Our own efficient and experienced producers can gain some advantage.

The research suggests that most of the metals found in abundance in Canada will be facing relatively low growth situations, and prices around current levels, through from 1990 to the year 2000. More specifically, predictions are for fairly flat or 1 percent growth for copper, 2 percent growth for aluminum (and that only provided there is continuing concerted market research), some development opportunities which could give an upturn to zinc, a continued flat pattern for lead, nickel and silver, and a lower demand for tin and for steel. Things look better for magnesium and some of the newer specialty minerals. Many of the specialty minerals, however, are linked to the fate of steel. Others, although in growing markets, are mined in small amounts by one or two suppliers and are therefore subject to erratic pricing and supply. These specialty metals, of course, represent only a very small fraction of present mining activity in Canada. There is also expected to be an increased demand for high quality source powders for ceramics, but market potential may be closely related to having the technology to deliver a consistent product at a relatively low price.

New strategy needed

Once the metals industry recognizes that it is in competition with more than just other suppliers of similar raw material, then a strategy must be adopted to compete successfully. The Report notes a need for great marketing capability and market sensitivity. Since it takes five to ten years to develop a new product, management needs an intimate knowledge of the consumers' needs, individual or corporate. Sometimes one must identify a market need before the customer has done so. To do this kind of thing requires a fundamental change in philosophy.

It is crucial to recognize that in such a situation a higher priced material may prevail over a lower priced one if the material performance is unique or extraordinary in some way or the overall system cost turns out to be lower. In other words, if the unique properties of the expensive material allow either functional savings at the product end or manufacturing savings during processing and assembly, a higher price per pound may not matter. Our metals may be cheaper than the advanced new materials, but that does not mean people will buy them.

What are the strategies that must be adopted by the metals industry? They might be listed as follows. Note that each strategy has an important science and technology component.

1. Research into technology, and management techniques, to lower the costs of production
2. Greater involvement with "downstream" product developments, including work with customers.
3. Intensive research and development in new, metal-based materials (e.g., new alloys, glassy metals, powder metallurgy and rapid solidification, new forming and casting techniques.)
4. Further research and development work on specialty minerals, seeking new, lower cost sources and production techniques, as well as new uses.

Four areas of concentration

Let us look briefly at each of these strategies.

1. Lowering cost of production. For immediate survival and for success in the near term, this is the most essential strategy to be followed. As indicated earlier, this has the beneficial effect of delaying substitution at the margin. It permits profitability even in times of low prices and it assures maximum market share for our own producers. By and large, our companies have already geared their efforts toward this goal, with most research in the field of "process improvements." Leaner management structures and reduced labor intensity have resulted. Although such efforts were overdue, and there is still room for much more research and technology along these lines, it is only fair to give credit to our mining companies for their accomplishments in this area. Further work is being contemplated, including cooperative, pre-competititve research and better coordination with universities and government laboratories, but the general direction has already been established.

2. Development of new products. There are exceptions, notably Alcan and some others, but Canadian metals companies tend to leave the downstream product-oriented research to their customers. This could turn out, in the long run, to be fatal. The future consumption of minerals will depend largely on the research done into new uses for existing materials. There must be a huge increase in conjoint research work done with people in the transportation, construction and packaging industries, and even with the customers of those industries. In other words, we must direct our research efforts several steps downstream to maintain markets for existing materials in the long term.

3. Development of new, metal-based materials. New knowledge permits the development of materials with new properties. Whether these properties allow new functions and higher quality or are useful simply because they reduce ultimate manufacturing costs, they will permit the new materials ultimately to prevail. There are rapid advances being made in this field as we come to understand molecular configuration and structure. Metals can compete only if we develop the new alloys, glassy metals and other materials that can be produced as a result of rapid solidification techniques, powder metallurgy, new forming and casting techniques and so on. Yet, astoundingly, Canada lags far behind other countries in this kind of research investment! Even what little is being done seems to be at universities or government laboratories. With a few exceptions, our companies have not yet seized the challenge nor do they seem to understand its crucial importance.

4. Development of specialty minerals. Although the tonnage figures are likely to remain low for many of the specialty metals, there is potential for high value-added and for a profitable pricing structure. Again, the answer lies in more research and development. Titanium looks promising but must compete with composites and ceramics. Niobium and neodinium are useful in super-magnets which might form the basis for huge new atomic research facilities and for transportation systems, as well as for automobile engine parts. Germanium, tantalum and gallium are increasingly important in electronics, albeit in