

INDUSTRIAL PLANTS

September 2021

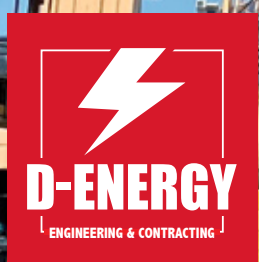
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Special issue of "IMPIANTISTICA ITALIANA" Official magazine of ANIMP Italian Association of Industrial Plant Engineering

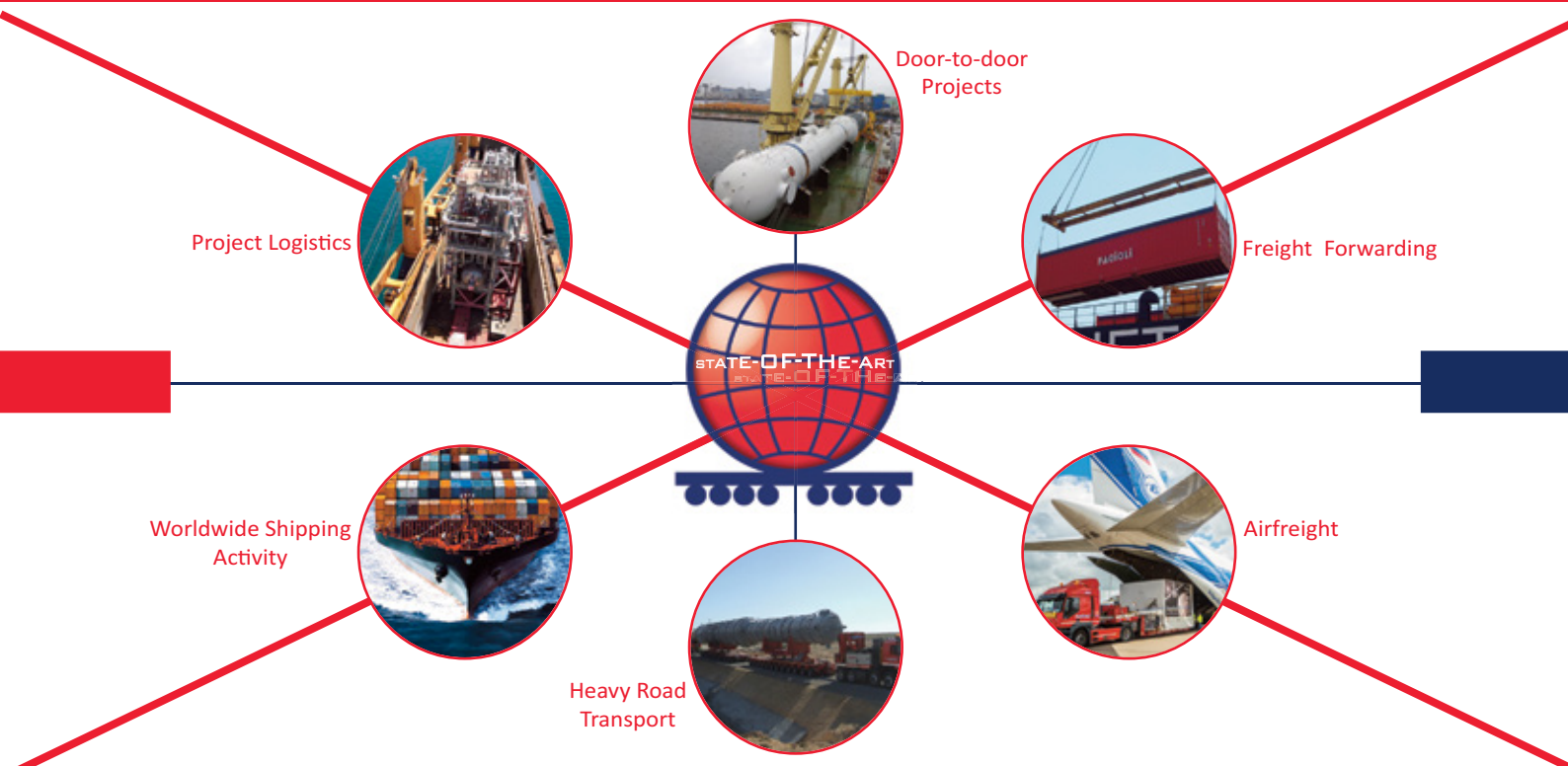
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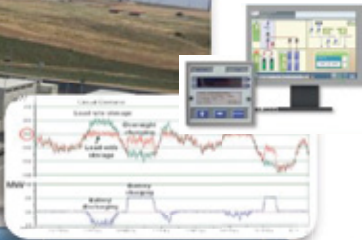
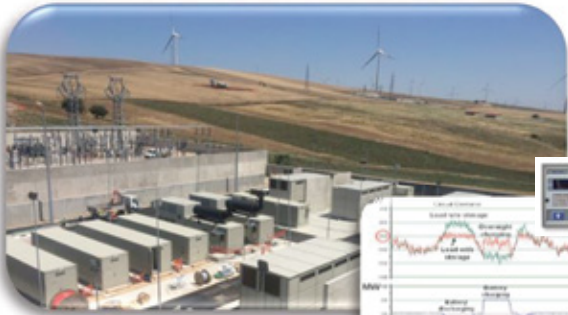
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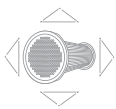


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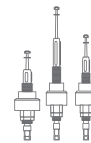
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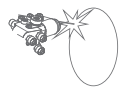
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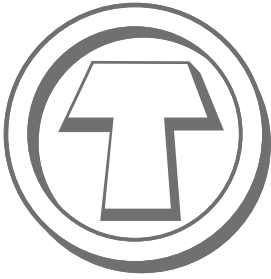
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The New World after Covid-19



Antonio Careddu
ANIMP President

I am pleased to introduce the latest number of *Industrial Plants*, the yearly publication for international audiences of ANIMP, the Italian Association of Industrial Plant Engineering Companies, which includes engineering firms and general contractors, plant component manufacturers, service suppliers as well as universities, with the main focus on designing and building large industrial plants in every corner of the world.

With more than 500 current members, for over 50 years ANIMP has strived to develop a world-class supply chain, competitive globally in any industrial plant market, in order to promote growth, development, innovation and international cooperation.

Following our tradition, the current issue shows a selection of our industry's recently completed projects or of those under execution, both in international and domestic markets, with special focus this year on the themes and geographies around the Dubai Expo 2020.

What a world in which we are living now! Although the progress and the outcome of the pandemic and related consequences are still quite uncertain, we see that the world has started developing significant corrective measures: not only vaccinations, inevitably the most important single factor, but also numerous changes in individual behavior and habits as well as in new business models: more focus on collaborative digital solutions, a rationalization of the supply chains, etc. – in many ways, we live in a different world and

today more the ever we know that global problems can be solved with a global approach only, hence multilateralism is the way. This is valid for pandemic and for climate change too.

“ANIMP has emphasized decarbonisation, circular economy projects, the increasingly widespread adoption of ESG concepts and the preparation of many ‘green’ projects, particularly in order to take advantage of today’s numerous incentive programs

Over the last year, among many other programs, ANIMP has emphasized decarbonisation, the launch of factual circular economy projects, the increasingly widespread adoption of the ESG ‘credo’ - Environment, Social, Governance, and above all the preparation of many ‘green’ projects, particularly in order to take advantage of the numerous Governmental programs to stimulate aggregate demand and to re-launch the world economies in a ‘green’ fashion:

- 1 ANIMP has established and structured a collaborative JIP (Joint Industry Program) among many players, large and small, for the creation of industry-shared guidelines on quantitative metrics to assess the environmental, social and governance

(ESG) sustainability of the supply chains in the plant engineering sectors, with particular attention to equipment suppliers and suppliers' services, including subcontractors. This is an increasingly required framework in large project tendering around the world.

- 2 The energy transition is one of the dominant themes today. It is now clear that in order to mitigate climate change and to meet the Paris COP 21 objectives, an alternative to coal and primary fossil fuel sources in general must be found as soon as possible. We will also probably have to change our habits, lifestyles and diets.

This cannot be done overnight. With the currently known technology development status, there is no so-called "silver bullet" that can solve all the problems in a short time.

ANIMP has started to put together all the pieces of this new puzzle, to ensure that all industrial sectors of our supply chain can provide new, valid and competitive solutions. One of ANIMP's goals is to identify the activities already underway, to assess the capabilities of players already active in the supply chain and to add missing pieces. In this concrete way, the ANIMP will add value to the overall effort, by forming the more complete supply chain of plant engineering and component supply players necessary for new rapidly growing technologies and applications: e.g. for the use of hydrogen, offshore wind, etc.

“ANIMP has started to put together all the pieces of the new decarbonization puzzle, to ensure that all industrial sectors of our supply chain provide new and competitive solutions

In addition to putting together the technical and human resources and experiences among all our players, in order to satisfy the Clients' future needs, ANIMP will also leverage on any available financial resources, *our stake holders will make available to stimulate* innovation for products and services in support of the Italian businesses.

Collaboration among partners, winning our natural suspicions are key factors of success in all the above initiatives.

“The Italian industry looks at this ‘new future’ with optimism, since historically we have always excelled in inventiveness, flexibility and capacity to adapt to new and unpredictable circumstances

Hence, in one sentence, we are fully aligned with 'Connecting Minds, Creating the Future!

We look at this 'new future' with considerable optimism. In spite of the difficulties, inevitable we trust our skills, capabilities and flexibility. Historically, the Italian industry has always excelled in entrepreneurship, in inventiveness, in its capacity to adapt to new and unpredictable circumstances, in the speed of adoption and optimization of new breakthrough technologies. In the industrial plants sector, we are one of the world leaders, with more than 5,000 companies, large and small, employing 400,000 people.

We are ready for new challenges. We also remain always grateful to the Italian and other partner industries for their strong and continuing support.

Antonio Careddu

Antonio Careddu

Antonio Careddu graduated at Politecnico di Milano University and joined Saipem as an electrical engineer.

From 1991 to 1998 he was assigned various roles in Saudi Arabia, Mexico, Malaysia, Republic of South Korea, Oman. In 1999 he came back to Italy to take the responsibility as Department Manager and later as Project Director. In 2010 he became Country Manager and CEO of Saipem Contracting

Algérie and in 2012 Chairman and CEO of Saipem France.

In 2013 he returned to Italy and was appointed Director of the Saipem's Innovation, Systems and Corporate Marketing Unit.

In August 2018 he was appointed Head of Onshore Business Development, Commercial and Tendering.

ANIMP President since mid-2018



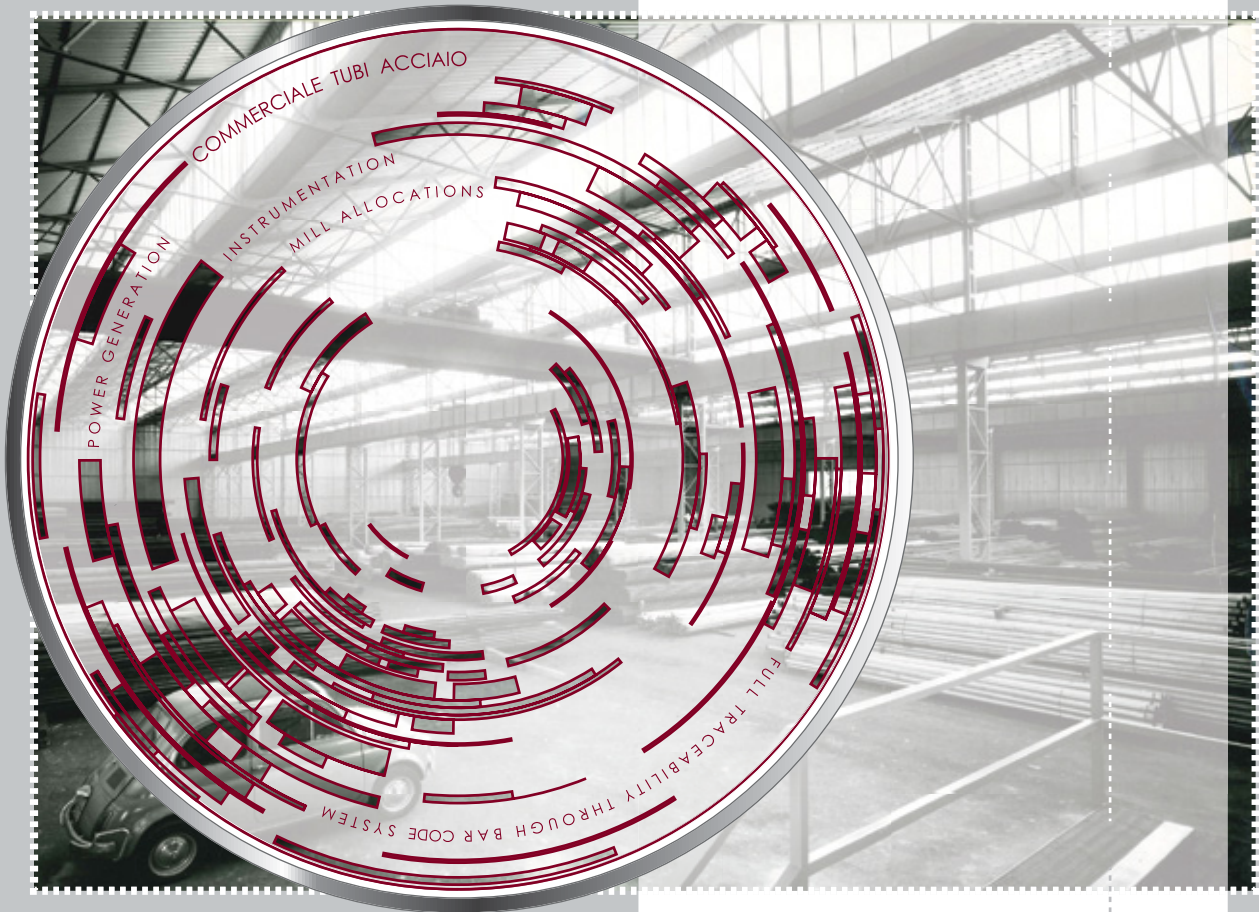
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Behind every problem there is an opportunity

The design, testing and delivery of complete and integrated modular E-Houses satisfy the growing need of “Plug and Play” digital solutions

Tiziano Frascoli, CEO D-Energy S.r.l.

