THE EUROPEAN STEEL TECHNOLOGY PLATFORM - *ESTEP*

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ABSTRACT

On March 2004 the European Steel Industry launched a Technology Platform, now called ESTEP, in order to identify its R&D and Innovation needs and implement the necessary initiatives on a long term vision (2030).
In about one year period three large complementary industrial programmes were developed, based on the four strategic Pillars of the Platform (Profit, Partnership, Planet, People), encompassing numerous innovative and break-through actions in the steel fabrication and product application fields, with the involvement of major Stakeholders. These come from several European industrial sectors (steel companies, suppliers, customers, SME), Universities and Research Centres; the European Commission and the EESC Consultative Commission on Industrial Change are also Stakeholders, as representatives of National Governments and the Unions.
A Strategic Research Agenda (S.R.A.) set up by six Working Groups involving around 100 people, is now in its implementation stage, which also includes a large transversal programme on Human Resources.
A brief outlook of this important European initiative undertaken with the help of the Commission, will be here reported, with a particular attention paid to the third Programme "Appealing Steel Solutions for End Users ". This programme in fact, with its three priority actions addressing the highly stimulating challenge of customers demands of super – high performance steels on the *Automotive, Construction and Energy* sectors, seems to be perfectly matching the spirit and the structure of the present SHS Steels Conference.

KEYWORDS

European Steel Industry, Oil & Gas Industry, Automotive, Construction, Pipelines, High Strength Steels, Power Generation

1. THE EUROPEAN STEEL TECHNOLOGY PLATFORM: OBJECTIVES, PROGRAMMES, ORGANISATION

The EU-25 Steel Industry, with its total annual production now coming close to 200 million tonnes, the associated turnover of more than 100 bn € and the direct employment generated for around 350.000 EU citizens, to which an extraordinary numerous galaxy of other derivative jobs has to be added, is a key sector for European economy. Its vitality and competitiveness is therefore of paramount importance for the future of Europe and its citizens.
On the other hand the Steel Industry has an ambition: coupling its two main strategic targets of growth and sustainability, while remaining among the leading actors on the competitive international scenario of the next 20-30 years.
It is to achieve these important targets that on March 2004 a Group of Personalities, among whom the European Commissioner Mr Philippe Busquin, and the President of EUROFER Mr Guy Dollé, launched an initiative for the creation of a ***Steel Technology Platform*** in a long term vision (2030),

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to boost innovation, to develop new technologies and new steel solutions, while implementing the necessary R&D actions.
This Platform, now called **ESTEP**, is based upon four Pillars, derived from the concepts of sustainable development :

Profit : ensuring profit through innovation and new technologies

Partnership : responding to society needs with partners of the steel sector in three priority fields :
Automotive, Construction, Energy

Planet: developing break-through technologies to meet environmental requirements (to mitigate the burden, diminishing the energy consumption and drastically lowering the emissions)

People : attracting and securing human resources and skills

The overall frame for the developmental R&D&I actions of ESTEP faces the main challenges to the sustainable global competitiveness, such as the growing impact of globalisation, the need of matching steel supply and demand (even for the high performance materials), the environmental constraints and the new European rules, the opportunities – but also criticalities – coming from the EU enlargement process.

Three industrial R&D programmes of large societal impact were then developed (Fig. 1) to face these challenges and meet the strategic objectives of the steel industry :

1. **Safe, clean, cost-effective and low capital – intensive technologies**
2. **Rational use of energy resources and residues management**
3. **Appealing steel solutions for end users**

A fourth transversal programme was also developed, focussing on human resources.

