we expect input costs to decline meaningfully in 2009, with a primary contributing factor being polysilicon pricing. We expect new polysilicon capacity/production, reduced end demand, and struggling module manufacturers to contribute to lower polysilicon prices, a primary input to overall module costs. We expect polysilicon supply to shift toward lower long-term contract prices, with "blended" polysilicon pricing down substantially from recent levels of $\geq$\$250/kg at some less fortunate companies. Furthermore, we anticipate UMG-Si use will begin to emerge in 2009, helping to lower module costs for some companies. Overall, we expect costs throughout the value chain to decline more meaningfully in 2009, helping to partially offset ASP declines.
  - **Adjustments to incentive structures:** incentives have declined in the industry's largest markets (e.g. Germany, Spain), overriding the impact of cost reductions at least in Spain, which instated a 500MWp annual cap. Incentives have been

streamlined or improved in some smaller markets (e.g. Italy, France, South Korea) which should augment regional demand.

- **Global economic and capital markets issues:** although difficult to quantify the primary factor impacting demand over the near-term will be ongoing credit market constraints, limiting financing for project installations.

- **Currency effects:** significant currency volatility will have a substantial impact on industry dynamics looking into 2009. We address this in more detail in the following sub-section.

Currency exchange rates have been very volatile

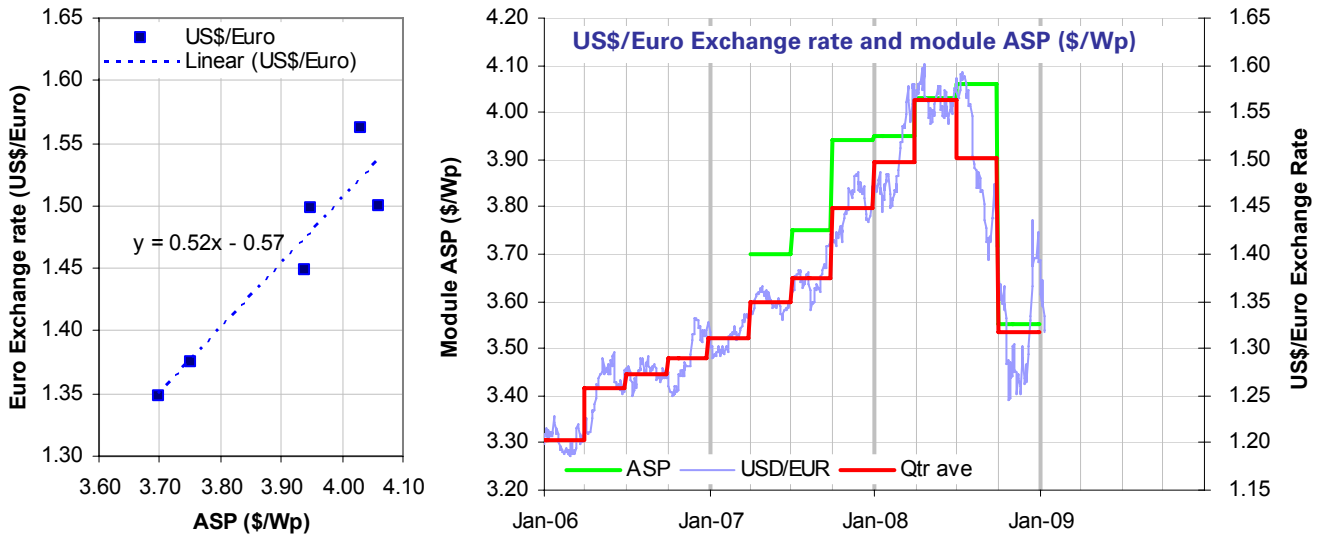
Foreign exchange effects can be substantial: as shown in Figure 15 foreign exchange rates can have a significant impact on module ASPs and company performance depending on currency based costs and prices. The right graph in Figure 15 charts the daily Euro exchange rate (US$/Euro) and the quarterly average back through the start of 2006, superimposed with the average solar PV module ASP trend (i.e. for typical crystalline silicon based solar PV modules, with average ASPs taken from company reports). The graph on the left shows the relationship between the Euro/US$ exchange rate and module ASPs in a scatter chart, highlighting the relationship in terms of relative scale and correlation.

After peaking in 2Q08, the Euro has given back almost two years worth of gains versus the US$ in less than two quarters.

- **A brief history of the US$ vs the Euro:** until 3Q08 the Euro had appreciated versus the US$ in every quarter since the beginning of 2006, with some quarters recording a >4% q/q increase; this effectively raised module ASPs for many manufacturers, expanding margins. After peaking in 2Q08, the Euro has given back almost two years worth of gains versus the US$ in less than two quarters, before strengthening again late in 4Q08. Volatility continues to be pronounced with the Euro weakening again since the end of 4Q08. We continue to use DB's FX forecast in our company financial modeling.

- **Module ASPs will drop substantially due to currency effects:** the sharp 4Q08 depreciation in the Euro versus the US$ will have a significantly negative impact on module ASPs, reversing many quarters of currency related gains in a short period of time. We already estimated in an earlier section in this report the double digit currency impact expected q/q in 4Q08 for most module manufacturers. This could clearly exacerbate an oversupply induced price decline in early 2009.

Figure 15: Euro/US$ exchange rate versus module ASP



Source: Pacific Exchange Service and Deutsche Bank estimates

Quantifying the impact to solar PV module suppliers: significant currency fluctuations can have substantial consequences for solar PV module suppliers. Figure 15 (smaller graph to the left) shows that a $0.10/Euro appreciation can mean a nearly $0.17 increase in module ASP. For companies with a cost structure outside the Euro zone, denominated largely in US$s, we estimate that module ASPs increased from ~$3.50/Wp in 2006 to ~$4.05/Wp at a peak in 2Q08, in large measure due to a much stronger Euro. The ~$0.55/Wp increase over the two year period equates to a 16% ASP increase, strongly benefiting margins and earnings for companies with US$ denominated cost structures. To further illustrate this point, three conditions are presented in Figure 16, covering various ASP, cost, and gross profit/margin conditions.

Figure 16: Quantifying up the effects of Euro vs US$ fluctuations

Case 1: Base (2006)	Case 2: First year (2007)	Case 3: Peak (2Q08)
ASP: $3.50/Wp Cost: $3.00/Wp **Gross profit: $0.50/Wp** Gross Margin: 14.3%	**ASP: $3.75/Wp** Cost: $3.00/Wp **Gross profit: $0.75/Wp** Gross Margin: 21.4%	**ASP: $4.05/Wp** Cost: $3.00/Wp **Gross profit: $1.05/Wp** Gross Margin: 30.0%

Note: in each of the above cases we hold the module production cost fixed at $3.00/Wp. We realize module costs vary among suppliers, and we calculate that over the time period indicated in the three cases, module costs per Wp has likely varied from as low as <$2.60/Wp to as much as >$3.50/Wp.

- **Case 1** shows a gross margin structure at the base case of $3.50/Wp module ASP.
- **Case 2** shows that a $0.25/Wp ASP increase could translate to a >700bps increase in gross margin (on higher revenue from flat shipments).
- **Case 3** shows a peak ASP case (2Q08) in which gross margin dollars per Wp more than doubled, driving gross margin to 30% (on higher revenue from flat shipments).
- Coupled with a very strong production capacity and shipments growth over the past two years, the Euro driven ASP increase has been quite substantial to both revenue and earnings growth for solar PV module companies. This impact has begun to reverse, and could continue to unwind in 2009.
- **Note:** the $3.00/Wp cost used in the above simplified examples does not fully take into account heavy investments in capacity ramps and higher costs for raw materials (p-Si). We chose to show simplified examples to illustrate a simple point. When accounting for changes in costs over the two years, it is helpful to remember that gross margin averaged ~24% in 2Q08 among the major pure play module suppliers based in China.

Source: Deutsche Bank estimates

Currency effects have served to exaggerate the operating performance of many companies.

- **Exaggerated revenue growth:** the many solar PV module suppliers with US$ cost bases realized substantial increases in revenue and gross profit growth due to a strongly appreciating Euro over the past couple years. This has served to exaggerate the underlying operating performance of many companies. The trend has already begun to reverse, and we expect many companies to experience an "exaggerated" downside impact over the near term.

Crystalline-silicon (c-Si) solar PV modules cost dynamics

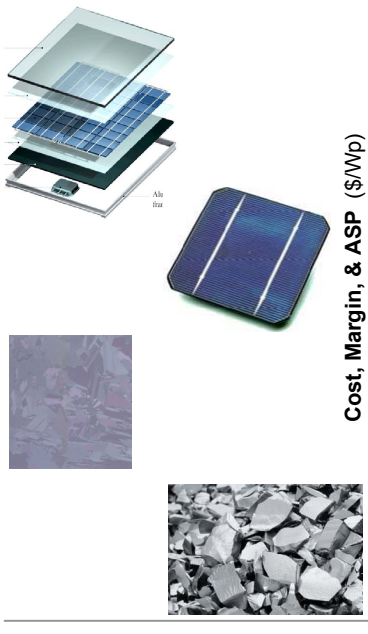
Establishing an analysis framework that can be applied across companies: crystalline-silicon solar PV modules are the bulk (>85%) of solar PV module shipments today, and will have a dominant effect on driving solar PV industry price and cost dynamics. c-Si module ASPs will trend significantly lower in 2009 (Figure 3), and we do not believe costs will decline enough to enable c-Si module producers to maintain recent margin structures. We fully expect some company business models to be tested. Figure 17 breaks down c-Si module cost components, presenting five separate conditions based upon the price of polysilicon (i.e. the raw material for making wafers, and the primary, marginal cost input) and gross margin.

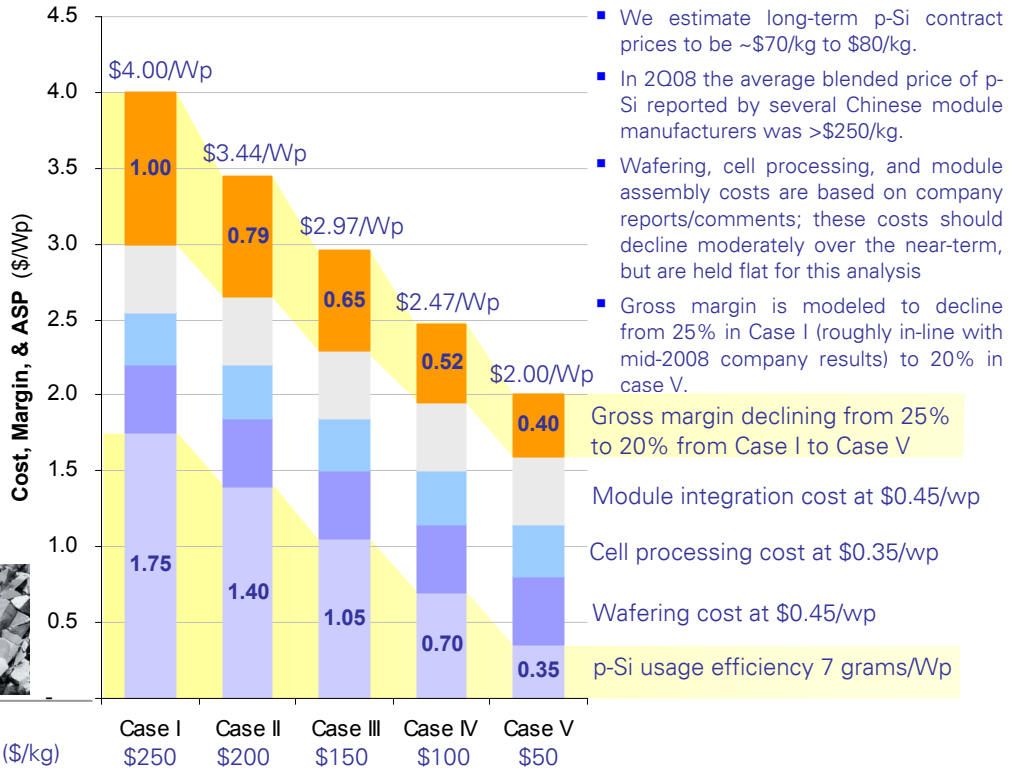
Polysilicon today represents the largest cost input by a wide margin. We assume gross margin declines from 25% to ~20% from Case I to Case V. This offers a sensitivity analysis framework in which we toggle the input cost of polysilicon, and for which we can toggle any of the other input costs as required in a company by company assessment.

The data presented in Figure 17 assumes an integrated business model between the ingot and the module.

- **Rationale for present inputs:** it is very important to note that the data presented in Figure 17 assumes an integrated business model between the ingot and the module (i.e. polysilicon is purchased, and the company manufactures ingots, wafers, cells and modules). This is not the case for many companies. For companies that purchase wafers, for example, additional margin (i.e. that of the ingot/wafer manufacturer) will have to be built into cost structures; this, of course, would hold once again for companies that purchase cells. To make matters more complex, many companies have blended business models in which partial integration has been completed (i.e. a company may manufacture a percentage of wafers or cells, and purchase the rest, making cost calculations more difficult as "middle-man" margins and discrete price dynamics upstream in the value chain must be accounted for). There are very few companies that have successfully integrated from silicon manufacturing all the way downstream (e.g. Renewable Energy Corp). We built the model as shown for simplicity's sake, and to bracket potential company operating ranges, understanding that a near-term assessment was most relevant.
- **Variance error caution:** input costs for polysilicon by company vary substantially, and while some companies give polysilicon input cost data, others do not. We offer "typical" wafering, cell processing, and module integration costs collected from a host of companies in Figure 17. In some cases the data does vary significantly. The model presented offers a means to conduct sensitivity analyses by company, understanding that business models (e.g. degree of upstream integration) vary.

Figure 17: Crystal silicon solar PV module cost breakdown, margins, and ASP





Source: Company reports and Deutsche Bank estimates

c-Si module manufacturing cost/Wp of <$2.00 may be required by the end of 2009 to maintain a healthy business model.

- **Module costs and ASPs – putting things in perspective:** market dynamics will drive c-Si module ASPs lower, and costs will struggle to keep pace. We are forecasting average c-Si module ASPs to drop to <$3.00/Wp by the end of 2009 (e.g. an average quarterly ASP of ~$2.85/Wp in 4Q08), with module spot prices potentially lower entering 2010. We believe it is quite conceivable that c-Si module spot prices could drop to $2.50/Wp, or even modestly below by 1Q10 (i.e. a ~40% drop from an average ASP of >$4/Wp in 3Q08), requiring a c-Si module cost basis of ~$2.00/Wp to maintain a healthy business model (i.e. gross margin of ~15% to 20%). We believe such a cost/Wp target is achievable by some companies when considering polysilicon sourcing, improved conversion efficiency, and cell and module processing cost improvements.

Specific c-Si module cost drivers (by manufacturing category): while the focus always seems to be on polysilicon, there are several module cost drivers that must be considered. The production category breakdown is detailed in Figures 17 and 18; this cost breakdown (rather than a bill of materials, plus direct and indirect costs) is most applicable to available company data. The following looks at each in order of potential cost impact.

Waves of new polysilicon production were due to come on-line beginning in late-2008.

- **The polysilicon market will continue to ease:** historically, polysilicon sold for $35/kg or less when the driver was the semiconductor industry. The solar PV industry introduced a new dynamic beginning roughly three years ago, driving a polysilicon shortage, and prices that climbed into the stratosphere. In 2006 nearly all the top six polysilicon producers announced plans to aggressively expand capacity; announcements of greater capacity expansion plans followed. With a two to three year lead time, we expected the initial wave of new polysilicon production to hit the market by late-2008, with additional waves through 2009 and 2010. The production coming on-line over the coming couple years should be more than enough to fulfill c-Si solar PV module demand. (Please refer to the "supply/demand" section of this report.)
  - **Polysilicon prices offer the best near term cost reduction potential:** we expect polysilicon prices to offer the greatest near term relief to overall cost inputs. Figure 17 initially presents a blended polysilicon cost of $250/kg (Case I), noting that this was a likely price for the most silicon-oppressed module manufacturers, with the expectation that by 2010 the blended cost of polysilicon for some companies could decline to <$100/kg, potentially approaching long term contract pricing of ~$75/kg. We are skeptical that input polysilicon costs can drop below 2009 long-term contract pricing; we present a polysilicon input cost of $50/kg as an extreme case. While mid-term contracts will remain painful (unless re-negotiated successfully), spot pricing has already dropped to ~$150/kg for reasonable quantities. (Please refer to the "supply/demand" section of this report for more detail.)

If a blended cost of p-Si could approach long term contract prices, then a module price of ~$2.20/Wp could be supported with 15% to 20% GM for a fully integrated upstream manufacturer.

  - **Polysilicon cost and module price requirements:** based upon various company inputs, we believe the blended cost of polysilicon (i.e. a combination of virgin, scrap, and reclaim polysilicon) was as much as $250/kg to $260/kg for some companies in mid-2008. Using an average silicon consumption efficiency of 7 grams/Wp, which may be aggressive for some companies, the cost of polysilicon would be ~$1.75/Wp (see Figure 17). With a $4.00/Wp module ASP, the cost of polysilicon alone would be 44% of the module ASP. Using a blended polysilicon cost of $100/kg and the same silicon usage efficiency of 7 grams/Wp, the cost of polysilicon would be $0.70/Wp; if we hold other costs steady, a module price of $2.50/wp could support ~20% gross margin for a business model integrated from ingot to module. If spot prices for polysilicon decline to contract or modestly below for a prolonged period of time (i.e. enabling a blended cost of polysilicon to approach long term contract prices), then the cost of polysilicon could drop as low as $0.50/Wp, and a module price of ~$2.20 could be supported with gross margin approaching 20% for that same, fully integrated upstream manufacturer.
  - **The impact of UMG-Si:** we have become increasingly optimistic on the near term viability of upgraded metallurgical grade silicon (UMG-Si) based solar PV modules.

We note that PhotoWatt has been selling UMG-Si based modules for well over a year, Canadian Solar has been selling modest quantities of modules since mid-08, Q-Cells has been preparing to sell large quantities of UMG-Si based modules beginning in 2009, and companies like Trina Solar have announced intentions to introduce a UMG-Si based product in the near future. We believe UMG-Si presently sells for between $40/kg and $60/kg, but believe with scale this price can gravitate to ~$40/kg, and potentially below over the long term. This will be necessary, as we believe a comparison with present semiconductor grade silicon modules requires that high purity silicon remain greater than ~$80/kg for the economic argument of UMG-Si modules to make sense, and with anticipated improvements in UMG-silicon crystallization techniques and possibly device structure, the high purity silicon cost could drop to ~$70/kg as a cut-off for UMG-Si based module to retain economic viability. Regardless, we believe UMG-Si will help bias overall silicon costs for 2009 downward, albeit modestly.

Figure 18: Ingot, wafer, cell, module cost/Wp progression for ingot to module integrated business models (c-Si)

	Present average	Present best case	High utilization average	High utilization goal	DB Base case
Ingot ($)	0.23	0.20	0.20	0.15	0.20
Wafer ($)	0.27	0.21	0.25	0.20	0.25
Cell ($)	0.30	0.19	0.28	0.20	0.35
Module ($)	0.55	0.45	0.37	0.30	0.45
Total ($)	**1.35**	**1.05**	**1.09**	**0.85**	**1.25**

Notes

- **Present average:** we estimate present average processing costs total ~$1.35/Wp as indicated in the above table. These estimates are for an integrated manufacturer (i.e. from ingot to module; no tolling). It is important to note that this estimate assumes lower utilization of assets (i.e. late 2008), and are biased higher as a result.
- **Present best case:** we estimate present "best case" processing costs total ~$1.05/Wp as indicated in the above table; this would be for an integrated manufacturer (i.e. ingot to module; no tolling) at high utilization. We note that the best cell processing cost claimed by a company is $0.19/Wp; we are somewhat skeptical of this claim, but believe that over time, something very close to this could be achieved. If we discount cell processing costs somewhat, then a "present best case" total costs estimate is likely closer to $1.10/Wp.
- **High utilization average:** we estimate 2009 high utilization average processing costs could total ~$1.09/Wp as indicated in the above table. Again, this would be for an integrated manufacturer (i.e. ingot to module; no tolling). Such a number would exclude companies that could be in financial distress with under-utilized assets; this is a normalized estimate. Lastly, we still view a module cost of meaningfully <$0.40/Wp as a challenge looking through 2009.
- **High utilization goal:** we estimate that a high utilization average total processing costs goal could be ~$0.85/Wp, and note that some companies (e.g. YingLi) are estimating a modestly lower number. We believe this is a multi-year goal, and would involve only mc-Si wafers. We believe module processing costs of ~$0.30/Wp will be a challenge, and will take some time to achieve.
- **DB base case** (Figure 17 and above table): our ingot and wafer base case processing cost estimates are consistent with the high utilization average; we assume this will emerge later in 2009 as the industry is further rationalized, and we normalize for under-performing companies. Our cell and module processing costs are higher than the high utilization average to account for what we believe may be overly aggressive cell processing cost estimates, difficulty in lowering module processing costs, and a higher bias by European manufacturers. We believe our $1.25/Wp total processing costs estimate is reasonable, and strikes a balance between the lower utilization present average, the high utilization average, while taking into account best case claims, and a rationalizing industry through 2009. Our intention was to define a model with which to conduct sensitivity analyses by company.
- **Geographic inputs:** the lowest processing cost inputs we have gathered are in Asia; the highest are in Europe. Foreign exchange rates and higher cost bases in Europe are the primary culprits. We expect more comparable ingot and wafering costs across regions, with a greater disparity in cell and particularly, module processing costs (i.e. much higher in Europe).
- **Companies:** we collected ingot, wafer, cell and module cost per Wp estimates for "best of breed" manufacturers and "average" manufacturers. These numbers came from pure play solar PV value chain manufacturers (e.g. not from companies like MEMC Electronics). We note (1) a significant degree of variance error in all of the categories, (2) significant differences in "best of breed" and "average" estimates, and (3) data that we believe may have been low at the cell and module levels. We have done our best to normalize this data to provide useful metrics for comparison.

Source: Deutsche Bank

- **Wafering cost per Wp** (Figure 18): we believe a reasonable estimate to use for average multi-crystalline ingot plus wafering costs is ~$0.45/Wp (and slightly more for single-crystal wafers). We have heard claims of ingot plus wafering costs as low as $0.35/Wp, but believe such a cost basis is limited, at best. For wafer suppliers like ReneSola and LDK Solar, polysilicon is largely purchased, then turned into ingots which are cropped and sliced into individual wafers. Suppliers like REC are integrated back through polysilicon manufacturing, offering an overall cost advantage at the wafer level or further down the value chain. MEMC Electronics, for example, produces polysilicon, but has largely outsourced solar wafer manufacturing; we expect this to be brought in-house.
  - **Ingot and wafering cost variance:** we note a tightening of estimated cost per Wp in the data collected for ingot and wafer manufacturing over the past six month. Regardless, there is still meaningful variance error, indicating volume, capability, and quality differences among suppliers.

A "best of breed" cell processing cost of $0.19/Wp has been claimed; we believe this is the exception.

- **Cell cost per Wp** (Figure 18): a significant majority of module suppliers process cells internally. Some companies (e.g. Q-Cells, JA Solar, China Sunergy) focus on processing cells above all else, and sometimes to the exclusion of all else; this is quite understandable as the cell is where any intrinsic technology advantage would likely reside. These companies are typically the cost per Wp leaders at the cell level. We have heard claims of "best of breed" cell processing costs of $0.19/Wp; we believe this is the exception, and may be an aggressive claim. We believe that "average" cell processing costs are meaningfully higher. We estimate that a reasonable "average" cell processing cost would be at or above $0.30/Wp; we have modeled $0.35/Wp in our base case model to account for a higher bias from Europe, and some skepticism on low cost claims from Asia.
  - **Conversion efficiency:** conversion efficiency is the single greatest differentiation among companies at the cell level; it is largely controlled at the cell level. Manufacturing process flows (i.e. typically based upon device technology), and basic manufacturing cost efficiencies also weigh heavily.
- **Module cost per Wp** (Figure 18): we note significant variance in module cost per Wp estimates, as manufacturing methodologies (e.g. equipment, level of automation, geography) vary widely. We have heard of module processing cost claims as low as ~$0.35/Wp which we find aggressive, to numbers close to $1.00/Wp which we find absurdly uncompetitive. We estimate that a reasonable "average" module processing cost would be ~$0.45/Wp looking through 2009.
- **Tolling costs – another layer of modeling complexity:** the figures presented above are cost estimates for internal production, and the overall costs in Figure 18 are for a company integrated from ingot through module. Most solar PV companies do not manufacture polysilicon, so the data in Figure 18 can be applied to most solar PV companies in the front half of the value chain as a baseline from which to conduct sensitivity analyses. Many companies outsource elements of the ingot to module value chain, incurring "tolling" costs for outsourced manufacturing services. This practice extends from companies involved in one element of the value chain (e.g. JA Solar – cells) to companies involved in all elements of the value chain (e.g. REC). Even companies that are involved in all elements of the value chain may purchase some services/intermediate products externally as all value chain elements are typically not perfectly balanced.

Tolling (outsourced manufacturing services) margins can be rich and increase the total processing costs shown in Figure 18.

  - **Outsourcing ingot/wafer:** a polysilicon supplier (e.g. MEMC Electronics), or a cell/module manufacturer (e.g. JA Solar, SunTech) often ships manufactured/purchased polysilicon to a wafer supplier to convert the polysilicon into wafers. A typical price may have been ~$0.60/Wp to $0.70/Wp, offering the wafer supplier very high margin business. This introduces a significant degree of cost inefficiency in the value chain, driving up costs for non-integrated manufacturers.

- **Continuous improvement cost reduction:** ongoing cost reduction in each of the above categories requires continuous improvement programs rather than technology breakthroughs. We do not expect technology breakthroughs in c-Si solar PV technology over the near term, and consequently do not expect step function cost reductions. We do anticipate gradual improvement in technology (e.g. conversion efficiency), manufacturing processes, material costs, and indirect costs over the next few years. As we are re-assessing the near-term potential for the industry, our time horizon for the purposes of this piece is relatively short (e.g. one to two years).
    - **Potential limits of longer term cost reduction:** the solar PV industry is still immature, and is progressing down a learning curve with a significant degree of cost still to be extracted from the overall value chain. We believe that as the learning curve toward commodity manufacturing and the practical limits of c-Si based solar PV module technology are surmounted, much of this cost will be extracted, and cost reductions for the upstream portion of the value chain will inevitably slow, and could eventually arrest. This could result in a cost floor for c-Si module manufacturing, but we do not expect this for several years.

An industry average c-Si module cost would more likely approach $2.00/Wp over the next couple years.

What could c-Si module pricing really do? If the solar PV industry progresses through a healthy rationalization in 2009, and normalized (i.e. higher utilization players) production processing costs subsequent to polysilicon achieve a reasonable range of ~$1.05/Wp in 2010, and if we assume the blended cost of polyslicon declines to $100/kg in 2010, then a module cost for a fully integrated upstream manufacturer could be ~$1.75/Wp. This could support a c-Si module ASP of ~$2.20/Wp with a 19% gross margin, or ~$2.05/Wp with a 15% gross margin. Now, if we assume that not all companies producing will be fully integrated, and we include a reasonable estimate for tolling margins, and maintain our $100/kg polysilicon blended cost assumption, then an average module cost would likely be closer to ~$2.00 or more depending on the degree of outsourcing. This would support a c-Si module ASP of $2.50/Wp at a 20% gross margin, and $2.35 at a 15% gross margin. Realistically speaking, we expect c-Si module ASPs to drop to well under $3.00/Wp in 2009, to drop to <$2.50/Wp in 2010, and to approach $2.00/Wp by the end of 2011.