D-Energy is a privately owned Italian manufacturer with capabilities and proven experience to provide its Clients in the Oil and Gas Industry, Chemical, Petrochemical and Power Industry with a complete integrated solution consisting of Modular E-Houses. The E-Houses are fully developed, engineered, manufactured, assembled and tested in D-Energy factory before being shipped to site, ready for fast installation and commissioning using a “Plug and Play” concept. D-Energy equipment complies with international standards and performance criteria for onshore and offshore installation, designed with fire ratings up to H120 (in compliance with BS EN 12079-1:2006), with the capacity to withstand seismic and blast events, suitable for ambient temperatures between -45°C and +55°C, resistant to the worst environmental conditions supplied with special paint coating cycles (jet fires).

The ‘Plug and Play’ concept guarantee: tailor made design, a unique partner & supplier, cost & time effectives solutions

As past track records D-Energy has provided (supplied and sub-supplied) products and services to major international Companies such as Schneider, ADNOC, Bonatti, ENI, Exxon Mobil, DNO, Emerson, Honeywell, KPO, KT Kinetics Technology, OMV, Pertamina, SMA, Sonatrach, TCO, Turboden, and others, serving more than 20 countries.

Headquartered in Cesano Boscone (Italy) with a manufacturing unit and a construction facilities yard for



the manufacturing of any biggest size Modular E-houses in the Massa Carrara port, in Tuscany region; D-Energy has also a presence in Abu Dhabi – UAE (D-Energy Operating Equipment LLC).

Our yard more than 30.000 m² in Marina di Carrara 2 km far from port able to move oversize modules

The Covid-19 pandemic caused an unprecedented global health and economic crisis, which raised not only



serious economic problems in many industries, but also critical challenges related to consumer health and other fundamental rights.

For Italy - and especially for the north of the country, where D-Energy has its headquarters - these have been complicated years. The restrictive measures have inevitably influenced - and continue to influence - the dynamics of the market, the execution of contracts, the content of their clauses, as well as the way of working. Almost two years after the start of the pandemic, we have had to adapt to this 'new world'. This new challenge, together with the uncertainty in the energy market and the new global commitment to reduce emissions and pollution in order to create an increasingly "green world", has led us to study innovative solutions to reduce the environmental impact of our installations.

In a world like "energy", which is certainly not one of the greenest, but which we will not be able to do without for many years, the choice of oil companies to move towards E-House solutions certainly reduces the "production of pollution".

A great deal of transport is saved, waste management in a company that respects the rules of differentiation instead to manage on the field, the choice of materials with the least possible pollution, is certainly not much

compared to all the technological innovations that have been studied to reduce pollution, but the principle must always be that each of us must do as much as possible to contribute to limiting damage. D-Energy wants to be all of this, and with a view to further increasing our commitment, and thanks to our long-standing collaboration with the multinational company Schneider Electric, we have begun a process of material analysis and technical choices that will enable us to achieve these objectives, all through the "Green Premium" brands, with which Schneider shares with its partners clear and transparent information on its mission regarding global environmental and health challenges related to the use of hazardous substances, their environmental impact and consequently gives important end-of-life guidance to preserve the planet's finite resources and provide efficiency to help its customers achieve more with less energy and resources.

Joint venture projects with Schneider (world wide)

As a result, we have applied "smart manufacturing": a new way of understanding the "production of a good" starting from its design and arriving at delivery dictated by the need to transform companies and the



Schneider Electric – ADNOC
South East TIE Project- PKG C
N. 5 ELECTRICAL SUBSTATION



Schneider Electric - Tengiz Chevron Oil kz
TCO Orken village
UPS building



Schneider Electric - Turboden
Palayan Binary Power Plant Project Phillippines
Compressor.power and automation E-House



Schneider Electric - JOCAB (TOTAL)
Absheron Early Production platform
Electrical and Control Room E-House

entire supply chain into more efficient, productive, and economically and environmentally sustainable entities.

This certified programme demonstrates the commitment to sustainable performance for customers: the efficient use of energy and natural resources means that CO2 emissions can be reduced, thus reducing environmental impact, and optimising the cost of resources.

This certified programme demonstrates the commitment to sustainable performance for our customers: the efficient use of energy and natural resources means that CO2 emissions can be reduced, thus reducing the environmental impact, and optimising the cost of resources

As reflected in the EXPO 2020 slogan: “Connecting minds, creating the future”, we are happy to be present at this event to share an important principle of ours, in which we strongly believe. The pandemic has indeed forced us to stop and reflect. It is now crucial to ensure that this devastating moment can become an opportunity for our entire planet. We are honoured to be able to be present and share with you this article and share the goal of this event and are open to any kind of initiative in line with our principles.

I would like to conclude this short article with a quote from one of the most famous Italians in the world, Galileo Galilei: “behind every problem there is an opportunity”.

Good luck to the UAE for this wonderful opportunity. We have been present with our branch, D-Energy Operating Equipment LLC located in Abu Dhabi, for 2 years now and we are ready to bet with you.



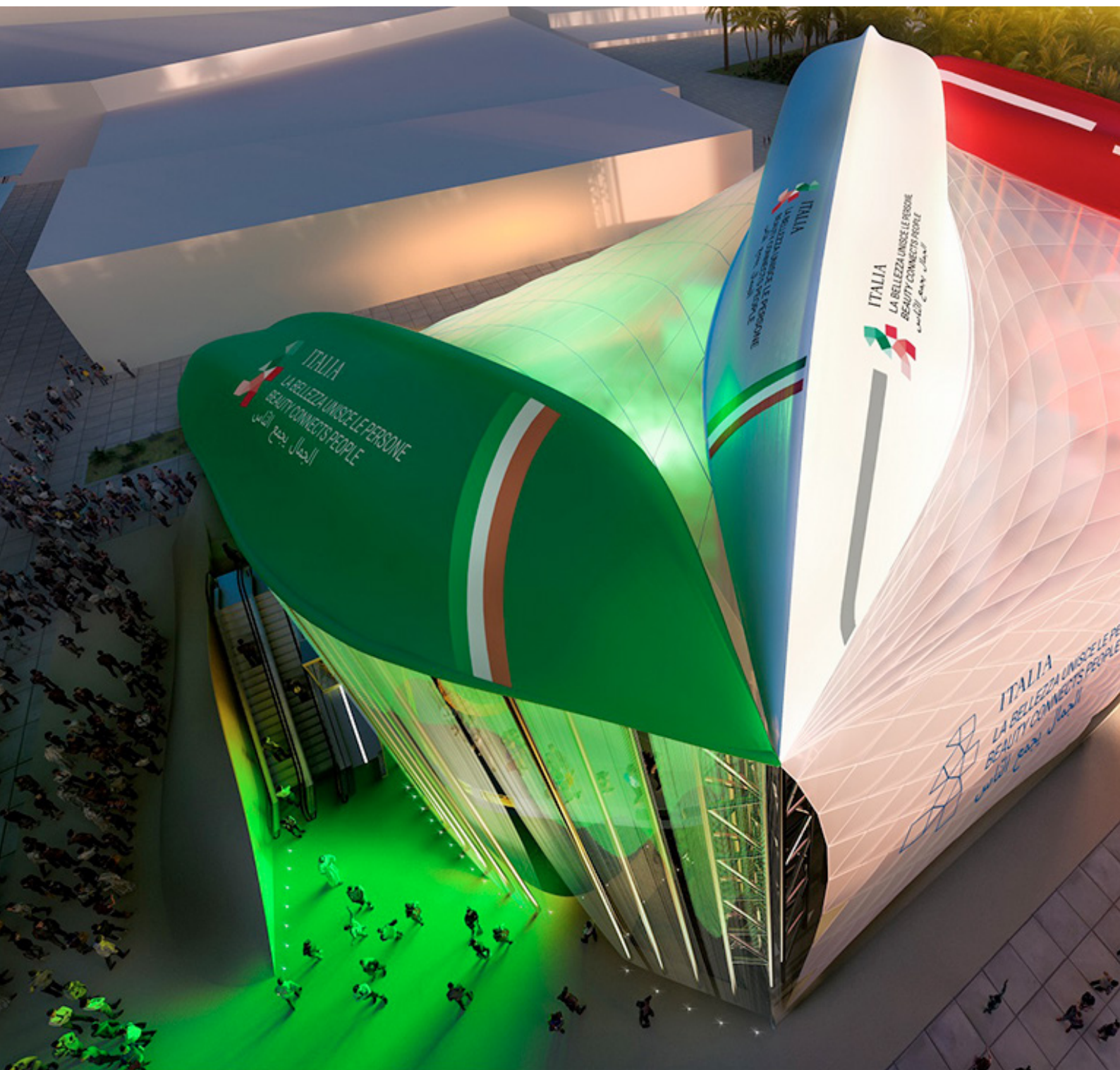
Tiziano Frascoli

Tiziano Frascoli, CEO of D-Energy Engineering and Consulting, has more than 30 years of experience in the world of energy.

During his early days, he worked in several engineering companies as an instrument and automation engineer. In ABB for a long period of time, he learned the skills of general and project management, until he became a Project Director.

Subsequently he worked as a Commercial Director, Proposal Manager and Business Development Manager for new markets, the most important of which was Kazakhstan.

Thanks to his experience, in 2015 he founded D-Energy as well as two other two companies, of which he is the CEO.



Rendering Padiglione Italia

The Italian industry meeting the Dubai Expo 2021 challenge

Interview with H.E. The Ambassador of Italy in the UAE, Dr. Nicola Lener

By **Daslav Brkic**, Executive Editor

INDUSTRIAL PLANTS - September 2021



In addition to traditional oil&gas markets, this area is starting to invest significantly in the new renewable energy projects for the energy transition. This new type of investments has not slowed down even during the pandemic.

It is not a coincidence that the headquarters of IRENA (International Renewable Energy Association, headed by Francesco La Camera, an Italian top expert), are located here. IRENA continues the work with a very clear strategy and policy recommendations to numerous Governments, in order to achieve the climate-change goals.

The UAE are quite aware of the new energy paradigm and they pursue the 'green' objectives with focus and determination: continuation of the traditional investments until the new carbon-free energy sources will be ready in sufficient quantities. In particular, they are lining up significant investments in solar energy and hydrogen.

It might be important to underscore that the oil produced in the Emirates is already one of the cleanest and lowest cost crudes in the world.

Beyond energy, there are significant and growing investments in water, desalination and power plants, applying the most modern technologies available on the market today".

We also see a growing trend towards mandatory local content in the area. What are your views?

"Local content is certainly a major and growing Government objective here, which needs to be factored in by international companies.

As to SMEs, it can constitute a remarkable challenge and a further incentive to joint efforts (by merging or setting JVs or optimizing the Italian supply chain) in order to reduce their relative impact".



Nicola Lener

Your Excellency, first of all, thank you very much for this interview and for sharing your viewpoints with us.

The new capex investments in the energy, power and water sectors in the Gulf countries have been major and traditional markets for our Companies. How do you see these markets today, also in the light of the energy transition?

"Inevitably, we have witnessed a slowdown during the year 2020, as a direct consequence of the pandemic. However, today we see interesting recovery signals, mostly in the UAE and GCC countries.

What is the impact on our companies of the evolution in geopolitics on the Gulf countries: an expansion of Chinese entities and a generally growing Chinese influence, maybe a rapprochement with Iran, some 'reshoring' trends in western economies?

"The recent agreement with Israel – previously considered inconceivable - shows how 'the impossible is possible'!

We cannot rule out future developments, indeed we hope they will come. An agreement between the two shores of the Gulf would certainly be very beneficial for the stability of the whole Region, but it is always very difficult to make forecasts.

China is certainly a major trading partner and one of the main destinations of UAE oil & gas exports. Its influence here has been growing, commercially and technologically, since they value the role of the UAE as a solid East-West balancing partner along the Silk Road.

In the long term, the UAE will try to take more and more benefit from its geographical advantage of being a hub between the two worlds. Isn't the 'connectivity' the core of EXPO2020 Dubai theme?

Within this framework, Italy has many good cards to play, provided that we remain always very competitive, as individual companies and as a country system. There are lots of good growth opportunities here for large and complex projects, also in partnership with international companies, e.g. in infrastructure, energy, etc."

What are your expectations for the Italian manufacturing and EPC general contracting Companies at the Expo? What will be the critical factors of success?