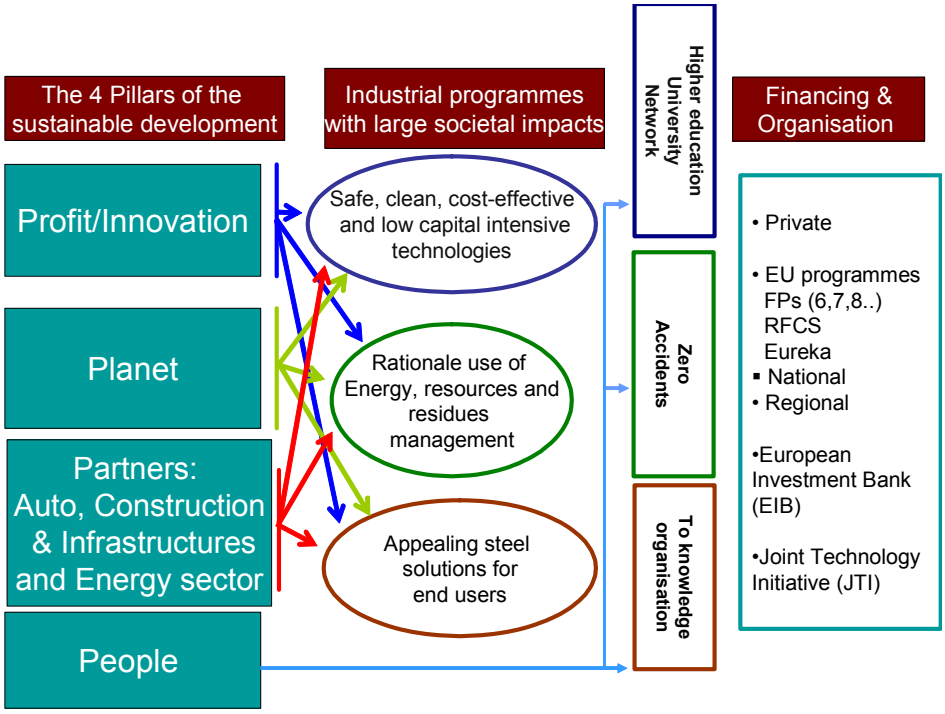

Fig. 1 Implementation of the S.R.A.: need for a critical mass of means

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Six Working Groups were active in the organisational chart sketched in Fig.2, with involvement of more than 100 people working on the four programmes.

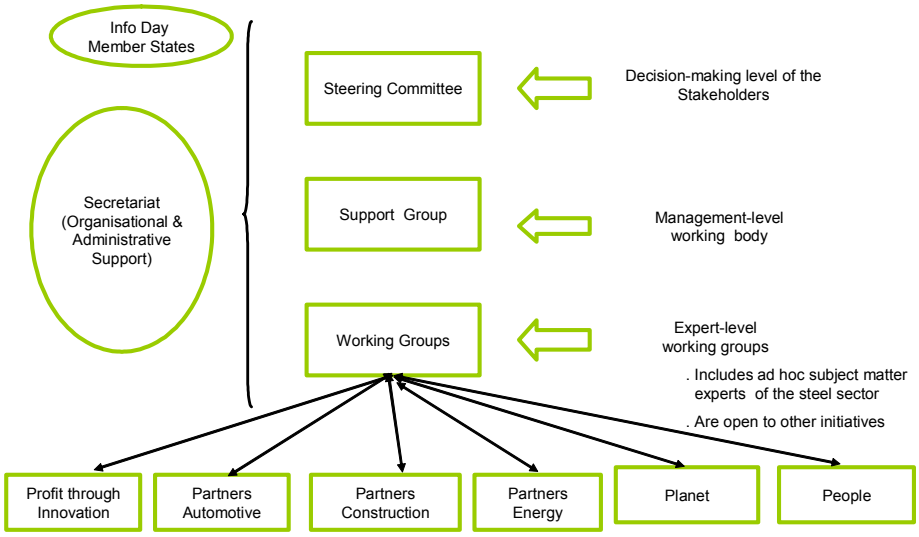

Fig. 2 The Steel Technology Platform

The **Strategic Research Agenda (S.R.A.)** in its update version, has been approved by the governing bodies of ESTEP and its implementation phase has already been started by planning the use of various financial communitary tools (the 7th Framework programme, the Research Fund Carbon Steel (RFCS), Eurêka and even National or Regional programmes, etc).

The third ESTEP industrial programme in particular, with its three priorities of fulfilling the customers expectations in terms of superior steel materials and solutions in Automotive, Construction and Energy sectors, seems perfectly in line with the spirit of this Conference, so demonstrating the high level of tuning of the international Scientific Community R&D streamlines and the steel industry needs.

The paper makes an extensive use of the official ESTEP documents and communications, published since March 2004, to which reference is made for further information [1 – 4].
The authors are presently serving in ESTEP Organisation respectively: J.C.C. as Chairman of the Support Group and G.B. as Leader of the WG6 Energy

2. THE ESTEP PROGRAMME 1: Safe, *clean, cost-effective and low capital – intensive technologies*

In the long term, innovation is required in the steel production processes and manufacturing technologies in order to meet essential key challenges :

- To achieve highest standards of quality with highly productive, safe and efficient processes
- To renew continuously steel products on offer
- To ensure a short time to market
- To favour sustainable development and clean operations of the steel industry

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The promotion of cost-effective processing solutions while preserving the natural resources constitutes a mandatory and permanent target for the steel sector.
The steel industry, together with the downstream primary processing sector, has recently made large investment in the reduction of production costs and improvement of quality (advanced computer systems, extensive use of measurement sensors, artificial intelligence and modelling, etc.) with significant benefits obtained with regard to the reliability and robustness of facilities, leading to higher production rates, greater yields and better consistency of products delivered to the customers.

