Off Wall Street
Consulting Group, Inc.

P.O. Box 2647
Cambridge, MA 02238

tel: 617.868.7880
fax: 617.868.4933
internet: research@offwallstreet.com

New Rec: American Superconductor (AMSC$57.13) Mar 6,2000

Position: Sell Target: $25 Timing: 2 (1=aggressive; 5=cautious)

$000	Q4 00e	Q1 01e	Q2 01e	Q3 01e	F2000E	F2001E	F2002E	F2003E
Rev.	5100	3790	4515	3790	14935	15885	16460	17860
EPS $	(0.24)	(0.15)	(0.19)	(0.20)	(1.06)	(0.78)	(1.13)	(1.44)
YYGro	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CnsRev	n/a	n/a	n/a	n/a	15700	54100	101200	204400
PSR	n/a	n/a	n/a	n/a	73	69	66	61
Consen	n/a	n/a	n/a	n/a	(1.06)	(0.12)	0.48	2.03

CnsRev=Consensus Revenue Projection

Shs.Out: 19.13M Market Cap: $1.1 B FYE: March

Summary: AMSC shares have more than quadrupled in the last six months, powered by a doubling of “street” sales estimates and by the publication of a report by the Gilder Group touting American Superconductor as a company that has a technology that could be critical to “the new information power market.”

Superconductors can carry direct current (DC) with no loss of energy to dissipation from resistive heating. However, superconducting materials lose resistance to electrical current only at very low temperatures. High temperature superconductors are only “high temperature” relative to low temperature superconductors. High temperature superconductors actually operate at about minus 321 degrees Fahrenheit, while low temperature superconductors operate at minus 452 degrees Fahrenheit.

Both "street" analysts and Gilder Group are enthused about the market potential for Superconducting Magnetic Energy Storage (SMES) units, which use Low Temperature Superconductivity (LTS), and which store electricity which can be quickly released in the event of a voltage disturbance. They argue that the internet economy will require higher power "quality" and reliability, and that utilities view SMES units of different sizes as cost effective and dependable solutions to the impending problem. Despite having lowered near term SMES sales estimates from $42 M to $27 M in 2002 because of disappointing results, analysts now predict SMES sales will reach $500 M in 2008.

The second leg of the bull story for AMSC is High Temperature Superconductors (HTS). HTS wire, unlike copper, experiences little or no energy loss while transmitting energy. While SMES is supposed to be the biggest revenue generator for AMSC near term, HTS is promoted as the more important revenue generator longer term. HTS sales estimates have also been raised recently, supposedly because of successes with demonstration programs for HTS, especially with underground cable. Analysts also claim that manufacturers are interested in HTS because it reduces size and weight and cost in large electric motors and generators.

There are several reasons why the "street's" expectations for both SMES technology and for HTS technology are unrealistic. With regard to SMES, analysts project that 50% of total electricity will be used by the internet in a decade. We doubt that will be the case. One utility company representative calls the idea "ludicrous". Even were it true, the quality problems that analysts anticipate as a result would not likely occur since utilities plan their facilities well ahead for increased usage. Moreover, computer users would require longer backup capability than the one or two seconds offered by SMES, so that a local backup would be required anyway. Computer users are not likely to trust the utility with mission critical computers and will want their own backup. Computer "farms" will continue to use UPS and generators. For these reason so-called power quality SMES will be unnecessary.

SMES is also not a solution to capacity overload, and will not replace new power lines, as analysts contend. While so-called distributed SMES (D-SMES) may help stabilize dangerously overloaded lines, this would only be a temporary solution in unusual situations, as we discuss below, and utilities will build more lines to solve overload problems.

It is interesting to note that the Gilder Group report which has been the "intellectual" fuel powering AMSC shares higher makes a serious fundamental error in its description of SMES technology when it calls it a HTS technology, and claims it uses HTS coils. SMES is not based on HTS technology, but is rather a Low Temperature Superconducting technology. This error shows Gilder Group's fundamental lack of understanding of the issues involved.

While AMSC entered the SMES business in 1997, it has been in the HTS business since 1987. HTS has never been and is not likely to ever be a successful product. The problems are numerous. First, it does not appear to be well understood that the manufacture of HTS wire requires the use of silver metal. This alone makes HTS wire uncompetitive with copper. AMSC likes to tout the Pirelli cable project in Detroit, where over 400 feet and 18,000 pounds of copper will be replaced by a 250 pounds of HTS wire. The HTS cable is only one third the diameter of the copper cable it is replacing and maintains the power rating of the copper cable. However, management does not mention that of the 250 pounds, 218 pounds is silver metal costing over $16,000 versus the less than $15,000 needed to buy the copper. Were HTS to ever take off, it would drive silver prices through the roof and would render the product still less competitive. Regrettably, we think the only replacement for the silver is gold.