"In this context, the Expo is a huge opportunity. Some of the main themes are climate and water, with dedicated weeks when numerous international conferences will be held. The world will bring and



illustrate the most modern technologies.

In its Pavillion, Italy will showcase its innovation and sustainability capabilities in order to contribute to the common goal of tackling the most urgent global challenges.

But we will also present practical, effective and useful solutions, which is where our industry excels in any case.

I like to extend the concept of 'beauty' to our industrial world: to demonstrate that the proposed solutions are socially and environmentally good, ethical, real, correct...right, in one word.

The Expo will not be a fair nor a simple exhibition, but rather an articulated global platform to demonstrate what we have to offer. Yes, there will be commercial events too, but I believe that the most important single challenge will be for our enterprises to illustrate and to prove innovative solutions".

How will you support the participation of Italian companies at the Dubai Expo?

"There will be lots of events organized by our Embassy, by the ICE – Institute for Foreign Trade and by the Italian Expo Commissariat.

For example, 'Theme Weeks' and 'Innovation Talks' to discuss critical and important issues, such as mitigating climate change, water treatment, waste recycling, food production, health care and wellbeing – and of course energy. As I said, the concept of innovation will be the one 'connecting the dots', and therefore a challenge to our capacity to implement innovative solutions.

We will also organize commercial initiatives, many of them specifically put in place by the Italian Trade Commission. For example, in November we will have a conference on renewable energy.

Also, geographical conferences (e.g. for ASEAN countries, but also Africa and Latin America) and



business forums on specific themes.

We will also try to join the activities of other countries, in order to emphasize the international cooperation".

Lastly and perhaps most importantly – what did I forget to ask you?

"Just a thought: there is lots of talking today about 'reshoring' the manufacturing activities.

I think the pandemic showed very clearly the need for Italian and European manufacturing companies to optimize their global supply chains in order to make them more concentrated and less scattered.

Within this main driver, if we look not only at back-reshoring, but also at near-reshoring, the UAE and the GCC area present some competitive advantages (in

terms of geography, incentives, connectivity, regulatory framework) that could be carefully evaluated by our companies".



Nicola Lener

Nicola Lener was born in Cagliari on 18 August 1968. He is graduated in Law from the University of Cagliari and entered the diplomatic career on 18 June 1993.

He began his career by serving in the Diplomatic Ceremonial of the Republic and in the General Directorate for Political Affairs. From 1997 to 2004 he was Head of the Economic and Commercial Office of the Embassy in Lima, Peru, and subsequently of the one in Amman, Jordan.

Back in Rome, he was assigned to the General Directorate for Italians Abroad and Migration Policies. From 2006 he was Consul General in Casablanca, Morocco, and from

2010 he was Vice Ambassador in Ottawa, Canada.

In 2014 he returned to the Ministry, in the General Directorate for the Promotion of the Country System, where he dealt with the internationalization of the Italian economic system and from 2016 he was Deputy General Manager.

Since the 1st October 2019 he has been the Ambassador of Italy to the United Arab Emirates.

He speaks English, French and Spanish. Married with four children, he is passionate about art and travel.

Since 2014 he has been an officer of the Order of Merit of the Republic.



Saipem's journey towards decarbonization

It is crystal clear the whole world is moving in the direction of decarbonization, and it is happening fast

Chiara Petrella, Group Environmental Manager

Claudia Attanasio, Environment&Social Manager, E&C Onshore Division
Saipem



world's most ambitious plans to tackle climate change. Ideas present in that Deal just a bit more than one year ago, seen as radical at the time, are now routinely presented in the main government's agendas.

The science is not missing any occasion to report us news of more melting, more storms, more droughts, as well as more fires. We can mention IPPC (*Intergovernmental Panel on Climate Change*), which through its assessments, determines the state of knowledge on climate change. They are telling us we need a step change in the pace of our decarbonization processes: we need to accelerate the actions to change current emissions' trends and get on track to achieving the long-term temperature goals set by the Paris Agreement. For over a decade, the UNEP (*United Nations Environmental Programme*) Emissions Gap Reports have provided a yearly review of the difference between where greenhouse emissions are predicted to be in 2030 and where they should be to avoid the worst impacts of climate change. The pandemic caused a drop of up to 7 per cent in carbon dioxide emissions in 2020. However, as the UNEP Emissions Gap Report 2020 shows, this dip will have an insignificant impact on the Paris Agreement goal of limiting global warming to well below 2°C, and pursuing 1.5°C, unless the international community prioritizes a green recovery.

So, we have plenty of tools to keep awareness up. It is not an easy job to track all the inputs, as the energy scenarios, the technology developments, as well as political initiatives around the world.

For this reason, in Saipem we consider the decarbonization with a "holistic" approach, involving all the functions throughout the company and promoting a change in our "Corporate mindset", addressed by policies and procedures throughout our business. We are even aware that a huge step forward like the one required to all of us, cannot be even imagined without a deep switch in our mindset, meaning in the way we address choices and drivers in our area of influence, at work as well at home.

"In Saipem we consider the decarbonization with a 'holistic' approach, involving all the functions throughout the company and promoting a change in our 'Corporate mindset'"

Probably it is the first time we are witnessing a so radical, as well as global, increasing of awareness and actions, or at least commitments, at the same time, as it is happening in the last few months. Before COVID 19 it was difficult to find immediate cause-effect relations between our actions and their impacts on the environment and, mainly, on our lives and future. Pandemic helped to show how a change in the environment, in terms of ecosystems, biodiversity and climate, may have a tangible consequence right now, not in a far future. Surely the pandemic acted as a catalyst on establishing this sort of enhanced awareness.

For instance, only at the end of 2019, the European Commission announced the EU Green Deal, one of the

So, awareness and behavioral change programs will be integrated part of our Decarbonization programs. We aim to create "agents of change", in order to "enable evolution" within our Organization, as well as outside it, throughout our clients, suppliers and all the players of our value chain.

We are seriously starting to consider the environmental topics as a sort of "E factor", present in all the Company

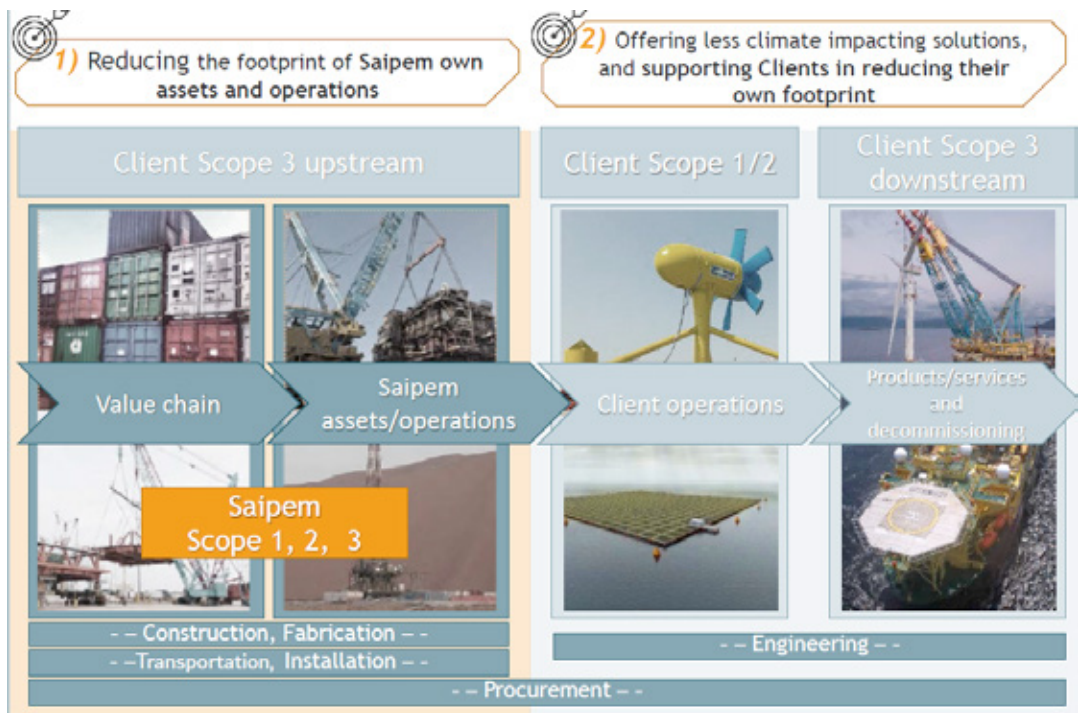


Figure 1 – Saipem decarbonization pillars and relevant GHGs emissions Scopes (Saipem and Client perspective)

processes, in the DNA of each Saipem function and people, being integrated across all our disciplines. In fact, Saipem, with its uncommon capabilities, is a global player in the energy transition and wants to proactively contribute to fighting climate change.

Saipem decarbonization framework

Decarbonization is certainly a complex challenge, which requires cooperation and a shared purpose of numerous players at the global level to achieve significant results. This is particularly true for the energy sector, where numerous different actors along the entire value chain will have to play a part in achieving the ambitious reductions that the Paris climate agreement calls for.

Saipem decarbonization approach is based on 2 macro - pillars:

1. Offering clients less climate impacting solutions and becoming partners in their decarbonization, as well as leading the path of value chain's energy transition, spreading the business to less impacting fields
2. Improving the efficiency of our own assets and operations for reducing our own Green House Gases – GHGs emissions (throughout all the Scopes 1, 2 and 3)

As far as concerns the first pillar, recognizing the actual global energy transformation and related risks and opportunities, Saipem plans to progressively reduce its dependence on the fossil fuels business acting as an innovative Solutions Provider to support Clients in identifying the best low carbon approaches and technological solutions.

“Its E&C backlog went from hi-carbon, to lower carbon in 2020, with Oil representing less than 25% compared with 50% at the end of 2016

Gas is the natural enabler of the energy transition. Going forward, we aim to do more renewables, green (including decommissioning) and infrastructures. Worldwide, renewable energy production is expected to grow by about 2.3% each year through 2040, and we are eager to have an important and growing role in this trend.

Going into details, Saipem contributes to the pursuit of the global decarbonization objectives:

- a) By supporting Clients to identify solutions, right from the early engineering stages, to reduce their carbon footprint, eg. through predictive estimation of emissions of the life cycle of the plants, allowing

the Clients to assess the overall environmental impact and its relevant costs.

- b) By exploiting technologies such as Carbon Capture Utilization and Sequestration, as well as both blue (in the short-medium term) and green (in perspective) Hydrogen to support customers in reducing their carbon intensity, as well as all the industry.
- c) Diversifying its order portfolio towards business segments such as renewable energy, including floating, and infrastructures for sustainable mobility.

As far as concern the second pillar, Saipem has in place both a short term and a long-term strategy.

Short-term strategy

Saipem started performing Energy Assessments and other proactive initiatives to reduce its GHG emissions over the last decade. However, a significant step was achieved in 2018, when specific climate related MBOs (Management by Objectives) were defined for Top Management and a Four-Year Strategic GHG Reduction Plan was issued. The plan aims to identify specific areas of improvement and targets to reduce, in a short-term scenario Saipem's overall GHG emissions, which also represent a portion of the indirect (Scope 3 upstream) emissions of clients.

The GHG strategic Plan is renewed annually, extending every year the time horizon, and providing the results achieved. The results are further verified by a Third Party and disclosed externally through the Saipem Sustainability Report.

Saipem follows a hierarchical approach to improve its way to use energy, establishing the following priorities for action:

1. Energy consumption and flows monitoring, with the purpose of identification of areas where to carry out interventions and improvement
2. Energy Saving, with the promotion of virtuous behaviors, policies, as well as management options to reduce not necessary consumption and energy waste
3. Energy Efficiency, identifying areas for improvement in the use of energy
4. Renewable Energy used mainly for self-production in our asset as well.

In 2020 alone, the measures implemented resulted in a saving of 26,700 tonnes of CO₂ equivalent, measured against Saipem's 2018 emissions baseline. It is estimated that, thanks to the GHG Strategic Plan, Saipem will not emit 255,000 tonnes of CO₂ equivalent

into the atmosphere over the 2019-2024 timeframe.

Medium- and long-term strategy

During 2020, Saipem broadened the horizons of its reduction strategy, aiming at the medium (2025) and long (2035) term.

In relation to the provisions of the Paris Agreement, in February 2021 Saipem communicated to the markets the first objectives set in the medium and long term:

- Reduction of 50% of the total GHGs emissions Scope 1 and di Scope 2 within il 2035 (versus the baseline 2018).

In relation to Scope 2, the target foresees the achievement of Net Zero by 2025.

Group environmental 2021 MBOs are related to build the present Net Zero program and roadmap.

The targets shall be considered as a first statement and they are supported by an implementation plan. The implementation plan will be reassessed periodically, due to new external regulatory and market pressures, stakeholders' expectations, including Clients requests,





as well as benchmark analysis, and technological developments, energy scenarios availability, and similar inputs.

“In February 2021 Saipem communicated to the markets the first objectives set in the medium and long term: Reduction of 50% of the total GHGs emissions Scope 1 and di Scope 2 within il 2035 (versus the baseline 2018)”

In fact, the speed of our decarbonization depends not only on Saipem approach, but on the availability of mature technology and the ability to scale supply chains.

There are two elements to achieve our long-term targets, that are considered in the roadmap and developed in parallel: reduction of our own emissions and compensation of residual emissions “*difficult to abate*”, giving priority to reduction activities.

A transversal multidisciplinary group works throughout the organization, to identify both emission reduction measures and developing analysis for addressing policies and standard procedures towards the reduction targets.