The most recent industrial development is *thin slab casting*, a technology now available both for carbon and stainless steels. However, further innovation is required to achieve the development of much more integrated and flexible processes, to go further in reducing the successive steps of heating and cooling quite often associated with rolling/shaping operations or specific thermo-mechanical treatments. During many of these operations, a large portion of the product surface is exposed to oxidising condition that results in the formation of scale, a major cause of iron loss and a potential source of defects.

Following the successful industrial development of thin slab casting, the research work led to the development of a more integrated process, the "*strip casting*" process which operates in a few industrial pilot plants for producing carbon and stainless steel. However, many problems remain to be solved before thin strip casting can be applied to the mass production of high quality grades such as those used in automobile manufacturing and to other complex steels at an industrial level, so requiring further innovative actions of R&D.

Great flexibility is needed in the whole steel industry production chain to cope with the expanding range of products that will have to be supplied at low cost. Much more compact lines with very short response times and extended ranges of capability would be of benefit to the steel sector.

To meet these challenges, three major R&D Themes have been identified, which constitute the base of ESTEP programme n°1 (Fig. 3):

- *Novel integrated routes for an "oxide free" and energy efficient processing*
- *Flexible and multifunction production chain*
- *Intelligent manufacturing*

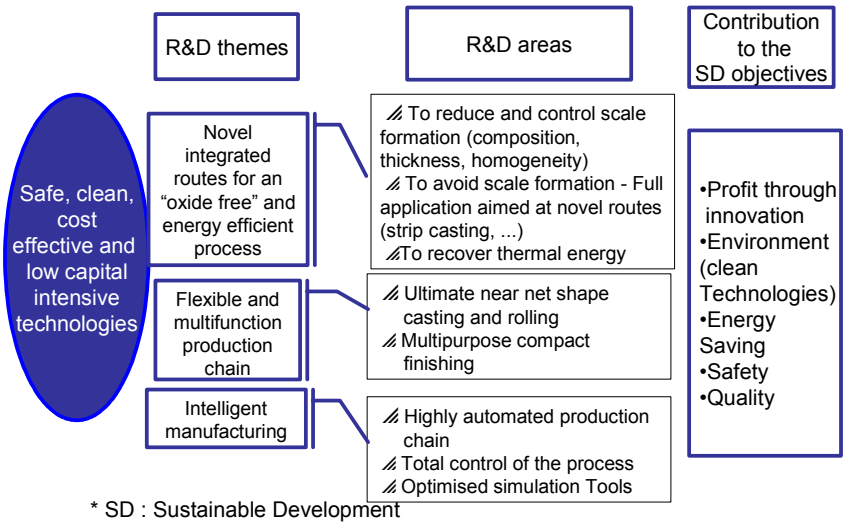

Fig. 3 Safe, clean, cost-effective and low capital intensive technologies: achieving the SD objectives through R&D

To conclude, some socio-economic aspects related to this programme can be outlined.

1. Large potential savings are expected first from a reduction and eventually the suppression of scale formation in hot rolling, deriving from the foreseeable dramatic reduction in demand on pickling units and acid consumption, with positive consequences on the environmental burden. The iron yield would also increase by an estimated amount of 0.35%.
2. The development of the new compact-processes lines can offer an opportunity of shortening the time-to-market, while reaching a high processing efficiency and productivity.
3. A high beneficial effect of a highly automated and totally controlled manufacturing is expected on the maintenance and quality costs aspects.

3. THE ESTEP PROGRAMME 2: *Rational use of energy resources and residues management*

Only a brief illustration of this – however very important – programme will be made here, even though the most advanced projects so far are included in it.
The EU integrated steel industry is based on intensive materials and energy utilisation. The optimisation of energy consumption in the steel making processes, the rationale use of raw materials and recycling of residues are three main targets of this programme, to which a fourth one of paramount importance must be added. The control and drastic reduction of CO_2 emissions.

The Platform came into being just by virtue of the CO_2 issue and soon after its launching a framework was established to develop a major integrated project - **ULCOS (Ultra – Low – CO_2 steelmaking)** – to achieve a massive reduction in CO_2 emissions: 50 % in the long term as compared to a modern Blast Furnace.
This project was accepted for financial aid by the European Commission and rapidly got under way on September 2004. A JTI (Joint Technology Initiative) is expected (industry, governments, universities, institutions and other subjects) in the near future to support the industrial demonstration stages of ULCOS.