Currently AMSC reports that it can manufacture HTS wire for $300/kA-m. Copper costs $10/kA-m (kilo-ampere-meters). The company thinks that over a five year period and with a boosting of capacity from the current 200km/year to 2,000km/year it could bring the cost down to $50/kA-m, still not nearly competitive with copper. Even then this estimate does not appear to take into account the possibility of higher silver prices, or improvements in copper cable manufacturing that might take place. Thus, even if AMSC were to be successful in its goal in five years, HTS could only be used in very limited applications where it would be impossible to use copper. This would be only in places where the amount of space available is not large enough to fit copper, but would accommodate the 66% thinner HTS cable. The small number of applications that might justify the much higher cost will not be enough to make HTS a commercial success. In addition, so called "life-cycle "costs of maintaining HTS installations should increase their relative cost. These include cooling equipment needed to maintain low temperatures and backups for the cooling equipment in the event a cooling system goes down. It will take many, many years before "life-cycle" costs of HTS are well understood because there will be so few installations.

But HTS has other problems. While $10/kAm would make HTS competitive, the company also claims that even at $50/kAm some applications would be feasible. When AMSC talks about reaching $50/kAm, and perhaps someday $10/kAm, merely by raising capacity, it is not describing a run of wire that could actually be used in a field application. Wire that could actually be used in field applications will be much more costly to produce because more wire will be needed in application than in theory. First, when transmitting alternating current, which is the majority of applications, HTS is not "superconducting" and does have energy losses. Though the nominal losses from the HTS wire are less than with copper cable, these losses are magnified by at least 11 times by the cooling systems required to run with HTS wire, because they also use a lot of power. Thus, HTS is not as energy saving as is commonly believed. In order to keep the AC losses to acceptable levels, significant amounts of redundant extra HTS wire must be incorporated, further reducing the wire's competitiveness. Another show-stopping problem is that the conduction capacity of HTS wire drops significantly as length increases, meaning proportionally more wire is needed for longer applications. There has been very little improvement in this area. As a result, only unusual short run applications might use HTS, but they will be few and far between. Longer run applications would require much more wire density, and would raise the cost significantly.

Furthermore, HTS are extremely vulnerable to magnetic fields, which limit their ability to conduct. In fact, for any envisioned application, costly additional HTS wire would be needed because even the magnetic field generated by the HTS wires themselves significantly reduce the wire's current-carrying capacity. The notion that motors and generators, which require high magnetic fields, will use HTS is made highly dubious by the fact that in order to get around this problem, motors using HTS wire are envisioned being operated closer to the temperatures of low-temperature-superconductors than of high-temperature superconductors. This means that the main advantage of HTS, which caused the initial euphoria over their discovery in 1986, namely its ability to be cooled cheaply with liquid nitrogen, would no longer hold because liquid nitrogen would not cool the HTS wire to the lower temperatures required.

Thus, serious technical problems should prevent HTS from ever becoming commercially viable. We go into these technical problems, and their cost implications, for those so inclined, in more detail, below.

Finally, we note that predictions that AMSC could make a commercially viable product at a cost of $50/kAm or at $10/kAm, and would find a market at these price levels do not allow AMSC to make any money, since it would be selling product at its cost. AMSC will have to sell product at twice its cost to earn a 50% gross margin. This makes the idea that AMSC can ever make money even more outlandish.

Thus, while AMSC has been an interesting company from a theoretical point of view, it is not likely to ever be a commercial success. It really should not be a public company, in our view, because it is basically sucking the public’s money into a large research hole from which investors will never emerge with company profits. Of course, that is not the same thing as stock market profits, which are obtainable even when no business profits will ever exist, as long as share prices go up.

Discussion:

I. SMES

1. AMSC's SMES product was developed by Superconductivity Inc, which AMSC acquired in April 1997. SMES uses LTS to store electricity which it can quickly release in response to voltage sags of less than a couple seconds in duration. In this way equipment backed up by a SMES is protected from short (about 1 second) voltage disturbances which otherwise could have triggered expensive equipment shut-down. SMES units cost from $725,000 to $1 million per unit and are the only commercially available product AMSC purports to

have.

Initially AMSC attempted to market power-quality (PQ)- SMES units to manufacturing plants. In February 1999 AMSC began marketing "distributed"-SMES, or D-SMES to utilities with the idea that if multiple SMES units were distributed over a transmission grid they could protect the utilities customers from voltage sags.

2. On Sept. 29, 1999 the Gilder Group released the inaugural issue of the "Power Report." The report also inaugurated a run up in AMSC's stock price from $13 to over $60 per share. In the report the authors contend that the internet and telecommunications revolutions will demand higher-quality electricity, or "information-quality" power as they call it. Despite the fact that the computer, internet and telecommunications revolutions have proceeded nicely under present power-quality levels, they pronounce that "Information-quality power is one of the greatest business opportunities of our time." Finally they feature AMSC as a company primed to cash in on all of this courtesy of their SMES product. However, the authors betray their lack of knowledge about AMSC when they incorrectly state that AMSC's SMES product is based on HTS technology when in fact SMES is based on LTS technology.