Technology plays a crucial role in the whole process and is constantly evolving. It is a must to keep abreast of any technological advancements that may enhance our assets and operation energy efficiency. These will be part of the overall strategy towards Net Zero.

“It is a must to keep abreast of any technological advancements that may enhance our assets and operation energy efficiency”

Building a clear picture of a “living” State-of-the art technologies, measures, and potential for GHG reductions is considered a fundamental pillar.

The following macro -areas of intervention will be addressed in the next years for reducing emissions of Saipem’s own assets (*eg. vessels, rigs, fabrication yards, temporary construction facilities*):

- Retrofit of the fleet
- Alternative fuels / electrification
- SELF Renewable
- Digitalization, Innovation
- Renewal of specific assets

Estimating Scope 2 emissions will consider also future electrifications (*e.g., ships in ports, rigs, etc.*), which represents the transition of a portion of their emissions from SCOPE 1 to SCOPE 2.

As we are aware, SCOPE 2 emissions are indirect and presently generated using electricity in particular in office buildings located around the world, as well as some Fabrication Yards in non-remote areas, with the availability of connection to the electricity grid.

Our idea is that all permanent sites of the Group will be powered by electricity in all areas where this possibility is available, thus we collaborate with local suppliers to purchase the maximum possible share of renewable energy.

As a wrap up, actions can be clustered into 2 pillars:

- Scaling up current solutions, mainly for the short term
- Investing in Innovation, to achieve long term targets
- It means that accelerating the development and deployment of zero-carbon technologies will be pivotal in the next decade.

Scope 3 emissions FOCUS on SCOPE 3

Saipem commitment is to make a proactive tangible impact throughout all the 'value chain'.

In fact, Regarding the SCOPE 3 emissions (the indirect ones arising from the activities of the value chain) Saipem aims to keep a "leading role" in supporting and stimulating suppliers and the various players in the value chain to reduce their footprint.

Since a company's scope 3 emissions often overlap with other companies' emissions, strategies to reduce scope 3 emissions are particularly fertile ground for opportunities to identify synergies and collaboration. Scope 3 emissions reduction efforts by one company can therefore lead to emissions reductions in other companies' inventories.

Saipem aims to work in partnership with suppliers, especially in procurement of materials, services, as well as aspects related to sustainable mobility.

We believe that despite the complexities, the reduction of Scope 3 not only has enormous potential to prevent the worst impacts of climate change, but it can also lead to significant benefits for businesses. Companies can mitigate risks within their supply chain, catalyze innovations and collaborations, and respond to growing pressures from investors and other stakeholders.

Emissions estimation methodologies and tools

Saipem believes that it is essential to work on the

reliability of the analytical methods of GHGs emissions estimation and evaluation, to support the investment and collaboration strategies.

In fact, Saipem has in place an Air Emissions Estimation Methodology providing a complete, consistent, and transparent method to estimate the quantity of specific pollutants emitted into air. The methodology allows the quantification of pollutants and GHG emissions derived from both direct and indirect sources, as extraction and transportation of used fuels, transmission, and distribution losses of purchased electricity, water supply and wastewater management, input materials and waste management, transport of materials, use of employee cars, overnight and air travel business trips. The methodology is certified by third-party experts in accordance with the relevant international standards on emissions quantification, monitoring, and reporting.

“It is essential to work on the reliability of the analytical methods of GHGs emissions estimation and evaluation, to support the investment and collaboration strategies

Emissions estimation methodologies FOCUS on SCOPE 3

As anticipated, for Saipem a transparent, reliable, and traceable monitoring and reporting system is considered a must.

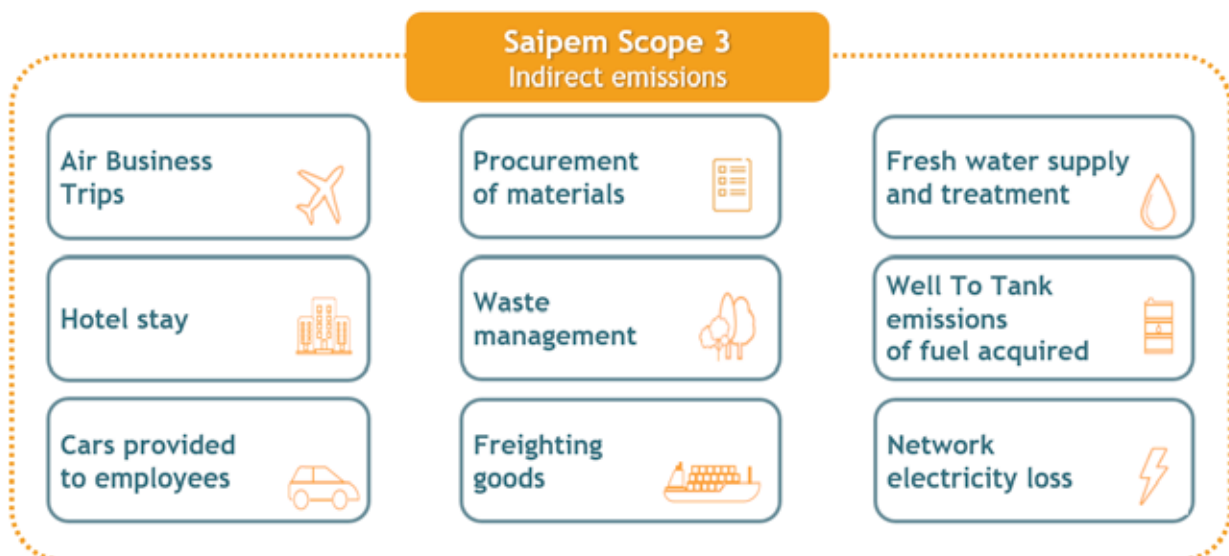


Figure 2 - Saipem Scope 3 current boundaries

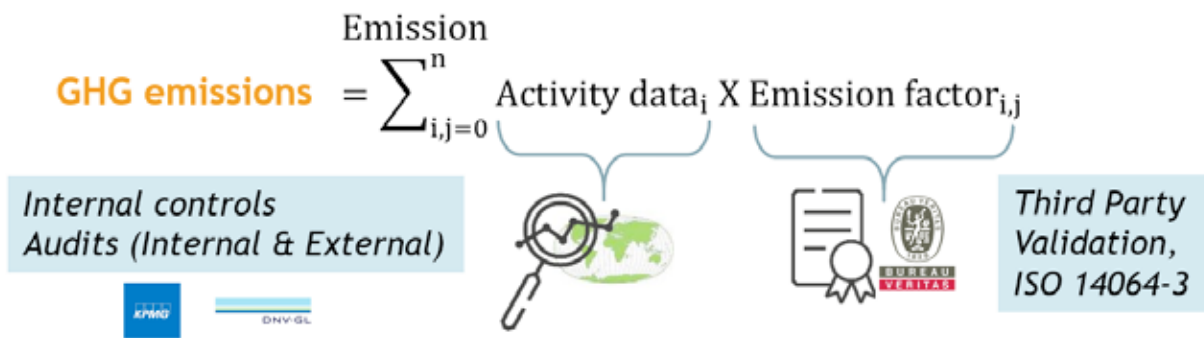


Figure 3 - Emissions estimation formula

“For Saipem a transparent, reliable, and traceable monitoring and reporting system is considered a must

Therefore, GHGs emissions are mapped and accounted in EPC/EPCI different range of projects (eg. refineries, LNG plants, windfarms), for upstream (*plant construction and installation, including procurement phase*), midstream (*operational phase*) and downstream (eg. *use of plant products, decommissioning*).

Quantifying in a robust way a company's scope 3 emissions is an essential starting point for their effective management.

As an initial step, Saipem used to perform a scope 3 emissions' screening to determine which scope 3 categories are most relevant in terms of emissions in their value chain for understanding where it is more effective to act. Understanding means creating tools and methodologies to measure GHGs emissions in a reliable and transparent way and, consequently, put into practice actions for maximizing their reduction.

For this reason, we have in place reliable and transparent methodology.

As anticipated, it is used for the first screening of main areas contributing to SCOPE 3 emissions: some are related to mobility [as flights, hotels, Corporate cars] others to services as waste and water management, others to procurement of materials.

The estimation is based on the classic formula: activity data multiplied by the relevant emission factors.

How do we ensure this methodology is RELIABLE and TRASPARENT?

Well, we can say it is based on a solid calculation. Emissions factors, together with the methodology, are

validated by an independent Third Party, as per main international standards, as ISO 14064.

Data are reported periodically by sites and projects worldwide and are subject to internal and third-party audits before being disclosed.

Exploding the SCOPE 3 we can identify 2 main “contributors”: the mobility, for which we have measures in place, and the biggest slice is procurement of materials, for which we decided to perform in deep examinations, by means of a dedicated “GHG Supplier Model Tool”, better detailed below.

GHG Supplier Model tool

The analysis of EPC/EPCI Projects, demonstrates that the Procurement phase of most projects generate a large part of Saipem Scope 3 emissions and Clients consider the ability of an EPC contractor to share or optimize Scope 3 emissions to be a competitive advantage.

In this framework SAIPEM developed a methodology and a tool to estimate the emissions across the supply chain, from raw material to final site delivery and to rank the suppliers based on their carbon footprint.

The tool has been developed to allow the identification of different production routes granting minimal emissions in the supply chain. It can work:

- At project level: to Estimate the CO2 emission from the material purchased for a project, since the design phase, depending on supply chain choices
- At category level: to Compare two or more suppliers for a specific procurement category, based on their GHG emission

A test run period is ongoing to finalize the tool and assess the suitability of the model for our vendor management processes and vendor selection.

SCOPE 3 reduction: main actions

As anticipated, Saipem Scope 3 main contributors are connected to MOBILITY and PROCUREMENT. For this reason, acting with suppliers is a fundamental pillar of our decarbonization path.

As far as mobility is concerned, just the rationalization of business travels would lead to a 30% reduction in the emissions of the flights. The action involves the more conscious and rational use of transport systems, acting on the culture of employees in terms of sustainable mobility, partnerships with airline companies, rentals, taxi companies, replacement of car fleets with the increasingly massive inclusion of low impact vehicles.

Furthermore, Saipem promotes the location of its offices in strategic and easily accessible areas. An example is the choice of the new headquarters in Milan in a strategic area, connected to public transport such as buses, subways, suburban railways and primary high-speed lines.

Similar choices have also been addressed in the recent past in other important locations, such as GPS in Zurich, Moss Maritime in Norway, and Saipem Ltd London and will be the model that will be followed in future choices.

Anyway, we are perfectly aware we are just at the beginning of the path, being confident we are approaching this path in the more conscious and reasonable way.



Chiara Petrella

Chiara Petrella has graduated as Environmental Engineer and has developed over 20 years' experience in main environmental issues management, as climate change and energy efficiency, waste valorisation and circular economy, spill risk assessments and management. She developed a long-standing experience in HSE Management Systems in operative construction sites and in complex Organizations, as well as in promoting HSE awareness and culture in a big multinational Corporation.

She joined Saipem since 2005 and is currently appointed as Group Environmental Manager, with the main task on identifying both short and long term environmental strategic actions to be applied throughout the Company's sites and projects worldwide. Her current focus is on Green House Gases emissions reduction in Saipem's assets and operations, considering Corporate climate-related risks and opportunities.



Claudia Attanasio

Claudia is the Environmental&Social Manager of Saipem's E&C Onshore Division. Together with her team, she ensures assistance to sites and projects for the environmental management, developing guidelines and methodologies for the assessment of the environmental and social impacts and for the implementation of preventive and protective measures. She started her career in Saipem in 2012, working as Project Environmental Manager in onshore and offshore projects.

She is deeply involved in the development of Saipem's strategy for Green House Gases reduction with the strong commitment to find technical and management solutions to improve the energy efficiency of projects operations and reduce the emissions of GHG.

She holds a Master's degree in Forestry and Environmental science and before joining Saipem she was an Environmental consultant for 10 years.

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Quality Risk Management in Oil & Gas Industry

Projects today are getting larger and more complex and several factors combined increase the level of project-related risk within the sector. The challenge therefore is to manage the political and other risks that are unavoidable in the industry. How well these risks are analyzed and managed will often be key to a project's success. The main techniques proposed by Xylem are: condition-based monitoring, predictive maintenance, critically-based maintenance, performance center or center of excellence.

Massimo Rebecchi, Xylem Srl President and Ceo

My multinational Client asked Xylem to explore the Operational Risks faced by Construction companies in today's business and regulatory environment, and how the right information technology can help mitigate those risks. Operational risk is experienced at the corporate level, but these considerations mainly focuses on what impacts can have every day on construction plants activities.

The purpose of this reflection is to encourage and facilitate the development of a more systematic, prioritized, risk-based approach to quality management to support the principles of "Good Construction Practice" and to complement existing quality practices, requirements and standards.

Quality in this context is commonly defined as fitness for purpose. Construction activities are about generating information to support decision making while protecting the safety and rights of participating subjects. The quality of information generated should therefore be sufficient to support good decision making.

Each step of the business process is setting the stage for decision making by one or more of the parties involved. Quite a number of these decisions are formalized by legislation and by design applicable standards.