Cadmium telluride solar PV module ASP and cost dynamics

CdTe is the only truly competitive thin film product: thin film modules still account for a rather small percentage of total solar PV modules, but are ramping quickly off a small base. The two largest thin film players today are First Solar (i.e. cadmium telluride (CdTe) panels) and Energy Conversion Devices (i.e. manufacturer of triple junction amorphous silicon germanium (a-Si/Ge) devices by the company's wholly owned UniSolar subsidiary). First Solar is the largest by a substantial margin, and defines the benchmark for low cost module manufacturing. We offer an analysis of CdTe modules for comparison with c-Si modules in the present, dynamic environment.

From glass to solar PV module – vertical integration and monolithic integration help Manufacturing techniques and independence from silicon drive low cost: First Solar's CdTe (cadmium telluride) solar PV modules are manufactured using a proprietary Vapor Transport Deposition (VTD) technology (for absorber layer deposition) as well as other equipment to convert glass sheets into functioning solar PV modules. The product is monolithically integrated (i.e. multiple cells are created concurrently in module sized arrays using semiconductor type processing), and the entire process is vertically integrated from input glass to finished module. Since no silicon is used, costs are not affected by the supply and demand dynamics of p-Si.

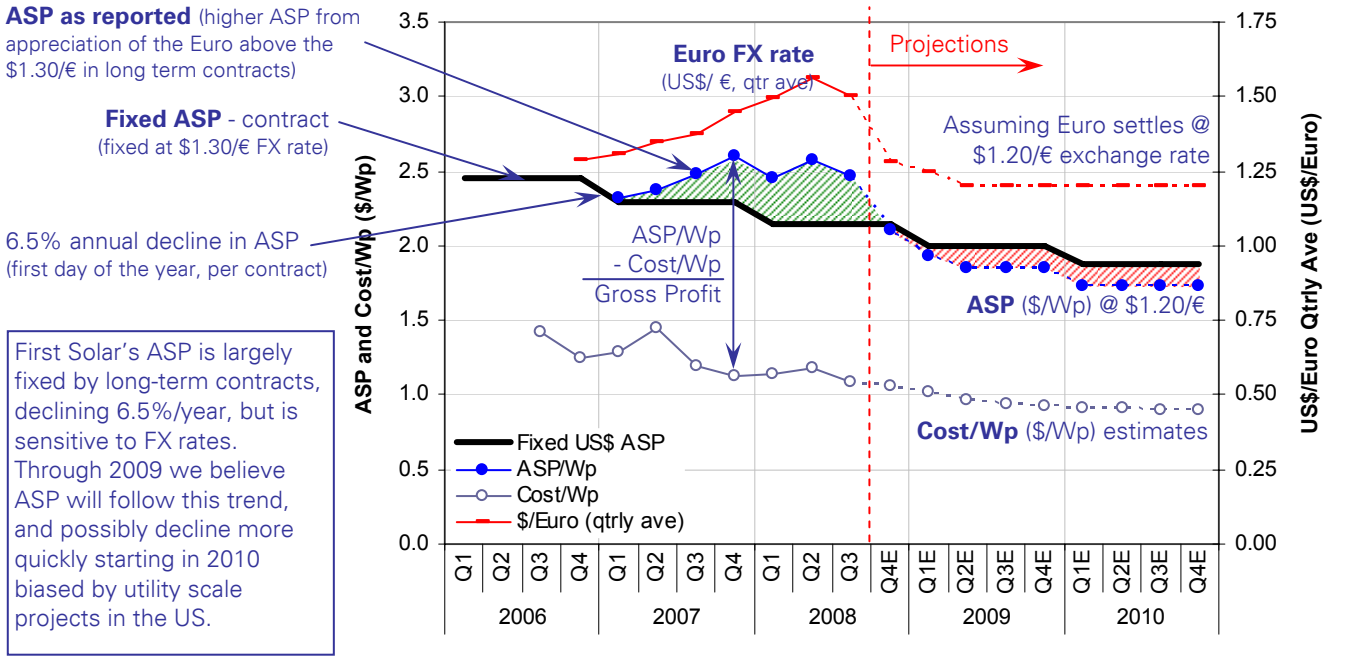
- **High yield, multi-region, low cost manufacturing proven for CdTe:** First Solar has already demonstrated the capability to scale CdTe module manufacturing with large, high yielding production facilities in three separate regions (i.e. US, Germany, Malaysia). The

company's operational performance is well supported by documented quarterly module production, ASP, and cost data. Figure 19 presents First Solar's (1) contracted ASP (fixed at a $1.30/€ exchange rate, declining 6.5% at the beginning of each year – the thick black line), (2) actual quarterly ASP (as reported), (3) the US$/Euro exchange rate (quarterly average), and (4) quarterly production cost ($/Wp).

We have modeled an average 2010 CdTe module ASP of $1.67/Wp.

- **Currency effects are pronounced:** as with the majority of the industry, currency effects are pronounced as shown by reported ASP data. Reported ASP peaked at ~$2.60/Wp at the end of 2007 and again in mid-2008, and will decline to <$2.00/Wp by 1Q09. For simplicity's sake ASP projections in Figure 19 are based on a constant Euro exchange rate of ~$1.20/€, driving an ASP of ~$1.84/Wp exiting 2009, and $1.72/Wp exiting 2010. When modeling the company, we use DB's FX forecast through 2010, and when incorporating the company's hedging strategy, we derive a slightly more favorable ASP exiting 2009 (i.e. $1.94/Wp with an average 2009 ASP of $1.90), and a less favorable ASP in 2010 (i.e. average of $1.67/Wp). We understand that FX rates will likely require frequent revisions to our estimates.
- **2010 ASP could decline more quickly:** we have modeled contract prices in Figure 19 as just detailed. We believe that 2010 average module ASP could decline modestly faster as a more meaningful percentage of business could derive from utility scale business in the US, which we believe will carry a lower ASP. We have modeled this effect in our company specific modeling.
- **Cost/Wp reduction:** we have forecasted a modest decline in First Solar's module production cost ($/Wp), reaching $0.92/Wp by the end of 2009, and ~$0.90/Wp by the end of 2010. We believe our 2010 estimate is conservative, and that with all four factories in Malaysia running at full capacity, cost/Wp could drop meaningfully below $0.90/Wp in 2010. These estimates should enable First Solar to maintain industry leading gross margin in a high 40% range.

Figure 19: First Solar ASP, cost, and the Euro exchange rate



Source: Company reports, Pacific Exchange Service, and Deutsche Bank estimates

Comparing baseline c-Si to CdTe

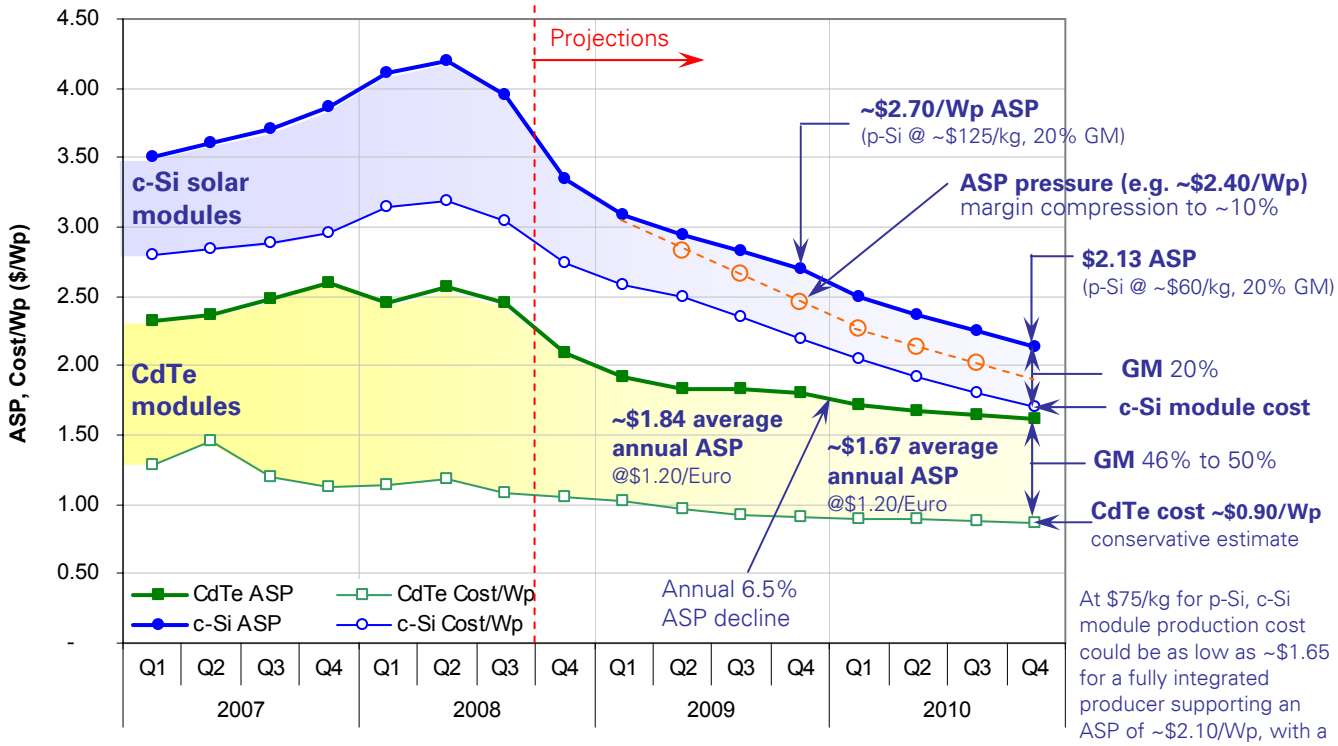
Base case ASP and cost dynamics

Comparing c-Si and CdTe to assess future competitiveness: Figure 20 graphs ASP, cost, and gross margin for a c-Si solar PV module and a CdTe module. In the c-Si case we use a largely linear ASP decline as a base case, and a more pronounced ASP decline (orange line) to illustrate potential margin compression for a fully integrated upstream producer. Base case gross margin declines from ~25% to ~20%, and compresses to ~10% with more aggressive ASP declines (orange line). Declining blended polysilicon costs are indicated at points in the graph. This offers a baseline model for sensitivity analyses by company. In the CdTe case we use a CdTe case defined by our First Solar expectations; it is consistent with the case defined in the prior section, but includes modest ASP adjustments consistent with our company forecast through 2010. These two data sets show how ASP and related metrics might trend over the next couple of years, and how they may fair relative to each other, offering a baseline model to assess the competitive threat of one technology versus the other.

We expect First Solar itself, rather than c-Si competitors, to exert the primary pressure on company ASPs beginning in 2010 as the company prices modules to open new market segments.

- **The gap will narrow, but CdTe remains most competitive:** Figure 20 clearly shows a narrowing gap in the competitiveness of c-Si modules with respect to CdTe modules. Interestingly, we expect reasonably close percentage price declines in c-Si and CdTe modules by the end of 2009 (e.g. ~31% for c-Si, and ~24% for CdTe), but much greater potential margin compression for c-Si based module companies as delineated in the graph (i.e. remember, costs indicated are for a fully integrated c-Si upstream manufacturer; no tolling costs are included; hence, average industry c-Si costs will likely be higher). More interestingly, we expect First Solar itself, rather than c-Si competitors, to exert the primary pressure on company ASPs beginning in 2010 as the company prices modules to open new market segments (e.g. utility scale in the US), in which First Solar might be a participant at the system level, beginning a tangible change to the business model.

Figure 20: Module ASP, cost, and GM trends – c-Si and CdTe – base case for sensitivity analyses and ASP driven case



Source: Company reports, and Deutsche Bank estimates

High efficiency silicon based systems will offer CdTe a rival at the LCOE level, but c-Si will never close the gap at the module level.

- **c-Si solar modules will never challenge CdTe modules on cost and ASP, and CdTe modules will enjoy a persistent margin advantage, but at the system and LCOE levels, the gap will narrow:** this analysis shows continued ASP and cost advantages for CdTe modules (a narrowing but insurmountable gap); this may be disheartening news for companies that participate in the c-Si value chain up through the module only, but when considering the complete picture, the competitive gap will be narrowed at the installed system and LCOE levels. And, high efficiency silicon based systems will offer CdTe a rival at the LCOE level. Again, we reiterate that LCOE is the most important metric when determining the ultimate competitiveness of a technology and/or product.

c-Si module costs and ASP: the c-Si module price and cost curves in Figure 20 are intended to serve as baseline cases from which to assess company and technology competitiveness and trends.

- **c-Si module ASP and cost projections:** c-Si module costs were derived largely based on changes to polysilicon prices, coupled with our estimates for processing costs, and "healthy" business model gross margins through 2010. For the purposes of this example, we based our cost estimates on a declining blended price of polysilicon (i.e. holding other costs flat), with a blended price of ~$150/kg in 2009, and ~$100/kg in 2010. We then used a declining gross margin beginning at 25% to calculate a base case ASP trend as shown (i.e. heavy blue line). We then superimposed more aggressive ASP declines (i.e. orange line) to demonstrate potential margin compression for surviving companies; we also note that holding ASP as per our base case, and increasing total costs for companies that are not fully integrated upstream would accomplish similar margin compression, and is an equally probable eventuality.
  - **Changes could be more abrupt, and will not be as linear as depicted:** in Figure 20 we have shown c-Si module costs and ASPs declining in fairly linear fashion; this is for modeling purposes from which to conduct sensitivity analyses. On a company basis we look at price and cost declines that will likely be more abrupt and certainly will not be linear (e.g. near-term (e.g. 4Q08, early-09). Near-term ASP declines will be significant, while near-term cost declines will be more gradual.
- **c-Si module cost reductions:** Figure 18 detailed module cost/Wp by processing category, and while we believe processing costs will decline to levels indicated over the longer-term, we believe the greatest impact to c-Si module cost/Wp over the near-term will clearly be the price of polysilicon. We believe some companies could see a percentage of polysilicon costs approach $60/kg or below (e.g. for long-term contracts with specific suppliers), but we expect blended average polysilicon costs will likely stay meaningfully higher over the next one to two years. We do consider a blended price of polysilicon as low as $50/kg as one of our cases (i.e. Case V in Figure 17), but believe this is an unrealistically low number to assume for a blended price of polysilicon for modeling purposes through 2010.

With a blended polysilcon price of $50/kg, and industry leading c-Si processing costs, a module cost of ~$1.50 would be feasible. This could result in an ASP of $1.70 with ~10% GM.

- **What is the disaster scenario for CdTe?** If we assume a blended price of polysilcon of $50/kg, and "high utilization average" total processing cost from Figure 18 with modestly higher module processing costs in 2010, or ~$1.15/Wp, then a module cost of ~$1.50 would be feasible. This could result in an ASP of $1.70 (e.g. roughly equivalent to a CdTe price using previously specified currency exchange rates) with a gross margin of ~11%. The important thing to note is that this would hardly vanquish CdTe, but rather force lower pricing on what would still be high margin product; remember, at a ~$1.70/Wp ASP, First Solar would have a module gross margin of ~47% in 2010. We believe that in order to compete for utility scale bids, a CdTe module may already be assuming a lower price (e.g. <$1.50/Wp) beginning as early as 2010.

CdTe module cost and ASP: the CdTe module price and cost curves in Figure 20 are intended serve as a baseline case derived from First Solar data and DB forecasts, from which to assess company and technology competitiveness and trends.

- **CdTe module ASP and cost projections:** CdTe module ASP and cost curves were derived from First Solar data (historical) and DB projections based upon market dynamics and technology progression. The CdTe ASP curve in Figure 20 uses First Solar's long-term contracts as a basis (priced below market, and consuming a significant majority of future production), with DB currency exchange rate assumptions. The discrepancy between these ASPs and those calculated in our company model for First Solar in 2009 are minor, and involve currency hedging strategies, and a potentially more dynamic, quarterly currency exchange rate forecast. Nonetheless, for comparison and modeling purposes we believe an average CdTe module ASP of ~$1.67/Wp in 2010 is reasonable.

We believe some CdTe modules could be priced <$1.50/Wp for utility scale applications beginning in 2010.

  - **More stability with CdTe module ASP:** since First Solar defines the CdTe segment of the solar PV module industry, ASPs will largely be defined by the company. We anticipate long-term contracts, priced below market, will offer a greater measure of stability to CdTe module prices over the coming one to two years. Currency effects (up and down) and the impact of entering new market segments (down) will introduce volatility to ASP forecasts. At the company level we are forecasting CdTe module prices to be modestly higher (e.g. ~$1.90/Wp vs ~$1.84/Wp) than indicated in Figure 20 in 2009, and in line (e.g. ~$1.67/Wp) with those indicated in 2010. This equates to average CdTe module ASP declines of ~23% y/y in 2009, and ~12% y/y in 2010.

We believe 2010 CdTe module cost/Wp could drop to <$0.90/Wp.

- **CdTe module cost reduction:** First Solar reported a manufacturing cost of $1.06/Wp for 3Q08. Given the company's Malaysia ramp, and newly announced factory in the US, we expect scale (aside from ongoing improvements to conversion efficiency and manufacturing line throughput) to further drive costs lower. We have modeled CdTe module production costs of ~$0.92/Wp by the end of 2009, and ~$0.90/Wp by the end of 2010 in Figure 20. We believe there could be an element of volatility with 2009 manufacturing cost/Wp estimates as the company ramps Malaysia, and adjusts on a quarterly basis to industry demand requirements (e.g. factory utilization could fluctuate modestly). We have modeled 2010 module cost/Wp conservatively, and believe it could drop to <$0.90/Wp.

CdTe module cost structure offers significant price latitude for volume manufacturers.

  - **CdTe manufacturer margin structure remains industry leading:** the CdTe module manufacturing cost structure, as defined by First Solar, has supported industry leading margins with below market pricing. Even with our conservative cost/Wp estimates in 2010, should CdTe module pricing drop to $1.40/Wp, gross margin of >35% could be maintained. If we model cost reduction less conservatively, a $1.40/Wp, ASP could support a gross margin $\geq$40%. This offers significant price latitude for volume CdTe module manufacturers at the module level.

Production technologies at the module level – c-Si and CdTe

Conclusions: the two primary production technologies, c-Si and CdTe, will draw closer in competitiveness over the coming couple years as c-Si ASPs and costs drop substantially. We believe, however, that only one production variant of c-Si module technology will be able to compete effectively with CdTe at the LCOE level – high efficiency c-Si on single axis trackers.

- **c-Si cannot challenge CdTe at the module level:** although the gap will narrow, CdTe module cost and ASP leadership will not be effectively challenged by c-Si modules. This is meaningful when a company's business model stops at the module.
- **c-Si module manufacturers will suffer significant margin compression:** despite polysilicon cost reductions, we expect most c-Si module manufacturers will almost certainly experience meaningful margin compression though 2009 and 2010.

- **CdTe module manufacturer gross margin will gradually decline:** the only volume CdTe module manufacturer will likely experience gradually declining margins through 2009 and 2010.
- **We expect margins to be volatile quarter to quarter, and across companies:** we anticipate CdTe company margins will be more stable, with ASPs and costs more predictable. We expect idled capacity to wreak havoc with non-differentiated c-Si module manufacturing company margins, and we expect contract re-negotiations up the value chain to induce significant volatility in c-Si module manufacturing company margins.
- **Average c-Si LCOE will narrow the gap, but not catch CdTe LCOE:** c-Si will close the LCOE gap with CdTe, potentially offering some impetus for CdTe ASP declines in 2010.
- **CdTe module price declines will be driven more by First Solar:** we believe CdTe module price declines in 2010 will more likely be driven by First Solar itself while opening new market segments (e.g. utility scale in the US).

High efficiency c-Si will be the only volume technology able to compete with CdTe at the LCOE level.

- **High efficiency c-Si LCOE will challenge CdTe:** high efficiency c-Si will be able to compete with CdTe at the LCOE level, while average c-Si will struggle to. Regardless, CdTe should be able to maintain industry leading margins.
- **Two volume production technologies could disproportionately drive the market:** market segmentation will become more obvious, with two volume production technologies (i.e. CdTe, high efficiency silicon on single axis trackers) capable of claiming the utility scale segment, and setting LCOE benchmarks for solar PV.

Module cost is only part of the argument: while the module is arguably the most important element of a solar PV system, the final arbiter of competitiveness is the cost of the electricity delivered from the system. To complete the analysis we address system level costs and levelised cost of electricity (LCOE) in the next section.

System cost/Wp and LCOE

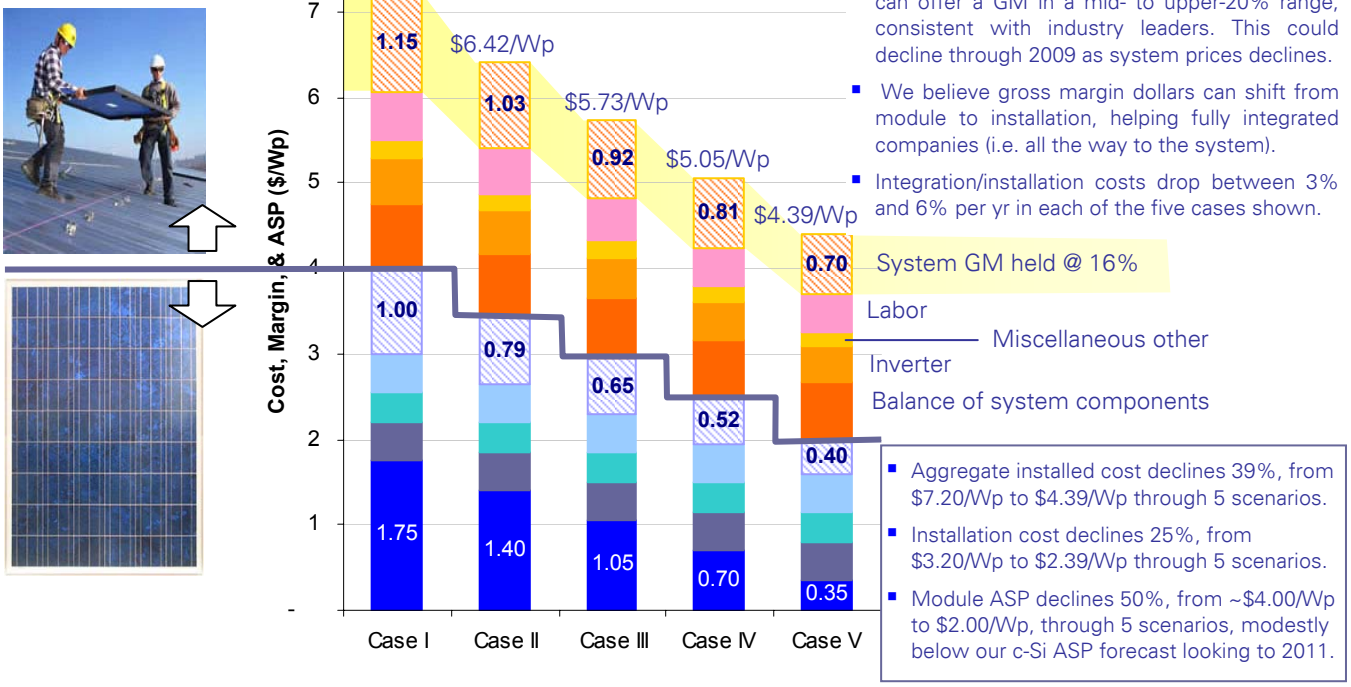
Installed system cost/Wp – crystalline silicon

Power has shifted from upstream in the value chain to downstream.

Power has shifted away from the module manufacturers: a c-Si module represents roughly half the total installed cost of a system. A significant decline in module prices will certainly reduce system prices; however, it is important to note that in a c-Si module oversupply situation, there are few, if any, price support mechanisms at the module level, while there are price support mechanisms (e.g. incentive programs) at the system level. This clearly shifts the power from upstream in the value chain to downstream. All things being equal, this would imply that a price "collapse" at the module level would induce a more moderate decline at the system level, enabling system installers to maintain or even improve margin structures. While an increase in the cost of capital may eliminate the ability to improve margin structures, we do expect strategic minded downstream players to fare better through the shake-out.

- **Balance of system costs:** in Figure 21 we add balance of system costs to c-Si module costs defined previously to establish a baseline c-Si model for installed system cost/Wp. Again, this analysis is intended to offer a baseline for a model, and scenario analyses (i.e. Case I through Case V) from it, to further assess technology, company and system competitiveness at the system level, and potential installed system pricing trends.
- **Variance error can be significant:** frustratingly, variance error in assessing balance of system components, labor, and gross margin in particular is large, and varies greatly with the size of the installation and the installer.

Figure 21: c-Si installed system cost/Wp – costs by segment and gross margin



Source: Deutsche Bank estimates

Modeling system costs is frustratingly imperfect, but necessary: cost data for solar PV installations varies substantially, making it virtually impossible to represent average industry c-Si system installed costs with an overarching model. We note that the cases in Figure 21 exclude tracking systems and land (or rooftop) costs. (We will address single axis tracking in a subsequent section in which we compare the three competing volume technologies – average c-Si, high efficiency c-Si, and CdTe.) We did our best to aggregate data for (1) balance of system components, (2) inverters, (3) miscellaneous costs, and (4) labor, and assumed what we believe is a reasonable mid-teens percentage gross margin at the system level for a non-integrated integrator/installer (i.e. purchases system components).

- **Balance of system components:** balance of system components costs cover the hardware necessary to install the system, including the mounting structure, mounting hardware, electrical connectors, cables, monitoring systems, etc. This data contained the greatest variance error.
- **Inverter:** the inverter is the costliest system component after the module. We believe inverters cost as much as ~$0.70/Wp for small systems to less than $0.30/Wp for larger scale commercial systems. In our base case analysis we use a value closer to the lower end of the range; this value declines through the five cases.
- **Miscellaneous other costs:** this includes all other costs like warranty reserves, costs tied to securing permits, and managing rebates, etc. These can be more substantial in emerging markets that are much less efficient.
- **Labor costs:** labor costs include system layout/design (electrical and structural), materials management, as well as labor required for the actual system installation. Labor costs decline as a percentage of total costs as scale increases.
- **Gross margin:** while we have heard integrator installers claim/report gross margins that range from mid-single digit percentages to upwards of 30%, we believe that a reasonable gross margin to use for a non-integrated (i.e. no upstream manufacturing participation) installer would be in a mid-teens percentage range. We believe that over time, non-integrated installers could see gross margins compress to 10% to 15%, while integrated (e.g. like SunPower, or REC) installers could see stacked gross margin in the low to mid-20% range, and in some cases higher.
  - **Margin stacking is important when considering business models:** while calculating the gross margin of a company integrated from ingot to system, for example, is quite complex (e.g. involving direct costs, tolling costs, downstream costs, etc.), it is also important when considering business models. A company able to integrate from far upstream all the way downstream has an intrinsic advantage in controlling costs, and maximizing its margin structure. Furthermore, margin compression at the module level can potentially be compensated for at the system level, and systems businesses (not necessarily gated by internal module production capacity) can potentially source c-Si modules at much lower prices as c-Si module ASPs fall. For c-Si based companies, we believe such an integrated business model will likely fare best over the next couple years.