3. In its prospectus for the recent secondary offering, AMSC promotes the following investment thesis:
a) The rapid growth of the internet will mean that within 20 years "30% to 50% of the nation’s electricity supply may be required to meet the direct and indirect needs of the internet."
b) The current electric transmission system is already taxed and either is, or will become unable to offer the level of voltage stability needed by this growing internet economy.
c) Therefore i) AMSC's D-SMES product will be demanded by utilities to provide voltage stability to their section of the transmission grid. ii) AMSC's HTS cables will be positioned to replace some 2,200 miles of power cable in the US so as to increase their capacity.

Not only does this thesis say nothing about the competitiveness of SMES vis-a-vis a myriad of established voltage stability solutions offered by established companies such as ABB, and Siemens, it also defies common sense. Computing, internet, and telecommunications use has, and continues to grow at a breathtaking pace despite the supposedly dire quality problems of the present transmission system. Security, bandwidth, speed, software compatibility, intellectual property, and software bugs all appear to be far greater constraints to the internet economy than the capacity of the electric transmission network. Most of the recent power quality incidents appear to revolve around increased use of air conditioners during the summer rather than increased web surfing activity.

Indeed, one utility company executive described the notion that that the internet economy would consume 50% of the nation's electric power as “absolutely ludicrous”, and said that population and air conditioning are the major drivers of demand.

Moreover, while power outages are a threat to many industries, power quality SMES, or PQ-SMES, is not a solution for them. SMES can provide at best about one second of protection from voltage disturbances. Battery backups are commonly available in such cases and can provide power until a backup generator can be started, which SMES cannot.

4. D-SMES, which is the product that AMSC would like to market to utilities is not really a power quality solution, as AMSC management would like investors to think. Our utility industry sources tell us that D-SMES is not even intended as a power quality application for them since it won't protect either them or their customers from experiencing voltage faults. Customers who want protection from these faults would still need to employ power quality equipment on-site. In fact D-SMES makes no sense as a fault-protection device for a utility's transmission grid since utilities do not want to inject extra power at the moment of the fault. Rather, D-SMES is intended to help the utility maintain voltage on a heavily loaded portion of its grid only after a fault has occurred.

Industry sources tell us that D-SMES would only make sense in sections of their grid which are isolated, and which can only be radially connected to a single generator. We think the number of such opportunities is limited because for reliability reasons utilities almost always connect their transmission systems with adjacent utilities and generators. We think it is rare that a section of the transmission grid would be served by only one generator.

5. SMES sales have always fallen well short of management expectations. In March 1999 AMSC announced it anticipated sales of 30 SMES units during the fiscal year. Nine months later (Jan. 2000) it had only announced 10 orders, with 4 more hoped for in FQ4 2000.

AMSC's first announced order for D-SMES was six units to the Wisconsin Public Service (WPS) and had nothing to do with the state securing its future as an internet mecca. Rather, Wisconsin's voltage stability problems stemmed from an unexpected growth in summer tourism and cottage-goers served by an isolated portion of the transmission grid.

D-SMES was such a hard sell that AMSC had to provide WPS a buyback provision for the 6 units. AMSC won't recognize any revenue on the units until this provision expires. From AMSC's May 10 1999 press release:

> "For this first D-SMES system, American Superconductor included an innovative buyback provision that gives Wisconsin Public Service a high degree of flexibility in strengthening its position in the new, competitive utility environment. American Superconductor has agreed to buy back one or more of the SMES units after 2002 depending on WPS's changing needs. American Superconductor has opted to defer recognition of revenue from this sale to a future date based on the terms of the buyback option."

The term "innovative" seems inappropriate to describe the giving away of product. It is a sign of AMSC's desperate need for affirmation of the D-SMES business model that it would make such a deal.

We think the only reason WPS choose D-SMES, is because of the buyback provision. Patrick Schrickel, COO of WPS even said as much: "By using D-SMES, WPS avoided or delayed a $4.5 million investment at this point in time."

6. We think AMSC may realize no revenue from the 6 D-SMES it "sold" to WPS. The initial 6 D-SMES serve only as a stop-gap solution to the WPS stability problem in its northern loop. WPS has published its cost models for 6 longer-term solutions. The cheapest of these, called the "Tripoli-Highway 8 plan" costs $12 million and calls for the 6 SMES units to be removed and sold for $3.75 million in 2002. This solution takes advantage of a major new 345 kV transmission line WPS is building from Minnesota to Tripoli (Wisconsin) scheduled for completion before the end of 2002, and which involves building a new 115 kV line from Tripoli to the northern loop.

By comparison, the "D-SMES plan," which would entail adding 6 additional SMES units through to 2010, would cost $17 million and would have the highest transmission losses of any solution.

Consequently, we think WPS will return the 6 SMES units to AMSC in 2002/2003.