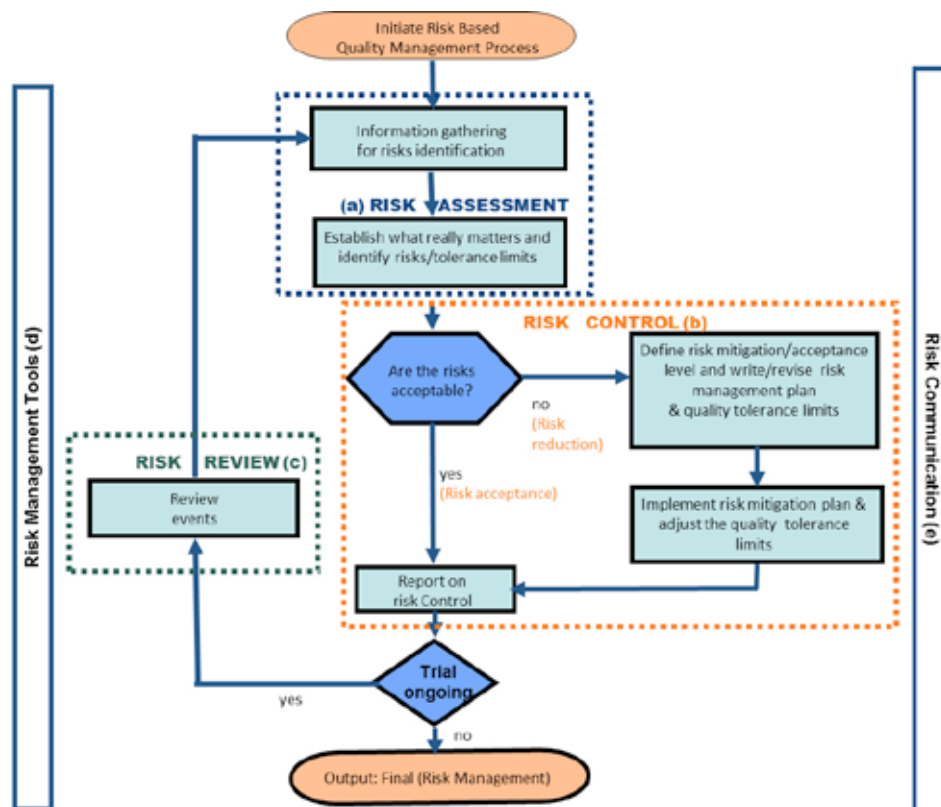
The challenge for oil & gas industry is to manage the political and other risks that are unavoidable in the industry with effective returns.

Decision Making Process, Value of Information and Flexibility

Many complex decision problems in petroleum exploration and production involve multiple conflicting objectives. Under these circumstances, managers have a growing need to employ improved and systematic decision processes that explicitly embody the firm's objectives, desired goals, and resource constraints.

Over the last two decades, the advances in computer-aided decision making processes have provided a mechanism to improve the quality of decision making in modern petroleum industry. Walls (1996) developed a decision support model

Fig. 1 - Quality Risk Management Process



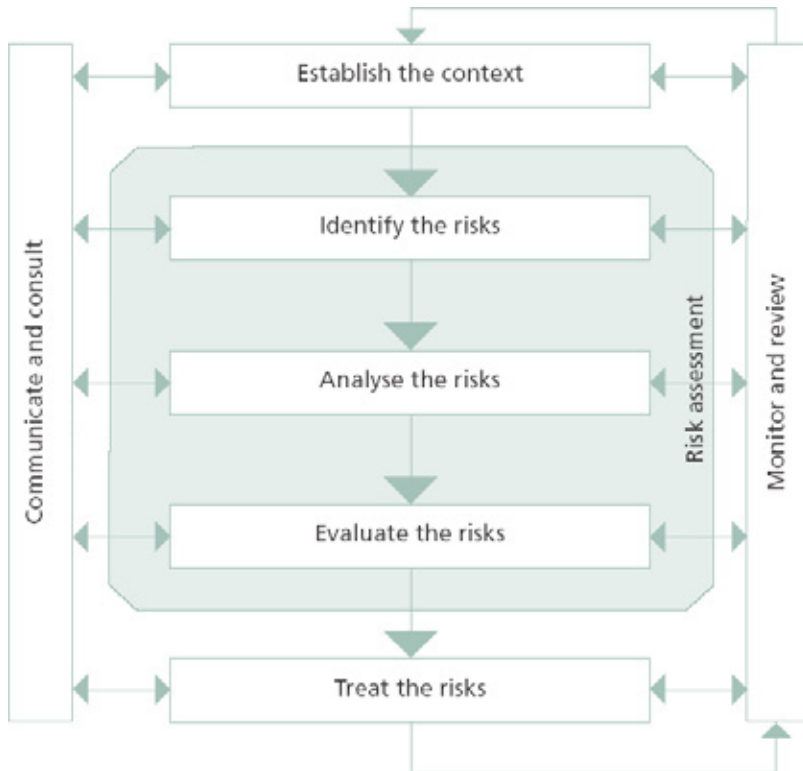


Fig. 2 - Risk Process Evaluation Loop:
 1. Credit risk,
 2. Liquidity risk,
 3. Operational risk,
 4. Market risk,
 5. Political risk,
 6. Foreign exchange risk

that combines the toolbox systems components to provide a comprehensive approach to exploration petroleum planning from geological development through the capital allocation process.

Right Information in Time

Most oil & gas companies would agree that the most significant challenge for their enterprise is management of information. Oil & gas companies continue to work to be able to create intelligence from the massive amount of technical and business data, both structured and unstructured, that they have collected. The ultimate goal in collecting all this information is to speed time to first oil, reduce risks, and meet compliance requirements with information life-cycle management.

Fig. 3 - Stakeholders in small business



Some companies are establishing new information governance structures to harness OT and IT (Operational Technology and Information Technology) data sources, and we expect others to follow.

Data Quality

When it comes to information related to assets the issue of data quality hits oil and gas companies. These are typical complaints that I collect:

- asset databases are incomplete;
- documents (including drawings) are not updated;
- information stored in the different company systems are not consistent or integrated;
- information is not available or not properly synchronized on mobile devices;
- data quality is not systematically audited. Poor data quality heavily impacts the decision-making process, increasing the risks of operational mistakes. Oil & gas companies need to carefully tackle this issue to avoid reducing effectiveness of operations. Additionally inconsistent data across systems (typically GIS, Geographic Information Systems, and EAM / ERP, Enterprise Asset Management / Enterprise Resources Planning) increases the risk of fines from regulators.

Prevention of Non Compliance

Every time there is a not approved deviation from procedures and specifications we have a non conformance. With the increasing regulatory pressure, oil & gas companies cannot afford the risk of being non-compliant to some rules. For this reason the possibility to meet a non conformance can be considered in medium-high level.

The non conformance has always a deep impact on project plan to search for a deviation or to rebuilt

materials, or to obtain new authorization to proceed with site and camp operations.

Is very important (and only few companies do it) to analyze the non conformances to understand how our project setup distribute the non conformances value.

More stringent requirements for timely reporting on operations and accidents might be required, as well as risk mitigation plans for critical operations such as drilling. Oil & gas companies need to ensure that vital documents, including approvals for drilling, building, and maintenance, are available throughout the enterprise and across enterprise boundaries to minimize risk and ensure regulatory compliance.

Real Time Monitoring and Predictive Maintenance

During the construction phase, major uncertainties are related to volumes in place and economics. As the level of information increases, these uncertainties are mitigated and consequently the importance of the uncertainties related to the recovery factor increases. The situation is more critical in offshore fields and for heavy-oil reservoirs.

In order to avoid excessive computation effort, some simplifications are always necessary. The key point is to define the simplifications and assumptions that can be made to improve performance without significant precision loss. Simplifications are possible, for instance, in the modeling tool, treatment of attributes and in the way several types of uncertainties are integrated.

Best-in-class companies use a variety of techniques to reduce maintenance costs, increase uptime, and increase availability.

These techniques include the following points.

Condition-based monitoring

Placement of sensors to measure various conditions (temperature, vibration etc.) to detect situations that may indicate potential equipment failure. The more sophisticated systems have alerting capabilities and are integrated with enterprise asset management applications that can automatically generate inspection or work orders.

Predictive maintenance

Predictive maintenance goes beyond condition-based maintenance in applying advanced analytics to predict potential equipment failures, providing enough notice to procure complex non-commodity replacement equipment. Xylem identify a departure from normal operating levels of a piece of equipment rather than comparing performance with expected performance levels for the equipment class.

Risk criterion	Objective
Safety	Safety must be upheld at all times. No injuries or fatalities will be accepted
Financial impact	Project costs should remain within allocated budget
Media exposure	The project must ensure that the reputation of the business is protected from negative media exposure
Timing	The project must be completed within the contractual timeframe
Staff management	The project must utilise existing staff skills. Where a particular skill set is not available, sub-contracting may be considered
Environment	The project must operate within requirements of environmental legislation and be consistent with the business's environmental commitment

Fig. 4 - Examples of risk criteria for a project business

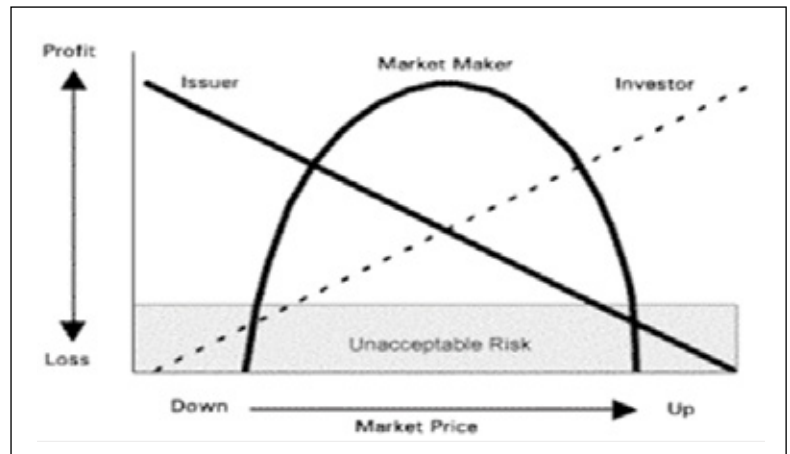


Fig. 5 - Market risk: the viewpoints of three participants

Criticality-based maintenance

This technique informs decisions on maintenance strategy by identifying which assets are critical to the process and what the process impacts would be if the asset were to fail. Criticality-based maintenance also informs procurement strategy so that inventories, and the costs associated with keeping them, are reduced but not at the expense of increased downtime.

Performance center or center of excellence

The most advanced companies have adopted centers of excellence where engineering staff are able to bring together engineering knowledge for root cause analysis when potential problems are identified. Centers of excellence can also have a view of multiple assets to support decision making and maintenance planning and even suggest future equipment design modifications.

Operations and Decisions

Making important decisions in the petroleum industry requires incorporation of major uncertainties, long time horizons, multiple alternatives, and complex value issues into the decision model. Decision analysis can be defined on different and embedded levels in petroleum exploration and production stages. Decision analysis is a philosophy,



Fig. 6 - Threats: oil and gas industry

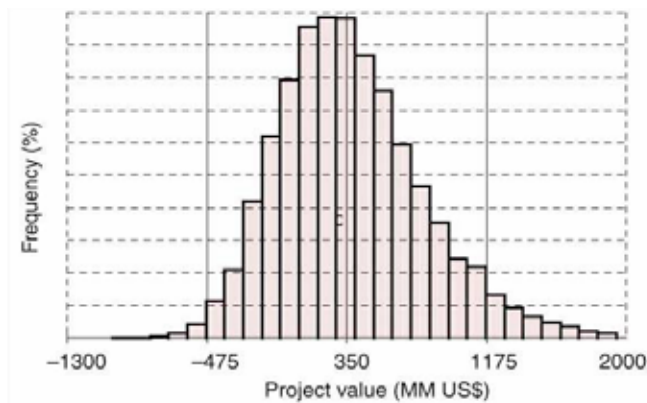


Fig. 7 - Cumulative risk frequency at project's value level

articulated by a set of logical axioms, and a methodology and collection of systematic procedures, based upon those axioms, for responsibly analyzing the complexities inherent in decision problems.

Conclusions

Projects today are getting larger and more complex. The attraction of upstream profits is also driving many companies to consider expanding their investments, moving from investor to operator, or entering into the space from adjacent energy sectors. At the same time,

the graying of experienced project managers is reducing available capabilities. These factors combined increase the level of project-related risk within the sector.

Unless a company follows a strategy of complete risk avoidance and stays solely within its national boundaries, it will be faced with the need to consider political risk when investing outside its home country. The challenge therefore is to manage the political and other risks that are unavoidable in the industry. How well these risks are analyzed and managed will often be key to a project's success.

Classic political risk in the form of expropriation and nationalization remains a threat, although it is not as prevalent as it once was. Remember, that expropriation or nationalization does not in and of itself violate international law, provided there is prompt, fair and adequate compensation to the investor. Risks of contract repudiation such as was experienced by Enron in India, and so-called "creeping nationalization" as evidenced by punitive taxation, burdensome labor and environmental regulations, price and monetary controls, pose a greater and probably more likely risk today.

While political risk can be managed through insurance, strategic alliances and partnering, it can also be minimized, by taking some actions, which may seem obvious, but are too often ignored. Effective techniques include keeping a low profile, maintaining close relationships with the host government, anticipating change and working with it, avoiding geographical concentration, being a good corporate citizen and utilizing local suppliers and personnel to the greatest extent possible so as to create an economic link with the host country that establishes a national constituency with a stake in your continued political survival. However, no form of political risk insurance can protect a company if it engages in bribery or corruption, or pollutes the environment. Such actions would probably void any political risk insurance that was obtained.