A company integrated from far upstream all the way downstream has an intrinsic advantage in controlling costs, and maximizing margin structure. And, margin compression at the module level can potentially be compensated for at the system level.

- **Learning curve and cost reduction:** we expect labor costs, for example, to decrease on an absolute basis over the next couple years for a given installation as efficiencies are introduced (i.e. the industry still has a meaningful percentage of the learning curve to surmount). It is quite possible that several years in the future this reduction could reverse as the industry matures, and efficiencies have been realized.

Scenario analyses off the base case: we anticipate integration/installation costs could decline from ~$3.20/Wp to ~$2.40/Wp (this is system size dependent as well); we depict this with five different cases in Figure 21, building off the module cases in Figure 17. For integrated installers (i.e. ownership of the upstream portion of the value chain), this number can be meaningfully lower as there is more margin latitude, and potential cost efficiencies.

Based on these balance of system costs, we believe c-Si installed system cost/Wp could decline to ~$4.55/Wp (e.g. a $2.13/Wp module ASP and $2.42/Wp of installation costs), for an integrated (i.e. upstream integration) offering, potentially reaching this level by 2011.

It is conceivable to think of a c-Si installed system price of ~$4.00/Wp in 2011, but this would likely carry a GM of <15% for the best of the integrated manufacturer/installers.

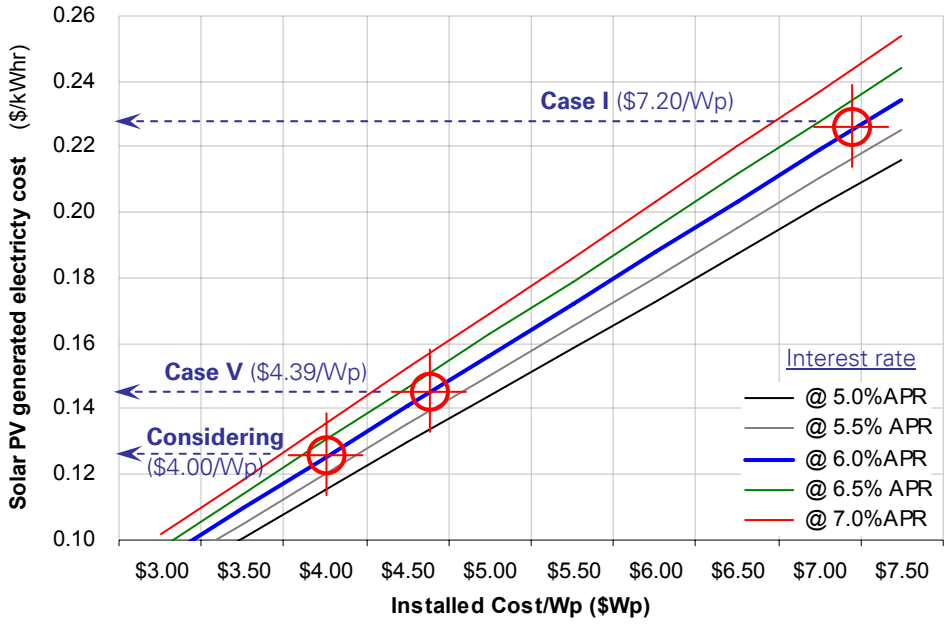
What could c-Si based system pricing really do? We believe ASP pressures (more so at the module level) could drive c-Si based installed system pricing to ~$4.50/Wp over the next couple years. This could potentially afford mid-20% gross margin performance to the leading companies integrated from ingot/wafer/cell through system installation. It is conceivable to think of a ~$4.00/Wp installed system price in 2011, but this would drive slim margins at the module level for module manufacturers, and at the system level for integrated, and particularly non-integrated installers. For example, if we use a c-Si module manufacturing cost of $1.75/Wp as previously calculated, and a balance of system cost of $1.69/Wp (i.e. no margin), a fully integrated installer could offer an installed system price of $4.00/Wp with a 14% gross margin. For comparison's sake, a 24% gross margin would require an installed system price of ~$4.50/Wp. Such prices would be for large system installations.

- **Such a low installed system ASP could only be supported in efficient markets:** lastly we would point out that we believe c-Si installed system prices approaching $4.00/Wp over the next two to three years could only be supported by industry leading companies in efficient markets (i.e. such a price could not likely be supported in a new, immature market with intrinsic inefficiencies).

Levelized Cost of Electricity (LCOE) – crystalline silicon

The final arbiter of competitiveness: the cost of generating electricity is the most important metric in assessing the competitiveness of a solar PV technology, a company, and the industry. Cost reductions at the module and system level affect the numerator of the LCOE calculation, serving to lower cost/kWh. We have updated our solar PV industry model to account for system level price changes. Figure 22 details the relationship between a c-Si based system installed cost and LCOE for various costs of capital. Our installed system price for cases I and V are indicated, as well as a $4.00/Wp installed system price.

Figure 22: Levelized Cost of Electricity (LCOE) – installed cost/Wp versus $/kWh for various costs of capital



- LCOE is calculated accounting for ITC benefits, with a system located in San Luis Obispo (i.e. near where PG&E is planning to install a 250MWp system).
- Excludes tracking systems
- 20 year useful life
- 20 year term
- We use NREL's PVWatts to calculate the solar PV system output (kWhr/year).
- A 37% decline in installed cost (from $7.20/Wp to $4.55/Wp) leads to an LCOE range of $0.229/kWhr to $0.145/kWhr. (ITC benefit included)

Source: Deutsche Bank estimates

For our five cases, LCOE for an average c-Si solution spans a range of ~$0.23 to $0.145, including the ITC benefit.

- **LCOE spans a range of ~$0.23/kWh to ~$0.145/kWh:** with an installed cost of $7.20/Wp (Case I), we calculate a LCOE of $0.219/kWhr. This includes the ITC benefit. This electricity generation cost is arguably high and not yet competitive with grid rates, but is still well below PG&E's top residential rate of ~$0.36/kWhr. With an installed cost of $4.39/Wp (Case V), we calculate a LCOE of $0.144/kWhr. Again, this includes the ITC benefit, and offers a much more competitive rate.
- **How low can average c-Si go over the next several years?** With an installed cost of $4.00/Wp, we calculate a LCOE of $0.125/kWhr, roughly equivalent to PG&E's residential baseline (lowest) rate. We believe such a $/kWh could be competitive with the leading technologies (i.e. CdTe and high efficiency silicon on single axis trackers) that have already won bids for utility scale systems beginning in 2010, but note that it would require industry leading cost reduction, and a low margin structure. We do not believe that costs for average efficiency c-Si solutions can be confidently projected with reasonable margin (i.e. a sustainable business model) in order for companies to compete effectively for bids in 2009 against the LCOE leaders.
- **What does it take to win a utility scale bid?** We believe that utilities in the US require a cost/kWh of ~$0.11 to ~$0.14 for winning bids, including the benefit of the ITC. We estimate that PG&E's 250MWp PPA agreement with SunPower (see our note of 10 Sep 08) has a $/kWh of ~$0.13 to ~$0.14 beginning in 2010 (ITC included). This would equate to lower than a Case V scenario for "average" c-Si, but to a higher installed system price (e.g. ~$5.00/Wp) when considering a single axis tracking system and high efficiency c-Si panels (more on this in the next section). Lastly, we believe that a recent contract may have been awarded with a $/kWh of slightly ~$0.11 for electricity delivery beginning in 2011 (ITC included); if this is true, we believe it would set a new bar for solar PV generated electricity pricing.

A step function LCOE reset and eventual rebalance (c-Si)

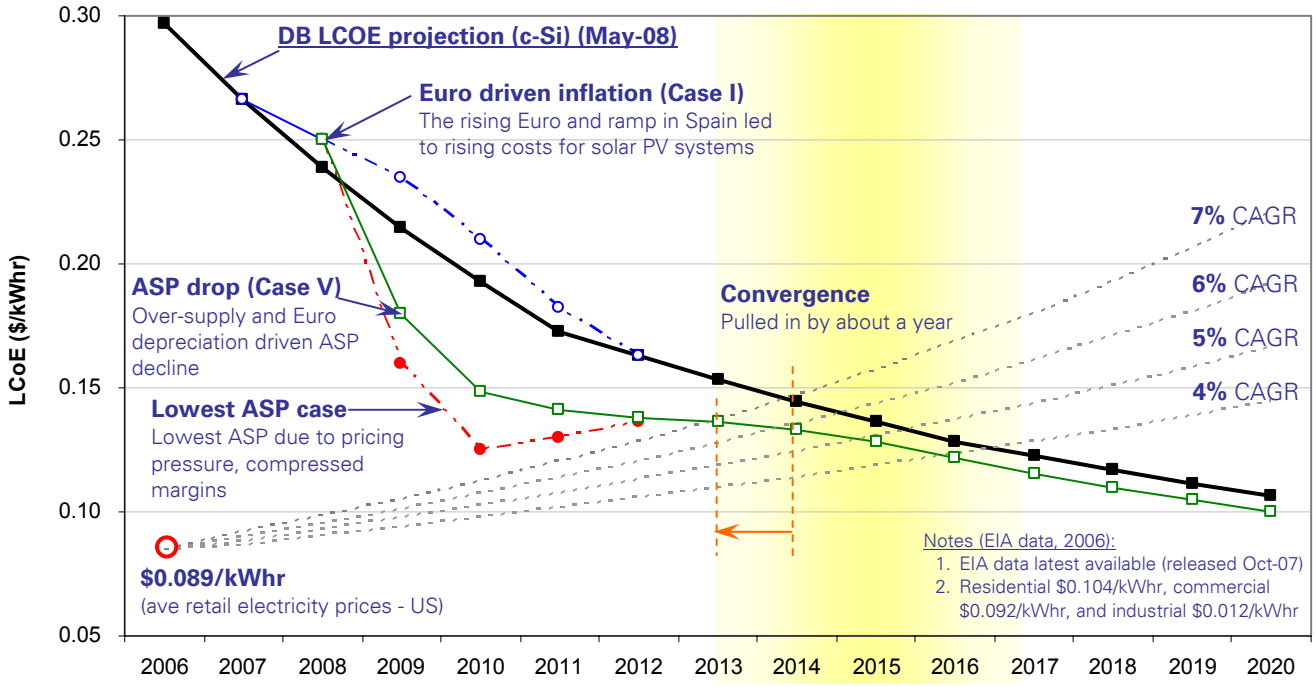
Good for the industry, bad for many companies: module and installed system price reductions are good for the long-term health of the industry, making the solar PV industry's LCOE more competitive. Recent and anticipated price reductions for modules, and further anticipated price reductions for systems will effectively shift LCOE curves down in the near term (Figure 23). This will serve to accelerate the LCOE "learning curve" over the near term. We then expect the LCOE curve to flatten, assuming a more gradual downward progression than our prior forecast. This will enable cost reduction to catch up in a more rationalized industry, enabling more gradual LCOE reduction over many years.

Recent and near-term price reductions will reset solar PV LCOE curves lower, pulling in grid parity by about a year from our prior estimate.

- **Grid parity about a year sooner than prior projections:** the effect of this reset to solar PV LCOE curves is to pull in grid parity by about a year. We acknowledge that "grid parity" is an ambiguous metric, and is geographically and case by case driven. For the purposes of this analysis we define grid parity as equivalence with the average retail price of grid supplied electricity in the US (i.e. one of the most cost competitive electricity markets). Excluding incentives, we anticipate average conversion efficiency c-Si solar PV solutions could approach grid parity within four to seven years, depending on the CAGR of grid supplied electricity.
- **Painful for many companies; long-term beneficial for some:** the shake-out will adversely affect all companies over the near-term, and adversely affect many companies over the long-term (e.g. many companies may not survive). Companies with leading LCOE solutions should survive the shake-out and serve to consolidate the industry, taking market share through the shake-out and over the coming years. The companies in our coverage universe that best epitomize long-term industry consolidators are First Solar and SunPower.

Adjusting our LCOE profile: Figure 23 graphs our prior (May-08) average conversion efficiency c-Si LCOE curve with the three cases of Figure 22 superimposed (i.e. Case I, Case V, and lowest case). Realistically we are expecting an LCOE curve that begins to track a Case III (i.e. $150/kg polysilicon) profile in 2009 and progresses to a Case IV (i.e. $100/kg polysilicon) profile in 2010, before beginning to level out (i.e. interpolate between the Case I and Case V curves in Figure 23).

Figure 23: Convergence projection – c-Si solar PV LCOE versus average grid electricity prices in the US



Source: Deutsche Bank estimates

- **Euro inflated Solar PV LCOE (Case I):** with primary markets in Europe, an industry-wide module shortage, and the strong appreciation of the Euro versus the US$ through 2Q08, module and system pricing had undue support, and slowed our projected decline in average c-Si LCOE. These factors defined Case I in our analysis, and if these trends continued, LCOE would likely have traced the Case I line shown above (blue). We believe the Case I LCOE curve would have trended back toward our original forecast several years in the future.
- **Module ASP declines drive LCOE lower:** the current shift to a module over-supply condition, the 4Q08 rapid deflation of the Euro versus the US$, Spain's 2009 installation cap, exacerbated by severe near-term credit restrictions have led to a rapid decline in module ASPs. The power has shifted downstream to system installers with financing. This is serving to drive a step function decline in LCOE curves, resetting the bar below our prior expectations over the near-term; this would be reflected in Case III / Case IV curves interpolated between the boundary conditions of Cases I and V in Figure 23.
- **Lowest ASP case condition shown for comparison and to bracket the potential magnitude of a near-term reset:** when considering a "lowest" c-Si installed system price (i.e. ~$4.00/Wp), we would expect LCOE to over-shoot on the downside and then recover before converging with a Case V trend line. We do not anticipate this kind of c-Si solar PV price in the near term, but include it for comparison's sake, and to offer a low range bracket for analyses.

The more important impact may be that a near-term, more aggressive narrowing of the gap with respect to grid electricity prices could significantly accelerate demand under existing incentive programs should lending return later in 2009.

- **A lower LCOE (although not at parity) will increase demand when lending returns:** an accelerated near-term learning curve (i.e. a steeper LCOE curve decline) will pull in grid parity convergence by roughly a year for an average conversion efficiency c-Si system. However, the more important impact may be that a near-term, more aggressive narrowing of the gap with respect to grid electricity prices could significantly accelerate demand under existing incentive programs should lending return later in 2009. (We note that the EIA's average grid price data represents the average baseline rate across the US for residential, commercial, and industrial customers.)
  - **Lower installed prices boost the value of incentives:** Figure 23 details average c-Si LCOE without incentives. As industry dynamics drive installed prices lower, incentive induced project returns increase (barring significant jumps in the cost of capital), effectively making incentives more valuable. This should accelerate demand over the next few years as lending loosens.

Module and system prices are not the only factors to consider: module and system ASPs have significant influence on LCOE trends. Other LCOE drivers include:

- **Migration to larger systems:** an increasing mix of larger solar PV system installations has helped lower LCOE. We expect this trend to re-accelerate once credit eases. The largest systems (e.g. utility scale) are driven by the lowest LCOE solutions; now that two production technologies (i.e. CdTe, high efficiency c-Si) have successfully won utility scale system bids, we anticipate this will drive further cost reduction by industry leaders, and a mix toward larger systems over the next few years.
- **Scale of the solar PV industry:** the solar PV industry is immature. As companies grow and the industry consolidates, we expect efficiencies to be realized that will help to lower LCOE for several solar PV technologies. This extends beyond the upstream portion of the value chain that receives inordinate attention. For example, significant cost reductions in inverters have been realized over the past several years; we expect such improvement to continue as the industry grows.
- **Growing experience base:** system integrators and installers still comprise a fragmented base in most markets. As system sizes increase, and the downstream portion of the value chain consolidates, we expect efficiencies to emerge that will lower the soft costs of system installations. This can be particularly pronounced in new markets, typically fraught with inefficiencies when they first emerge.

We expect the shake-out to run its course through 2009 and 2010 with significant industry consolidation. This should offer a more stable environment during which time LCOE curves will likely adopt more gradual declining profiles.

Near-term volatility; long-term more stable: industry dynamics promise a rough ride over the near-term, with step function resets in component pricing, and LCOE. We expect the shake-out to run its course through 2009, and wind down through 2010 with significant industry consolidation. This should offer a more stable environment beginning in 2010 during which time LCOE curves will likely adopt more gradual declining profiles. This does presuppose that incremental lending returns later in 2009, and improves through 2010.

Comparing the leaders

CdTe versus high efficiency c-Si with and without tracking

We anticipate industry leaders will come to dominate the solar PV industry over the next several years, with non-differentiated survivors serving in subordinate capacities.

Who is really driving the industry? We would argue that companies with the most competitive LCOE solutions in volume production are driving the solar PV industry. Despite some arguments to the contrary, we believe this will become painfully clear as the shake-out progresses. We anticipate industry leaders will come to dominate the solar PV industry over the next several years, with non-differentiated survivors serving in subordinate capacities (e.g. as a supplemental provider of modules at low margin, as outsourced manufacturing for industry leaders, or relegated to discrete markets or niches, as regionally based installers, as lower margin suppliers). While there will likely be room for many non-differentiated companies (both upstream and downstream), we expect margin structures to be meaningfully lower than industry leaders.

How should we look at the industry? We believe that the companies that will define and advance the solar PV industry are the LCOE leaders. Over the next couple years we believe this will fall to two production technologies from two companies within our coverage universe: First Solar – CdTe and SunPower – high efficiency c-Si. This does not mean that other technologies and companies (e.g. average conversion efficiency c-Si) will be vanquished; they will not. There is hardly enough capacity from these two companies to satisfy demand over the next several years. We expect lower margin offerings driving trailing LCOE solutions will find a healthy place in the market as demand will require it, but there will likely be fewer of these companies one to two years from now.

We believe industry leaders are gaining market share now, will gain market share through the shake-out, and will consolidate market share gains as industry growth accelerates.

- **Market share will gravitate to industry leaders:** we have said this several times in this piece, and cannot say it enough – we believe industry leaders are gaining market share now, will gain market share through the shake-out, and will consolidate market share gains as industry growth accelerates. Companies with the most competitive solutions and the strongest balance sheets will emerge as the near-term and the long-term winners.

Assessing the LCOE leaders: Figure 24 details installed system cost/Wp for what we consider the solar PV industry leaders – those companies that can offer the lowest LCOE solutions. The analysis follows the same logic of our prior analysis for average efficiency c-Si based solutions, breaking down a base model into five cases. We have included (1) First Solar's CdTe solution, (2) SunPower's high efficiency c-Si fixed mount solution, and (3) SunPower's high efficiency c-Si single axis tracking solution. We believe that First Solar's solution and SunPower's single axis tracking solution offer the solar PV industry's lowest LCOE solutions.

- **Considering the next couple years, and industry dynamics:** again, cases I through V evaluated module and integration/installation costs and how industry dynamics might impact these costs over the next couple years; the cases are intended to serve as a baseline for sensitivity analyses on a company by company basis.
- **System prices differ substantially:** the costs in Figure 24 are baseline costs for various installed system cost cases driven by polysilicon prices (for the c-Si solutions), technology improvement, incremental cost reductions, and gross margin. CdTe module prices are determined via a BOM cost model rather than a "processing" cost model as with c-Si. We have maintained our prior GM assumptions for modeling purposes for CdTe. Our gross margin assumptions for high efficiency c-Si modules from SunPower are higher than for average c-Si module companies, and are consistent with recent

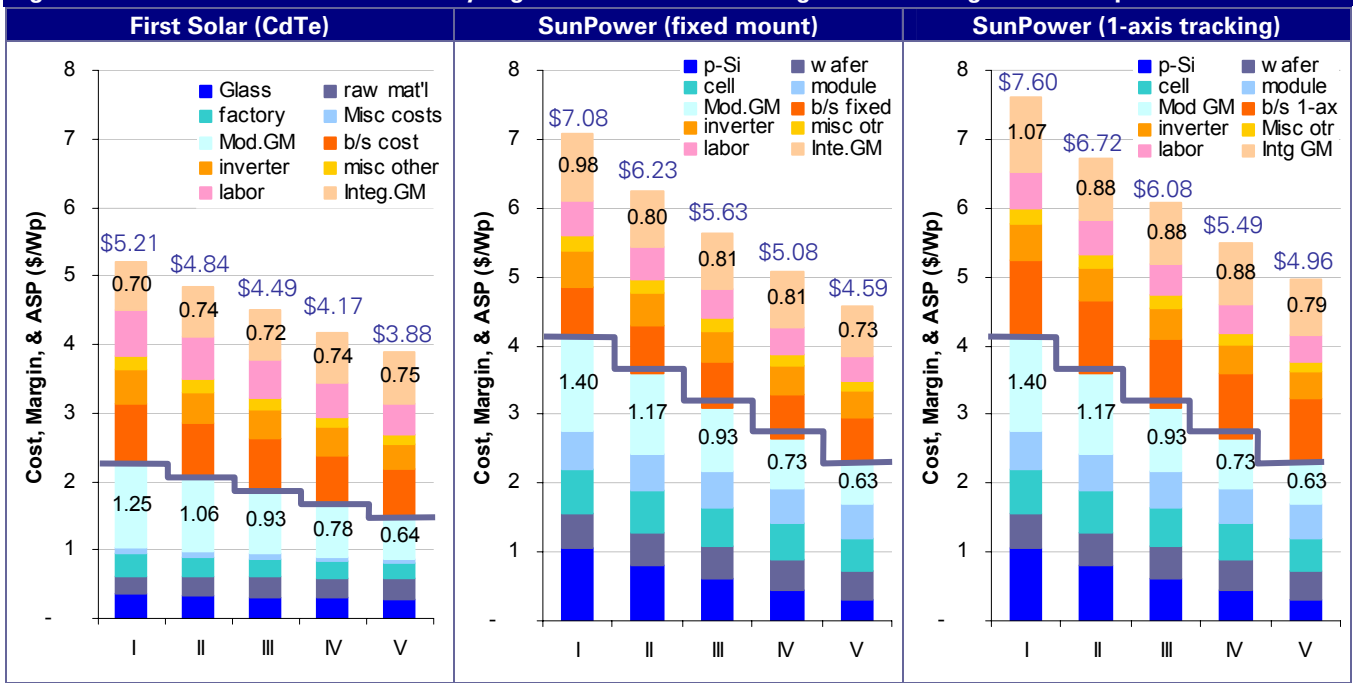
company reports (i.e. Case I at ~34% declining to ~27% in Case V). We assume an installation gross margin in a mid-teens percentage range.

- **System margins in an integrated model:** these costs/prices would equate to integrated system gross margins approaching 30% for a fully integrated company using high efficiency c-Si panels, and in a mid-30% range for an integrated company using CdTe panels. (When comparing to SunPower reported system business gross margin – a low 20% range – it is important to remember that these historical reported numbers include systems built with third party c-Si modules as well, and much lower overall gross margin than we would estimate for high efficiency panels, and full integration).

The most important comparison is between CdTe and high efficiency c-Si on single axis trackers; these are the industry's most competitive LCOE solutions.

- **Energy generation is the LCOE equalizer:** several factors define energy generation by technology (e.g. conversion efficiency, geography, temperature coefficient of power, spectral response, etc.). CdTe has a relative advantage over fixed mount c-Si in energy generation per rated power due primarily to spectral response and temperature effects. However, single axis tracking systems with higher efficiency panels can generate significantly more power at a substantial power output to cost benefit. Consequently, while we will look at all three solutions indicated above, we believe the most important comparison is between CdTe and high efficiency c-Si on single axis trackers. (Note: we would encourage a review of our 9 Jul 07 piece "*Solar Photovoltaics – technology and economics: thin films and crystalline silicon*" for a detailed explanation of energy generation by technology.")

Figure 24: Estimated costs broken out by segment – base model using Cases I through V for comparison



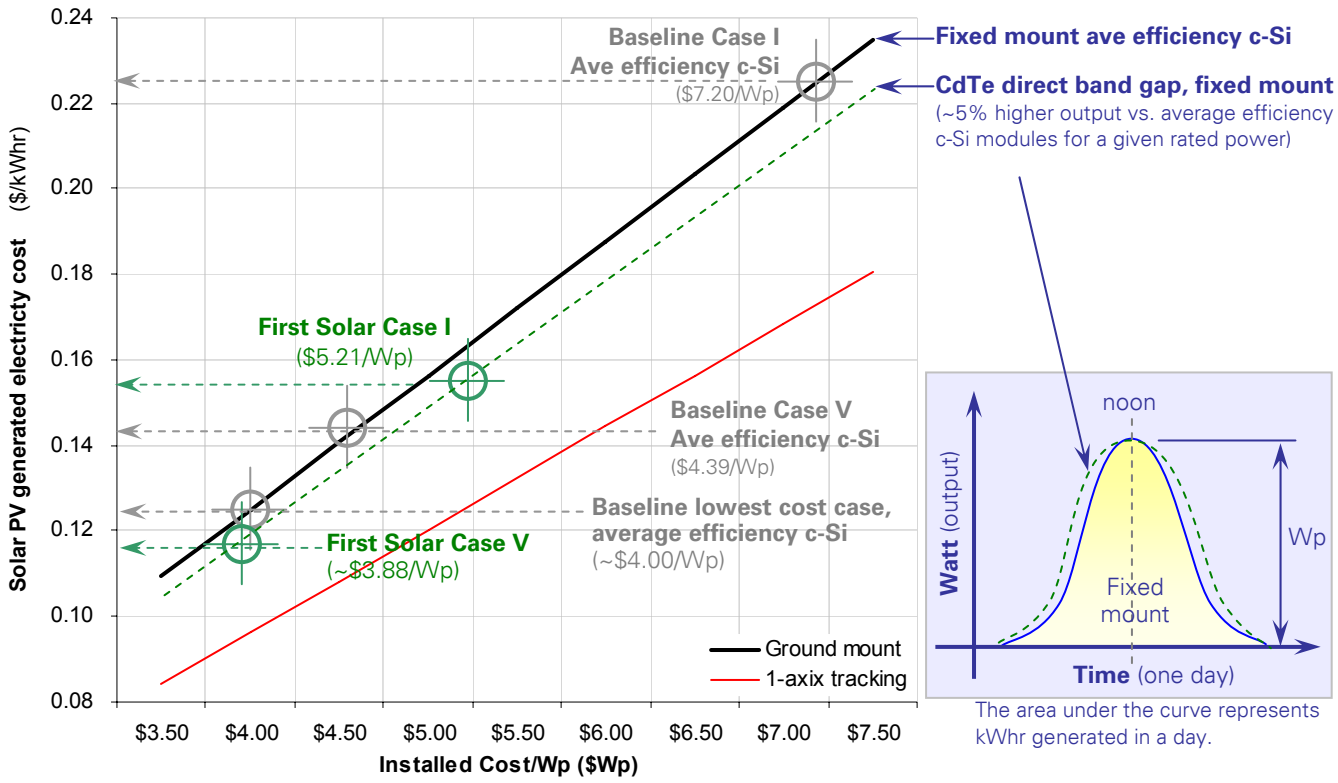
First Solar (CdTe)	SunPower (fixed mount)	SunPower (1-axis tracking)
▪ CdTe module ASP declines from $2.28/Wp in Case I to $1.51/Wp in Case V. ▪ Module gross margin declines from ~55% in Case I to ~43% in Case V (assumes a module $/Wp of $0.87). ▪ System integration/installation gross margin climbs from ~14% in Case I to ~19% in Case V.	▪ SunPower module ASP declines from $4.15/Wp in Case I to ~$2.33/Wp in Case V. ▪ Module gross margin declines from ~34% in Case I to ~27% in Case V. ▪ System integration/installation gross margin remains in a mid-teens percentage range.	▪ Module ASP, and gross margin and system integ/install gross margin the same as in the fixed mount cases. ▪ Tracking system replaces fixed mount hardware, adding incremental cost that is <<10% of installed system price using a T20 tracker. ▪ System power output is >30% higher.