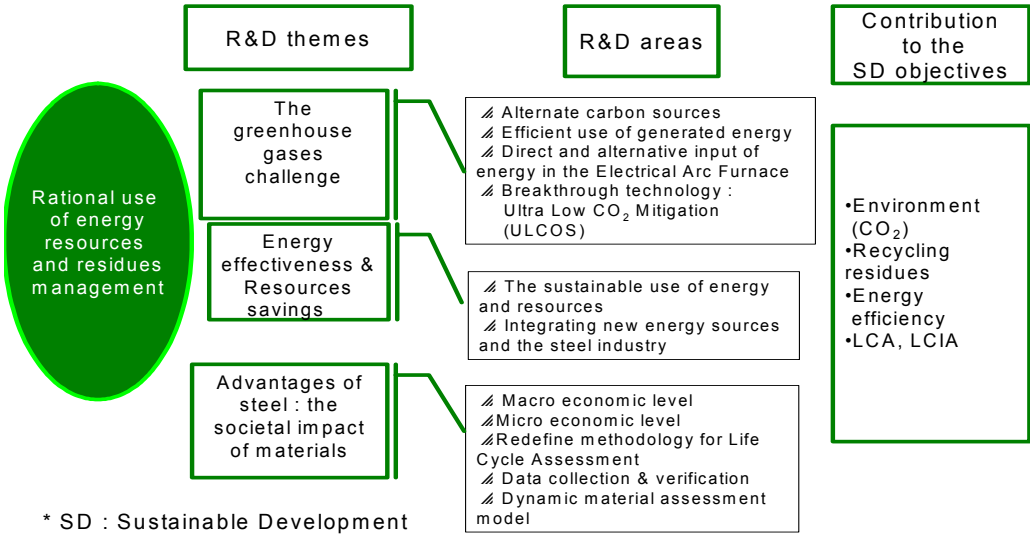

Fig. 4 Rational use of energy resources and residues management: achieving the SD objectives through R&D

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The ULCOS project constitutes in effects an important part of the overall programme n°2, whose structure , reported schematically in Fig 4 , bases upon three major R&D Themes : (Courtesy of the coordinator J.P.Birat)

- *the greenhouse gas challenge*
- *energy effectiveness and resources savings*
- *advantages of steel: the social impact of materials*

From the socio-economic point of view it can be said that this programme will contribute to the global climate change challenge and the first effects are expected in the medium term (2010-2020). ULCOS will deliver new process routes based on iron ore with a verification of its feasibility in terms of technology, economic projections and social acceptability.

The optimisation of energy consumption and the conservation of natural resources (fuels) will also bring a significant contribution to the sustainability of steelmaking activities.

The sub-programme "Social Impact of Materials" would allow strengthening the competitive position of steel products by the valorisation of the steel – intensive solutions.

Finally a re-defined methodology for Life Cycle Assessment will contribute to an improvement of the social acceptance of the steelmaking industry and of the steel products.
The overall societal impact of this programme is therefore extremely high and fits perfectly with the Priority Themes identified in the April 2005 Commission Document for the future 7th Framework Programme for European R&D.

4. THE ESTEP PROGRAMME 3: *Appealing Steel Solutions for End Users*

Partnership developed by the Steel Industry extends from the field of industrial sectors more related to processes and plants, to the typical one of manufacturers and end-users. Marine technology, shipbuilding, oil & gas industry, automotive, constructions, packaging, chemical and mechanical engineering are examples of a long fruitful cooperation.
This is made up of many structured links, all necessary for the achievement of the overall target which could be defined as " cost-effective processing of complex steel products ", to meet society needs.
Three priorities have been identified in three industrial sectors :

- ***Automotive***
- ***Construction and Infrastructures***
- ***Energy (Extraction and Transportation of energetic fuels; Power Generation)***

These priorities lead to three respective sub-programmes, the structure of which will be outlined here in some detail, as practically coincident with many of the corresponding streamlines and Sessions of this Conference.

4.1. Sub-programme *Automotive sector*

On a worldwide scale the transport sector is responsible for about 20% of the GHG emissions, but mobility (by road – air) cannot be eliminated being essential in the development of a modern society and especially in Europe, where the ongoing integration process largely benefits of that.

The Automotive industry stimulates lightweight car innovations; however, besides the new fuel technologies, new transport concepts and construction methods are required for the future.
In addition, because of the enormous number of fatalities, especially among young people, the safety of passengers and drivers is becoming an absolute priority.

Partnership of car makers (who only have the vision on vehicles development) and steel producers (who only are capable of tailoring the proper material to the particular component or subassembly) is absolutely mature and well experienced to meet the challenging common target of realising a safe, light and cheap car for the future.

The ambitious aim of this Steel Industry Partnership in particular is to set up a production and manufacturing chain using high performance (High Strength) steels, including new forming/joining techniques and new coating processes.