Information technology can help mitigate operational risks. Organizations that understand their risk profile and take concrete action to mitigate risks will be better positioned to be successful in the marketplace.



Massimo Rebecchi

Massimo Rebecchi is graduated in Civil Geotechnical Engineering. He has achieved PhD in Minerals and Petroleum Engineering in the United States. For years he was freelance professional as Mud Logger and Drilling Project Manager. He attended important construction projects under CCC-Sicon Oil group.

As a GE consultant in Nuovo Pignone since 2010, he attended several strategic Projects. During this experience

he established Xylem srl in Milan. As President and Managing Director he satisfied the Operations, Project and Quality requirements of several Main Contractors.

Today Xylem is a Lead Business Consultant Company in Industrial Construction (Oil, Gas, Process, Mills, Rail) for Operations, Project Management and Sourcing Quality Management located in Italy, Emirates, France and Algeria.



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Italy-Montenegro HVDC link - Cepagatti converter station

HVDC links key role in decarbonization

Giovanni Cerchiarini (*) - Head of International Operations, Terna

Snow, frost and blackouts knocked down Texas in the last weeks of February 2021. The US state, linked to the sunny images of cowboys' horseback riding in the desert reported by the most iconic filmography, has become the symbol of the disasters that climate change can cause. The traditionally warm and sunny state was struck by a snow and ice storm unprecedented

in the last century, with temperatures several degrees below freezing for a prolonged period, causing enormous distress to citizens. As temperatures dropped more and more, many people turned on their domestic heating, trying to protect themselves from the exceptional cold that hit the area. As a consequence, electricity demand rose well beyond the levels expected for the season. At the same time, the freezing weather put a large part of the power generation park out of

service, causing a strong imbalance between withdrawals from and feed into the grid. In essence, the infrastructure was caught unprepared when cold and snow began to bite. The Electric Reliability Council of Texas (ERCOT), the system operator that manages the state's power grid, was therefore forced to stop supply in rotation to try to stabilize the system and avoid an uncontrolled blackout. Many users were left without power (and electric heating) for days, sometimes for more than a week, during a wave of extreme cold. The prolonged power outages caused suffering, death and destruction. Businesses were unable to function, leading to lost production and ripple effects to suppliers and other parts of the U.S. economy. Meanwhile, in many buildings across Texas, pipes froze, then thawed and spewed water, creating additional costly damage. The imbalance on the free spot market between energy demand and supply sent energy prices through the roof, from about 50 USD/MWh before the storm to the regulated cap of 9.000 USD/MWh for about a week; as a result, those end-users who were not disconnected and whose contracts exposed them to spot prices, accrued bills 100 to 200 times higher than usual, whilst for those with fixed prices contracts, the onus fell on the power companies, some of which ended up facing bankruptcy, with additional ripple effects.

The maelstrom was exacerbated by the fact that Texas has its own electricity grid, which it consciously chose to separate from other states both in the east and west of the US to prevent it from coming under the jurisdiction of federal institutions. This means that, differently from the rest of the US, but also from Europe, network isolation does not allow access to nearby state support for system balancing when momentary failures or overloads take place. If the same situation had occurred elsewhere, interconnections could have at least partially compensated for the peak in demand and

the production failures that occurred due to the cold wave, avoiding or mitigating rolling blackouts. On top of this, Texas does not impose obligations on producers to maintain adequate reserve margins capable of guaranteeing the supply of electricity and contributing to the stability of the grid in all circumstances. Faced with the cold emergency, the state found itself without weapons.

“The maelstrom in Texas of last February and its consequences is just the latest and more prominent demonstration that climate change causes extreme weather events with a frequency and an intensity never experienced in the past, putting the energy infrastructure to the test

What happened in Texas is just the latest and more prominent demonstration that climate change causes extreme weather events with a frequency and an intensity never experienced in the past, putting the energy infrastructure to the test. Heat waves and wildfires in California and Western Australia, stormy winds in northern Italy, and an unprecedented ice storm in Slovenia are some other recent egregious examples **(Figure 1)**

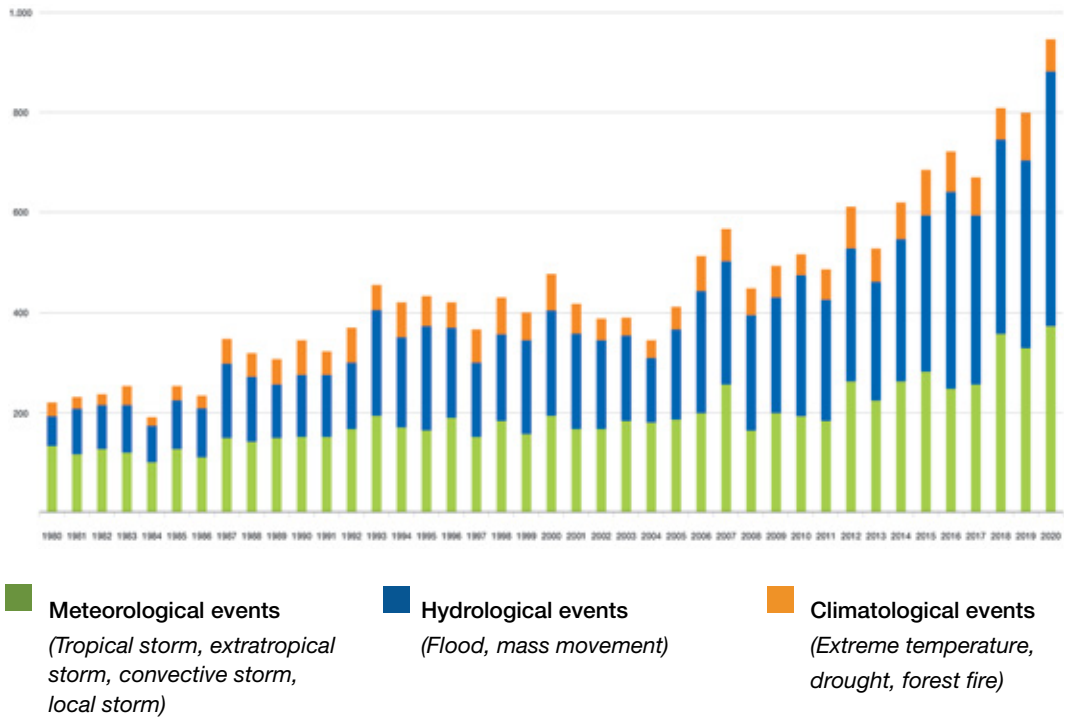
Science has largely established the direct link between the increasing concentration of greenhouse gases in the atmosphere and the progressive modification of the planet's climate balance, which leads to significant temperature rises, prolonged periods of drought and an increase in frequency and severity of extreme weather events. Greenhouse gas emissions represent the major impact of human activity on the environment.

In a global effort to fight climate change, many countries have therefore committed to decarbonization targets.



Submarine cable laying

Figure 1 - Number of weather-related loss events worldwide 1980 – 2020. Source: Munich Re - NatCatSERVICE



Accounted events have caused at least one fatality and/or produced normalized losses \geq US\$ 100k, 300k, 1m, or 3m (depending on the assigned World Bank income group of the affected country).

Italy-Montenegro HVDC link - Kotor converter station valve hall



Approaches may vary by geography, both in terms of scope and of degree of enforcement, with some regions leading the effort while others following, tools devised to reach targets may differ, but one trend emerges clearly: decarbonization efforts are increasingly ambitious over time, along with the sense of urgency that climate change is a planetary issue that needs to be tackled right away. Please see the “Decarbonization targets” box for details.

How will the power sector and power transmission grids contribute to decarbonization? Their role is crucial in many ways: electricity is the most decarbonised energy vector due to its ability to integrate carbon neutral renewable energy sources (RES) like solar and wind, and the one that, more than any other, allows for a real increase in energy efficiency. Decarbonization will therefore require a substantial shift to electricity as energy vector, resulting in electricity demand growth even after considering the improvement in energy efficiency (just consider, for example, the expected radical shift from fossil fuel based to electric vehicles). But integrating a large portion of RES

into the electricity system is not a simple task, as RES production depends on the instant availability of wind and sun, sources that cannot be stored as oil and gas, and therefore lack their firmness and dependability. The latter statistically increases with the geographic footprint where energy can be instantly exchanged: if wind dies here, most likely there will be abundant wind elsewhere, and to some extent this is also true for the sun radiation. Therefore, to effectively address the dependability issue, power transmission networks must not only connect an unprecedented fleet of new RES production plants, but also enable to move their produced energy much farther apart than in the past, increasing their capacity and the mutual support between distant areas.

“Decarbonization will require a substantial shift to electricity as energy vector, resulting in electricity demand growth even after considering the improvement in energy efficiency”

Electricity networks therefore play a twofold crucial role in a global warming scenario: on one hand they are on the receiving end of extreme weather events triggered by climate change and must sharply increase their resiliency to continue supplying their essential service; on the other hand, they are at the very forefront of the fight against climate change. Because of the above, worldwide grid investments surged in recent years, and

are expected to surge even more in the near future, making up a significant share of overall investments in the power sector (**Figure 2**)

The paradigm shift in the power sector is also changing the average size and complexity of transmission projects. A sector that for decades has been relatively stable from a technological and design point of view, using largely standard, off-the-shelf components, is facing new challenges to transport much larger quantities of energy and for longer distances than in the past, preserving system stability and power quality on wider interconnected footprints even in the presence of the loosely predictable power fluctuations brought by renewable generation. This not only requires a large increase in digitization across the industry, but also makes strong skills indispensable for managing complex cross-industry projects, especially for subsea HVDC projects (project management, supply chain management, risk control, cables engineering and installation, offshore execution, etc.). A solid multi-sector technological know-how is also needed to make the right choices in a rapidly evolving context, which often requires custom solutions to tackle the correct balance between many conflicting and sometimes uncertain dimensions (e.g., proven vs. new technologies, immediate vs. future needs, costs, timeliness, etc.).

What role can be played by cables, and particularly HVDC cables, in this badly needed accelerated

“The transmission sector that for decades has been relatively stable from a technological and design point of view, using largely standard, off-the-shelf components, is facing new challenges to transport much larger quantities of energy and for longer distances than in the past, preserving system stability and power quality

development of transmission networks? In most of the world, and especially in those areas where electricity demand density is highest, land is at premium, and nobody wants an overhead line over or close to his/her house. In a typical example of NYMBY syndrome, everyone wants/needs a reliable, resilient, and environmentally friendly electricity system, but no one wants to see it. Still, electricity must be transported in larger quantities and at longer distances than in the past. Power cables provide an alternative solution to overhead lines on in land installations and they are the only solution for long submarine interconnections. They also have clear resiliency advantages because they don't suffer extreme winds, ice or wet snow, conditions that may put out of service, sometimes for long time, traditional overhead lines.

HVDC cables provide further help, because they have little to no electromagnetic emissions, a topic which raises increasing – if not scientifically

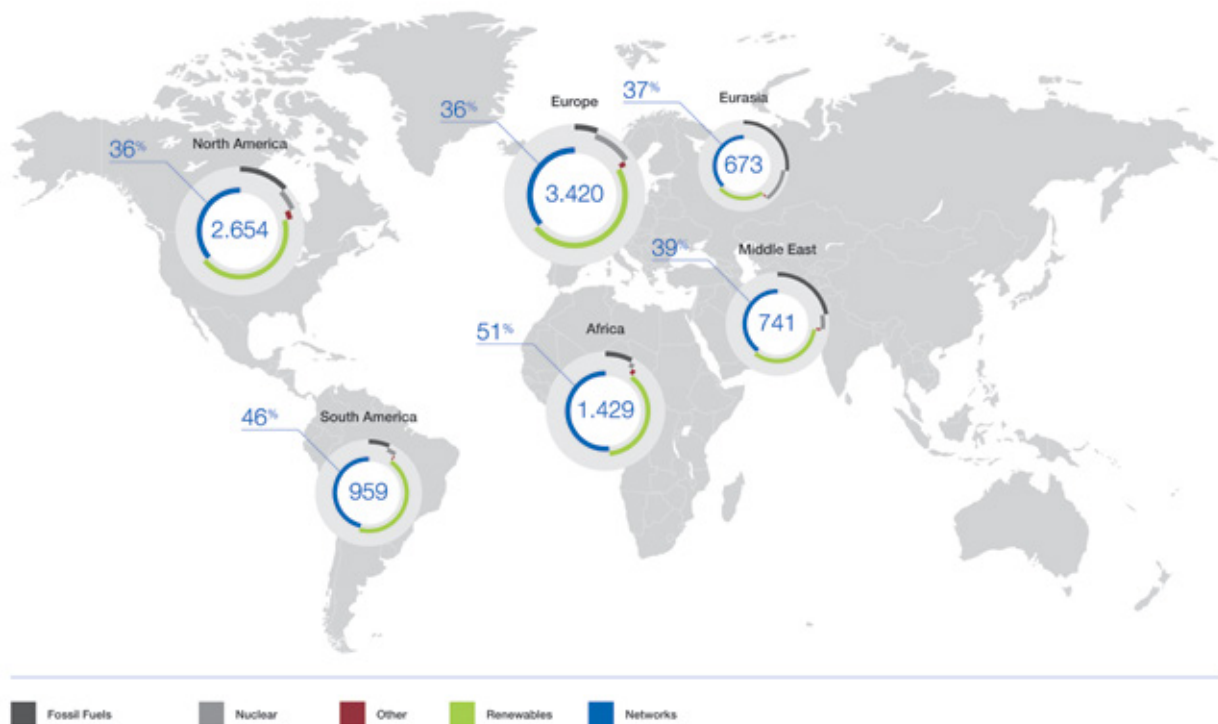


Figure 2 - Cumulative investments in generation, distribution and transmission (\$Bn | 2019-40).