Source: Deutsche Bank estimates

First Solar's CdTe solution – module cost and LCOE leader

Module cost plus technology performance offers industry leading LCOE: when considering First Solar's CdTe modules, installed system prices, and projected energy generation for a system located in California, we detail system price versus LCOE in Figure 25. We include curves for an average conversion efficiency c-Si system (the baseline case) and a CdTe system; we include data points for Case I and Case V, as well as for the lowest cost hypothetical case for average c-Si for comparison's sake. We estimate, for example, that Case I systems for respective technologies are concurrent market offerings (i.e. offered at the same time in the market). The Case I designation by technology is not at all indicative of similar company operating models, but clearly shows the LCOE advantage of a CdTe system.

Figure 25: LCOE versus installed system cost – CdTe vs average efficiency c-Si (based on 6% interest rate)



Source: Deutsche Bank estimates

The LCOE gap can clearly narrow between c-Si and CdTe, but will never close completely. CdTe will retain a meaningful LCOE advantage.

- **CdTe retains an advantage, but the gap will narrow:** if we assume blended polysilicon costs collapse to ≤$50/kg, and c-Si system gross margins compress to ~10% for a leading, integrated average c-Si technology based company as in our prior analysis (i.e. a system cost/Wp of ~$4.00), a c-Si system would offer a LCOE ($/kWh) that is still at least a $0.01 higher than a Case V scenario for First Solar. The Case V scenario for First Solar still assumes strong margin performance, and we believe is a much more reasonable probability over the next couple years than the lowest c-Si case. The LCOE gap can clearly narrow between c-Si and CdTe, but will likely never be closed completely; CdTe will retain a long term competitive advantage at the module, system and LCOE levels.
  - **Pennies matter greatly:** $0.01/kWh (or less) matters greatly when considering what one must pay for electricity over the long-term. When considering energy usage profiles from commercial and industrial customers in particular, a fraction of a cent can add up to very substantial electricity expenses over the course of time. While less of an issue for the residential market, a one cent LCOE advantage is very significant when bidding on commercial or utility scale projects.

In order to begin to compete with CdTe LCOE, an integrated, average c-Si system company's GM would likely have to be in a single digit range.

- **Operating model comparison clearly shows CdTe advantage:** as indicated above, gross margin for a c-Si system whose LCOE can begin to approach that of a CdTe system would likely be close to 10% for an integrated supplier with polysilicon prices ≤$50/kg, and would decline to below 10% for polysilcon prices modestly higher than $50/kg. We believe First Solar, the only volume CdTe producer in the industry, can offer modules at a gross margin in a low- to mid-40% range, and systems at a gross margin in a mid-30% range with a more competitive LCOE. When accounting for system and operating company margin structures, the advantage of CdTe is quite clear.
  - **CdTe has significant margin latitude to pursue new markets:** CdTe clearly has significant margin latitude with which to play (i.e. First Solar could lower prices at the module and system levels to open up new markets, incurring some margin degradation in the process). With system margins as high as the low- to mid-30% range, we believe CdTe module and system prices could be reduced to enable LCOEs attractive enough for US utilities. We believe that a recent bid may have been won for ~$0.11/kWh for energy delivery in 2011 (including the benefit of the ITC), which would imply that if this bid were won by a CdTe solution pricing must further decline from our Case V estimate, further widening the projected gap with c-Si based solutions. Barring a faster cost decline, this could result in margin degradation in out years, but would still be quite consistent with an industry leading margin structure. Regardless, the data indicates that such business is very likely outside the envelope that average c-Si solutions can address.
- **CdTe technology enables higher output compared to c-Si in fixed tilt configurations, lowering LCOE:** we believe properties of CdTe cells (e.g. a wider spectral response, lower temperature coefficient of power) enable a CdTe solar PV system to generate roughly 5% more power per rated output than an average c-Si solar PV system. This is reflected in Figure 25 (green line).

SunPower's high efficiency c-Si, 1-axis tracking solution – a LCOE leader

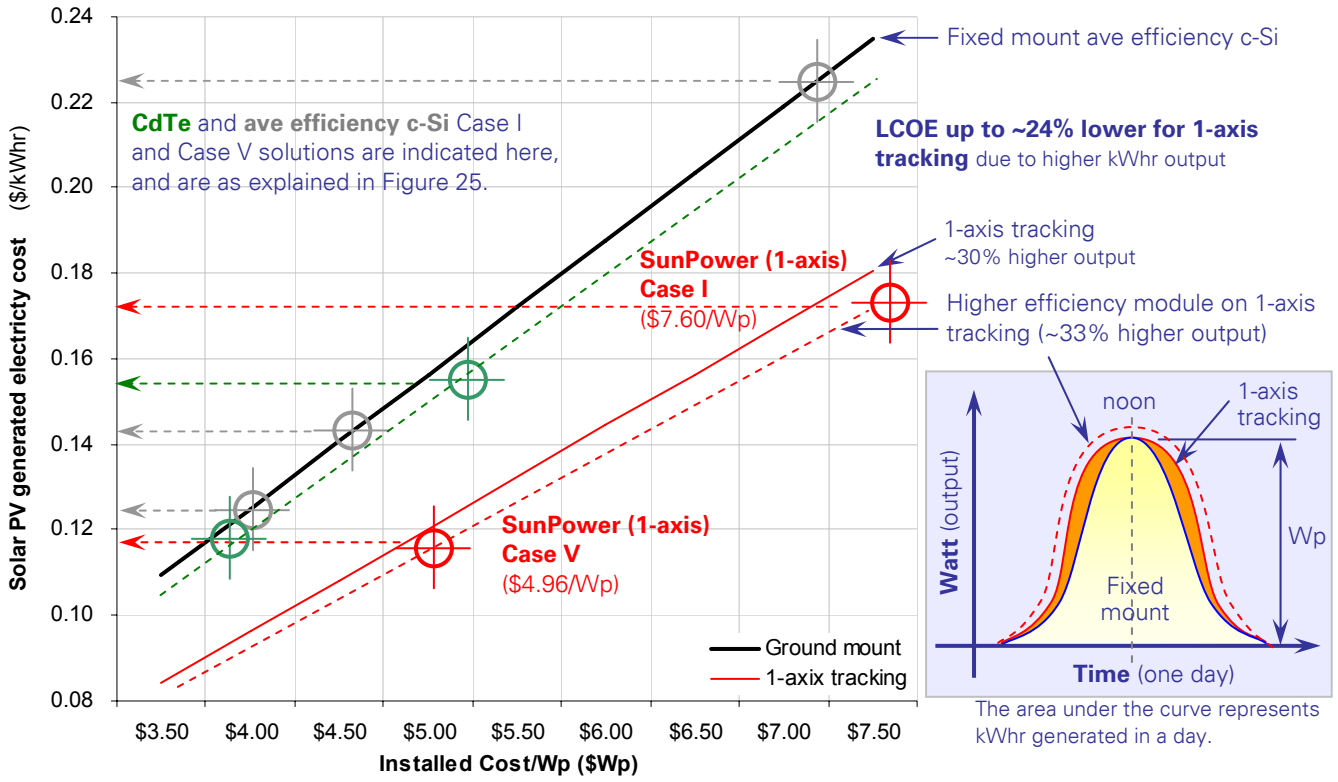
With internal single axis tracking systems and high efficiency c-Si panels, SunPower can offer an unparalleled incremental cost to power output benefit for one axis tracking systems.

Single axis tracking boosts the benefit of high efficiency c-Si: SunPower offers the industry's highest efficiency panels; these panels do come at a higher cost, but the cost can be compensated for by increased power generation. At the module level, as the cost of polysilicon drops, SunPower's module manufacturing cost will benefit less than many c-Si manufacturing peers; this is more a tribute to SunPower's long-standing sourcing strategies rather than to the competition. Regardless, as a large system integrator, SunPower also has the benefit of an integrated model all the way downstream to energy generation. And, with internally designed and manufactured single axis tracking systems, coupled with high efficiency c-Si panels, we believe the company is able to offer the industry's best incremental cost to power output benefit for one axis tracking systems. We believe this solution can rival CdTe, albeit with a lower, but still quite healthy margin structure.

- **High efficiency c-Si is ideally suited for 1-axis tracking:** we believe SunPower's high efficiency c-Si panels are ideally suited for 1-axis tracking, as higher conversion efficiency panels are able to take greater advantage of tracking benefits. We believe 1-axis tracking systems generally deliver 25% or more incremental power (kWh/day) for average efficiency c-Si panels in a higher sunlight region; we believe SunPower's high efficiency c-Si panels on the company's T20 trackers can deliver more than 30% incremental power under the same sunlight conditions. This is delineated in Figure 26 with the red lines; the solid red line indicates a 30% incremental power output profile over average c-Si fixed tilt systems, and the dashed red line indicates a 33% incremental power output profile over average c-Si fixed tilt systems.
- **Expanding the comparison to include SunPower's low LCOE solution:** Figure 26 includes our analysis for CdTe and average conversion efficiency c-Si as just discussed, and adds SunPower's single axis tracking, high efficiency c-Si solution. The system price versus LCOE curve shifts down substantially for SunPower's solution as system cost

increases appreciably, but power output increases significantly more. We include data points for Case I and Case V. Again, we estimate that Case I systems for respective technologies are concurrent market offerings (i.e. offered at the same time in the market). The Case I designation by technology is not at all indicative of similar company operating models, but clearly shows the advantage of SunPower's high efficiency c-Si tracking solution compared to average c-Si solutions.

Figure 26: LCOE versus installed system cost – 1-axis tracking vs CdTe vs average efficiency c-Si (6% interest rate)



Source: Deutsche Bank estimates

- **Using the PG&E deal as a large system baseline:** SunPower is one of the very few companies pioneering the utility scale solar PV market (another is First Solar). The company recently won a 250MWp contract with PG&E for electricity delivery beginning in 2010; we believe the winning bid may have been ~$0.13/kWh to ~$0.14/kWh. While we present baseline cases I through V in this analysis, we believe that Case IV (i.e. a system price of $5.49/Wp) or Case V is most applicable for larger scale systems with energy delivery scheduled beginning as early as next year. We believe a comparison with a First Solar Case V is most appropriate.

We believe SunPower's high efficiency c-Si solution on T20 1-axis trackers can offer a comparable LCOE to CdTe, albeit at somewhat lower margins.

- **SunPower's 1-axis tracking solution can challenge CdTe:** we believe the most appropriate comparison is between Case V CdTe and Case V high efficiency c-Si on 1-axis trackers. As indicated in Figure 26, we believe SunPower's high efficiency c-Si solution on T20 1-axis trackers can offer a comparable LCOE to CdTe, and offer a LCOE well below that of average c-Si solutions. We believe these are the two most competitive solar PV LCOE solutions in production.
  - **Margin structures must be considered for a true comparison:** we estimate the margin structure of the SunPower solution includes modules and systems in a high-20% gross margin range for a fully integrated company. These margin estimates are lower than those for CdTe (e.g. low-40% range for modules, mid-30% range for systems), giving CdTe an implicit advantage should a leading company using this technology chose to exercise greater margin latitude to pursue business.

- **Tracking increases output:** the output of a solar PV module is maximized when light hits the surface with a vertical orientation. As the sun moves across the sky, the incident angle of the light changes throughout the day, peaking in the middle of the day when incident light is normal to the module surface. This is shown in the right graph in Figure 26. The yellow shaded area under the curve represents the total kWhr output for the day for a fixed mount system; the orange shaded area represents the incremental energy generated due to one axis tracking; the red dotted line indicates the incremental energy generated from SunPower's high efficiency c-Si, one axis tracking solution. One axis tracking allows the solar PV array to adequately track the sun throughout the day, raising system output (kWhr/day) as shown in the 1-axis tracking curves (red lines).
  - **Some one axis trackers are better than others:** most 1-axis trackers are parallel to the ground, and do not maximize light collection and incremental power generation. SunPower's T-20 trackers are tilted (for northern and southern hemisphere locations) with telescoping legs, enabling more energy output.
  - **Tracker cost is another advantage of theSunPower solution:** SunPower's T20 tracker was internally developed and is internally manufactured. We believe SunPower's incremental tracking cost/Wp is significantly below competitors' that would purchase tracking systems separately. We believe the combination of low cost tracking and high efficiency panels offers the industry's best power output to cost benefit.
- **The benefits of vertical integration:** SunPower is one of very few companies integrated from the solar PV cell (i.e. where the majority of IP resides) to energy generation, enabling cost and efficiency advantages that few other companies have. This also insulates the company more from precipitous c-Si module price declines as it can direct production internally to projects. Furthermore, we believe the company may be able to drive industry leading installation times and costs as well.
- **Land and high efficiency arrays:** another potential advantage for SunPower that could better level the playing field with CdTe is land cost. Due to higher efficiency, a SunPower array can take up less land than a lower efficiency CdTe array. This, however, will be partially offset by increased land required for tracking. We do not account for land costs in this analysis.

The SunPower fixed tilt solution enables the company to participate in virtually all market segments.

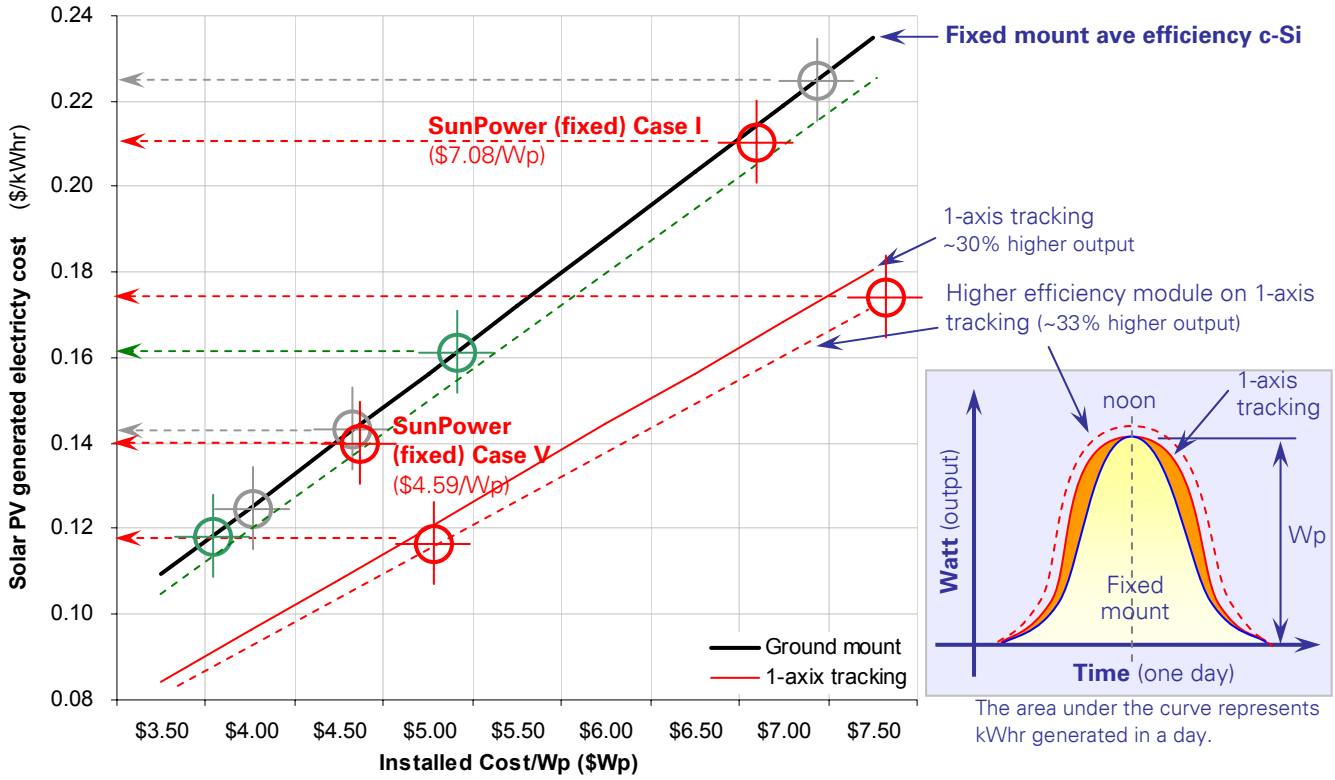
SunPower's high efficiency c-Si on fixed mounts

High efficiency c-Si more than competes with average conversion efficiency c-Si: for completeness, we evaluated SunPower's modules on fixed mounts for comparison with average efficiency c-Si modules (i.e. lower efficiency, lower ASP, lower margin). With polysilicon representing a smaller percentage of SunPower's module costs, it is not surprising to see a narrowing gap between average c-Si and high efficiency c-Si from Case I and Case V (Figure 27). SunPower offers the industry's optimal solution for area constrained installations, and we believe offers an ideal solution for residential and small commercial installations in a fixed mount system. Again, as a large system integrator, with an extensive channel distribution strategy, SunPower can leverage its distributor base for residential and small installations, and benefit with an integrated business model all the way downstream to energy generation for larger installations.

- **Expanding the comparison to include SunPower's fixed mount solution:** Figure 27 includes our analysis for CdTe and average conversion efficiency c-Si, and high efficiency c-Si on 1-axis trackers, and adds SunPower's high efficiency c-Si fixed mount solution. The system price versus LCOE curve will shift modestly down from the average c-Si curve as power generation increases on a per rated Wp basis due to attributes of SunPower's technology (e.g. a lower temperature coefficient of power compared to average c-Si cells, etc.). We include data points for Case I and Case V. Again, we estimate that Case I systems for respective technologies are concurrent market offerings (i.e. offered at the same time in the market). The Case I designation by technology is not

at all indicative of similar company operating models, but shows the advantage of SunPower's high efficiency c-Si fixed mount solution compared to average c-Si solutions.

Figure 27: LCOE versus installed system cost – c-Si solutions vs CdTe (based on 6% interest rate)



Source: Deutsche Bank estimates

The gap will narrow, but we expect SunPower's fixed tilt solution will deliver a better LCOE than c-Si competitors, and at a healthier margin structure.

- **The gap will narrow, but high efficiency c-Si will retain an advantage:** high efficiency c-Si modules have higher costs, higher power density, moderately higher output power per rated Wp, and carry an ASP premium compared to average efficiency c-Si modules. Despite the higher module ASP, we believe SunPower's fixed mount solution delivers a lower LCOE than an average efficiency c-Si solution (Figure 27). As the cost of polysilicon declines, we expect this gap to narrow considerably. If we consider our Case V scenario, a LCOE for SunPower's fixed tilt solution is modestly lower than that of an average c-Si solution (we maintain a roughly 15% module ASP premium for SunPower in this comparison; $2.33/Wp versus $2.00/Wp). Under these conditions, we believe SunPower would retain a significantly better margin structure than an average efficiency c-Si competitor.
  - **Margin structures must be considered for a true comparison:** we estimate the margin structure of the SunPower solution includes modules and systems in a high-20% gross margin range for a fully integrated company. These margin estimates are lower than those for CdTe (e.g. low-40% range for modules, mid-30% range for systems), but significantly higher than for average c-Si based company solutions.

For area constrained installations SunPower clearly has the optimal solution.

- **Area constraints and unique designs:** for area constrained installations SunPower clearly has the optimal solution, and we believe can command a price premium as a result; this tends to bias our system and LCOE numbers higher, and could contribute to a perceived closing of the gap from average efficiency c-Si systems. Furthermore, we believe SunPower's unique module designs, such as T10 low weight tilted (and non-tilted PowerGuard) modules for weight limited roof applications will help to maintain higher ASPs and margins.

- **The benefits of vertical integration:** SunPower is one of very few companies integrated from the solar PV cell (i.e. where the majority of IP resides) to energy generation, enabling cost and efficiency advantages that few other companies have. This also insulates the company more from precipitous c-Si module price declines as it can direct production internally to projects. Furthermore, we believe the company may be able to drive industry leading installation times and costs as well.

Conclusions

First Solar has the most competitive LCOE solution for large scale installations.

SunPower can match First Solar's LCOE with a lower, but still very healthy, margin structure.

Average c-Si based company LCOE will lag even as the cost of polysilicon declines substantially.

- **First Solar and SunPower are clear industry leaders:** First Solar and SunPower have the most competitive LCOE offerings for commercial and industrial scale installations.
- **Industry leaders have sustainable competitive advantages:** we believe First Solar and SunPower have sustainable, technology based competitive advantages.
- **SunPower has the best business model:** we believe an integrated business model from IP (i.e. the cell) through energy provisioning is best and absolutely critical for c-Si players.
- **First Solar has the luxury of time to build out its business model:** First Solar has a less sophisticated business model than SunPower, although the company is building out its downstream strategy and presence. Due to its cost structure and technology approach, we believe First Solar has the luxury of time in building out its downstream business.
- **Industry leaders will gain market share at the expense of non-differentiated companies:** again, we believe industry leaders are gaining market share, will gain market share through the shake-out, and will consolidate market share as industry growth accelerates at the expense of non-differentiated players with weaker balance sheets.
- **Average c-Si solutions will have difficulty competing head to head with industry leaders:** average efficiency c-Si solutions would have to resort to unsustainable business models to compete with the industry leaders in LCOE.
- **There will be ample opportunity for less differentiated companies, but business will be less attractive:** for the less differentiated companies that survive the shake-out there will be ample opportunity as demand growth accelerates; however, we do not expect company operating structures to approach those of industry leaders.

Near-term and numbers

The strong get stronger

Rationalizing the industry over the near term: when considering (1) the macro-economic environment, (2) our new supply/demand forecast, and (3) our near-term ASP and cost assessments and forecasts, and then applying these inputs to companies across the industry, we can draw some rather clear conclusions overall, and for our coverage companies.

The industry is bi-furcating: we believe there is a clear differentiation emerging between the higher quality companies in the industry (e.g. determined largely by product competitiveness, balance sheet strength, and more compelling long-term business models) and the lower quality companies in the industry (e.g. those without differentiation and/or with weaker balance sheets).

Stronger players are gaining near-term market share at the expense of weaker players.

- **The weak get weaker and the strong get stronger:** the most obvious indication of this bifurcation is dramatic production cuts by several companies to adjust for much lower near-term demand. This is not universal, and the higher quality companies, with product differentiation and strong balance sheets, are not cutting production nearly as much. This would argue that these stronger players are gaining near-term market share at the expense of weaker players. It seems apparent that these stronger players have greater channel acceptance and pull, and better access to near-term projects. We believe this is an indication that as conditions deteriorate, there is a clear preference to minimize business risk, and pursue business with companies that will likely emerge from the present downturn intact, and likely stronger; these are the companies that are not being forced to cut production in any meaningful way (e.g. First Solar, SunPower).

Most upstream companies do not control their end market destiny.

- **Financiers are helping to drive this dynamic:** banks have clearly become much more selective with respect to project partners when it comes to project financing. We believe that companies without strong balance sheets are having far greater difficulty securing a seat at the project table. Many upstream companies (i.e. companies that predominantly operate from ingot through module in the value chain) rely on downstream integrator/installers for access to projects (i.e. most upstream companies do not control their end market destiny). In the wake of the credit crisis, we believe the project planners and particularly the project financiers are exerting much more influence on who upstream (e.g. module suppliers) partners will be, and the financial strength of upstream suppliers is of paramount importance in being "selected" for incremental project business.

Factors that determine competitive strength are:
- ***relative product competitiveness,***
- ***balance sheet strength,***
- ***business model,***
- ***brand development,***
- ***segment participation.***

- **No company is immune, but some are far stronger than others:** while some companies are far better positioned than others, no company is immune to the ongoing shake-out. We believe the segmentation of the industry into higher and lower quality companies is emerging clearly. The primary factors that determine competitive strength in the present environment are (1) relative product competitiveness (e.g. LCOE), (2) balance sheet strength, (3) business model maturity, (4) brand development, and (5) segment participation (e.g. market segment and geography). We believe the best positioned companies in our coverage universe are clearly First Solar and SunPower.
- **Categorizing companies and the shake-out:** we would categorize solar PV companies into (1) industry leaders, (2) tier-2 companies (e.g. non-differentiated established players and/or those yet to enter the market with differentiated products), and (3) tier-3 companies (i.e. non-differentiated, weaker players; often small and private). We expect industry leaders to be negatively impacted over the near term, but also consolidate market share and establish stronger market positions ahead of the industry's next

growth phase. We expect tier-2 companies to bear the brunt of the shake-out, with many being consolidated over the next one to two years. And, we expect tier-3 companies to be decimated.

Quantifying the shake-out in 2009 – the present disconnect

Demand growth has come down substantially: in May-08 we had originally forecasted y/y demand growth (i.e. in MWp installed) in 2009 of 38%, versus consensus revenue implied demand growth of well over 50%. We have reduced our 2009 y/y demand growth forecast to 10% as detailed earlier in this piece.

10% demand growth can support a bit more than 20% production growth while maintaining a reasonable supply/demand balance.

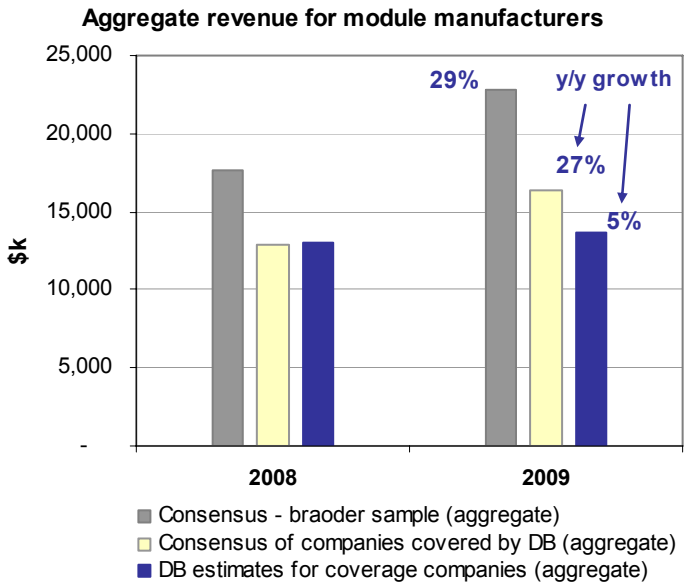
- **10% end demand growth can support modestly more than 20% module production growth (i.e. in MWp):** for argument's sake let us assume 10% demand growth is correct in 2009; this would clearly be 2H09 loaded. When including a reasonable estimate for FGI (to include downstream company, channel, and project staging inventory), we estimate the industry can support a bit more than 20% production growth while maintaining a healthy supply/demand balance.
- **Average annual ASP decline of ~22% negates potential revenue growth for module manufacturers:** with an estimated average annual y/y ASP decline of ~22% in 2009, this would argue for flat to negative aggregate revenue growth as MWp installed growth plus channel sales are overcome. Under such conditions, additional production could precipitate further ASP declines. If we assume that in 2H09 incremental lending returns, and elasticity of demand drives a more pronounced demand ramp, then it is quite possible that aggregate demand and revenue growth would be positively impacted. This could more convincingly argue for aggregate revenue growth y/y in 2009 that could be flat to modestly up. (This could be further impacted in either direction by volatile currency exchange rates.) We believe such a dynamic will shift market share (i.e. revenue) to industry leaders as much as production can support. It is important to remember that our average annual c-Si module ASP decline of ~22% y/y in 2009 would have been much more had 4Q08 not recorded such a precipitous ASP decline.
  - **2009 y/y aggregate revenue growth based upon cross-section of companies considered:** consequently, we anticipate y/y aggregate revenue could be down well over 20% for some Chinese manufacturers, and up significantly for select, industry leading manufacturers. With a reasonable cross-section of companies biased toward industry leaders, we anticipate aggregate revenue could be modestly up y/y in 2009, possibly in a low- to mid-single digit percentage range.