7. It is interesting to note that prior to the announcement of the sale of D-SMES to WPS in May 99, the State of Wisconsin Investment Board owned 994,300 shares (then 6.36%) of AMSC. It sold 18% of the position over the course of AMSC's stock run-up between Oct. 27 1999 and Feb. 2 2000, bringing its stake to 810,900 shares. By affirming AMSC's D-SMES strategy, the WPS order has contributed to a run-up in AMSC stock price which has benefited the state retirement fund by about $30 million in gains at current prices.

Wisconsin is also home to The University of Wisconsin Applied Superconductivity Center in Madison. This center was started in 1982 and is a major center for superconductivity education and research in the US, with about $3 million in funding per year. AMSC is listed as an industry sponsor of the center and AMSC lists the center as a collaborative research partner. Two alumni from the center now work for AMSC. The center also appears to have a close relationship to SMES. In its promotional literature SMES is listed as one of six "major technology transfer exercises of the center."

Finally, and perhaps no longer surprisingly, the division of AMSC which manufactures SMES units, Superconductivity Inc., is based in Madison Wisconsin.

8. A competitor to AMSC, Intermagnetics General Corp, delivered a SMES prototype to the US Air force for testing in their FY ended May 30 1999. However, Intermagnetics dropped its SMES project because, according to Intermagnetics, "the cost of SMES is significantly higher than for other energy

storage systems." Intermagnetics thinks there is essentially no market for SMES other than for a few extreme and desperate situations.

9. In another sign that AMSC is having difficulty selling SMES units, AMSC's inventory "primarily in the SMES business unit," has ballooned $2.965 million, up 59 % for the 9 months ended Dec. 31 1999. In fact AMSC's inventory has increased sequentially every quarter since March 31 1998, and is now up 147% from March 98 despite flat revenue.

10. Thus, while Wall Street has raised near term estimates for SMES, and calls it a reason to buy AMSC shares, the reality is that AMSC has installed only 2 units in the past 9 quarters and does not appear to have actually received any revenue for the unit installed at an Owens Corning plant in April 98 (FQ1 99).

Even though AMSC has announced 10 SMES units ordered in FY2000, none have been shipped and no revenue has been recognized on these sales announcements to-date.

SMES does not appear to be a profitable business for AMSC. At $725,000 per unit, the price of SMES is too high for AMSC to sell many units, but too low to make money. The table below shows total SMES revenue and units sold. Much of the revenue prior to FY 1999 was from development contracts rather than from commercial sales.

Fiscal Year: $,000	1995	1996	1997	1998	1999	2000 (9 months to Dec. 99)
SMES rev	4,323	3,633	3,376	3,563	1,510	585
SMES net inc.	(1,264)	(2,378)	(2,955)	na	na	na
SMES op. inc.	na	na	(1,934)	(2,670)	(5,246)	(5,031)
Units shipped	0	2	2	4	2	0
AMSC-projected SMES unit sales:						30
units ordered:						10

SMES sales by quarter:

$,000	Q4 97	Q1 98	Q2 98	Q3 98	Q4 98	Q1 99	Q2 99	Q3 99	Q4 99
SMES rev	262	2,269	791	437	66	22	63	14	1,410
SMEs op. inc.						(1,221)	(1,374)	(1,329)	(1,321)
units shipped	0	3	1	0	0	1	0	0	1

	Q1 00	Q2 00	Q3 00
SMES rev	289	233	63
SMEs op. inc.	(1,675)	(1,545)	(1,811)
units shipped	0	0	0

II. HTS

11. We think AMSC may never successfully commercialize its HTS products. AMSC provides some of the explanation for this on page A-6 of its FY1999 10-K: "The Company has produced and sold prototype HTS wires and electromagnetic coils for use in several development and demonstration

programs. Nevertheless, significantly better strength, flexibility, and electrical performance need to be achieved over longer wire lengths and at lower costs for the commercialization of HTS wire and wire products to be successful. Despite the advances to date...hurdles to commercialization continue to exist."

12. Let's begin with cost. Investors don't know much about HTS, but they do know about silver. The process used by AMSC to manufacture HTS wire requires the use of silver metal. While the cost of the silver metal required currently represents only about 2.5% of the total manufacturing cost of HTS wire, by our estimate, this cost alone makes HTS wire uncompetitive with copper wire.

A demonstration project is underway whereby Pirelli cables will use AMSC's HTS wire to build a HTS cable for installation into a 400 foot-long underground section in Detroit. AMSC likes to highlight the fact that 18,000 lbs of copper will be replaced by only 250 lbs of their HTS wire. However, they neglect to point out about 218 lbs of this is silver and that they are replacing $14,700 worth of copper with $16,300 worth of silver, which is 95 times more expensive per lb.

Silver is irreplaceable to AMSC's HTS wire manufacturing process for a variety of technical reasons: its permeability to oxygen and inertness to the superconducting material are a couple of the more crucial reasons why silver, and only silver is useful (gold could be used but it is even more expensive.)

The final cross section of the HTS wire typically consists of 70% silver and 30% superconducting material by volume and there is essentially no technical way to eliminate the amount of silver needed in AMSC's wire production process.