The out-coming ESTEP programme for Automotive, sketched in the usual format in Fig.5, is actually split in two large R&D Themes :

- *new functional surfaces by special coatings*
- *complex components from new steel grades and innovative manufacturing method*

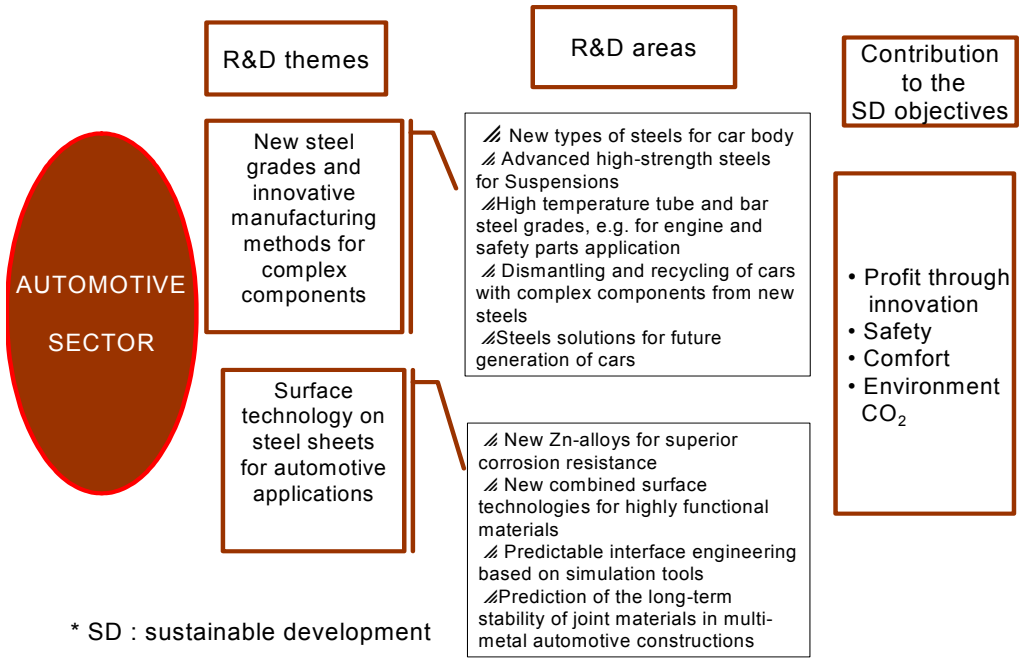

Fig. 5 Appealing steel solutions for end users (automotive sector): achieving the SD objectives through R & D

Details at the level of extensive R&D areas, are reported in the Graph. Worthy to mention the project, on a long term vision, devoted to innovative high-Mn or other new complex steels with very high strength and exceptionally good formability, the behaviour of which is predicted in line with the plot of Fig.6 (courtesy of Dr Rolf Steffen).
The setting up of steelmaking processes in the liquid state and the subsequent high temperature transformation, starting with solidification, is a really challenging target for the steel producer, not achievable in the short – medium term.

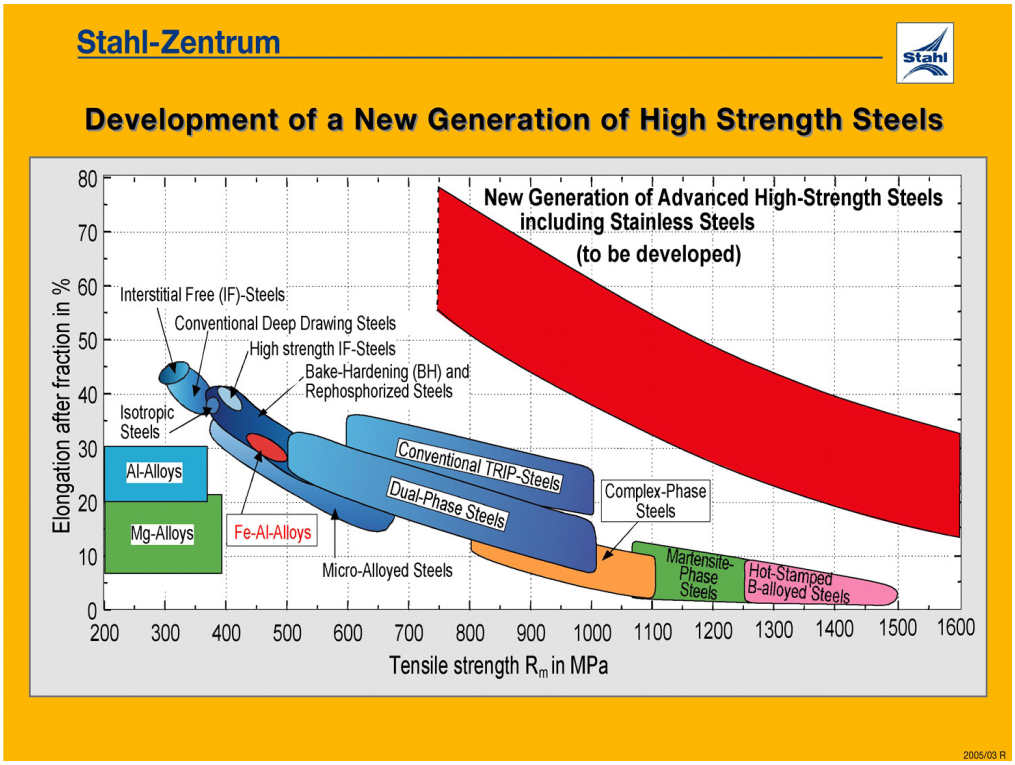

Fig 6 New generation of High Strength Steels for Light Weight Construction (courtesy of Dr Rolf Steffen).