When considering ~22% average annual c-Si module ASP declines, industry revenue growth could be flat in 2009.

- **The present disconnect at the module level is large:** as of mid-Jan 2009 consensus revenue forecasts for publicly traded module and module related production companies, rolled up to an aggregate y/y 2009 revenue growth forecast of 29%. If our demand forecast is anywhere near correct, this is much too high. We do believe that investor expectations are for much less than 29% aggregate revenue growth for module manufacturers, but are likely still above a mid-single digit percentage aggregate revenue growth forecast for a company cross-section biased towards industry leaders. Consensus estimates must come down substantially to begin to reflect reality.
  - **Quantifying the present disconnect at the module level:** Figure 28 graphs aggregate consensus estimates and DB estimates for module and module related manufacturing companies. We include 20 public module and module related manufacturing companies in Europe, the US and Asia in the largest sample size, and then the 13 of those 20 companies that are covered by DB for direct comparison. While this is not exhaustive, we do believe it is an adequate sample size to quantify and compare the disconnect between industry growth projections from company revenue forecasts (i.e. proposed supply), and demand forecasts (i.e. MWp likely to be installed plus channel inventory).

- **Solar PV module related companies in 2009:** when assessing near-term industry dynamics we believe it is clear that market share shifts are underway. We believe that this will enable industry leaders to significantly outgrow the industry in 2009 (i.e. >10% y/y MWp installed growth, and roughly flat y/y revenue growth), and tier-2 and tier-3 companies to significantly under-perform the industry in 2009. For example, we have 2009 y/y revenue contraction of >>20% for some companies, and revenue expansion of upwards of 50% for one company (i.e. First Solar). (We offer a more quantitative assessment below.)

Figure 28: Aggregate revenue for module and module related manufacturing companies (consensus and DB)



Notes:

- **Consensus estimates:** aggregate consensus revenue estimates of 20 module manufacturing and module manufacturing related public companies rolls up to 29% y/y growth in 2009.
- **Consensus estimates of smaller sample size for direct comparison to DB:** aggregate consensus revenue of 13 module manufacturing and module manufacturing related public companies covered by DB rolls up to 27% y/y growth in 2009.
- **DB estimates:** aggregate DB estimates of 13 module manufacturing and module manufacturing related public companies rolls up to ~5% y/y growth in 2009.
- **DB coverage companies in analysis:** SAS, Motech, Canadian Solar, Energy Conversion Devices, Evergreen Solar, First Solar, Q-Cells, ReneSola, SunPower, SunTech, Trina Solar, MEMC Electronics, YingLi.

- **A majority of coverage companies are forecasted to have revenue declines y/y in 2009:** DB has 7 of 13 coverage companies with declning revenue y/y in 2009. The significant majority of these companies are Chinese or Taiwanese; most have little differentiation and overcommited balance sheets. Consensus estimates have 1 of 13 with declining revenue y/y in 2009.
- **Industry leaders account for positive aggregate revenue growth in 2009:** among our coverage companies, we expect industry leaders First Solar, SunPower, Q-Cells and SolarWorld to consolidate market share, and grow meaningfully y/y in 2009. These companies largely account for a modest aggregate revenue increase y/y in 2009.
- **FX:** currency exchange rates used in this analysis were as of 14 Jan 09.

Source: Deutsche Bank and First Call

Industry leaders will take a larger share of a slower growth market in 2009.

Market share dynamic: if aggregate y/y 2009 revenue growth for module related manufacturers will likely be negative, then all company estimates will likely have to come down, with some declining far more than others. We believe the segmentation of the upstream portion of the solar PV value chain into higher and lower quality companies is becoming much more pronounced. We expect this segmentation to drive market share shifts, with the higher quality companies taking a larger share of a slower growth market in 2009. Several factors are driving this dynamic.

Financiers are serving as primary gates for module company success.

- **Banks are helping to consolidate market share among solar PV companies:** we believe financiers are now, more than ever, serving as primary gates for module company success. In financing projects, banks are becoming very particular in choosing partners, assessing risk based upon a company's ability to survive over the long term. Such an assessment primarily involves the company's products, brand, business model, balance sheet, and segment participation.

- **Product risk:** established products with long field track records carry low risk. New thin film products, and thin film and c-Si products from companies without manufacturing or field related track records, for example, carry higher risk. We believe lenders are increasingly reluctant to fund projects or companies for which the products are perceived to have higher risk, and established integrator/installers are more judicious with respect to new product incorporation based upon thorough risk assessments. This could winnow the field of new products/companies getting to market, at least over the coming year, enabling established players to further consolidate market share, in a slower growth market.

- **Brand risk and channel risk:** we believe very few companies have effectively built solar PV brands. We believe those few that have (e.g. SunPower) have much more effective channel distribution strategies, and end market access (e.g. access to projects), across multiple geographies. We believe these players will have an advantage in gaining incremental market share through 2009, supporting revenue, and positioning the company for above industry growth.

We expect a downstream integration scramble by many upstream companies that will likely result in very limited success.

- **Business model risk:** we believe very few companies have long-term strategic business model plans that have been effectively executed upon. We believe companies with limited value chain exposure, particularly upstream in the value chain in which prices will fall faster than costs, and little direct downstream exposure (e.g. access to projects and reliable distribution) present higher risk profiles through the shake-out. We expect a downstream integration scramble by many upstream companies that will likely result in very limited success through 2009. This should allow strategic minded companies with more mature business models to further consolidate market share through 2009.

Balance sheet strength will be a primary determinant of who survives this shake-out.

- **Balance sheet risk:** many companies have weak and/or overcommitted balance sheets, introducing substantial liquidity risk should the shake-out linger. We believe many companies built manufacturing capacity and secured materials under the operative premise of 1H08: that "if we have silicon and can produce, all product will be sold at adequate prices to sustain capital spending, working capital needs, and support solid margins." Now, the operative premise has changed, financing conditions have become very restrictive, and financial (e.g. pre-payments, mid-term contract pricing, etc.) commitments could well become overbearing for many companies. We anticipate many companies could encounter liquidity issues in 2009, with timing based more on latitude to severely curtail capital spending, and restructure financial commitments. This too, will allow industry leaders with strong balance sheets to consolidate market share via capturing more available projects over the near term, and position them to garner even more share as demand growth accelerates later in 2009 or 2010.

- **Market segment risk:** some companies participate more effectively in particular market segments (e.g. residential, commercial, industrial), and some are equally capable of participating in several segments. Additionally, some companies participate with proven products in nascent market segments defined by technology (e.g. thin film). Very few companies have built out a global infrastructure to most effectively take advantage of a shifting geographic market. Companies that have only cursorily addressed these market segmentation issues will have a higher risk profile for capturing business, particularly as markets shift geographically. We believe SunPower has the best business model and infrastructure in this respect.

Primary differentiation now involves:
1. products (lowest LCOE),
2. balance sheet strength.

- **Differentiation involves two primary things now:** the two most important company differentiations primarily involve (1) products (i.e. lowest LCOE), and (2) balance sheets. If a company has a proven product that can offer the most competitive levelized cost of electricity (LCOE), it will have a significant advantage, particularly in project related bids (e.g. First Solar, SunPower); this will drive market share gains as the market grows, particularly for commercial and industrial/utility installations. Companies with weaker

balance sheets will more likely be dismissed from project bids due to a higher risk profile; we believe this issue is driving meaningful near-term share shifts among solar PV companies.

Production cuts by solar PV module related manufacturing companies are very asymmetrical.

- **Production cuts are asymmetrical:** production cuts by solar PV module and module related manufacturing companies are very asymmetrical. We note significant near-term (e.g. 4Q08, and likely 1Q09) production cuts, particularly from Chinese module related manufacturers, and much lesser production cuts, if any, from industry leaders. This would clearly indicate a near-term shift in market share in a slower growth market, as lower risk companies consolidate available business.
- **Third-tier players will be decimated:** we believe many third tier module suppliers, many of which are private, will likely be disproportionately decimated as the shake-out unfolds through 2009, reducing a source of marginal supply to the market. This will help rationalize supply, and allow the stronger players to consolidate this incremental market share.

System level revenue disconnect: as of mid-January, 2009 consensus revenue forecasts for publicly traded systems related companies (e.g. integrator/installers), rolled up to an aggregate y/y 2009 revenue growth forecast of 18%. If our demand forecast is anywhere near correct, this is too high. While the sample size is smaller than in the module related case, we believe the numbers are quite relevant.

- **System level revenue growth y/y in 2009:** if we assume (1) 10% MWp growth is correct in 2009, (2) there are price support mechanisms at the system level, (3) system ASPs will decline y/y at a lesser rate than module ASPs as some of the cost savings of lower module prices are passed on, and (4) geographic shifts adjust aggregate ASPs for the industry (e.g. less in high priced Spain, more in low priced German, with initial growth in higher priced Italy), we would estimate y/y aggregate revenue growth at the system level could be in a negative low-single digit percentage range. If our sample is biased toward industry leaders, we believe aggregate revenue growth y/y in 2009 could be in a low- to mid-single digit percentage range.

Aggregate y/y revenue growth estimates for publicly traded systems related companies (~18% y/y in 2009) must come down substantially.

- **Quantifying the present disconnect:** consensus estimates for nine publicly traded systems related companies (e.g. integrator/installers) roll up to ~18% y/y aggregate revenue growth in 2009. We include nine public systems related companies in Europe and the US, six of which are covered by DB. While this is not exhaustive, we do believe it is an adequate sample size to quantify and compare the disconnect between industry growth projections from company revenue forecasts (i.e. proposed revenue from installations), and demand forecasts (i.e. MWp likely to be installed). While the disconnect is less pronounced than with module related companies, we believe this 18% consensus aggregate revenue growth forecast must come down substantially to reflect reality in 2009.

Individual company revenue growth forecasts: we expect some companies to be hurt far more than others through this shake-out. Industry dynamics are driving market share shifts over the near-term, which will likely become more pronounced when industry growth recovers, provided enough production capacity exists at the leading companies.

- **The winners:** we believe industry leaders like First Solar and SunPower in our coverage universe will emerge from this shake-out with market share gains and more solid market positions. We believe these companies can grow revenue meaningfully through the shake-out years (i.e. 2009 and 2010), and will be in a position to continue to outgrow the industry when growth accelerates.
    - **Production capacity could be a gating item to share gains for differentiated companies:** we believe that production capacity will likely gate market share gain potential for leading companies whose primary business is module manufacturing

(e.g. First Solar), and will to a lesser degree gate overall share gains and revenue growth for leading companies with a strong systems related business complement (e.g. SunPower).

- **The losers:** we believe non-differentiated companies (e.g. primarily c-Si module manufacturers without a technology based advantage) with weaker balance sheets will suffer through the shake-out, with some being consolidated, and some becoming followers in the industry. We expect these companies to see revenue declines y/y in 2009, with some experiencing substantial y/y revenue declines of >>20%. We expect many of these companies to potentially lose money in 2009, and those with strained balance sheets will likely face liquidity issues.

A referendum on business models

Strategic minded companies, with clear differentiation, and strong balance sheets are faring much better, and will thrive over the long term.

The present shake-out is offering a validation or repudiation on business models: we have written on business models since we began covering the solar PV industry, pointing out what we believe would be the most resilient business models over the near-term and over the long-term. We believe the present shake-out, accelerated and potentially more severe than our prior prediction, is offering a validation or repudiation of business models. The more strategic minded companies, with clear technology and market differentiation, and conservative balance sheet management are faring much better, and we believe will thrive over the long term. The short term oriented companies, fixated on non-differentiated product manufacturing and short-term distribution, with a greater focus on speed to capacity rather than careful balance sheet management are suffering. This will intensify in 2009.

- **Module related businesses:** most component providers (i.e. those without any technology differentiation) will experience significant margin contraction over the near-term. This type of business provided the best returns in yesterday's environment when access to polysilicon defined operational success.
- **Integrated business models all the way downstream:** while system integrators will likely experience margin compression over the near-term, today's business environment is defined by access to projects and capital to finance projects. Those integrator/installers with access to end markets (i.e. projects) will fare far better. And those integrator installers with ownership of or access to technology that enables the lowest LCOE will fare best of all.

The cost of energy is the most important metric: the ultimate metric of competitiveness is LCOE; module cost per watt is an important input, but rather dictates what kind of business model is most appropriate for a company's competitiveness in certain business environments. In short, if a company makes only solar PV modules, then being the low cost module manufacturer is an imperative to compete over the long term. If a company controls the value chain to the end user, then it is not imperative to be the low cost module manufacturer provided the company's technology enables adequate cost to be extracted further down the value chain.

Varying degrees of vertical integration help to varying degrees: the more of the value chain a company owns as the value chain compresses, the more latitude the company will have in reducing costs, trying to keep pace with declining prices. The degree to which vertical integration to the end user is required is best illustrated by two industry leaders:

If a company makes only solar PV modules, then being the low cost module manufacturer is an imperative to compete over the long term.

- **Low cost module manufacturer (i.e. thin film):** First Solar relies on technology to be the lowest cost (by a wide margin) manufacturer of solar PV modules, and has historically ended its ownership of the value chain at the module. With such a business model First Solar can effectively compete "discretely" with clear leadership, and a clear long-term competitive advantage in a particular portion of the value chain. It is not imperative that the company own the downstream portion of the value chain, since First Solar's cost structure and pricing latitude offer the company substantial leeway in an

industry shakeout. Furthermore, First Solar Electric positions the company to more aggressively move downstream with the design and sale of systems, and eventually energy, and enables the company to more effectively open the utility market.

If a company controls the value chain to the end user, it is not imperative to be the low cost module producer provided the company's technology enables more cost to be extracted further down the value chain.

- **High cost module manufacturer (i.e. crystalline silicon):** SunPower relies on technology to give it competitive module costs (but hardly close to First Solar's), but owns the downstream portion of the value chain with which it can capture substantial cost savings unavailable to lower conversion efficiency technology approaches (i.e. First Solar's CdTe). SunPower's vertical integration to the end user via PowerLight gives the company cost reduction latitude through the BOS and installation/integration portions of the value chain, something required to offset the higher cost of c-Si modules. Furthermore, the company's ownership of the value chain all the way to the end customer allows it to sell energy rather than simply modules and systems, allowing the company to participate aggressively in what we believe will become the most economically attractive portion of the value chain over the long-term.

We expect a near-term scramble to adjust business models will be less than successful: we believe several upstream manufacturing companies that lack downstream ownership of the value chain will try to integrate downstream via acquisitions, joint ventures (e.g. as with SunTech and MMA Renewable Ventures), or directly. We believe that most of these efforts will meet with very limited success over the near-term as many of these companies do not have adequate capital to fund operations and pursue acquisitions (i.e. weak or overextended balance sheets), and capital is not readily available from the capital markets or elsewhere, and strong downstream players will likely block (either directly or indirectly) efforts to do so. Furthermore, banks (lenders) will likely have a forceful say in which companies succeed and which do not considering banks' decision making influence on project finance and company expansion plans (i.e. which companies and projects will get financed).

Selling energy in the commercial market should maximize profitability over the long term.

Solar PV is a commodity, but there should be areas of strong profitability: ultimately, we believe a company must sell energy in the commercial market to maximize profitability over the long term, and if a company owns a cell technology that minimizes LCOE, all the better. The two companies in our coverage universe that epitomize this are SunPower and First Solar.

The greatest returns will ultimately derive from selling energy on a commercial (not utility) scale in a distributed model.

- **Energy business:** we believe that the greatest returns will ultimately derive from selling energy on a commercial (not utility) scale in a distributed model. As the price of solar PV generated electricity falls below average grid costs, the return on a long term power provisioning agreement in the absence of incentives is largely a function of the widening spread between cheaper solar PV electricity and more expensive grid electricity. When grid parity is reached, returns on this business should eclipse those of the component/system business in potentially all cases, with an improving return structure as the spread widens.

Valuation framework

Solar PV company stock valuation

Our long term outlook for the solar PV industry remains very strong. We believe ongoing market events have helped drive a rapid re-rating of valuation in the solar PV space. And, we believe that in light of ongoing credit market events, the market is more emphatically discounting the solar PV industry shake-out that began in 4Q08. We have consistently cautioned that investor perceptions may change suddenly regarding what future growth potential is worth based upon capital market conditions; this applies to even the highest quality companies in the space.

The changing environment

Investor perception has changed substantially over the past few months. Current solar PV stock valuations reflect more deterioration in macroeconomic conditions with the most proximate systemic shock administered by the credit markets, with the conclusion that going forward, capital access will remain difficult, capital velocity will slow, and capital costs will rise as risk premiums more closely reflect reality.

While we have evolving indications, what is not clearly quantified yet is how exactly this changed environment will impact end-demand, specific company business models, long-term industry growth, and ultimately individual stock valuations. We believe that what is imputed in current solar PV stock valuations however, is a sweeping conclusion that industry economics will drive an accelerated shake-out period through 2009, incorporating a multivariable impact from rising capital costs, project push-outs/cancellations, sharper ASP declines, currency fluctuations, restricted capital market access, and declining fossil fuel costs to name the primary ones, which could result in lower revenue growth profiles, margin compression, lower profits, and lower valuation multiples.

With these generic conclusions as a background, we note that the impact on individual companies will vary widely, and that high quality companies will not only be impacted less, but will likely be able to strengthen market positions via competitive differentiation of product, value chain participation, size/scale, business models, balance sheet strength, operational execution track record, and geographic and market segment diversity.

Assessing a changing environment

Some would argue that equity prices appear cheap in general; however, they remain expensive relative to credit. The question is how will this disparity get resolved – will the credit markets heal so stocks rally and be at levels seen before? (unlikely), or will equities correct further to reflect the lower availability and higher price of credit? (possibly), or will there be a combination of the two to drive equilibrium? (more likely). At the moment, we do not know. However, it would not be unreasonable to assume that capital allocation and the cost of capital will be more rational with a healthy appreciation for risk across all asset classes in today's credit contraction environment.

We are not changing our valuation methodology, but are trying to better incorporate the broader reality of new economic conditions under which solar PV industry must now operate. We have previously stated that in valuing stocks in an emerging high growth industry such as solar PV, it is often difficult to place much relevance on historical valuation metrics in the absence of comparables, the existence of typically only small, new entrants, evolving business models, and industry and market segment volatility.

While noting significant volatility in valuation metrics, we have also outlined that growth can justify higher multiples and that the substantial anticipated growth rate of the solar PV industry (i.e. ~20% to 50% CAGR) can justify higher valuation multiples for companies with the operational and financial performance to deliver commensurate with the underlying industry numbers. Furthermore, we postulated that P/E multiples approaching or exceeding 30x forward estimates might be reasonable in the early stages of an industry growth phase; we used the early, higher growth phase and subsequent maturation of the semiconductor industry as a potential comparable for valuation purposes (e.g. the semiconductor industry typically maintained a mid to high 20s P/E multiple through the higher growth years of the early to mid 1990s for industry leaders, compressing to well under 20x post the 2000 bubble as industry maturity was discounted).

Reasonable forward P/E multiples may be ~20x for the highest quality industry leaders, and <10x for solid followers.

In incorporating the broader economic reality, driven largely and centered around the present capital malaise (that will not be easy to shake off), we believe it is appropriate to acknowledge what might be an "accelerated maturation" of the industry, and re-rate multiples for solar PV industry companies. While it is much too soon to declare the solar PV industry mature (it quite clearly is not), we have to be realistic in incorporating vital macroeconomic and capital market inputs, even more so in an industry that has yet to achieve stand-alone economic viability. Suffice it to say, recent events have warranted a re-rating of valuation, and we are inclined to value the highest quality solar PV company stocks in a ~20x range of forward EPS (rather than the 20x to 30x plus range we had previously used), below the semiconductor industry during its growth phase in the early to mid 1990s to account for the deteriorating macro-economic environment. More broadly, we would argue that non-differentiated companies that do not appear to have liquidity worries later in 2009 or 2010 should trade in a high single digit to low double digit range on forward EPS. This helps reflect new operating environment realities, and has precedent in a prior high growth, technology focused industry.

Coverage companies and estimates

Coverage companies and estimates: we are adjusting our C2009 estimates for solar PV sector coverage companies to be consistent with our 2009 industry outlook and company positioning assessments.

Figure 29: Summary of changes to coverage solar PV and solar PV related companies

	Rating	Price target ($)		C2009E DB Old	C2009E DB New	C2009E Consensus	C2010E DB New	C2010E Consensus
CSIQ	Hold	$7	Revenue ($M)	731	**621**	949	**910**	1,424
			EPS ($)	0.30	**(0.12)**	0.40	**1.00**	1.82
ENER	Hold	$35	Revenue ($M)	634	**479**	565	**726**	~800
			EPS ($)	2.48	**1.73**	2.18	**2.76**	~3.50
ESLR	Hold	$4	Revenue ($M)	364	**300**	384	**482**	587
			EPS ($)	0.07	**0.04**	0.20	**0.30**	0.51
FSLR	Hold	$160	Revenue ($M)	2,003	**1,868**	1,996	**2,561**	2,660
			EPS ($)	6.77	**6.45**	7.02	**8.15**	8.94
SPWR	Hold	$45	Revenue ($M)	1,900	**1,748**	1,946	**2,402**	2,775
			EPS ($)	2.45	**2.25**	2.82	**3.15**	3.73
AMAT	Hold	$8.50	Revenue ($M)	5,127	**5,127**	5,911		
			EPS ($)	0.08	**0.08**	0.30		
WFR	Buy	$18.50	Revenue ($M)	1,615	**1,615**	1,817	**1,876**	2,176
			EPS ($)	2.30	**2.30**	2.41	**2.75**	2.86

Notes:

- **ENER:** we have adjusted our price target from $41 to $35. C2010 consensus estimates include estimates for C4Q10 numbers which are not included in First Call numbers.
- **ESLR:** we have adjusted our price target from $7 to $4.
- **AMAT:** we include our recently updated estimates for Applied Materials, adjusted on 7 Jan 09.
- **WFR:** we include our recently updated estimates for MEMC Electronics, adjusted on 18 Dec 08.
- 2010 aggregate y/y revenue growth for solar PV coverage companies is 35% as per DB estimates versus 45% y/y MWp growth and a ~12% average annual y/y ASP decline in 2010. 2010 consensus growth off of what we believe are more realistic 2009 numbers is too high.

Source: Deutsche Bank and First Call

Canadian Solar (CSIQ, Hold, $7 price target)

We maintain our hold rating and $7.00 price target on CSIQ.

Severe conditions crush performance outlook: Canadian Solar (CSI) reported 3Q08 revenue in line with expectations, but fell short on EPS due to foreign exchange adjustments from a sharply lower Euro. Noting the present credit crisis, resultant demand destruction, and what we believe are market share shifts, CSI guided 4Q08 revenue down sharply, driven by lowered production and significant ASP declines.

The rapid deterioration in the credit markets, and a sharp inversion in the $/Euro has led to an abrupt over-supply condition and an accelerated module ASP decline. As a low margin player in a competitive industry, we expect CSI will struggle over the near term with ASP declines outpacing cost declines, and much lower production into early 2009. Should conditions persist, and market share shifts materialize in a lower growth industry environment, we anticipate cash constraints could begin to hinder the company's operational flexibility.

We are lowering our 2009 EPS estimate for CSIQ to ($0.12) from $0.30.

Lowering estimates: consistent with our 2009 solar PV industry outlook, we are lowering our revenue and EPS estimates for CSI to reflect a more difficult near-term environment.

- **C2009 revenue and EPS estimates:** our new revenue and earnings estimates for C2009 are $621M and ($0.12), down from our previous estimates of $731M and $0.30, respectively. Consensus estimates are $949M and $0.40.

Our 2010 EPS estimate for CSIQ is $1.00.

- **C2010 revenue and EPS estimates:** our new revenue and earnings estimates for C2010 are $910M and $1.00, respectively. Consensus estimates are $1,424M and $1.82

Valuation: maintain Hold rating, $7 price target: CSI is a smaller, upstream solar PV company, ramping production capacity in a highly competitive industry; the company is in need of capital to fund planned expansions amidst a credit contraction environment. We estimate the company will post a modest loss in 2009, and therefore value the stock at $7 or ~1.1x our TBV estimate of ~$6.30, in line with smaller cap peers.

- **Solar PV company valuation metrics:** keeping in mind deterioration in both the macroeconomic and solar PV industry landscapes, and the resultant re-rating of valuation, we are inclined to value the highest quality solar PV company stocks in a ~15x to ~20x range of forward EPS, below the semiconductor industry (i.e. ~20x to ~30x) during its growth phase in the early to mid 1990s. More broadly, we would argue that non-differentiated companies that do not appear to have liquidity worries later in 2009 or 2010 should trade in a high single digit to low double digit range on forward EPS. This helps reflect new operating environment realities, and has precedent in a prior high growth, technology focused industry. While we primarily focus on P/E, we look to other measures such TEV/Sales, TEV/EBITDA, P/TBV and DCF as checks. In the absence of earnings we use TBV, setting a base valuation reference point in a ~1.0x to ~1.5x TBV range depending on the quality of operations, balance sheet strength, and recovery potential justifying a premium, or a discount within the range.

Company specific risks - upside risks include: (1) a rapid demand rebound, (2) minimal ASP declines, (3) a weakening U.S. dollar, and (4) more favorable policy and incentive programs. **Downside risks** include (1) gauging end demand for company products amidst industry demand destruction, (2) rapid ASP declines/high input costs dislocating business model assumptions, (3), capital constraints hindering operational flexibility, and (4) managing currency dislocations. **Industry risks** include (1) government subsidization and policy changes, (2) a shift in the competitive landscape and market share shifts, (3) time to commercialization of technologies and applications, (4) the rate of solar PV progression toward grid price parity, (5) concrete metrics and perception regarding competing and non-competing energy sources, (6) potential value chain margin compression as the solar PV industry matures, and (7) general economic risk.

Energy Conversion Devices (ENER, Hold, $35 price target)

We maintain our Hold rating on ENER and adjust our price target to $35.