Copper conductor costs about $10/kilo-Ampere-meter (kAm). In order for HTS wire to replace copper it must be cheaper than this. However, just on the basis of the cost of silver alone, HTS wire is already far more expensive.

13. Additionally, HTS also possess fundamental technical limitations which will make them uncompetitive for commercial applications.

Superconductors are not "superconducting" when transmitting alternating current (AC). They have losses. This is a major problem because all of AMSC's proposed HTS applications of which we are aware involve AC.

Even though these losses are nominally lower than for copper cable, they are multiplied by many times when the power consumed by the cooling system is also accounted for. The result is that HTS has no advantage over copper in terms of reducing the amount of power lost within the device. They are not energy saving as is commonly believed.

14. Industry observers have long held that in order for HTS wire to be commercially cost-competitive the cost of HTS wire must reach $10/kAm.

AMSC also argues that some applications would be feasible at $50/kAm. AMSC claims it can reach a cost of $50/kAm in five years.

However, the problem with AMSC's claim to be able to reach a cost of $10/kAm or $50/ kAm in the laboratory is that it is not the same as reaching these cost levels outside the laboratory and in the field. For any real final application, the amount of HTS wire required will actually be significantly higher than one would expect based just on the nominally reported values of current density.

a) The HTS material is very brittle and will lose some of its current carrying capacity during the wrapping process incorporating it into a cable or other product. Furthermore, during operation, the HTS wires in the final product will create magnetic fields which interact with each other and reduce their collective current carrying capacity. Due to these factors, HTS wire incorporated into a cable will typically lose 35% of its current carrying capacity, meaning that 1.5 times more HTS wire is required.

b) It is not widely understood that the AC losses in HTS wire can actually be quite serious if the wire is operated near its nominal current-carrying limit. Almost all of AMSC's proposed applications are AC. In order to suppress AC losses to an acceptable level, the cable would need to operate at only a fraction of its nominal capacity - likely less than half. Therefore, 2 to 5 times (or even more) additional HTS wire would be needed in order to suppress AC losses. The tradeoff here is between paying for more HTS wire up-front, or paying more in operating costs to keep the wire cool after it has been installed.

c) Applications are designed around the average current carrying capacity specified for the application. However, for AC applications, the current is constantly fluctuating and the peak current is 1.4 times greater than the average current. This means that the cable must be designed with 1.4 times more HTS wire than one would expect based on reported values of current density.

d) Every HTS power application must be designed with excess current-carrying capacity so that heavy-loading conditions do not exceed the HTS wire capacity. We estimate about 1.5 times more wire would be needed to accommodate this.

We therefore conservatively estimate that 6 times more HTS wire would be needed for the majority of potential applications compared to the amount one might expect based on nominally reported values of current density. Therefore, even if AMSC succeeds in reduce the nominal cost of its HTS wire to $50/kAm by 2004, its final cost for product usable for an application would still be $300/kAm - far higher than the $50/kAm cost claimed as viable for some commercial niches.

The table below shows that AMSC would need to reach nominal wire performance of 630 kA/cm^2 in order to realize the hoped for $50/kAm target for final applications. However, the theoretical maximum current density attainable for the bismuth-based HTS material which AMSC uses is only about 1000 kA/cm^2. We don't think AMSC can ever realize a long-length HTS wire having 630 kA/cm^2.

In the past, AMSC has increased the current density of short (less than 3 feet) samples of its wire at a rate of about 9 kA/cm^2 per year. Thus, even if 630 kA/cm^2 were even possible with AMSC's present wire making process, based on the historical rate of wire improvement it would take 60 years to realize 630 kA/cm^2 on a short sample.

No provision has been made for profit for AMSC. If gross margins of 50% are included, the HTS performance would again need to double. Yet this would still be an underestimate because the cost of incorporating the HTS wire into HTS cable, and the gross margins of the cable manufacturer have not been included. HTS cable is far more complicated than copper cable, and so the cost of making HTS cable would also be higher.

Cost of HTS wire based on reported (nominal) current density.

		Reported HTS wire current density:		Cost breakdown of HTS wire:							
	Tape length	Whole wire	HTS portion	Silver	Silver	BSCCO	BSCCO	Manf	Manf.	tot.	tot.
Year	(feet)	kA/cm^2	kA/cm^2	$/kAm	$/m	$/kAm	$/m	$/kAm	$/m	$/kAm	$/m
1997	300	5.3	15.9	21.2	1.1	28.0	1.5	950.7	50.2	1000	52.8
1998	500	10	30	11.3	1.1	14.9	1.5	473.9	47.2	500	49.8
1999	650	14	42	8.0	1.1	10.6	1.5	281.4	39.3	300	41.9
2004	650	35	105	3.2	1.1	4.2	1.5	42.5	14.8	50	17.4

Current density needed for HTS wire to realize $50/kAm

		Reported HTS wire current density:	
	Tape length (feet)	Whole wire	HTS portion
Year		kA/cm^2	kA/cm^2
1997	300	636	1908
1998	500	600	1800
1999	650	504	1512
2004	650	210	630

15. The conduction capacity of a HTS drops significantly as the length of the wire increases. This means that if the application which the HTS wire will be used for is greater than the length at which the current density of the wire is reported, then still more HTS wire would be needed. While AMSC likes to report the performance improvements of shorter lengths of HTS wires, we understand that in cities underground cables are typically 2,000 to 25,000 feet in length.