The importance of the Automotive sector for EU economy is enormous and the present programme will certainly contribute to the implementation of a new and effective integrated approach (Design, Materials and Processes) necessary for innovation in this important sector.

Ecological aspects related to material/weight saving, because of the high strength, and societal aspects, related to safety of all road users, will be covered by the programme.

4.2. Sub-programme *Construction & Infrastructure sector*

The importance of the Construction industry for the E.U. is also enormous (12 million workers, 1098 billion Euro annual turnover), but steel is unfortunately often not first choice for the realisation of buildings and infrastructures. Steel is however one of the most relevant construction materials and exploiting its full potential by developing new grades, building components and systems and composite structures with relevant construction technologies is absolutely needed.

Different challenges are to be addressed to meet societal needs in the sustainability frame, like demographic changes and urbanisation, safety and health, seismic and fire resistance, recycling and reuse of constructional materials.

The construction industry is highly fragmented and there is a need for the steel industry to work more closely with customers in the future, seeking technical and commercial alliances with architects and designers, and, eventually, with decision makers too.

The outcoming programme for construction sector, as depicted in Fig.7, bases upon two main R&D themes:

- *Safe and Healthy Steel Construction*
- *Sustainable Steel-intensive Construction*

A foreseeable list of R&D areas is listed in the graph.

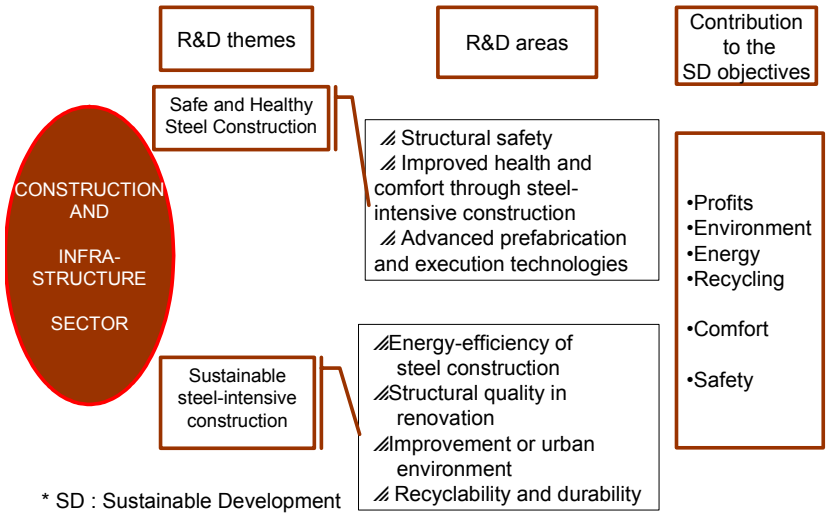

Fig. 7 Appealing steel solutions for end users (Construction and infrastructure sector): achieving the objectives through R&D

From the socio-economic point of view, it can be said that steel construction captures economic and environmental goals with social desirability. The quality of built environment greatly influences the performance of individuals, organisations and the well-being of society in general.

Steel-based construction, with accurate and pre-fabricated components, enables resource savings and waste reduction, being the steel itself a completely recyclable material.

4.3. Sub-programme *Energy sector*

This sub-programme addresses the broad industrial sector of the energetic fuels in the various aspects of their extraction, transportation and, eventually, utilisation in Power Generation plants.

Fossil fuels are at the center of this program, but alternatives for Power Generation will be also explored with some attention.

It seems certain in fact that for the next 30 years energy consumption by fossil sources (oil, gas, carbon) will remain very high, around 80% of the total consumption, which is predicted to grow by 60% (from 10230 MTOE in 2002 to 16300 in 2030). Whilst much less durable than coal (>200 years) the oil/gas reserves are estimated to last however for several decades more.

Within this global frame the world electricity demand will grow faster than total energy, as it will be doubled within the same period (from 17000 Twh to 34000 Twh). An enormous increase of gas consumption (a factor of four) is predicted over the time period of interest of this Platform, with a large portion of it used for Power Generation.

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Both parts of this whole "energy chain", the upstream one connected to Oil & Gas exploration, production and transportation, and the downstream one, power generation, will therefore need adequate – high performance – steel materials and components to face their challenges and match the targets.
Here again, as for the Automotive sector, there are just ideal conditions present to implement a fruitful cooperation between steel industry and the Oil & Gas and Power Generation Industry.