Solid execution and market focus position the company better: Energy Conversion Devices reported F1Q09 (Sep) results modestly ahead of expectations, guided F2Q09 (Dec) similarly, and kept F2009 guidance largely unchanged. We believe ECD's unique products, solid operational execution, and focus on the rooftop market (with smaller projects facing less financing difficulty) position it better in overcoming the impact of the credit crisis and industry demand destruction, but can hardly render the company immune. ECD did report cancellations and postponements due to customer credit issues, but was able to re-allocate near-term shipments to other customers at comparable terms. Like most other players in the industry, ECD is in an aggressive capacity expansion mode, but unlike some it has the advantage of adequate cash on its balance sheet to fund the expansion, strong order backlog (i.e. ~$2.0B, with $1.6B under take or pay agreements) to help navigate a difficult market environment, and the potential for further growth based on market expansion for its BIPV solar PV products. However, given the combined dynamic of demand destruction and sharp ASP declines looking into 2009, we are cautious on near-term prospects for the solar PV industry, and believe the near-term dynamic will not leave ECD unscathed.

We are lowering our 2009 EPS estimate for ENER to $1.75 from $2.48.

Lowering estimates: consistent with our 2009 solar PV industry outlook, we are lowering our revenue and EPS estimates for Energy Conversion Devices to reflect a more difficult near-term environment.

- **C2009 revenue and EPS estimates:** our new revenue and earnings estimates for C2009 are $479M and $1.75, down from our previous estimates of $634M and $2.48, respectively. Consensus estimates are $566M and $2.17.
- **C2010 revenue and EPS estimates:** our new revenue and earnings estimates for C2010 are $726M and $2.76. Consensus estimates are ~$800M and ~$3.50 (we note there are no C4Q10 consensus estimates in First Call).

Valuation: maintain Hold rating, lowering price target to $35 from $41: ECD has a comparatively strong technology and market position, and is rapidly transitioning to sustainable profitability, with future potential from new technologies/IP (e.g. PRAM), offset partially by a receding inconsistent financial history and very aggressive capacity ramp, we value the stock at $35 or ~20x our ongoing C2009 EPS estimate of $1.75, consistent with what we believe is appropriate for higher quality solar PV company stocks.

- **Solar PV company valuation metrics:** keeping in mind deterioration in both the macroeconomic and solar PV industry landscapes, and the resultant re-rating of valuation, we are inclined to value the highest quality solar PV company stocks in a ~15x to ~20x range of forward EPS, below the semiconductor industry (i.e. ~20x to ~30x) during its growth phase in the early to mid 1990s. More broadly, we would argue that non-differentiated companies that do not appear to have liquidity worries later in 2009 or 2010 should trade in a high single digit to low double digit range on forward EPS. This helps reflect new operating environment realities, and has precedent in a prior high growth, technology focused industry. While we primarily focus on P/E, we look to other measures such TEV/Sales, TEV/EBITDA, P/TBV and DCF as checks. In the absence of earnings we use TBV, setting a base valuation reference point in a ~1.0x to ~1.5x TBV range depending on the quality of operations, balance sheet strength, and recovery potential justifying a premium, or a discount within the range.

Company specific risks - upside risks include: (1) a rapid demand rebound, (2) minimal ASP declines, (3) a weakening U.S. dollar, and (4) more favorable policy and incentive programs. **Downside risks** include (1) gauging end demand for company products amidst industry demand destruction, (2) cancellation or postponement of customer orders/shipments, (3) operational execution missteps in capacity expansion, (4) ASP pressure. **Industry risks** include (1) government subsidization and policy changes, (2) a shift in the competitive landscape and market share shifts, (3) time to commercialization of technologies and

applications, (4) the rate of solar PV progression toward grid price parity, (5) concrete metrics and perception regarding competing and non-competing energy sources, (6) potential value chain margin compression as the solar PV industry matures, and (7) general economic risk.

Evergreen Solar (ESLR, Hold, $4 price target)

We maintain our Hold rating on ESLR and adjust our price target to $4.

Waiting on the Devens ramp; capital constraints may limit future expansion: Evergreen Solar's 3Q08 results fell short of guidance as the company's Devens facility production ramped a bit slower than expected, and an incremental cost drag points to higher losses in 4Q08, and pushes out profitability to 2H09. The Devens production ramp is the key for the company to be commercially viable as it begins to satisfy 1GWp of contracts worth ~$3B. Despite an aggressive revenue production ramp through 2009, we believe the company's business model still faces meaningful risk as we expect the company to be barely profitable in 2009, with negative FCF for quite some time, compounded by uncertainty with respect to demand destruction on company delivery schedules, and ASPs. We believe the company may need to tap the capital markets for as much as ~$400M in 2009 to fund capacity expansion plans should the Ever-Q JV IPO not materialize. Furthermore, the 30M incremental share base (causing ~25% dilution) arising from the Lehman Brothers bankruptcy simply frustrated matters.

We are lowering our 2009 EPS estimate for ESLR to $0.04 from $0.07.

Lowering estimates: consistent with our 2009 solar PV industry outlook, we are lowering our revenue and EPS estimates for Evergreen Solar to reflect a more difficult near-term environment.

- **C2009 revenue and EPS estimates:** our new revenue and earnings estimates for C2009 are $300M and $0.04, down from our previous estimates of $364M and $0.07, respectively. Consensus estimates are $384M and $0.20.

We are lowering our 2010 EPS estimate for ESLR to $0.30 from $0.55.

- **C2010 revenue and EPS estimates:** our new revenue and earnings estimates for C2010 are $482M and $0.30, down from our previous estimates of $681M and $0.55, respectively. Consensus estimates are $587M and $0.51.

Valuation: maintain Hold rating, lowering price target to $4 from $7: noting Evergreen's comparatively weaker market and financial position and a lack of earnings, offset partially by a potential technology/cost advantage, and accelerated progress toward independent production, we value the stock on a TBV metric. Given difficult capital market conditions, and Evergreen's potential need to tap credit lines/capital markets in 2009 in order to ramp production capacity in an on-going credit contraction environment, we assign roughly an in-line (with smaller cap solar PV peers) TBV multiple of ~1.2x TBV of $3.40 to arrive at our $4 price target.

- **Solar PV company valuation metrics:** keeping in mind deterioration in both the macroeconomic and solar PV industry landscapes, and the resultant re-rating of valuation, we are inclined to value the highest quality solar PV company stocks in a ~15x to ~20x range of forward EPS, below the semiconductor industry (i.e. ~20x to ~30x) during its growth phase in the early to mid 1990s. More broadly, we would argue that non-differentiated companies that do not appear to have liquidity worries later in 2009 or 2010 should trade in a high single digit to low double digit range on forward EPS. This helps reflect new operating environment realities, and has precedent in a prior high growth, technology focused industry. While we primarily focus on P/E, we look to other measures such TEV/Sales, TEV/EBITDA, P/TBV and DCF as checks. In the absence of earnings we use TBV, setting a base valuation reference point in a ~1.0x to ~1.5x TBV range depending on the quality of operations, balance sheet strength, and recovery potential justifying a premium, or a discount within the range.

Company specific risks - upside risks include: (1) a rapid demand rebound, (2) minimal ASP declines, (3) a weakening U.S. dollar, and (4) more favorable policy and incentive programs. **Downside risks** include (1) gauging end demand for company products amidst industry

demand destruction, (2) rapid ASP declines/high input costs dislocating business model assumptions, (3), capital constraints hindering operational flexibility, (4) operational execution missteps. **Industry risks** include (1) government subsidization and policy changes, (2) a shift in the competitive landscape and market share shifts, (3) time to commercialization of technologies and applications, (4) the rate of solar PV progression toward grid price parity, (5) concrete metrics and perception regarding competing and non-competing energy sources, (6) potential value chain margin compression as the solar PV industry matures, and (7) general economic risk.

First Solar (FSLR, Hold, $160 price target)

We maintain our Hold rating on FSLR and our price target of $160.

A well reasoned, tempered outlook for 2009: First Solar delivered 3Q08 results ahead of expectations, guided 4Q08 modestly higher, and guided 2009 ahead of expectations after offering a lengthy risk assessment and a conservative outlook. The company has expanded its market reach (both geographically and by market segment) in Europe and the US, and is one of two companies opening up the utility scale market in the US. As a clear industry leader, with long-term, sustainable competitive advantages, we expect First Solar to increase market share through the shake-out, and subsequently. With a realistic assessment of 2009 based on the impact of the credit crunch and industry demand destruction, we believe First Solar is better positioned than any other solar PV company (e.g. products, balance sheet, markets) to weather the growing storm. We expect the company to significantly outperform through the shake-out.

We are adjusting our 2009 EPS estimate for FSLR to $6.45 from $6.77.

Lowering estimates: consistent with our 2009 solar PV industry outlook, we are adjusting our revenue and EPS estimates for First Solar to reflect a more difficult near-term environment.

- **C2009 revenue and EPS estimates:** our new revenue and earnings estimates for C2009 are $1,868M and $6.45, down from our previous estimates of $2,003M and $6.77, respectively. Consensus estimates are $1,996M and $7.02.

We are adjusting our 2010 EPS estimate for FSLR to $8.15 from $9.15.

- **C2010 revenue and EPS estimates:** our new revenue and earnings estimates for C2010 are $2,561M and $8.15, down from our previous estimates of $2,955M and $9.15, respectively. Consensus estimates are $2,660M and $8.94.

Valuation: maintain Hold rating, $160 price target: as a rapidly growing thin film based solar PV module supplier with over ~2/3^{rds} of projected capacity already under long-term contract, coupled with more attractive fundamentals (e.g. long-term module cost per watt and LCOE advantage, positive operating cash flow, and a strong balance sheet), and a track record of solid execution, offset by deteriorating industry and macroeconomic fundamentals, First Solar is clearly a leading solar PV company and deserves a premium valuation to peers. With an earnings growth rate projected at ~40% over the next few years, we value FSLR at ~24x our C2009 EPS estimate to arrive at our $160 price target.

We recognize that a >20x multiple on C2009 EPS may appear rich considering capital market conditions, and the premium to our valuation range but we believe Fist Solar's fundamentals warrant some leeway at least in the near term. We believe First Solar's premium valuation can be justified based upon a faster growth profile, a clear, long-term competitive advantage, and a higher margin structure. Alternatively, we note that our $160 price target equates to ~20x our C2010 EPS of $8.15, and believe that fundamentals (and hence forecasts) are more predictable for First Solar through 2010 than probably any other solar PV company.

- **Solar PV company valuation metrics:** keeping in mind deterioration in both the macroeconomic and solar PV industry landscapes, and the resultant re-rating of valuation, we are inclined to value the highest quality solar PV company stocks in a ~15x to ~20x range of forward EPS, below the semiconductor industry (i.e. ~20x to ~30x) during its growth phase in the early to mid 1990s. More broadly, we would argue that

non-differentiated companies that do not appear to have liquidity worries later in 2009 or 2010 should trade in a high single digit to low double digit range on forward EPS. This helps reflect new operating environment realities, and has precedent in a prior high growth, technology focused industry. While we primarily focus on P/E, we look to other measures such TEV/Sales, TEV/EBITDA, P/TBV and DCF as checks. In the absence of earnings we use TBV, setting a base valuation reference point in a ~1.0x to ~1.5x TBV range depending on the quality of operations, balance sheet strength, and recovery potential justifying a premium, or a discount within the range.

Company specific risks - upside risks include: (1) a rapid demand rebound, (2) minimal ASP declines, (3) a weakening U.S. dollar, (4) acceleration of utility scale solar PV implementation in the US, and (5) more favorable policy and incentive programs. **Downside risks** include (1) gauging end demand for company products amidst industry demand destruction, (2) rapid ASP declines, (3) a relatively narrow customer base, and (4) operational execution missteps. **Industry risks** include (1) government subsidization and policy changes, (2) a shift in the competitive landscape and market share shifts, (3) time to commercialization of technologies and applications, (4) the rate of solar PV progression toward grid price parity, (5) concrete metrics and perception regarding competing and non-competing energy sources, (6) potential value chain margin compression as the solar PV industry matures, and (7) general economic risk.

SunPower (SPWRA, Hold, $45 price target)

We maintain our Hold rating on SPWRA and our price target of $45.

4Q08 and C2009 guidance revised; ITC passage should help: SunPower reported 3Q08 results ahead of expectations, but then lowered guidance for both 4Q08 and C2009 citing currency and currency hedging related issues; the company's recent hedging strategy and disclosure may have dented the company's reputation somewhat. Nonetheless, we believe SunPower is the solar PV industry's silicon-based technology leader, with the financial strength, business model, and execution ability to gather market share through the shake-out and beyond. We believe SunPower is the only solar PV company other than First Solar that can offer industry leading, utility scale competitive LCOE solutions. While no company is immune from the impact of the credit crisis and industry demand destruction, we believe SunPower is much better insulated against it. Furthermore, we expect the recent passage of an expanded US Federal Investment Tax Credit (ITC) late last year with (1) the removal of the residential ITC cap, (2) allowing utilities to use the ITC, and (3) enabling provisioning against the AMT, coupled with speculation regarding upcoming Obama administration initiative on alternate energy to benefit SunPower more than most. We expect the company to outperform through the shake-out.

We are adjusting our 2009 EPS estimate for SPWRA to $2.25 from $2.45.

Lowering estimates: consistent with our 2009 solar PV industry outlook, we are adjusting our revenue and EPS estimates for SunPower to reflect a more difficult near-term environment.

- **C2009 revenue and EPS estimates:** our new revenue and earnings estimates for C2009 are $1,748M and $2.25, down from our previous estimates of $1,900M and $2.45, respectively. Consensus estimates are $1,946M and $2.82.

We are adjusting our 2010 EPS estimate for SPWRA to $3.15 from $3.64.

- **C2010 revenue and EPS estimates:** our new revenue and earnings estimates for C2010 are $2,402M and $3.15, down from our previous estimates of $2,535M and $3.64, respectively. Consensus estimates are $2,775M and $3.73.

Valuation: maintain Hold rating, $45 price target: SunPower is the solar PV industry's crystalline silicon technology leader (i.e. highest conversion efficiency and lowest LCOE). The company has a solid operational track record (profitable and positive operating cash flow), is backed by long-term polysilicon supply contracts and a strong demand outlook compared to most, and a deeper ownership of the solar PV value chain. This is partially offset by deteriorating industry and macroeconomic fundamentals. Consequently, we believe SunPower can command a premium to the broader group. With an earnings growth rate

projected at ~30% over the next few years, we value the stock at $45 or ~20x our ongoing C2009 EPS estimate of $2.25, at the upper-end of our valuation range for high quality solar PV company stocks. Alternatively, we note that our $45 price target equates to ~14x our C2010 EPS of $3.12.

- **Solar PV company valuation metrics:** keeping in mind deterioration in both the macroeconomic and solar PV industry landscapes, and the resultant re-rating of valuation, we are inclined to value the highest quality solar PV company stocks in a ~15x to ~20x range of forward EPS, below the semiconductor industry (i.e. ~20x to ~30x) during its growth phase in the early to mid 1990s. More broadly, we would argue that non-differentiated companies that do not appear to have liquidity worries later in 2009 or 2010 should trade in a high single digit to low double digit range on forward EPS. This helps reflect new operating environment realities, and has precedent in a prior high growth, technology focused industry. While we primarily focus on P/E, we look to other measures such TEV/Sales, TEV/EBITDA, P/TBV and DCF as checks. In the absence of earnings we use TBV, setting a base valuation reference point in a ~1.0x to ~1.5x TBV range depending on the quality of operations, balance sheet strength, and recovery potential justifying a premium, or a discount within the range.

Company specific risks - upside risks include: (1) a rapid demand rebound, (2) minimal ASP declines, (3) a weakening U.S. dollar, (4) acceleration of utility scale solar PV implementation in the US, and (5) more favorable policy and incentive programs. **Downside risks** include (1) gauging end demand for company products amidst industry demand destruction, (2) rapid ASP declines, (3) operational execution missteps, (4) managing currency hedges, and (5) the lumpy nature of the company's systems business (and business model). **Industry risks** include (1) government subsidization and policy changes, (2) a shift in the competitive landscape and market share shifts, (3) time to commercialization of technologies and applications, (4) the rate of solar PV progression toward grid price parity, (5) concrete metrics and perception regarding competing and non-competing energy sources, (6) potential value chain margin compression as the solar PV industry matures, and (7) general economic risk.

We maintain our Hold rating on AMAT and our price target of $8.50.

Applied Materials (AMAT, Hold, $8.50 price target)

We already reviewed Applied Materials as part of our 6 Jan 09 semiconductor capital equipment piece *"SCE industry outlook getting stormier,"* which included our estimate and price target adjustments. In that piece we addressed our view of a meaningful moderation from prior growth expectations in the company's solar PV business.

Solar PV business likely to fall short of expectations in 2009: Applied entered the solar photovoltaic (PV) market with the acquisition of Applied Films for $464M in Jul-06, followed by the acquisitions of HCT Shaping Systems (wire saws) for ~$475M in Aug-07, and Baccini (screen printers and testers) for Euro 330M in Jan-08. HCT and Baccini serve the crystalline silicon (c-Si) solar PV markets, and have proven to be solid acquisitions. However, a high profile effort has been Applied's turnkey offering for thin film amorphous silicon (α-Si) solar PV module manufacturing on Gen 8+ size glass. While we anticipate slowing from prior expectations in 2009 in crystalline silicon related businesses as the solar PV industry wrestles with an overcapacity situation, we anticipate an even less sanguine outlook for the company's (α-Si) business. While expectations for this business in 2009 have come down substantially from previously lofty levels, we anticipate that expectations and shipments will likely come down further as large projects (e.g. Best Solar and potentially Moser Baer) revamp capacity expansion plans, pushing anticipated deliveries out beyond 2009.

- **Solar PV business revenue streams:** we believe HCT is presently running at a revenue run-rate of ~$200M/year with ~mid-30% gross margins, and Baccini is presently running above that level. When including other c-Si equipment and related business, we believe revenue from the c-Si component of Applied's solar PV business could be running at close to $700M/year with ~low-30% gross margins. However, we believe the

accelerating solar PV industry downturn could weigh on this segment, pressuring backlog and margins through 2009. Lastly, we believe that Applied will recognize several more SunFab lines in 2009, but not likely near the number of lines anticipated several months ago.

Maintaining lowered estimates: we lowered our revenue and EPS estimates for Applied Materials as part of our SCE industry review on 6 Jan 09 *"SCE industry outlook getting stormier,"* to reflect weakening conditions in the semiconductor, flat panel display and solar PV industries.

Our C2009 EPS estimate for AMAT is $0.08 versus consensus estimates of $0.27.

- **C2009 revenue and EPS estimates:** our revenue and earnings estimates for C2009 are $5,127M and $0.08, respectively. Consensus estimates are $5,558M and $0.27.

Valuation: Maintain Hold rating; $8.50 price target: Applied Materials is the industry leader with a broad product and technology portfolio. Considering the ongoing cyclical SCE downturn, compounded by an flat panel display (FPD) industry downturn and slowing growth in the solar PV industry, further exacerbated by global macroeconomic deterioration, we maintain our Hold rating on the stock, and value AMAT at ~2.0x TBV (i.e. $4.30), or ~$8.50

- **SCE company valuation metrics:** given that Applied is largely a SCE company we believe that a range of ~13x to ~20x forward EPS could apply in future upturns, with market share gainers garnering the upper end of the range. In downturns a range of ~1.0x to ~2.0x TBV could apply with quality of operations, balance sheet strength, and recovery potential justifying a premium or a discount within the range.

Company specific risks - upside risks include (1) an acceleration in technology upgrade cycles, (2) stronger than anticipated trough spending levels in logic, foundry, or both, and (3) a recovery in non-SCE businesses (i.e. solar PV or FPD). **Downside risks** include (1) a longer and deeper downturn in memory, (2) market share losses, (3) continued weakness in the FPD segment, and (4) further delays in solar PV projects. **General risks** include (1) government subsidization and policy changes, (2) a shift in the competitive landscape and market share shifts, (3) time to commercialization of technologies and applications, (4) and general economic risk

MEMC Electronic Materials (WFR, Buy, $18.50 price target)

We maintain our Buy rating on WFR and our price target of $18.50.

Near-term fundamental deterioration is severe: MEMC Electronics reported 3Q08 results largely in-line with lowered guidance, and guided 4Q08 below consensus estimates. As the quarter progressed the company's CEO resigned, and it twice revised 4Q08 guidance lower citing (1) further deterioration in semiconductor and solar PV markets, (2) risk associated with some semiconductor customers potentially canceling booked business for delivery in 4Q08, and (3) some solar PV customers potentially being unable to meet purchase conditions for shipment of product. We believe semiconductor and solar PV fundamentals could well trough in 1H09, and anticipate 1H09 will likely be worse than expectations for both industries, and 2H09 could be better than expectations for the solar PV industry, but not necessarily for the semiconductor industry, pending the modest return of project financing by mid-09. We believe this could arrest downward estimates revisions for MEMC in early 2009. With a strong balance sheet, strong cash flow, and solid market positioning, we continue to believe there is opportunity for MEMC share price appreciation over the longer term (hence our Buy rating) from present levels, but over the short term, however, we see few catalysts.

Maintaining lowered estimates: we lowered our revenue and EPS estimates for MEMC Electronic Materials following the company's twice revised 4Q08 guidance in mid-December, largely reflecting our conservatism with respect to weak conditions prevailing in the semiconductor business, and distressed conditions emerging in the polysilicon/solar wafer business.

- **C2009 revenue and EPS estimates:** our revenue and earnings estimates for C2009 are $1,615M and $2.30, respectively. Consensus estimates are $1,817M and $2.41.

Our C2010 EPS estimate for WFR is $2.75 versus consensus of $2.86.

- **C2010 revenue and EPS estimates:** our revenue and earnings estimates for C2010 are $1,876M and $2.75, respectively. Consensus estimates are $2,176M and $2.86.

Valuation: maintain Buy rating, $18.50 price target: we value WFR at ~8x our C2009 EPS estimate of $2.30 equating to ~$18.50. This is below the ~13x to ~20x multiple range we use for semiconductor materials companies to adjust for recent operational execution issues and severely weakening fundamentals, and places a trough valuation on the company as a commodity producer (polysilicon/wafers). While we anticipate longer-term revenue and earnings growth can be comparably healthy, we believe a couple quarters of solid execution and expectations management will likely be required to restore confidence and enable multiple expansion.

- **Solar PV company valuation metrics:** keeping in mind deterioration in both the macroeconomic and solar PV industry landscapes, and the resultant re-rating of valuation, we are inclined to value the highest quality solar PV company stocks in a ~15x to ~20x range of forward EPS, below the semiconductor industry (i.e. ~20x to ~30x) during its growth phase in the early to mid 1990s. More broadly, we would argue that non-differentiated companies that do not appear to have liquidity worries later in 2009 or 2010 should trade in a high single digit to low double digit range on forward EPS. This helps reflect new operating environment realities, and has precedent in a prior high growth, technology focused industry. While we primarily focus on P/E, we look to other measures such TEV/Sales, TEV/EBITDA, P/TBV and DCF as checks. In the absence of earnings we use TBV, setting a base valuation reference point in a ~1.0x to ~1.5x TBV range depending on the quality of operations, balance sheet strength, and recovery potential justifying a premium, or a discount within the range.
- **SCE company valuation metrics:** for SCE and materials companies we believe that a range of ~13x to ~20x forward EPS could apply in future upturns, with market share gainers garnering the upper end of the range. In downturns a range of ~1.0x to ~2.0x TBV could apply with quality of operations, balance sheet strength, and recovery potential justifying a premium or a discount within the range.

Company specific risks – downside risks include (1) polysilicon pricing, (2) investments to ramp polysilicon capacity in anticipation of shortages several years in the future, (3) risks tied to ongoing IP litigation, (4) operational execution missteps with capacity ramps and solar wafer contracts, and (5) potential risk to existing solar wafer contracts. **Industry risks** include: (1) a high degree of IC industry cyclicality, (2) a slowing in the secular growth rate of the solar PV industry, (3) competitive pressures and market share shifts, (4) a change in the polysilicon supply/demand dynamic, (5) delayed adoption of new technologies, and (6) general economic risk.

Final comment on stocks and the industry

Long-term bullish; near-term brutality: solar PV generated electricity represents a clean, distributed, virtually inexhaustible energy source that is presently economical with subsidization, and should reach stand-alone economic viability within four to six years. We believe the present industry oversupply dynamic, brutal as it may be, will accelerate the march toward grid parity over the coming years, and bring with it a period of extreme industry turbulence that will intensify through 2009 and could last at least through 2010. We expect near-term volatility for the industry, companies, and stocks. However, with an intense focus on reducing cost and building an industry, against a backdrop of what will likely be increasing grid supplied electricity prices worldwide, we are bullish on the long term outlook for the solar PV industry.

- **Positioning with solar PV company stocks:** if we are correct in our assessment that 1H09 will likely be worse than most expect, and 2H09 could be better than most expect, with a return to accelerating growth in 2010, then we believe the time to become more aggressive with key solar PV company stocks would be later in 1H09. We anticipate near term downside to solar PV stocks as the severity of the shake-out is better discounted over the coming months.

When the severity of the shake-out is better discounted we would be overwhelmingly partial to industry leaders FSLR and SPWRA.

- **Industry leaders for the long-term:** we believe that owning long-tem winners (i.e. companies with sustainable competitive advantages, able to deliver the lowest LCOE, with solid balance sheets) is the best approach, and would be overwhelmingly partial to industry leaders First Solar (FSLR) and SunPower (SPWRA).
- **Differentiated companies playing to market niches with little direct near-term competition:** we believe Energy Conversion Devices (ENER) could outperform through the shake-out and subsequently, but not likely to the degree that First Solar and SunPower could. We would be partial to ENER as the severity of the shake-out becomes better discounted, but note we anticipate more direct competition (e.g. light weight, flexible solar PV products) could emerge within two to three years for ECDs product.

We would remain very cautious on non-differentiated solar PV company stocks.

- **Non-differentiated companies will likely under-perform over the near-term and the long-term:** we would remain cautious on most other company stocks, as the long-term impact of the shake-out on less-differentiated and non-differentiated companies will be more severe.