16. HTS are also extremely vulnerable to external magnetic fields which could

cut their ability to conduct. Motor and generator applications require high magnetic fields. In order to be effective, motors using HTS must therefore operate at lower temperature. Prototype HTS motors are operated at about 27 K (Kelvin), which is -411F, which is a very low temperature, and which is an uneconomical temperature at which to operate a motor or generator.

17. Because HTS products must always be kept at liquid nitrogen temperatures, they will always require a cryogenic cooling system. The potential for failure of this parallel cryogenic system means that no HTS electrical product is likely to ever be as reliable or robust as copper-based equipment. The conservative electric utility industry with its focus on reliability therefore makes HTS-based electrical equipment a tough sell. These cooling systems and the backups required to keep them going in case one fails add to the overall costs of HTS.

18. Others have noted the problems. For example, a study produced by Bob Lawrence and Associates under contract to the Oak Ridge National Laboratory predicts that commercial introduction of HTS cable could begin only when " HTS cable with life cycle costs equal to conventional cable, and with twice the ampacity, has been demonstrated for at least 4 years , in multiple units and in multiple utilities."

We think that commercial HTS applications will be rare, and will only exist where limited space will not allow for a copper installation. These instances might exist in unusual circumstances in certain parts of urban areas where digging up and replacing a conduit may not be economically feasible. Even in these cases space will have to be found somewhere to house the cooling system that accompanies the HTS cable installation.

19. The market has recently become enthused about several other HTS companies. Conductus (CDTS), Superconducting Technologies (SCON) and Illinois Superconductor (ISCO) have recently run up on speculation that their HTS filters may become commercially useful for cellular phone base station applications.

Developments at these companies bear no relevance whatsoever to the success of AMSC. AMSC's HTS products are all focused on bismuth-based HTS wire made with the OPIT (oxide powder in tube) process and are intended for electrical equipment applications. CDTS, SCON and ISCO focus on a yttrium-based HTS produced by a totally different deposition processing route. Yttrium and bismuth-based HTS have radically different properties which make them non-interchangeable.

20. AMSC's 10K warnings about wire performance are important. AMSC needs to greatly improve HTS wire performance, but such improvement has been and will continue to be very slow.

Every year, in a section of its 10-K entitled "Status of HTS Wire Development," AMSC offers some wire performance numbers. It is a case where the quantity and quality of information provided is inversely proportional to its importance: the long-length wire current density is the single most important factor in evaluating the commercial potential of HTS.

The table below shows what AMSC reported in its 10-K for current density since 1993. Investors might note that AMSC never uses the same criteria for reporting its wire current density for more than two years consecutively. This makes it difficult for the layperson to make meaningful wire performance comparisons between years. However, in the table below we present the same data, but adjusted to allow for direct comparisons. What becomes clear is that except for 1998 when AMSC apparently doubled wire performance, performance improvements are too slow to matter, ranging from 0% to 20% per year.

HTS wire performance reported by AMSC in their 10-K

Year	Current density (kA/cm^2)	Wire length: (ft)	Measurement method:
1993	10.5	1000	HTS portion of wire
1994	8.8	3800	"
1995	12.7	3000	"
1996	12.7	3800	"
1996	16.5	300	"
1997	12.7	3800	"
1997	16.5	300	"
1998	10.0	500	Whole wire: HTS + (silver sheath)
1999	12.0	500	Whole wire: HTS + (silver sheath)

	Current density: whole wire (kA/cm2)		HTS portion of wire (kA/cm2)	
Year	wire length: 500 ft	wire length: 3800 ft	wire length: 500 ft	wire length: 3800 ft
1993	3.9	2.8	11.6	8.4
1994	4.0	2.9	12.0	8.8
1995	5.2	4.1	15.6	12.3
1996	5.3	4.2	15.9	12.7
1997	5.3	4.2	15.9	12.7
1998	10.0	8.9	30.0	26.8
1999	12.0	10.9	36.0	32.8

We think the manufacturing process used by AMSC for HTS wire offers little chance for the kind of revolutionary leaps in wire performance that would be needed in order to make them commercially viable. In fact AMSC's Dec. 15 1999 development contract renewal agreement with Pirelli actually states this when it calls for "evolutionary" manufacture improvements.

> "The critical current performance will be increased by invoking evolutionary manufacture improvements. These improvements will be centered on observations obtained during production manufacture campaigns."

Conclusion: 1998 was a special case. Future performance improvement will be too slow to matter.