Challenges for both sectors are in a way similar: guaranteeing the supply of energetic fuels and electricity at the lowest possible cost, with the highest level of reliability of plants and safety towards the citizens.

The newest technologies under development for fluid extraction and transportation (very high pressure gas pipelines and/or LNG-CNG vessels) and high efficiency power generation plants (gas turbine combined cycle and advanced coal fired plants with "zero" emission) could provide and answer to the societal needs.

Steel is the natural candidate to meet the challenges of future applications in the oil & gas industry, but the grades presently available might not match the dual target of high productivity and improved levels of safety. This applies equally to exploration, production and transportation systems, both on-shore and off-shore field, each with its own specific requirements.

Future steam power generation plants, working at increased temperatures and pressures demand the development of new higher chromium-content ferritic and austenitic steels that deliver greater creep strength and enhanced resistance to corrosion. A precise knowledge of the stability limits of the alloys at high temperatures is a crucial step to the success of these efforts. However, a realistic medium-term target is the development of steels for use in environments operating at pressures and temperatures up to 325 bars and 650°C, respectively. Such developments would allow significant improvements in advanced coal fired plants based on steel as well as challenging the application of Ni-base alloys in future plants operating at steam temperatures up to 700°C.

The steel industry is committed to the development of high performance, low-cost, environmentally friendly and safe solutions. Constant interaction with the various actors of the supply chain, including fabricators, is a key factor for success.

This is particularly true in the broad and still undefined field of alternative energies, where the final engineering solution of a plant may depend strongly on selection of the correct material (steel).

All these challenges in different industry sectors have generated a new ESTEP programme with numerous and complex research themes addressed to specific materials and components as well as more general problems and disciplines of wider interest. The Energy sector sub-programme is naturally split in two parts.

Respectively:

Exploration & Production &Transportation (see Fig. 8):

- *New highly-performing tubular materials for oil& gas wells and relevant infrastructures*
- *Steel pipes & components for High Productivity Energy Transportation*
- *Reliability, Integrity and environmental fracture control*

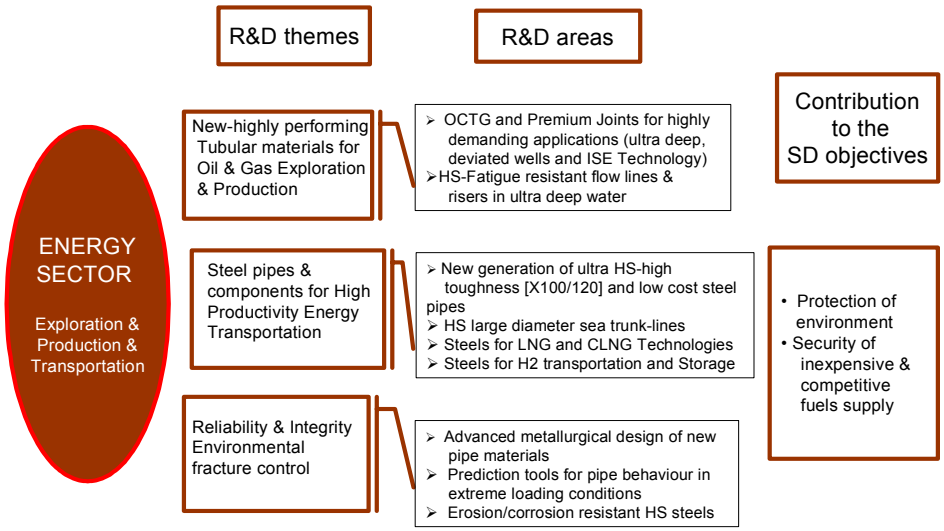

Fig. 8 Appealing steel solutions for end users (energy sector / Exploration, Production and Transportation): achieving the SD objectives through R & D

Power Generation – fossil fuels alternatives (see Fig.9)

- *New classes of heat resistant steels*
- *High corrosion and erosion resistant steels*
- *Steel and component manufacturing*
- *New steels and components for alternative power generation infrastructures*