Source: IEA World Energy Outlook 2019

DECARBONIZATION TARGETS

COP 15 (the 15th session of the Conference of the Parties, the decision-making body of the UN Framework Convention on Climate Change), held in Copenhagen in December 2009, was definitely a seminal moment in the fight against climate change. The Conference outcome document, called the Copenhagen Accord, includes several key statements in the path to fight climate change:

- it acknowledges climate change as one of the greatest challenges of our time;
- it supports the scientific view that the increase in global temperature should not exceed 2° C above pre-industrial level;
- it recognizes that deep cuts in global emissions are required.

The Copenhagen Accord resulted in emission reduction pledges to the year 2020 by countries covering more than 80% of global emissions. Those pledges were, however, not binding.

Six years later the world upped the ante at COP 21 in Paris, by producing the Paris Agreement which was signed off by 195 countries and the EU. The Paris Agreement confirms the 2° C maximum temperature increase target, but also promotes efforts to limit the increase to 1.5° C. Though not introducing an enforcement mechanism for individual countries targets, it sets up procedures for signatories to adopt ever ambitious GHG reductions over the years and regularly report on progress. The US made news when President Trump withdrew from the Paris Agreement in 2020, only for President Biden to re-join in February 2021.

Notwithstanding the Trump administration stance on the Paris Agreement, and climate change in general, with climate-sceptic in chief tweeting more often than not about climate change being a hoax, the US did not stand still in terms of moving on a path to decarbonization.

Bereft of a de facto emission reduction target at federal level, several US states took the initiative and set emission and renewables standards. Some of them today can boast very large renewables installations, Texas alone has almost 30 GW of wind and solar capacity.

On the other side of the ocean, Europe was a forerunner in setting decarbonization targets. Its Emissions Trading System (EU ETS) was launched in 2005 to limit carbon emissions by the power sector through 'cap and trade' of emission allowances. The EU ETS has since then been revamped several times, to include more sectors and address claims it was not effective in meeting its goals. Recently, the EU carbon allowance price has been steadily climbing, testimony to the fact that the ETS has gone through its initial learning phase and improved its effectiveness.

At the same time, Europe's carbon emissions reduction strategy has consistently been growing more ambitious and encompassing.

In 2008 the EU adopted the Clean Energy Package, which led to the 20-20-20 targets: a 20% reduction in carbon emissions, a 20% increase in energy efficiency and a 20% share of renewable sources in energy consumption (including power, heat and transport) by 2020.

In 2019 the European Green Deal was introduced, with the overarching goal of making Europe the first climate neutral bloc by 2050. The plan sets an intermediate emission reduction target of 55% by 2030 (vs. 40% for the Clean Energy Package), and follows an encompassing approach, by extending policy areas in its remit to the circular economy, biodiversity and "farm to fork" among others.

supported – worries. Please see the "HVDC advantages" box for details.

Terna has a long track record in design, construction and operation of submarine power cables, dating back to 1967 when the SACOI cable, connecting Tuscany to Sardinia via Corsica, entered operation; in 1987 SACOI was then revamped to become the world's first tri-

terminal HVDC link. As a matter of fact, Terna set more than one world record in the submarine cables domain (see Figure 3). In 2011 power started flowing between Sardinia and the Italian mainland through SAPEI, a HVDC submarine cable reaching 1.640 meters of depth, the deepest ever achieved and yet not outdone. The Sorgente-Rizziconi link, the 'underwater Messina bridge' connecting Sicily to Calabria starting from 2016, is the world longest HVAC link. More recently, Terna completed in 2019 the Italy-Montenegro HVDC submarine cable, with other international HVDC links currently in the works (**Figure 3**).

Precisely for this reason, Terna's 2021-2025 Business Plan provides for investments of € 8.9 billion (+ 22% compared to the previous plan) to manage the energy transition and ensure the integration of renewables. The company has earmarked 1.2 billion euros for investments aimed at grid reliability and projects improving the dynamic stability of the electricity system, in line with the guidelines that emerged from the Paris Agreement targets. The 21-25 Plan provides for targeted interventions and innovative solutions aimed at

Italy-Montenegro HVDC link - Cepagatti converter station



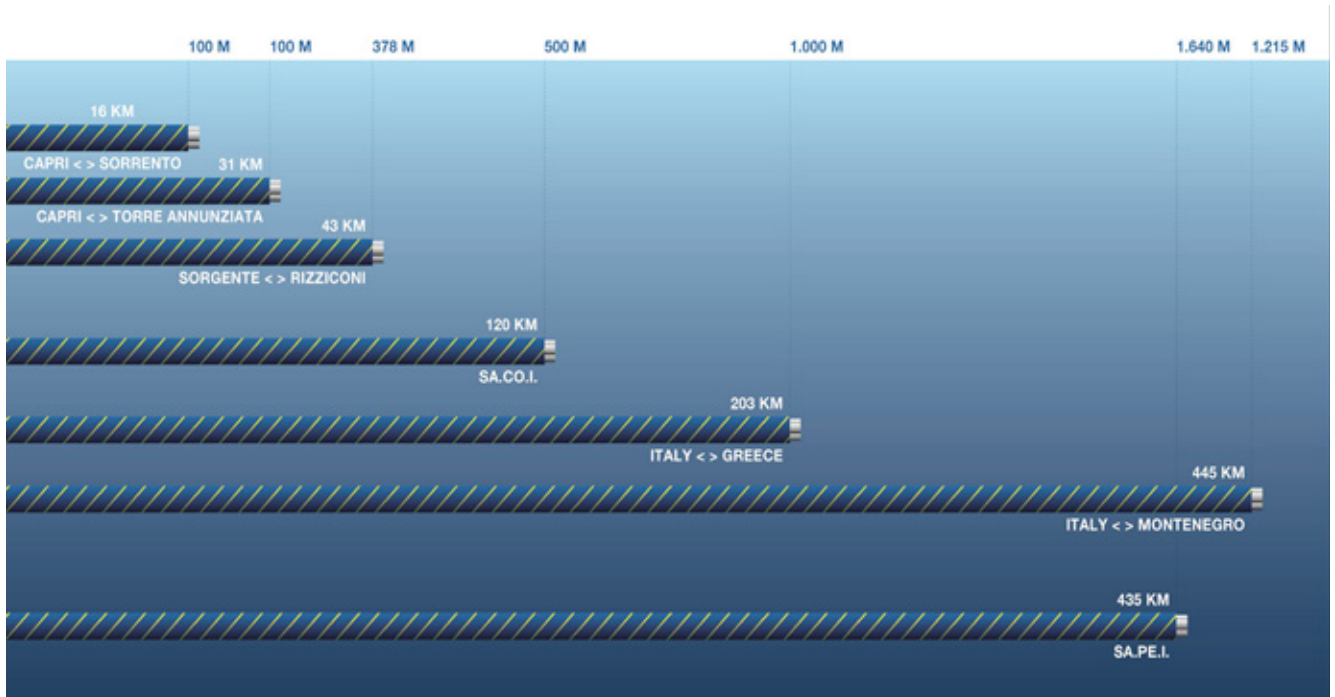


Figure 3 - Terna submarine cables

HVDC ADVANTAGES

HVDC transmission becomes interesting on very long interconnections. The breakeven distance at which the AC solution becomes technically infeasible, or where it is feasible but economically not convenient, depends on many factors and it is consequently hard to define a specific figure. Generally, such figure falls within the 300 to 500 km range for overhead lines and within the 40 to 100 km range for cable lines. Such ranges should be considered as very general for an order of magnitude only.

The main technical limitation of AC interties is the management of reactive power to be compensated both at light loads and full load conditions. This requires shunt inductive reactors and series capacitors for the light and full load compensation respectively. There are a number of AC overhead lines longer than 1.000 km completed in the last century with intermediate compensation stations [1]. Such solutions are no longer used today since the reduction in HVDC converter station costs makes HVDC transmission more attractive. Furthermore, the ability of a HVDC intertie to regulate independently the power on the DC link gives an opportunity to modulate the power on bordering AC lines as well. HVDC solutions remain the only option for very long submarine links. In fact, as mentioned above, the cost reduction of HVDC converter stations has generated an increase in submarine HVDC interties. Mass Impregnated Non-Draining (MIND) cables, although the pioneer technology in the cable industry since early 60s, still represents today a valid and reliable solution for HVDC transmission, especially for very deep waters with no rival technology. In the last 20 years the extruded HVDC cable technology came on the market becoming immediately attractive for land applications and for shallow water installations. In these same years the extruded solution has reached the MIND cable in terms of voltage rating and we will see the first application in the 500 kV range in the upcoming years [2].

As far as converter station technology is concerned, the new Voltage Source Converter (VSC) solution has contributed to draw attention on HVDC transmission. In fact, VSC became an alternative to the par excellence Line Commutated Converter (LCC) technology at the beginning of this millennium. VSC, with its larger flexibility and its intrinsic capacity to regulate the AC voltage on the interconnected points with the AC grid, has immediately attracted many Transmission System Operators (TSO) and in the last 20 years many HVDC interties using the VSC technology have been completed all over the world. In spite of the increasing number of installations, VSC technology must still be considered as under development since many versions have been developed over these last 20 years, and further versions of the current ones are expected to come. On the other hand, LCC technology remains more reliable, cheaper and much less onerous from a maintenance point of view. Furthermore, the combination of the "classic" well established LCC solution with a synchronous condenser and specific schemes of operation makes this "old school" technology an equivalent solution to VSC technology, as demonstrated by Terna in the upcoming refurbishment of the SACOI intertie [3,4].

dealing with the risks associated with the occurrence of adverse climatic events, the frequency of which has intensified as a result of the climate changes underway, as well as strengthening transmission capacity and interconnections with bordering countries.

(*) *The Author is grateful for the help in drafting this article by:*

Alessandra Laria - International Operations Program Management Office;

Massimo Marzinotto - Head of Presidio Tecnologico Impianti HVDC;

Gianni Restano - Head of International Regulatory Affairs

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Giovanni Cerchiarini

Giovanni Cerchiarini is the current Head of International Operations at Terna Group, after joining in 2017.

Giovanni devoted most of his career to Saipem, a global leader in engineering, procurement, construction and installation of complex onshore and offshore projects in the oil & gas, power and infrastructure industry sectors, where he served in a number of leadership capacities. Giovanni began his professional path with the company in 1990 as Site Superintendent, and he rapidly progressed to more senior roles, including Construction Manager, Project Manager and Project Director in various jurisdictions.

Within ten years, Giovanni was promoted to Operations Manager Onshore in Nigeria, a position which expanded his responsibilities to include all onshore projects within his region. Four years later he became the country's Managing Director. His responsibilities included overseeing all regional operations and project acquisitions, defining bid strategies and execution schemes, as well as promoting locally the interests of the Saipem Group, and coordinating the development of assets and facilities in line with local requirements.

In 2008, Giovanni further progressed from regional roles to global positions at the company's headquarters and embraced a wider range of responsibilities, including integration of several business units, development of project execution models, organisation of large project

task forces, integration of acquired businesses into the larger organisational structure, and optimisation of business processes with a focus on a more regional model. Giovanni was subsequently appointed Senior Vice President of Project Executions in 2011, Deputy COO in 2012, and Country President & CEO in 2013. He has successfully managed a portfolio of projects with a yearly turnover exceeding US\$ 6B.

In 2014, Giovanni joined the Indian conglomerate Larsen & Toubro as Board Director, where he led the International Hydrocarbon Mid- & Downstream Business. Giovanni was in charge of managing all international onshore projects, with a total value of US\$ 1.5B, and of establishing a standalone international organisation that would eventually consolidate both the company presence and performance in the GCC region, as well as developing new markets throughout Africa, CIS, and the Far East, focusing on culturally driven organisational change.

In 2016, Giovanni joined GE Grid Solutions as projects General Manager. Giovanni has been a key player in transforming the GE Grid SAS Project Management organisation, leading his team to implement a project execution model with global functional COEs to ensure sharing of expertise, process consistency and execution support across different Regions.

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Termomeccanica Pompe further asserts itself as an international player

Outstanding support to customers with ever more complex integrated pumping solutions and a growing network of local service companies

Daniele Cecchini, Sales Area Manager,
Sylvie Carret, Development and Promotion,
Termomeccanica Pompe



Over the last 25 years, Termomeccanica Pompe (TMP) has experienced constant growth, becoming a key supplier of engineered pumps solutions and related after-sales services. This expansion stems from TMP's 100-year long expertise combined with its innovation-based development strategies.