21. AMSC's early strategic R&D partners - Inco and Hoechst - focused on jointly developing processes for making HTS wire. This makes sense. A viable HTS wire making process is needed before HTS products can be commercialized using HTS wire. We think the fact that both of AMSC's wire making development partners terminated their contracts in mid-stream serves as a major no-confidence vote on the commercial potential of HTS wire.

AMSC's earliest development partnership was with the major Canadian nickel producer Inco and began in 1988, shortly after AMSC was founded in 1987. The partnership was intended to develop the "metal precursor" (MP) process for making HTS wire. The partnership planned to set up, by January 1996, a joint-venture to sell the raw materials needed for this process. Instead, Inco concluded there was no future in HTS and terminated its participation on Dec. 31 1996. It took Inco 9 years and $9.5 million dollars to reach this conclusion. AMSC has since stopped using the MP wire-making process.

In Feb. 1993 AMSC entered into an agreement with Hoechst to accelerate the "oxide powder-in-tube" (OPIT) process for making HTS wire. The project was to progress in two stages. Stage I (which was in 2 phases) intended to realize pilot-line manufacturing experience while stage II called for $7.5 million in funding from Hoechst to form a business relationship to commercialize HTS wire made by the OPIT process. Hoechst terminated its participation after just the first phase of stage I. Despite this, the OPIT process is today the only one AMSC and others use for manufacturing HTS wire.

AMSC now only has strategic partners who develop applications, leaving wire development completely to AMSC. AMSC has learned what happens when its industrial partners are closely involved in wire manufacturing: they quit wasting their money.

AMSC Strategic Partnerships					
HTS Wire Development Partners					
Partner	Partner responsibilities	Start Date	End date	Total funding provided ($,000)	
Inco	Develop the "metal precursor" (MP) process for making HTS wire	1988	terminated by Inco: Dec. 96	$9,500	
Hoechst	Develop the "oxide powder in tube" (OPIT) process for making HTS wire.	Feb. 18 1993	terminated by Hoechst: August 94	$1,800	

HTS Application Development Partners					
				Total funding provided to March 31 1999 ($,000)	Total funding remaining in contract
Pirelli	HTS cable design.	Feb. 1 1990	expires Sept. 30 2003	$15,300	$13,800
ABB	HTS transformer design.	April 1 1997	expires March 31 2001	$3,300 + $10,000 in equity	$1,700
EDF	HTS transformer design.	April 1997	expires March 31 2001	$3,400	$1,600

22. AMSC has a history of disappointing investors. For many years AMSC touted 1997 as the year it would finally launch its first significant commercial product - CryoPower . However, come June 1997, the company said that it had shifted its resources in power electronics away from the much-vaunted CryoPower to the new "clear growth opportunity" of SMES. SMES sales have been anemic and have lost money every quarter.

Investors should today have a sense of deja-vu, since AMSC is today promoting HTS cables and motors promising the same supposed benefits, size and weight savings, which it touted in its abandoned CryoPower product back in ‘95/’96.

23. Recent financial results leading up to the company’s secondary offering may not be as good as they seem. $2.5 M of revenue is associated with the December 15 1999 extension of Pirelli's previous development contract with AMSC which had ended Oct. 1 1999. As part of this extension AMSC recognized $2.5 million in revenue from Pirelli for R&D supposedly carried out prior to the quarter. This makes it look like Q3 was a breakout quarter with revenue doubling over the previous year when in fact revenue was flat.

The $2.5 M is further suspect since Pirelli had already paid AMSC 100% of the $ 7.75 million called for under the March ‘96 - Sept ‘99 development agreement. Pirelli also doesn't appear very anxious to pay this $2.5 million since it only agreed to do so in quarterly installments over the next 5 years. Five years seems a long time to pay for work ostensibly carried out in the past, especially given that the extended development agreement with AMSC only lasts four years.

AMSC was in dire need of cash, and inflated Q3 revenues could have helped to create interest in its February secondary offering. AMSC has been growing its cash burn rate. Given the growing burn rate, and without new funding, AMSC could have expected to entirely run out of funds around June 2000.

As previously noted, AMSC has also been steadily growing inventory for the past 9 quarters. It is hard to imagine why a company whose revenue derives mainly from R&D would need 281 days of inventory.