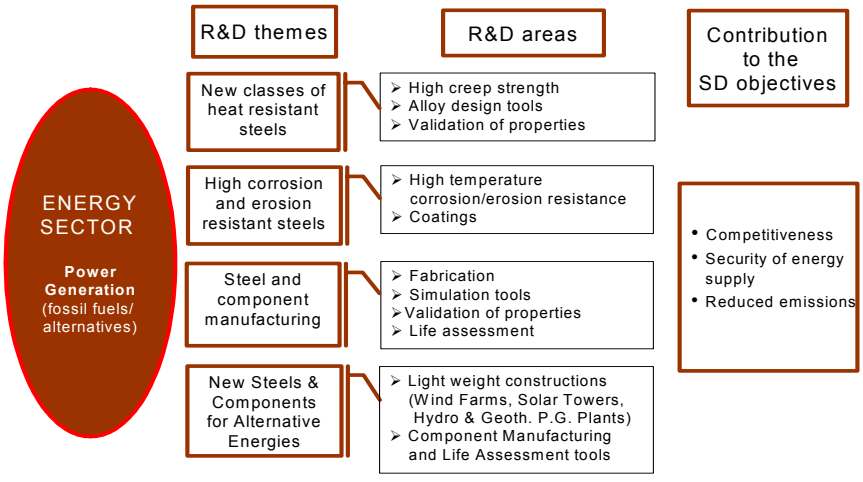

Fig. 9 Appealing steel solutions for end users (energy sector / Power Generation): achieving the SD objectives through R & D

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From the socio-economic side it can be simply and synthetically said that all different Energy sectors address the common targets of large societal impact :

- Security of inexpensive and competitive supply of fuels and electricity
- Efficiency and safety through integrity control
- Protection of the environment (zero accident/zero emission)

5.ESTEP LARGE TRANSVERSAL PROGRAMME: *Attracting and Securing qualified people*

A fourth large, transversal programme integrates the Strategic Research Agenda of ESTEP, being composed by a series of actions targeted on people.
Resources are in fact the key element in such ambitious plan of the steel industry, which could risk to become ineffective without the support of the qualified and motivated workers.

An ad-hoc programme has therefore been implemented with the dual target of 1*) attracting, retaining and valorising qualified people and 2) guaranteeing the health ad safety on work* with the aim of zero accidents.

The schematic layout of the programme is in Fig.10, which gives as well some details of R&D Themes and Areas : more information are available from the published ESTEP documents (1-4).

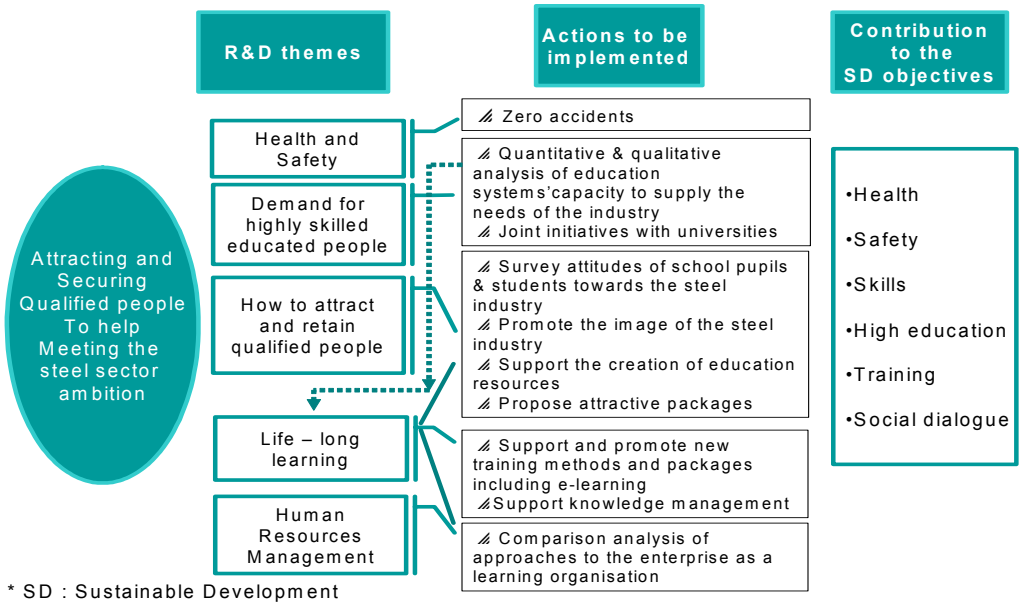

Fig. 10 Attracting and securing qualified people to help meeting the steel sector ambition

Worthy of mention is the initiative undertaken by the "People" Working Group inside the frame of training and formation, that is the project for the foundation of a kind of ***European High School of Steelmaking***, where different-highly qualifying-degrees could be made available to students aimed at spending their career in the steel industry. A feasibility study is under way.

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6. CONCLUDING REMARKS

The Steel Technology Platform ESTEP, whose objectives, challenges and plannings have been rapidly sketched out above, is a tool of large potential to help the implementation of the ambitious targets of the European Steel industry, however not dissimilar to those of other leading world realities.
The implementation of the relevant R&D programmes has just started with a steep derivative, since technological innovation is believed to be the key element for sustainable development.

It is here finally acknowledged how good the matching is between the content of the medium-long term R&D lines foreseen in the strategic research Agenda of the Platform and the main stream lines of the present Super High Strength Steel Conference in terms of material applications and performances, which clearly represent the overall trend of the Scientific International Community .

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