

## Foresight Summary for Titanium

### Business Drivers versus Technology Needs

Business Driver	Issues	Technology & Innovation Requirements
Market Competitiveness	Reduce extraction costs	Further development and scale-up of low cost emerging extraction processes, with a view of replacing costly Kroll Process
	Need for low cost downstream processing routes	Development of low cost 'non-melt' downstream consolidation routes of low cost particulate/sponge (i.e. the output from emerging extraction processes).
	Need for expansion into steel, chemical and automotive industries.	Cheap supply of low cost non-aerospace grade alloys from emerging reduction processes for automotive and chemical industries. Reduction of ilmenite for cheap alloying feedstock for steel industry.
	End user need for more stringent design codes and standards.	More detailed ASTM standards (with regard to both chemistry and microstructure) to reduce inconsistency of product from global suppliers.
	Need for improved tribological properties	Development of low cost, environmentally friendly surface engineering technologies.
	Requirement for new alloys to compete with steel/aluminium	Production and testing of alloys containing high melting point additions (which are unattainable with conventional Kroll Process) for improved mechanical properties.
	Superior Product Characteristics/Brand Differentiation	Publicity to potential customers of the advantages of Ti alloys.
Cost of ownership issues; Buildings, marine plant, etc.		Cost model to cover corrosion, low maintenance, weight saving versus energy consumption, penalties for outages, breakdowns, pollution, etc.
Increased knowledge base for cost effective component design.		Better understanding/modelling of microstructure, texture and microstrain evolution during primary and secondary processing and effects on mechanical performance.
The Ageing Population	Increased demand for use of prosthesis for older population	Development of low cost biocompatible alloys and Ti based foam products for potential bone growth applications.
Environmental and Legislation Concerns	Lower exhaust emissions/light weighting of engines	Cost effective production of light-weight exhaust systems, suspension systems, etc.
	Need for water desalination	Production of low cost piping and desalination units for potable water (for disaster areas and Third World countries).
	Flue gas desulphurisation	Plant linings, equipment and systems development.
	Nuclear plant shutdowns	Exploitation for waste containment and sarcophagus cladding.
Changing Lifestyles	Use of Ti in leisure industry.	Cost effective manufacture of sporting products.
	Ti in safety clothing, body armour and sensors, etc.	Low cost production of shape memory alloys and superelastic alloys for flexible light weight structures and actuators and, etc. (eg. TiNi and Ti-Nb-Ta-Zr alloys).
Defence	Light weight tanks. Rapid deployment, armour and general use	Development of processes for rapid manufacturing of components. Low cost production of superelastic Ti alloys for potential armour applications. Development of low cost armour piercing Ti alloys.