24. Financial projections:

$,000's	Q3 00 (12/99)	Q4 00E (3/00)	Q1 01E (6/00)	Q2 01E (9/00)	Q3 01E (12/00)	Q4 01E (3/01)
Revenue:						
HTS	4,968	3,100	3,000	3,000	3,000	3,000
SMES	64	2,000	790	1,515	790	790
tot. rev.	5,032	5,100	3,790	4,515	3,790	3,790
Expenses:						
Cost of Rev	5,083	5,100	3,790	4,515	3,790	3,790
R&D	2,264	3,100	3,410	3,751	4,126	4,539
SG&A	798	2,100	2,653	3,161	2,843	2,843
tot. exp.	8,145	10,300	9,853	11,427	10,759	11,171
Income from Operations:						
HTS	(1,302)	(3,498)	(4,274)	(5,035)	(5,004)	(5,329)
SMES	(1,811)	(1,702)	(1,789)	(1,877)	(1,965)	(2,052)
tot. inc Ops.	(3,113)	(5,200)	(6,063)	(6,912)	(6,969)	(7,381)
Net. int. inc.	230	1,131	3,169	3,037	2,891	2,731
Net income	(2,883)	(4,069)	(2,894)	(3,874)	(4,078)	(4,650)
EPS	(0.19)	(0.24)	(0.15)	(0.19)	(0.20)	(0.22)
As % of rev.						
HTS rev	98.7%	60.8%	79.2%	66.4%	79.2%	79.2%
SMES rev	1.3%	39.2%	20.8%	33.6%	20.8%	20.8%
tot. revenue	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Expenses:						
Cost of Rev	101.0%	100.0%	100.0%	100.0%	100.0%	100.0%
R&D	45.0%	60.8%	90.0%	83.1%	108.9%	119.8%
SG&A	15.9%	41.2%	70.0%	70.0%	75.0%	75.0%
Total expense	161.9%	202.0%	260.0%	253.1%	283.9%	294.8%
Income from Operations:						
HTS	-25.9%	-68.6%	-112.8%	-111.5%	-132.0%	-140.6%
SMES	-36.0%	-33.4%	-47.2%	-41.6%	-51.8%	-54.2%
tot. inc. Ops	-61.9%	-102.0%	-160.0%	-153.1%	-183.9%	-194.8%
Net int. inc.	4.6%	22.2%	83.6%	67.3%	76.3%	72.1%
other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Net income	-57.3%	-79.8%	-76.4%	-85.8%	-107.6%	-122.7%
% Year over year						
total rev.	94.7%	46.4%	67.0%	78.2%	-24.7%	-25.7%
Total expense	19.4%	33.0%	29.6%	49.7%	32.1%	8.5%

$,000's	F1997	F1998	F1999	F2000E	F2001E	F2002E	F2003E
Revenue:							
HTS	7,174	11,566	9,748	12,349	12,000	12,000	12,000
SMES	3,376	3,563	1,510	2,586	3,885	4,460	5,860
total rev.	10,551	15,129	11,258	14,935	15,885	16,460	17,860
Expenses:							
Cost of Rev	10,577	14,333	12,021	14,998	15,885	16,460	17,860
R&D	8,477	8,641	10,409	12,099	15,826	18,991	22,789
SG&A	4,291	4,910	6,078	6,582	11,499	13,168	14,288
Tot. exp.	23,345	27,884	28,508	33,679	43,209	48,619	54,937
Income from Operations:							
HTS	(10,860)	(10,085)	(12,005)	(12,011)	(19,641)	(24,577)	(27,115)
SMES	(1,934)	(2,670)	(5,246)	(6,733)	(7,683)	(7,582)	(9,962)
tot. inc Ops.	(12,795)	(12,755)	(17,250)	(18,744)	(27,324)	(32,159)	(37,077)
Net. int. inc.	821	543	1,912	2,003	11,828	8,580	5,445
other	(1,404)	(166)	13				
Net income	(13,377)	(12,378)	(15,325)	(16,741)	(15,496)	(23,579)	(31,632)
EPS	(1.27)	(1.06)	(1.01)	(1.06)	(0.78)	(1.13)	(1.44)
As % of rev.							
HTS rev	68.0%	76.4%	86.6%	82.7%	75.5%	72.9%	67.2%
SMES rev	32.0%	23.6%	13.4%	17.3%	24.5%	27.1%	32.8%
tot. revenue	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Expenses:							
Cost of Rev	100.3%	94.7%	106.8%	100.4%	100.0%	100.0%	100.0%
R&D	80.3%	57.1%	92.5%	81.0%	99.6%	115.4%	127.6%
SG&A	40.7%	32.5%	54.0%	44.1%	72.4%	80.0%	80.0%
Total expense	221.3%	184.3%	253.2%	225.5%	272.0%	295.4%	307.6%
Income from Operations:							
HTS	-102.9%	-66.7%	-106.6%	-80.4%	-123.6%	-149.3%	-151.8%
SMES	-18.3%	-17.6%	-46.6%	-45.1%	-48.4%	-46.1%	-55.8%
tot. inc. Ops	-121.3%	-84.3%	-153.2%	-125.5%	-172.0%	-195.4%	-207.6%
Net int. inc.	7.8%	3.6%	17.0%	13.4%	74.5%	52.1%	30.5%
other	-13.3%	-1.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Net income	-126.8%	-81.8%	-136.1%	-112.1%	-97.6%	-143.3%	-177.1%
% Year over year							
HTS rev.		61.2%	-15.7%	26.7%	-2.8%	0.0%	0.0%
SMES rev.		5.5%	-57.6%	71.2%	50.2%	14.8%	31.4%
total rev.		43.4%	-25.6%	32.7%	6.4%	3.6%	8.5%
total expense		19.4%	2.2%	18.1%	28.3%	12.5%	13.0%