Figure 30: Canadian Solar – income statement

Fiscal year ending December

Updated on Jan 15, 2009	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Total Sales	**$68.2**	$17.5	$60.4	$97.4	$127.5	**$302.8**	$171.2	$212.6	$252.4	$66.3	**$702.5**	$82.6	$109.3	$202.4	$226.7	**$621.0**	**$909.8**
Cost of Goods	**55.9**	17.1	57.9	91.1	112.9	**279.0**	143.0	179.5	213.3	66.5	**602.2**	78.6	101.3	184.7	205.9	**570.4**	**799.8**
Gross Income	**12.3**	0.3	2.5	6.3	14.6	**23.8**	28.2	33.1	39.1	(0.1)	**100.3**	4.0	8.0	17.8	20.8	**50.6**	**110.1**
R&D	**0.2**	0.2	0.2	0.3	0.3	**1.0**	0.3	0.4	0.6	0.4	**1.8**	0.4	0.5	0.7	0.9	**2.5**	**3.6**
SG&A	**11.0**	4.1	5.1	6.7	8.9	**24.8**	7.9	9.3	12.7	10.8	**40.8**	8.1	9.1	13.6	14.3	**45.1**	**58.0**
Operating Income	**1.2**	(4.0)	(2.8)	(0.7)	5.4	**(2.1)**	20.0	23.3	25.8	(11.3)	**57.7**	(4.4)	(1.5)	3.4	5.6	**3.1**	**48.4**
Other Income (Exp) & Other	**(1.9)**	0.2	(0.2)	1.2	0.4	**1.6**	6.0	(3.7)	(12.4)	(1.4)	**(11.5)**	(1.4)	(1.7)	(2.3)	(2.7)	**(8.1)**	**(4.1)**
Pretax Income	**(0.7)**	(3.8)	(3.0)	0.5	5.8	**(0.5)**	26.0	19.6	13.3	(12.7)	**46.2**	(5.8)	(3.2)	1.1	2.9	**(5.0)**	**44.3**
Taxes	**0.6**	0.1	(0.2)	(0.0)	0.2	**0.2**	7.0	(1.1)	2.3	(1.5)	**6.6**	(0.7)	(0.4)	0.1	0.3	**(0.6)**	**5.3**
Minority Interests																	
Extraordinary Item	**8.2**							10.2		130.0	**140.2**						
Net Income	**(9.5)**	(3.9)	(2.9)	0.5	5.5	**(0.7)**	19.0	10.5	11.1	(141.2)	**(100.6)**	(5.1)	(2.8)	1.0	2.6	**(4.4)**	**39.0**
Net Income-Continuing Operations	**(1.3)**	(3.9)	(2.9)	0.5	5.5	**(0.7)**	19.0	20.7	11.1	(11.2)	**39.6**	(5.1)	(2.8)	1.0	2.6	**(4.4)**	**39.0**
Avg. Shares Outstanding - Basic	**19.0**	27.3	27.3	27.3	27.3	**27.3**	27.4	28.1	34.8	36.4	**31.7**	36.6	36.9	37.1	37.4	**37.0**	**38.0**
Basic EPS	**($0.50)**	($0.14)	($0.11)	$0.02	$0.20	**($0.02)**	$0.69	$0.38	$0.32	($3.88)	**($2.49)**	($0.14)	($0.08)	$0.03	$0.07	**($0.12)**	**$1.03**
Avg. Shares Outstanding - Diluted	**19.0**	27.3	27.3	27.4	28.1	**27.5**	32.4	29.4	35.6	37.2	**33.6**	37.4	37.7	37.9	38.2	**37.8**	**38.8**
Diluted EPS	**($0.50)**	($0.14)	($0.11)	$0.02	$0.20	**($0.03)**	$0.62	$0.36	$0.31	($3.80)	**($2.51)**	($0.14)	($0.08)	$0.03	$0.07	**($0.12)**	**$1.00**
Avg. Shares Outstanding - Diluted	**19.0**	27.3	27.3	27.4	28.1	**27.5**	32.4	29.4	35.6	37.2	**33.6**	37.4	37.7	37.9	38.2	**37.8**	**38.8**
Diluted EPS (Excl. Charges)	**$0.03**	($0.14)	($0.11)	$0.02	$0.20	**($0.03)**	$0.62	$0.70	$0.31	($0.30)	**$1.34**	($0.14)	($0.08)	$0.03	$0.07	**($0.12)**	**$1.00**

Margin Structure*	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Cost of Goods Sold	**81.9%**	98.0%	95.9%	93.5%	88.5%	**92.1%**	83.5%	84.4%	84.5%	100.2%	**85.7%**	95.1%	92.7%	91.2%	90.8%	**91.9%**	**87.9%**
Gross Margin	**18.1%**	2.0%	4.1%	6.5%	11.5%	**7.9%**	16.5%	15.6%	15.5%	-0.2%	**14.3%**	4.9%	7.3%	8.8%	9.2%	**8.1%**	**12.1%**
R&D	**0.2%**	1.1%	0.3%	0.3%	0.3%	**0.3%**	0.2%	0.2%	0.2%	0.6%	**0.3%**	0.5%	0.4%	0.4%	0.4%	**0.4%**	**0.4%**
SG&A Expenses	**16.1%**	23.7%	8.4%	6.9%	7.0%	**8.2%**	4.6%	4.4%	5.1%	16.3%	**5.8%**	9.8%	8.3%	6.7%	6.3%	**7.3%**	**6.4%**
Operating Margin	**1.8%**	-22.8%	-4.6%	-0.7%	4.2%	**-0.7%**	11.7%	11.0%	10.2%	-17.1%	**8.2%**	-5.3%	-1.4%	1.7%	2.5%	**0.5%**	**5.3%**
EBITDA Margin	**2.1%**	-22.1%	-4.2%	-0.4%	4.4%	**-0.4%**	14.9%	13.6%	12.4%	-8.7%	**11.4%**	0.9%	3.3%	4.2%	4.7%	**3.8%**	**7.8%**
Tax Rate	**NM**	NM	NM	NM	4.3%	**-35.2%**	27.0%	-5.8%	16.9%	12.0%	**14.4%**	12.0%	12.0%	12.0%	12.0%	**12.0%**	**12.0%**
Net Margin	**-1.9%**	-22.0%	-4.8%	0.5%	4.3%	**-0.2%**	11.1%	9.7%	4.4%	-16.9%	**5.6%**	-6.2%	-2.6%	0.5%	1.1%	**-0.7%**	**4.3%**

Source: Company reports and Deutsche Bank estimates

Figure 31: Energy Conversion Devices – income statement

Fiscal year ending June

Updated on Jan 15, 2009	FY2007	Sep 07 1Q08	Dec 07 2Q08	Mar-08 3Q08	Jun-08 4Q08	FY2008	Sep 08 1Q09	Dec 08 2Q09E	Mar-09 3Q09E	Jun-09 4Q09E	FY2009E	Sep 09 1Q10E	Dec 09 2Q10E	Mar-10 3Q10E	Jun-10 4Q10E	FY2010E	Sep 10 1Q11E	Dec 10 2Q11E
Total Sales	**$113.6**	$47.0	$56.4	$70.0	$82.4	**$255.9**	$95.8	$97.8	$99.7	$109.2	**$402.4**	$126.8	$143.7	$153.8	$171.1	**$595.4**	$189.7	$211.7
Cost of Goods	**91.8**	36.8	43.6	47.2	53.8	**181.3**	63.1	64.5	65.8	71.9	**265.3**	83.3	93.9	100.2	110.7	**388.1**	121.8	135.0
Gross Income	**21.8**	10.3	12.9	22.8	28.6	**74.5**	32.6	33.3	33.9	37.3	**137.1**	43.5	49.8	53.6	60.4	**207.3**	67.9	76.7
R&D	**33.7**	3.5	2.6	1.7	2.2	**9.9**	2.2	2.5	2.6	2.5	**9.8**	2.8	3.0	3.4	3.8	**13.0**	4.1	4.4
SG&A	**24.2**	14.2	15.2	13.2	16.6	**59.3**	16.4	16.9	17.0	17.2	**67.5**	19.2	21.3	22.8	25.5	**88.9**	27.3	31.0
Operating Income	**(36.1)**	(7.4)	(4.9)	8.0	9.7	**5.3**	14.0	13.8	14.4	17.6	**59.8**	21.5	25.5	27.4	31.1	**105.5**	36.5	41.2
Share in the Income/(loss) of joint venture																		
Other Income (Exp) & Other	**17.3**	2.4	2.1	1.4	2.2	**8.1**	(1.1)	1.0	0.7	0.4	**1.0**	0.2	(0.2)	(0.5)	(0.9)	**(1.4)**	(1.3)	(1.6)
Pretax Income	**(18.8)**	(5.0)	(2.8)	9.4	11.9	**13.4**	13.0	14.8	15.1	18.0	**60.8**	21.7	25.3	26.9	30.2	**104.1**	35.2	39.6
Taxes		0.0	0.1	0.0	0.1	**0.2**	0.1	0.4	0.5	0.5	**1.5**	1.1	1.3	1.3	1.5	**5.2**	2.6	3.0
Other After Tax (Minority Interest)																		
Extraordinary Item	**6.4**	2.5	2.6	2.4	1.9	**9.4**	0.2	1.4			**1.6**							
Net Income	**(25.2)**	(7.6)	(5.4)	7.0	9.9	**3.9**	12.7	13.0	14.6	17.4	**57.7**	20.6	24.0	25.6	28.7	**98.9**	32.6	36.7
Net Income-Continuing Operations	**(18.8)**	(5.1)	(2.9)	9.4	11.8	**13.3**	12.9	14.4	14.6	17.4	**59.3**	20.6	24.0	25.6	28.7	**98.9**	32.6	36.7
Avg. Shares Outstanding - Basic	**39.4**	39.8	40.0	40.3	40.7	**40.2**	42.2	42.5	42.7	43.0	**42.6**	43.2	43.5	43.7	44.0	**43.6**	44.2	44.5
Basic EPS	**($0.64)**	($0.19)	($0.14)	$0.17	$0.24	**$0.10**	$0.30	$0.31	$0.34	$0.41	**$1.35**	$0.48	$0.55	$0.58	$0.65	**$2.27**	$0.74	$0.82
Avg. Shares Outstanding - Diluted	**39.4**	39.8	40.0	40.7	41.5	**41.1**	43.1	43.3	43.6	43.8	**43.4**	44.0	44.2	44.4	44.6	**44.3**	44.8	45.0
Diluted EPS	**($0.64)**	($0.19)	($0.14)	$0.17	$0.24	**$0.09**	$0.29	$0.30	$0.34	$0.40	**$1.33**	$0.47	$0.54	$0.58	$0.64	**$2.23**	$0.73	$0.81
Avg. Shares Outstanding - Diluted	**39.4**	39.8	40.0	40.7	41.5	**41.1**	43.1	43.3	43.6	43.8	**43.4**	44.0	44.2	44.4	44.6	**44.3**	44.8	45.0
Diluted EPS (Excl. Charges)	**($0.48)**	($0.13)	($0.07)	$0.23	$0.28	**$0.32**	$0.30	$0.33	$0.34	$0.40	**$1.37**	$0.47	$0.54	$0.58	$0.64	**$2.23**	$0.73	$0.81

Margin Structure*	FY2007	1Q08	2Q08	3Q08	4Q08	FY2008	1Q09	2Q09E	3Q09E	4Q09E	FY2009E	1Q10E	2Q10E	3Q10E	4Q10E	FY2010E	1Q10E	2Q10E
Cost of Goods Sold	**80.8%**	78.2%	77.2%	67.4%	65.3%	**70.9%**	65.9%	66.0%	66.0%	65.8%	**65.9%**	65.7%	65.3%	65.1%	64.7%	**65.2%**	64.2%	63.8%
Gross Margin	**19.2%**	21.8%	22.8%	32.6%	34.7%	**29.1%**	34.1%	34.0%	34.0%	34.2%	**34.1%**	34.3%	34.7%	34.9%	35.3%	**34.8%**	35.8%	36.2%
R&D	**29.7%**	7.4%	4.6%	2.4%	2.7%	**3.9%**	2.3%	2.6%	2.6%	2.3%	**2.4%**	2.2%	2.1%	2.2%	2.2%	**2.2%**	2.2%	2.1%
SG&A Expenses	**21.3%**	30.3%	26.9%	18.9%	20.2%	**23.2%**	17.1%	17.3%	17.0%	15.8%	**16.8%**	15.1%	14.8%	14.9%	14.9%	**14.9%**	14.4%	14.6%
Operating Margin	**-31.8%**	-15.8%	-8.7%	11.4%	11.8%	**2.1%**	14.6%	14.1%	14.4%	16.1%	**14.9%**	17.0%	17.7%	17.8%	18.2%	**17.7%**	19.3%	19.5%
EBITDA Margin	**-21.1%**	-8.0%	0.1%	20.5%	20.1%	**10.7%**	21.9%	21.3%	21.4%	22.5%	**21.8%**	31.1%	30.2%	29.5%	28.6%	**29.8%**	30.9%	29.9%
Tax Rate	**0.0%**	-0.1%	-1.8%	0.4%	0.5%	**1.2%**	0.4%	3.0%	3.0%	3.0%	**2.5%**	5.0%	5.0%	5.0%	5.0%	**5.0%**	7.5%	7.5%
Net Margin	**-16.6%**	-10.7%	-5.1%	13.4%	14.3%	**5.2%**	13.5%	14.7%	14.7%	16.0%	**14.7%**	16.3%	16.7%	16.6%	16.8%	**16.6%**	17.2%	17.3%

Source: Company reports and Deutsche Bank estimates

Figure 32: Evergreen Solar – income statement

Fiscal year ending December | New business model ----->

Updated on Jan 15, 2009	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Total Sales	**$103.1**	$14.1	$15.4	$18.2	$22.2	**$69.9**	$22.9	$22.8	$22.1	$47.0	**$114.8**	$48.5	$68.9	$84.8	$97.6	**$299.7**	**$481.7**
Cost of Goods	**91.2**	11.3	12.0	13.7	16.0	**52.8**	15.2	14.9	20.8	42.2	**93.1**	34.1	48.7	58.3	63.8	**205.0**	**$313.6**
Gross Income	**11.9**	2.8	3.4	4.5	6.2	**17.0**	7.7	7.9	1.2	4.9	**21.7**	14.4	20.1	26.5	33.7	**94.7**	**168.1**
R&D	**19.1**	5.2	5.2	5.4	4.8	**20.7**	4.9	5.9	5.5	5.5	**21.9**	5.5	5.8	5.7	5.9	**22.8**	**25.3**
SG&A	**21.2**	4.7	5.4	5.4	6.3	**21.9**	10.3	17.2	17.8	17.6	**62.8**	14.5	15.4	15.6	15.8	**61.3**	**70.2**
Operating Income	**(28.3)**	(7.1)	(7.2)	(6.3)	(4.9)	**(25.6)**	(7.5)	(15.2)	(22.1)	(18.2)	**(63.0)**	(5.6)	(1.0)	5.2	12.1	**10.7**	**72.6**
Other Income (Exp) & Other	**2.3**	0.9	(0.3)	2.6	5.7	**9.0**	7.5	6.2	(1.7)	(0.7)	**11.3**	(0.4)	0.9	1.1	(5.6)	**(4.0)**	**(21.0)**
Pretax Income	**(26.0)**	(6.2)	(7.5)	(3.7)	0.8	**(16.6)**	(0.0)	(8.9)	(23.9)	(18.9)	**(51.7)**	(5.9)	(0.1)	6.2	6.5	**6.7**	**51.6**
Taxes																	
Other After Tax (Minority Interest)	**0.9**																
Extraordinary Item	**1.5**																
Net Income	**(26.7)**	(6.2)	(7.5)	(3.7)	0.8	**(16.6)**	(0.0)	(8.9)	(23.9)	(18.9)	**(51.7)**	(5.9)	(0.1)	6.2	6.5	**6.7**	**51.6**
Net Income-Continuing Operations	**(25.1)**	(6.2)	(7.5)	(3.7)	0.8	**(16.6)**	(0.0)	(8.9)	(23.9)	(18.9)	**(51.7)**	(5.9)	(0.1)	6.2	6.5	**6.7**	**51.6**
Avg. Shares Outstanding - Basic	**65.7**	67.0	82.6	98.3	98.8	**86.8**	108.8	118.3	132.0	162.0	**130.3**	162.5	163.0	163.5	164.0	**163.2**	**173.5**
Basic EPS	**($0.41)**	($0.09)	($0.09)	($0.04)	$0.01	**($0.19)**	($0.00)	($0.08)	($0.18)	($0.12)	**($0.37)**	($0.04)	($0.00)	$0.04	$0.04	**$0.04**	**$0.30**
Avg. Shares Outstanding - Diluted	**65.6**	67.0	82.6	98.3	102.7	**86.8**	108.8	118.3	132.0	162.0	**130.3**	162.5	163.0	163.5	164.0	**163.2**	**173.5**
Diluted EPS	**($0.41)**	($0.09)	($0.09)	($0.04)	$0.01	**($0.19)**	($0.00)	($0.08)	($0.18)	($0.12)	**($0.37)**	($0.04)	($0.00)	$0.04	$0.04	**$0.04**	**$0.30**
Avg. Shares Outstanding - Diluted	**65.6**	67.0	82.6	98.3	102.7	**86.8**	108.8	118.3	132.0	162.0	**130.3**	162.5	163.0	163.5	164.0	**163.2**	**173.5**
Diluted EPS (Excl. Charges)	**($0.38)**	($0.09)	($0.09)	($0.04)	$0.01	**($0.19)**	($0.0)	($0.08)	($0.18)	($0.12)	**($0.37)**	($0.04)	($0.00)	$0.04	$0.04	**$0.04**	**$0.30**

Margin Structure*	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Cost of Goods Sold	**88.4%**	79.9%	77.7%	75.1%	71.9%	**75.6%**	66.4%	65.3%	94.3%	89.7%	**81.1%**	70.3%	70.8%	68.8%	65.4%	**68.4%**	**65.1%**
Gross Margin	**11.6%**	20.1%	22.3%	24.9%	28.1%	**24.4%**	33.6%	34.7%	5.7%	10.3%	**18.9%**	29.7%	29.2%	31.2%	34.6%	**31.6%**	**34.9%**
R&D	**18.5%**	37.1%	34.0%	29.6%	21.8%	**29.6%**	21.5%	25.9%	25.1%	11.8%	**19.1%**	11.3%	8.4%	6.8%	6.0%	**7.6%**	**5.3%**
SG&A Expenses	**20.6%**	33.6%	35.4%	29.9%	28.4%	**31.4%**	44.8%	75.5%	80.8%	37.3%	**54.7%**	30.0%	22.4%	18.3%	16.2%	**20.5%**	**14.6%**
Operating Margin	**-27.5%**	-50.6%	-47.0%	-34.6%	-22.2%	**-36.6%**	-32.7%	-66.7%	-100.3%	-38.7%	**-54.9%**	-11.5%	-1.5%	6.1%	12.4%	**3.6%**	**15.1%**
EBITDA Margin	**-18.5%**	-39.7%	-35.8%	-23.2%	-12.8%	**-26.0%**	-21.7%	-40.0%	-68.1%	-23.6%	**-35.0%**	24.7%	24.0%	26.8%	30.4%	**27.0%**	**38.8%**
Tax Rate	**0.0%**	0.0%	0.0%	0.0%	0.0%	**0.0%**	0.0%	0.0%	0.0%	0.0%	**0.0%**	0.0%	0.0%	0.0%	0.0%	**0.0%**	**0.0%**
Net Margin	**-24.4%**	-44.1%	-48.8%	-20.1%	3.6%	**-23.8%**	-0.1%	-39.2%	-108.1%	-40.2%	**-45.0%**	-12.2%	-0.1%	7.4%	6.7%	**2.2%**	**10.7%**

Source: Company reports and Deutsche Bank estimates

Figure 33: First Solar – income statement

Fiscal year ending December

Updated on Jan 15, 2009	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Total Sales	**$135.0**	$66.9	$77.2	$159.0	$200.8	**$504.0**	$196.9	$267.0	$348.7	$418.0	**$1,230.7**	$367.0	$427.2	$492.8	$580.8	**$1,867.7**	**$2,560.9**
Cost of Goods	**80.7**	36.9	48.9	77.0	89.8	**252.6**	92.6	122.3	153.3	201.9	**570.1**	182.6	218.2	246.4	287.1	**934.3**	**1336.1**
Gross Income	**54.2**	30.0	28.4	82.0	111.0	**251.4**	104.3	144.7	195.4	216.1	**660.6**	184.4	208.9	246.3	293.7	**933.4**	**1224.8**
R&D	**6.4**	3.1	3.8	3.9	4.4	**15.1**	4.8	7.7	10.0	10.2	**32.7**	10.3	10.1	10.2	10.5	**40.9**	**51.9**
SG&A	**45.1**	22.2	18.8	29.9	28.3	**99.1**	41.4	48.2	55.3	67.8	**212.8**	63.7	67.6	71.5	76.6	**279.4**	**355.7**
Operating Income	**2.8**	4.8	5.8	48.3	78.3	**137.2**	58.1	88.7	130.2	138.1	**415.1**	110.4	131.2	164.7	206.7	**613.1**	**817.3**
Other Income (Exp) & Other	**6.4**	3.5	2.1	5.4	7.9	**18.8**	7.1	5.1	2.9	3.2	**18.4**	3.1	3.3	3.6	3.7	**13.7**	**17.4**
Pretax Income	**9.2**	8.3	7.9	53.6	86.1	**156.0**	65.2	93.9	133.1	141.3	**433.5**	113.5	134.5	168.3	210.4	**626.8**	**834.7**
Taxes	**5.2**	3.3	2.6	15.1	30.8	**51.8**	18.6	24.2	33.8	35.3	**111.9**	16.7	16.9	16.8	19.1	**69.5**	**99.8**
Minority Interests																	
Extraordinary Item			(39.2)	(7.5)	(7.5)	**(54.2)**											
Net Income	**4.0**	5.0	44.4	46.0	62.9	**158.4**	46.6	69.7	99.3	106.0	**321.5**	96.9	117.7	151.5	191.3	**557.3**	**734.8**
Net Income-Continuing Operations	**4.0**	5.0	5.2	38.5	55.4	**104.2**	46.6	69.7	99.3	106.0	**321.5**	96.9	117.7	151.5	191.3	**557.3**	**734.8**
Avg. Shares Outstanding - Basic	**56.3**	72.3	72.6	75.7	78.2	**74.7**	79.1	79.9	80.4	81.7	**80.3**	82.7	83.7	84.7	85.7	**84.2**	**88.2**
Basic EPS	**$0.07**	$0.07	$0.61	$0.61	$0.80	**$2.12**	$0.59	$0.87	$1.23	$1.30	**$3.99**	$1.17	$1.41	$1.79	$2.23	**$6.60**	**$8.33**
Avg. Shares Outstanding - Diluted	**58.3**	75.4	76.1	79.1	81.3	**78.0**	81.6	82.0	82.4	83.7	**82.4**	84.7	85.7	86.7	87.7	**86.2**	**90.2**
Diluted EPS	**$0.07**	$0.07	$0.58	$0.58	$0.77	**$2.03**	$0.57	$0.85	$1.20	$1.27	**$3.89**	$1.14	$1.37	$1.75	$2.18	**$6.45**	**$8.15**
Avg. Shares Outstanding - Diluted	**72.5**	75.4	76.1	79.1	81.3	**78.0**	81.6	82.0	82.4	83.7	**82.4**	84.7	85.7	86.7	87.7	**86.2**	**90.2**
Diluted EPS (Excl. Charges)	**$0.05**	$0.07	$0.07	$0.49	$0.68	**$1.34**	$0.57	$0.85	$1.20	$1.27	**$3.89**	$1.14	$1.37	$1.75	$2.18	**$6.45**	**$8.15**

Margin Structure*	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Cost of Goods Sold	**59.8%**	55.1%	63.3%	48.4%	44.7%	**50.1%**	47.0%	45.8%	43.9%	48.3%	**46.3%**	49.8%	51.1%	50.0%	49.4%	**50.0%**	**52.2%**
Gross Margin	**40.2%**	44.9%	36.7%	51.6%	55.3%	**49.9%**	53.0%	54.2%	56.1%	51.7%	**53.7%**	50.3%	48.9%	50.0%	50.6%	**50.0%**	**47.8%**
R&D	**4.7%**	4.6%	4.9%	2.4%	2.2%	**3.0%**	2.4%	2.9%	2.9%	2.5%	**2.7%**	2.8%	2.4%	2.1%	1.8%	**2.2%**	**2.0%**
SG&A Expenses	**33.4%**	33.1%	24.4%	18.8%	14.1%	**19.7%**	21.0%	18.1%	15.9%	16.2%	**17.3%**	17.4%	15.8%	14.5%	13.2%	**15.0%**	**13.9%**
Operating Margin	**2.1%**	7.2%	7.5%	30.4%	39.0%	**27.2%**	29.5%	33.2%	37.3%	33.0%	**33.7%**	30.1%	30.7%	33.4%	35.6%	**32.8%**	**31.9%**
EBITDA Margin	**9.6%**	14.9%	15.3%	34.5%	42.4%	**32.1%**	34.1%	38.0%	42.1%	37.7%	**38.4%**	40.0%	39.8%	41.8%	43.1%	**41.4%**	**42.2%**
Tax Rate	**56.7%**	39.5%	33.6%	28.2%	35.7%	**33.2%**	28.5%	25.8%	25.4%	25.0%	**25.8%**	14.7%	12.5%	10.0%	9.1%	**11.1%**	**12.0%**
Net Margin	**2.9%**	7.5%	6.8%	24.2%	27.6%	**20.7%**	23.7%	26.1%	28.5%	25.4%	**26.1%**	26.4%	27.5%	30.7%	32.9%	**29.8%**	**28.7%**

* All numbers are on an operating basis and exclude special charges.

Source: Company reports and Deutsche Bank estimates

Deutsche Bank

Figure 34: SunPower – income statement

Fiscal year ending December

Updated on Jan 15, 2009	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Total Sales	**$236.5**	$143.2	$174.1	$234.3	$224.3	**$775.9**	$273.7	$382.8	$377.5	$391.9	**$1,425.9**	$362.3	$401.4	$465.4	$519.0	**$1,748.0**	**$2,402.3**
Cost of Goods	**181.4**	103.9	137.3	190.0	171.0	**602.1**	211.7	286.8	268.9	292.9	**1,060.3**	259.8	287.1	333.1	371.0	**1,251.0**	**1,708.4**
Gross Income	**55.2**	39.3	36.8	44.3	53.4	**173.8**	62.0	95.9	108.6	99.0	**365.5**	102.5	114.3	132.3	148.0	**497.0**	**694.0**
R&D	**9.7**	2.9	2.8	3.9	3.9	**13.6**	4.6	4.8	6.0	6.3	**21.8**	6.0	6.4	7.0	7.5	**26.9**	**33.6**
SG&A	**21.7**	14.0	17.7	19.3	23.6	**74.6**	24.3	34.6	37.3	38.8	**134.9**	43.2	46.7	52.2	55.5	**197.5**	**266.7**
Operating Income	**23.8**	22.4	16.3	21.2	25.8	**85.7**	33.1	56.5	65.2	54.0	**208.8**	53.3	61.2	73.1	85.0	**272.6**	**393.7**
Other Income (Exp) & Other	**9.4**	1.1	0.6	3.0	4.4	**9.2**	3.0	(1.4)	(2.3)	(1.6)	**(2.3)**	(0.4)	(0.5)	(0.6)	(0.7)	**(2.2)**	**(0.5)**
Pretax Income	**33.2**	23.5	16.9	24.2	30.3	**94.9**	36.1	55.2	62.9	52.4	**206.5**	52.9	60.7	72.5	84.3	**270.4**	**393.2**
Taxes	**1.9**	3.3	2.8	3.2	3.5	**12.8**	10.5	15.2	24.6	14.1	**64.4**	14.3	16.4	19.6	22.7	**73.0**	**104.2**
Amortization of Intangible Assets	**4.7**	6.9	7.6	6.9	7.1	**28.5**	4.3	4.0	4.2	4.2	**16.8**	4.2	4.2	4.2	4.2	**16.8**	**16.8**
Extraordinary Item		12.0	11.8	5.7	14.8	**44.3**	8.5	7.4	12.7	7.5	**36.0**	7.5				**7.5**	
Net Income	**26.5**	1.2	(5.3)	8.4	4.9	**9.2**	12.8	28.6	21.4	26.5	**89.3**	26.9	40.1	48.7	57.3	**173.1**	**272.2**
Net Income-Continuing Operations	**31.2**	20.2	14.1	21.0	26.8	**82.0**	25.6	40.0	38.3	38.2	**142.1**	38.6	44.3	52.9	61.5	**197.4**	**289.0**
Avg. Shares Outstanding - Basic	**65.9**	73.7	75.1	77.7	79.0	**75.4**	79.0	79.4	80.5	84.1	**80.7**	81.9	82.9	83.9	84.9	**83.4**	**87.4**
Basic EPS	**$0.39**	$0.02	($0.07)	$0.11	$0.06	**$0.12**	$0.16	$0.36	$0.27	$0.32	**$1.10**	$0.33	$0.48	$0.58	$0.67	**$2.08**	**$3.11**
Avg. Shares Outstanding - Diluted	**71.1**	79.1	75.1	82.6	85.8	**81.2**	83.7	84.0	84.5	87.6	**85.0**	86.1	87.1	88.1	89.1	**87.6**	**91.6**
Diluted EPS	**$0.36**	$0.02	($0.07)	$0.10	$0.06	**$0.10**	$0.15	$0.34	$0.25	$0.30	**$1.05**	$0.31	$0.46	$0.55	$0.64	**$1.98**	**$2.97**
Avg. Shares Outstanding - Diluted	**71.1**	79.1	79.8	82.6	85.8	**81.2**	83.7	84.0	84.5	87.6	**85.0**	86.1	87.1	88.1	89.1	**87.6**	**91.6**
Diluted EPS (Excl. Charges)	**$0.43**	$0.25	$0.18	$0.25	$0.31	**$1.00**	$0.31	$0.48	$0.45	$0.44	**$1.67**	$0.45	$0.51	$0.60	$0.69	**$2.25**	**$3.15**

Margin Structure*	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Cost of Goods Sold	**76.7%**	72.5%	78.9%	81.1%	76.2%	**77.6%**	77.3%	74.9%	71.2%	74.7%	**74.4%**	71.7%	71.5%	71.6%	71.5%	**71.6%**	**71.1%**
Gross Margin	**23.3%**	27.5%	21.1%	18.9%	23.8%	**22.4%**	22.7%	25.1%	28.8%	25.3%	**25.6%**	28.3%	28.5%	28.4%	28.5%	**28.4%**	**28.9%**
R&D	**4.1%**	2.1%	1.6%	1.7%	1.7%	**1.7%**	1.7%	1.3%	1.6%	1.6%	**1.5%**	1.7%	1.6%	1.5%	1.5%	**1.5%**	**1.4%**
SG&A Expenses	**9.2%**	9.8%	10.1%	8.2%	10.5%	**9.6%**	8.9%	9.0%	9.9%	9.9%	**9.5%**	11.9%	11.6%	11.2%	10.7%	**11.3%**	**11.1%**
Operating Margin	**10.1%**	15.6%	9.4%	9.0%	11.5%	**11.0%**	12.1%	14.8%	17.3%	13.8%	**14.6%**	14.7%	15.3%	15.7%	16.4%	**15.6%**	**16.4%**
EBITDA Margin	**17.0%**	19.6%	12.7%	11.7%	15.8%	**14.6%**	15.8%	17.9%	20.9%	17.2%	**18.1%**	20.2%	20.2%	20.0%	20.2%	**20.1%**	**20.9%**
Tax Rate	**5.9%**	14.2%	16.7%	13.2%	11.6%	**13.5%**	29.2%	27.5%	39.1%	27.0%	**31.2%**	27.0%	27.0%	27.0%	27.0%	**27.0%**	**26.5%**
Net Margin	**13.2%**	14.1%	8.1%	9.0%	11.9%	**10.6%**	9.3%	10.5%	10.1%	9.8%	**10.0%**	10.7%	11.0%	11.4%	11.9%	**11.3%**	**12.0%**

Source: Company reports and Deutsche Bank estimates

Figure 35: Applied Materials – income statement

Fiscal year ending October

Updated on Jan 04, 2009	FY2006	Jan-07 1Q07	Apr-07 2Q07	Jul-07 3Q07	Oct-07 4Q07	FY2007	Jan-08 1Q08	Apr-08 2Q08	Jul-08 3Q08	Oct-08 4Q08	FY2008	Jan-09 1Q09E	Apr-09 2Q09E	Jul-09 3Q09E	Oct-09 4Q09E	FY2009E	Jan-10 1Q10E
Total Sales	**$9,167.0**	$2,277.3	$2,529.6	$2,561.0	$2,367.0	**$9,734.9**	$2,087.4	$2,150.0	$1,848.2	$2,043.7	**$8,129.2**	$1,369.3	$1,232.3	$1,257.0	$1,332.4	**$5,191.0**	$1,305.8
Cost of Goods	**4856.8**	1201.3	1318.9	1338.2	1290.1	**5148.6**	1120.4	1151.8	1064.6	1209.7	**4546.4**	869.5	791.8	804.5	846.1	**3311.8**	832.4
Gross Income	**4310.3**	1075.9	1210.6	1222.8	1076.9	**4586.2**	967.0	998.2	783.6	834.0	**3582.9**	499.8	440.6	452.5	486.3	**1879.2**	473.3
R&D	**1138.3**	287.6	291.0	292.6	270.9	**1142.1**	273.2	287.1	268.6	275.2	**1104.1**	260.2	237.2	229.4	233.2	**960.0**	228.5
SG&A	**906.7**	228.7	231.5	231.4	241.9	**933.5**	239.9	241.4	245.3	238.5	**965.2**	225.9	214.4	207.4	209.9	**857.6**	205.7
Operating Income	**2265.2**	559.6	688.1	698.8	564.1	**2510.6**	453.9	469.7	269.7	320.3	**1513.6**	13.7	(11.1)	15.7	43.3	**61.6**	39.2
Other Income (Exp) & Other	**146.4**	15.7	19.3	15.0	18.2	**68.1**	16.4	16.4	14.2	6.2	**53.3**	15.6	16.9	16.9	16.6	**66.0**	16.4
Pretax Income	**2411.5**	575.3	707.3	713.8	582.3	**2578.8**	470.4	486.1	284.0	326.5	**1566.9**	29.3	5.8	32.6	59.9	**127.6**	55.6
Taxes	**782.7**	191.6	232.6	216.7	157.5	**798.4**	152.2	160.6	89.4	92.8	**495.1**	9.2	1.8	10.3	18.9	**40.2**	17.5
Other After Tax Extraordinary Item	**112.2**	(19.8)	63.3	23.6	3.0	**70.1**	55.8	22.9	29.8	2.6	**111.1**						
Net Income	**1516.7**	403.5	411.4	473.5	421.8	**1710.2**	262.4	302.5	164.768	231.1	**960.7**	20.1	4.0	22.3	41.0	**87.4**	38.1
Net Income-Continuing Operations	**1,628.8**	383.7	474.7	497.1	424.8	**1,780.3**	318.1	325.4	194.533	233.7	**1,071.8**	20.1	4.0	22.3	41.0	**87.4**	38.1
Avg. Shares Outstanding - Basic	**1551.3**	1394.7	1391.1	1385.5	1381.9	**1406.7**	1371.2	1356.7	1350.5	1338.2	**1354.2**	1343.2	1348.2	1353.2	1358.2	**1350.7**	1363.2
Basic EPS	**$0.99**	$0.29	$0.30	$0.34	$0.31	**$1.22**	$0.19	$0.22	$0.12	$0.17	**$0.71**	$0.01	$0.00	$0.02	$0.03	**$0.06**	$0.03
Avg. Shares Outstanding - Diluted	**1565.1**	1409.0	1407.3	1407.3	1403.7	**1427.0**	1383.9	1373.3	1367.6	1350.1	**1374.5**	1355.1	1360.1	1365.1	1370.1	**1362.6**	1375.1
Diluted EPS	**$0.98**	$0.29	$0.29	$0.34	$0.30	**$1.20**	$0.19	$0.22	$0.12	$0.17	**$0.70**	$0.01	$0.00	$0.02	$0.03	**$0.06**	$0.03
Avg. Shares Outstanding - Diluted	**1565.1**	1409.0	1407.3	1407.3	1403.7	**1427.0**	1383.9	1373.3	1367.6	1350.1	**1,374.5**	1355.1	1360.1	1365.1	1370.1	**1,362.6**	1375.1
Diluted EPS (Excl. Charges)	**$1.05**	$0.27	$0.34	$0.35	$0.30	**$1.25**	$0.23	$0.24	$0.14	$0.17	**$0.78**	$0.01	$0.00	$0.02	$0.03	**$0.06**	$0.03
Dividend Per Share	**$0.16**	$0.05	$0.05	$0.06	$0.06	**$0.22**	$0.06	$0.06	$0.06	$0.06	**$0.24**	$0.06	$0.06	$0.06	$0.06	**$0.24**	$0.06

Margin Structure*	FY2006	1Q07	2Q07	3Q07	4Q07	FY2007	1Q08	2Q08	3Q08	4Q08	FY2008	1Q09E	2Q09E	3Q09E	4Q09E	FY2009E	1Q10E
Cost of Goods Sold	**53.0%**	52.8%	52.1%	52.3%	54.5%	**52.9%**	53.7%	53.6%	57.6%	59.2%	**55.9%**	63.5%	64.3%	64.0%	63.5%	**63.8%**	63.8%
Gross Margin	**47.0%**	47.2%	47.9%	47.7%	45.5%	**47.1%**	46.3%	46.4%	42.4%	40.8%	**44.1%**	36.5%	35.8%	36.0%	36.5%	**36.2%**	36.3%
R&D	**12.4%**	12.6%	11.5%	11.4%	11.4%	**11.7%**	13.1%	13.4%	14.5%	13.5%	**13.6%**	19.0%	19.3%	18.3%	17.5%	**18.5%**	17.5%
SG&A Expenses	**9.9%**	10.0%	9.2%	9.0%	10.2%	**9.6%**	11.5%	11.2%	13.3%	11.7%	**11.9%**	16.5%	17.4%	16.5%	15.8%	**16.5%**	15.8%
Operating Margin	**24.7%**	24.6%	27.2%	27.3%	23.8%	**25.8%**	21.7%	21.8%	14.6%	15.7%	**18.6%**	1.0%	-0.9%	1.3%	3.3%	**1.2%**	3.0%
EBITDA Margin	**27.7%**	27.2%	29.7%	29.8%	27.3%	**28.5%**	25.5%	25.4%	19.2%	19.6%	**22.6%**	6.4%	5.1%	7.1%	8.8%	**6.9%**	8.0%
Tax Rate	**32.5%**	33.3%	32.9%	30.4%	27.0%	**31.0%**	32.4%	33.0%	31.5%	28.4%	**31.6%**	31.5%	31.5%	31.5%	31.5%	**31.5%**	31.5%
Net Margin	**17.8%**	16.8%	18.8%	19.4%	17.9%	**18.3%**	15.2%	15.1%	10.5%	11.4%	**13.2%**	1.5%	0.3%	1.8%	3.1%	**1.7%**	2.9%

Source: Company reports and Deutsche Bank estimates

Deutsche Bank

Figure 36: MEMC Electronics – income statement

Fiscal year ending December

Updated on Dec 17, 2008	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Total Sales	**$1,540.6**	$440.4	$472.7	$472.8	$535.9	**$1,921.8**	$501.4	$531.4	$546.0	$401.3	**$1,980.1**	$373.7	$383.2	$411.0	$447.3	**$1,615.2**	**$1,875.7**
Cost of Goods	**851.6**	217.9	227.1	234.0	242.3	**921.3**	242.1	248.6	276.3	220.7	**987.7**	216.7	229.9	236.3	255.0	**937.9**	**1102.0**
Gross Income	**688.9**	222.5	245.6	238.8	293.6	**1000.5**	259.3	282.8	269.7	180.6	**992.4**	156.9	153.3	174.7	192.4	**677.2**	**773.7**
R&D	**35.8**	9.5	9.4	9.9	10.5	**39.3**	10.3	10.0	10.3	8.8	**39.4**	7.7	7.9	8.0	8.3	**31.8**	**33.8**
SG&A	**94.9**	25.3	28.9	28.8	28.3	**111.3**	30.6	30.3	31.9	19.5	**112.3**	21.7	22.0	22.6	23.3	**89.6**	**100.3**
Operating Income	**558.3**	187.7	207.3	200.1	254.8	**849.9**	218.4	242.5	227.5	152.3	**840.7**	127.6	123.4	144.0	160.8	**555.9**	**639.6**
Other Income (Exp)	**32.2**	7.2	16.5	20.8	217.4	**261.9**	(198.4)	(3.8)	(5.8)	9.9	**(198.1)**	10.5	10.9	11.3	11.6	**44.3**	**50.2**
JV Royalty Income																	
Pretax Income	**590.5**	194.9	223.8	220.9	472.2	**1111.8**	20.0	238.7	221.7	162.2	**642.6**	138.1	134.3	155.3	172.4	**600.2**	**689.8**
Taxes	**112.2**	29.2	33.6	33.1	70.8	**166.8**	3.0	35.8	33.3	24.3	**96.4**	20.7	20.1	23.3	25.9	**90.0**	**103.5**
Equity in (loss)/income of JVs																	
Minority Interest	**(6.4)**	(1.4)	(1.3)	0.3	(1.0)	**(3.4)**	(1.1)	(1.4)	(0.8)	(0.8)	**(4.1)**	(0.8)	(0.8)	(0.8)	(0.8)	**(3.2)**	**(3.2)**
Extraordinary Item	**102.6**	29.6	25.3	36.6	24.0	**115.4**	57.7	25.4	4.8		**87.9**						
Net Income	**369.3**	134.7	163.6	151.5	376.4	**826.2**	(41.8)	176.1	182.8	137.1	**454.2**	116.6	113.3	131.2	145.8	**506.9**	**583.1**
Net Income-Continuing Operations	**471.9**	164.3	188.9	188.1	400.4	**941.6**	15.9	201.5	187.6	137.1	**542.1**	116.6	113.3	131.2	145.8	**506.9**	**583.1**
Avg. Shares Outstanding - Basic	**222.1**	224.0	225.0	225.0	228.2	**225.6**	228.5	228.3	226.3	223.8	**226.7**	221.8	219.8	217.8	215.8	**218.8**	**210.8**
Basic EPS	**$1.66**	$0.60	$0.73	$0.67	$1.65	**$3.65**	($0.18)	$0.77	$0.81	$0.61	**$2.01**	$0.53	$0.52	$0.60	$0.68	**$2.32**	**$2.77**
Avg. Shares Outstanding - Diluted	**229.7**	231.6	232.5	232.3	232.5	**232.3**	228.5	230.7	227.6	225.1	**228.0**	223.1	221.1	219.1	217.1	**220.1**	**212.1**
Diluted EPS	**$1.61**	$0.58	$0.70	$0.65	$1.62	**$3.56**	($0.18)	$0.76	$0.80	$0.61	**$1.99**	$0.52	$0.51	$0.60	$0.67	**$2.30**	**$2.75**
Avg. Shares Outstanding - Diluted	**229.7**	231.6	232.5	232.3	232.5	**232.2**	231.5	230.7	227.6	225.1	**228.7**	223.1	221.1	219.1	217.1	**220.1**	**212.1**
Diluted EPS (Excl. Charges)	**$2.05**	$0.71	$0.78	$0.78	$0.97	**$3.24**	$0.84	$0.92	$0.86	$0.61	**$3.23**	$0.52	$0.51	$0.60	$0.67	**$2.30**	**$2.75**

Margin Structure*	2006	1Q07	2Q07	3Q07	4Q07	2007	1Q08	2Q08	3Q08	4Q08E	2008E	1Q09E	2Q09E	3Q09E	4Q09E	2009E	2010E
Cost of Goods Sold	**55.3%**	49.5%	48.0%	49.5%	45.2%	**47.9%**	48.3%	46.8%	50.6%	55.0%	**49.9%**	58.0%	60.0%	57.5%	57.0%	**58.1%**	**58.8%**
Gross Margin	**44.7%**	50.5%	52.0%	50.5%	54.8%	**52.1%**	51.7%	53.2%	49.4%	45.0%	**50.1%**	42.0%	40.0%	42.5%	43.0%	**41.9%**	**41.3%**
R&D	**2.3%**	2.2%	2.0%	2.1%	2.0%	**2.0%**	2.1%	1.9%	1.9%	2.2%	**2.0%**	2.1%	2.1%	2.0%	1.9%	**2.0%**	**1.8%**
SG&A Expenses	**6.2%**	5.7%	6.1%	6.1%	5.3%	**5.8%**	6.1%	5.7%	5.8%	4.9%	**5.7%**	5.8%	5.8%	5.5%	5.2%	**5.5%**	**5.4%**
Operating Margin	**36.2%**	42.6%	43.9%	42.3%	47.5%	**44.2%**	43.6%	45.6%	41.7%	38.0%	**42.5%**	34.2%	32.2%	35.1%	36.0%	**34.4%**	**34.1%**
EBITDA Margin	**40.8%**	46.9%	48.1%	46.7%	51.4%	**48.4%**	48.1%	50.4%	46.7%	44.8%	**47.7%**	42.1%	40.0%	42.3%	42.6%	**41.8%**	**40.7%**
Tax Rate	**19.0%**	15.0%	15.0%	15.0%	15.0%	**15.0%**	15.0%	15.0%	15.0%	15.0%	**15.0%**	15.0%	15.0%	15.0%	15.0%	**15.0%**	**15.0%**
Net Margin	**30.6%**	37.3%	40.0%	39.8%	74.7%	**49.0%**	3.2%	37.9%	34.4%	34.2%	**27.4%**	31.2%	29.6%	31.9%	32.6%	**31.4%**	**31.1%**

Source: Company reports and Deutsche Bank estimates

Companies mentioned

Figure 37: Companies mentioned in this report

Anwell Solar	Hemlock Semiconductor	Renewable Energy Corp
API Petrochemische	JA Solar	Samsung
Applied Materials	Kaneka	SAS
AU Optronics	LDK Solar	Schott AG
Auria Solar	MEMC Electronics	Sharp
AVA Technologies	MiaSole	Showa Shell
Best Solar	Mitsubishi	Signet Solar
Canadian Solar	Mitsubishi Heavy Industries	Sumitomo
Centrotherm	Moser Baer	SunPower Corp
Chi Mei	MoTech	SunTech Holdings
China Sunergy	M-Setek	SunWays AG
DC Chemical	Oerlikon Solar	Tokuyama
Energy Conversion Devices	Pacific Gas & Electric	Trina Solar
Evergreeen Solar	PhotoWatt	T-Solar
First Solar	PrimeStar Solar	Ulvac
General Electric	Q-Cells	Wacker Chemie
Global Solar	QS Solar	Wurth Solar
GT Solar	ReneSola	YingLi

Source: Deutsche Bank

Appendix 1

Important Disclosures

Additional information available upon request

For disclosures pertaining to recommendations or estimates made on a security mentioned in this report, please see the most recently published company report or visit our global disclosure look-up page on our website at http://gm.db.com/ger/disclosure/DisclosureDirectory.eqsr**.**

Analyst Certification

The views expressed in this report accurately reflect the personal views of the undersigned lead analyst about the subject issuers and the securities of those issuers. In addition, the undersigned lead analyst has not and will not receive any compensation for providing a specific recommendation or view in this report. Steve O'Rourke

Equity rating key	Equity rating dispersion and banking relationships

Buy: Based on a current 12- month view of total share-holder return (TSR = percentage change in share price from current price to projected target price plus pro-jected dividend yield) , we recommend that investors buy the stock.

Sell: Based on a current 12-month view of total share-holder return, we recommend that investors sell the stock

Hold: We take a neutral view on the stock 12-months out and, based on this time horizon, do not recommend either a Buy or Sell.

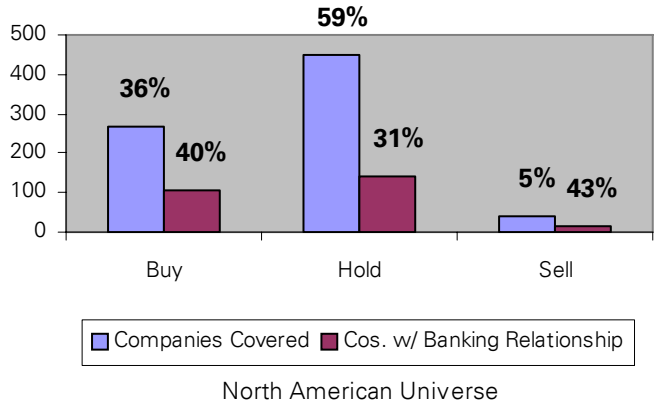
Notes:
1. Newly issued research recommendations and target prices always supersede previously published research.

2. Ratings definitions prior to 27 January, 2007 were:

Buy: Expected total return (including dividends) of 10% or more over a 12-month period

Hold: Expected total return (including dividends) between -10% and 10% over a 12-month period

Sell: Expected total return (including dividends) of -10% or worse over a 12-month period



North American Universe

Regulatory Disclosures

1. Important Additional Conflict Disclosures

Aside from within this report, important conflict disclosures can also be found at https://gm.db.com/equities under the "Disclosures Lookup" and "Legal" tabs. Investors are strongly encouraged to review this information before investing.

2. Short-Term Trade Ideas

Deutsche Bank equity research analysts sometimes have shorter-term trade ideas (known as SOLAR ideas) that are consistent or inconsistent with Deutsche Bank's existing longer term ratings. These trade ideas can be found at the SOLAR link at http://gm.db.com.

3. Country-Specific Disclosures

Australia: This research, and any access to it, is intended only for "wholesale clients" within the meaning of the Australian Corporations Act.
EU countries: Disclosures relating to our obligations under MiFiD can be found at http://globalmarkets.db.com/riskdisclosures.
Japan: Disclosures under the Financial Instruments and Exchange Law: Company name - Deutsche Securities Inc. Registration number - Registered as a financial instruments dealer by the Head of the Kanto Local Finance Bureau (Kinsho) No. 117. Member of associations: JSDA, The Financial Futures Association of Japan. Commissions and risks involved in stock transactions - for stock transactions, we charge stock commissions and consumption tax by multiplying the transaction amount by the commission rate agreed with each customer. Stock transactions can lead to losses as a result of share price fluctuations and other factors. Transactions in foreign stocks can lead to additional losses stemming from foreign exchange fluctuations.
New Zealand: This research is not intended for, and should not be given to, "members of the public" within the meaning of the New Zealand Securities Market Act 1988.
Russia: This information, interpretation and opinions submitted herein are not in the context of, and do not constitute, any appraisal or evaluation activity requiring a license in the Russian Federation.

Deutsche Bank Securities Inc.

North American locations

Deutsche Bank Securities Inc.
60 Wall Street
New York, NY 10005
Tel: (212) 250 2500

Deutsche Bank Securities Inc.
225 Franklin Street
25th Floor
Boston, MA 02110
Tel: (617) 988 8600

Deutsche Bank Securities Inc.
222 South Riverside Plaza
30th Floor
Chicago, IL 60606
Tel: (312) 537-3758

Deutsche Bank Securities Inc.
3033 East First Avenue
Suite 303, Third Floor
Denver, CO 80206
Tel: (303) 394 6800

Deutsche Bank Securities Inc.
1735 Market Street
24th Floor
Philadelphia, PA 19103
Tel: (215) 854 1546

Deutsche Bank Securities Inc.
101 California Street
46th Floor
San Francisco, CA 94111
Tel: (415) 617 2800

Deutsche Bank Securities Inc.
700 Louisiana Street
Houston, TX 77002
Tel: (832) 239-4600

International locations

Deutsche Bank Securities Inc.
60 Wall Street
New York, NY 10005
United States of America
Tel: (1) 212 250 2500

Deutsche Bank AG London
1 Great Winchester Street
London EC2N 2EQ
United Kingdom
Tel: (44) 20 7545 8000

Deutsche Bank AG
Große Gallusstraße 10-14
60272 Frankfurt am Main
Germany
Tel: (49) 69 910 00

Deutsche Bank AG
Deutsche Bank Place
Level 16
Corner of Hunter & Phillip Streets
Sydney, NSW 2000
Australia
Tel: (61) 2 8258 1234

Deutsche Bank AG
Level 55
Cheung Kong Center
2 Queen's Road Central
Hong Kong
Tel: (852) 2203 8888

Deutsche Securities Inc.
2-11-1 Nagatacho
Sanno Park Tower
Chiyoda-ku, Tokyo 100-6171
Japan
Tel: (81) 3 5156 6701

Global Disclaimer

The information and opinions in this report were prepared by Deutsche Bank AG or one of its affiliates (collectively "Deutsche Bank"). The information herein is believed to be reliable and has been obtained from public sources believed to be reliable. Deutsche Bank makes no representation as to the accuracy or completeness of such information.

Deutsche Bank may (1) engage in securities transactions in a manner inconsistent with this research report, (2) with respect to securities covered by this report, sell to or buy from customers on a principal basis, and (3) consider this report in deciding to trade on a proprietary basis.

Opinions, estimates and projections in this report constitute the current judgment of the author as of the date of this report. They do not necessarily reflect the opinions of Deutsche Bank and are subject to change without notice. Deutsche Bank has no obligation to update, modify or amend this report or to otherwise notify a recipient thereof in the event that any opinion, forecast or estimate set forth herein, changes or subsequently becomes inaccurate. Prices and availability of financial instruments are subject to change without notice. This report is provided for informational purposes only. It is not an offer or a solicitation of an offer to buy or sell any financial instruments or to participate in any particular trading strategy.

The financial instruments discussed in this report may not be suitable for all investors and investors must make their own informed investment decisions. Stock transactions can lead to losses as a result of price fluctuations and other factors. If a financial instrument is denominated in a currency other than an investor's currency, a change in exchange rates may adversely affect the investment. Past performance is not necessarily indicative of future results.

Unless governing law provides otherwise, all transactions should be executed through the Deutsche Bank entity in the investor's home jurisdiction. In the U.S. this report is approved and/or distributed by Deutsche Bank Securities Inc., a member of the NYSE, the NASD, NFA and SIPC. In Germany this report is approved and/or communicated by Deutsche Bank AG Frankfurt authorized by the BaFin. In the United Kingdom this report is approved and/or communicated by Deutsche Bank AG London, a member of the London Stock Exchange and regulated by the Financial Services Authority for the conduct of investment business in the UK and authorized by the BaFin. This report is distributed in Hong Kong by Deutsche Bank AG, Hong Kong Branch, in Korea by Deutsche Securities Korea Co. and in Singapore by Deutsche Bank AG, Singapore Branch. In Japan this report is approved and/or distributed by Deutsche Securities Inc. The information contained in this report does not constitute the provision of investment advice. In Australia, retail clients should obtain a copy of a Product Disclosure Statement (PDS) relating to any financial product referred to in this report and consider the PDS before making any decision about whether to acquire the product. Deutsche Bank AG Johannesburg is incorporated in the Federal Republic of Germany (Branch Register Number in South Africa: 1998/003298/10). Additional information relative to securities, other financial products or issuers discussed in this report is available upon request. This report may not be reproduced, distributed or published by any person for any purpose without Deutsche Bank's prior written consent. Please cite source when quoting.

Copyright © 2009 Deutsche Bank AG