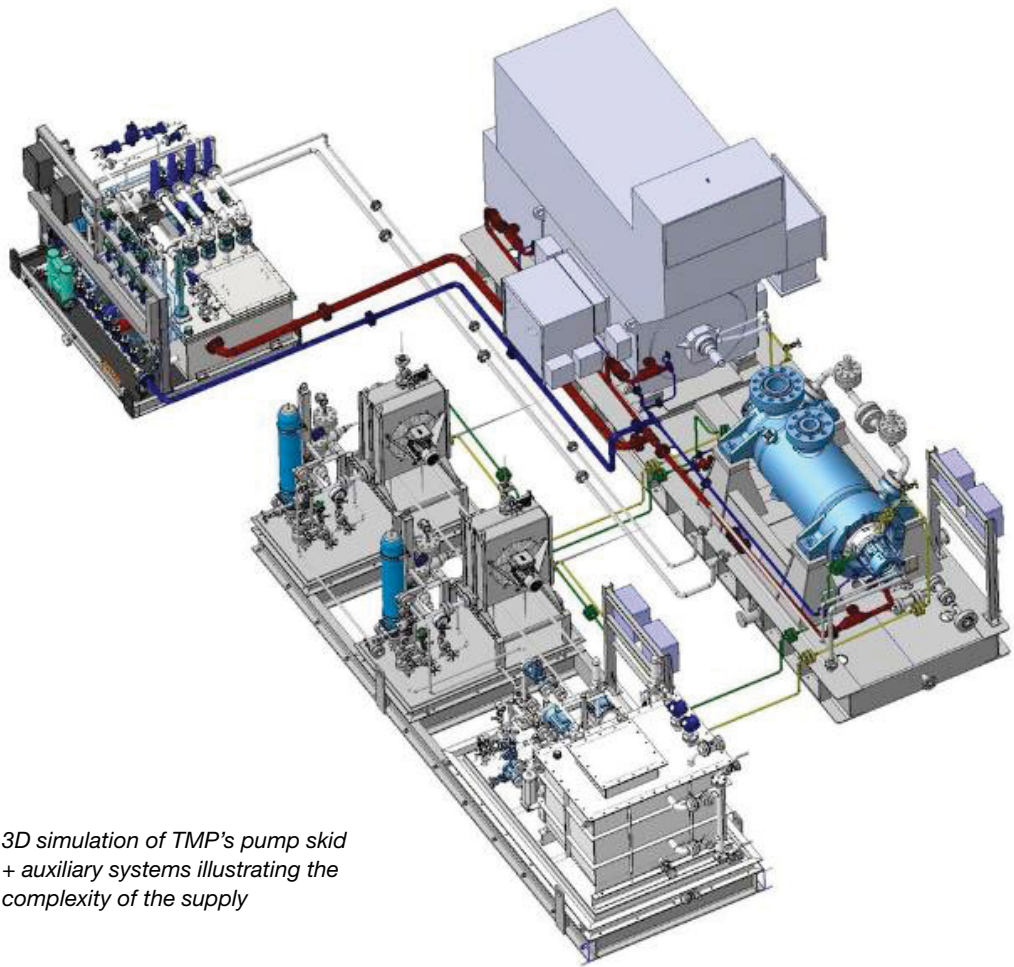
“Over the last 25 years Termomeccanica Pompe has experienced constant growth, becoming a key supplier of engineered pumps solutions and related after-sales services, globally

One of Termomeccanica Pompe's main key success factors has definitely been its capacity

to follow an intense internationalization and localization process, leading to the opening of local branches & subsidiaries in key areas for both its sales and operations, including procurement, production and service activities.

Today, Termomeccanica Pompe is a group of 9 branches & controlled companies spread over 7 countries who performs more than 80% of its business outside its domestic market (Italy).

MENA has been a key market for TMP for more than 40 years with regards to all its reference sectors, i.e. Oil & Gas, Water, Power Generation and Desalination. So much so that the company started establishing commercial companies and service centers in the area as early as the 2000s with the objective to improve the responsiveness of its services to local customers and end-users



3D simulation of TMP's pump skid + auxiliary systems illustrating the complexity of the supply

as well as to pro-actively contribute to national governments' localization programs.

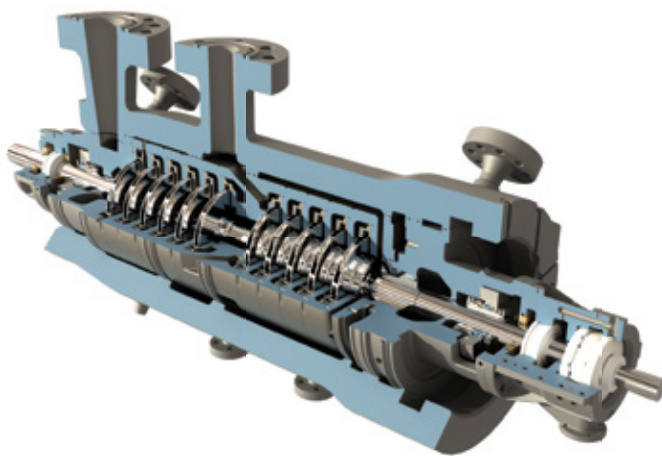
This article focuses on Termomeccanica Pompe's latest activities in the dynamic Abu Dhabi's (Oil & Gas) market, referring to one of its most recent contracts acquired for a major

onshore field upgrade project as well as to the opening of its newest service center located in ICAD II.

A key system integration job for ADNOC'S BAB 485 oil field upgrade project

Following various strategic contracts related the off/onshore facilities of the Umm Lulu, Umm Shaif, Sarb, Upper Zakum and Fujairah oil fields, Termomeccanica Pompe further strengthens its position as a "system integrator" of customized engineered pumping units for the UAE's Oil & Gas sector with its latest order for one of the area's largest onshore producing assets located 160 km southwest of Abu Dhabi city.

In fact, last year, TMP signed a contract with Archirodon for the supply of complex pumping units and their related auxiliaries for the Bab 485 onshore oil field upgrade project.



3D simulation of TMP's API 610 BB5-type pump performing main surface water injection service at the oil field



Termomeccanica Saudia workshop – outside view



Termomeccanica Saudia Co Ltd – Al Jubail workshop



Industrial City of Abu Dhabi (ICAD)

With this project, the Abu Dhabi National Oil Company (ADNOC) aims at strengthening its upstream sustainable growth plans. Indeed, the upgrade will enable to unlock the full potential of the field's existing assets and wells while tapping into new reservoirs, thus

sustaining long-term production output at 485,000 bpd. The project is part of ADNOC 2030 smart growth strategy as well as Abu Dhabi's Vision 2030 focusing on an ever-more value-added, diversified and sustainable economic growth of the Emirate.



Termomeccanica Pumps Services – workshop view (left) & on site intervention by local personnel (right)

This explains why ADNOC carefully considered the extent to which bidders would maximize In-Country Value (ICV) in the delivery of the project as part of the selection criteria for the award of the EPC contract. ICV is the mechanism ADNOC has integrated into its tender evaluation process to nurture new local and international partnerships and business opportunities in support of the development of the nation's economy.

ADNOC awarded the EPC contract to Archirodon Construction (Overseas) Co. Ltd. in 2019. The scope of such contract includes the development of oil producing wells, water injection wells, artificial lift wells, well-bays, let down stations, water injection clusters and other infrastructure required to sustain the production capacity of the field.

Termomeccanica's supply is related to said water injection clusters and consists of 3 main surface water injection pumping units with related auxiliaries.

Each pump skid is composed of a horizontal between bearings, radially split BB5-type pump (TMP MESB model) in super-duplex material, an electric motor and two auxiliary sealing systems plan 53B with forced air cooling, refilled by a single automatic top-up unit. Two of the pumps will be driven by a fixed speed electric motor

while the third one will be driven by a variable speed electric motor.

One of the main reasons Termomeccanica was awarded the contract for this job lies in its capacity to act as a true "system integrator", i.e. in its capacity to manage the complex supply of additional auxiliary systems located outside the main pump skids but key to their operations.

In this case, such systems include:

- the API 614 lube oil system unit with API 661 forced air coolers;
- the logic and control of the main parameters of the equipment, performed by a unit control panel with its associated machine monitoring system;
- a 24-pulse frequency converter in accordance with Shell DEP specifications that will modulate the speed of the electric motor in order to supply the quantity of water needed by the customer;
- an oil cooled transformer (ONAN) with input voltage to the primary winding of 33 kV.

This further auxiliaries' integration aims at ensuring the maximum flexibility and optimization of the water injection service at the field.

The design of the pumps and their auxiliary systems – installed on and off the pump skids – had to take into consideration operations of the pump at variable speed and under extreme external climate conditions, with temperatures

reaching up to 58°C. Termomeccanica's R&D Department performed roto dynamics analyses to optimize pump design as well as sizing of auxiliary systems.

Both the customer (i.e. Archirodon) and the end user (ADNOC Onshore) will have the possibility to control the project's production progress as well as to attend the functional tests of a complete train ('Complete Unit Test') at the TMP's HQ unique test center, whose dimensions and power capacity of up to 18 MW at a 50 Hz voltage allow to supply the adequate power to the job's transformers and to perform the simultaneous testing of the pump and its entire job's electro-instrumental train.

Service workshops in the Kingdom of Saudi Arabia and Abu Dhabi

Considering the key importance of the MENA market in terms of both new product and after-sales businesses, Termomeccanica Pompe started opening commercial companies and service centers in the area as early as the 2000s, first in Saudi Arabia and more recently in the UAE.

“Termomeccanica Pompe started opening commercial companies and service centers in MENA as early as the 2000s, first in the Kingdom of Saudi Arabia and more recently in the UAE

In 2005, Termomeccanica Pompe established a majority-owned company in Riyadh to act as its commercial arm in the country. Five years later, Termomeccanica Saudia Co. Ltd. added a service center to its local structure in order to offer all main repair & maintenance activities on rotating machines locally according to Termomeccanica's HQ standards. The service center is set up to perform its activities both at its strategically located workshop - i.e. in the industrial city of Al-Jubail, near Dammam and Bahrein - and on-site at customers' facilities.

Termomeccanica Saudia's service center has been successfully servicing key local utility companies such as the Saline Water Conversion Corporation (SWCC), National Water Company (NWC), Saudi Electricity Company

(SEC) and SABIC for over ten years now.

With a view to constantly improve rapport with customers, Termomeccanica Saudia's has been expanding its range of services, recently adding training courses to its portfolio. Training has indeed become key for companies who want to increase their localization & need to align to Saudi Arabia's Vision 2030 strategy & policies, which include specific requirements regarding the training of national personnel.

Thanks to the ready-to-use modules provided by the HQ's Training team in Italy, Termomeccanica Saudia is capable to autonomously develop and tailor technical training programs on the operations & maintenance of pumps installed at Saudi plants.

Termomeccanica Pompe has followed the same process in the UAE, first establishing a branch in Dubai in 2008, converted into a commercial company in 2012 – Termomeccanica Pompe Middle East FZE – with the aim to further support the company's service activities locally.

Late last year, TMP set up a new company - Termomeccanica Pumps Services LLC - with the view to take things to the next level and open its latest service center to better cater to local customers' and end users' needs related to the rotating equipment of their plants.

The company is located in ICAD II, i.e. the Industrial City of Abu Dhabi, very close to the Emirate's main petrochemical plants and refineries and just 150km away from Dubai and its industrial areas.

The 1,700m² workshop is fully equipped to carry out repair & maintenance mechanical works on rotating equipment, including the manufacture of critical parts.

The company will also offer field services for such equipment, namely supervision of installation & commissioning, main overhauls, troubleshooting / mechanical analysis and monitoring.

Lastly, with the support from its mother company, Termomeccanica Pumps Services will take an active part in the development and upgrading of local plants.

It is important to highlight that the company has already obtained its In Country Value (ICV) certificate and will therefore be able to service ADNOC on top of other existing Termomeccanica customers of the Power and Water sectors such as DEWA and SEWA.

Conclusions

Termomeccanica Pompe has become a major international engineered pumps manufacturer able to provide complex integrated solutions related to both new product as well as after-sales service that respond to customers specific project requirements.

The opening of its latest service center in Abu Dhabi is yet another demonstration of the company's commitment to invest wherever needed to keep improving responsiveness of

“With the opening of its latest service center in Abu Dhabi, Termomeccanica Pompe confirms to have become a major international engineered pumps manufacturer and service provider

services to its worldwide customer base while actively contributing to the development of local manpower and supply chains as per national localization policies.



Daniele Cecchini

Daniele Cecchini has a master's degree in Nautical Engineering from the University of Genoa.

Following his degree, he conducted a research project at Newcastle University (UK) thanks to a EU-funded scholarship.

He then began his career in the yachting sector, working in the R&D Department of the Azimut/Benetti group.

He joined Termomeccanica Pompe in 2012, where he started as a Project Engineer, a position that allowed him to deepen his

knowledge of centrifugal pumps and their related auxiliary systems, with a special focus on the Oil & Gas sector.

Today, Daniele Cecchini works in the Sales & Marketing Department where he is a Sales Area Manager and follows strategic markets such as the United Arab Emirates, Oman, South Korea and Japan, serving key customers such as Petrofac, Technip, NPCC, CPECC, Hyundai, JGC. He has acquired orders for various prestigious end-users, including ADNOC, PDO, Orpic and KIPIC.



Sylvie Carret

Sylvie Carret has a Master's Degree from the EM Lyon Business School and an MBA from York University (Toronto - Canada). Over the years, she has developed an international academic & work experience, mastering five languages – i.e. French, English, Spanish, Portuguese and Italian. Sylvie started her career in 1993 in Sales & Promotion for a French textile group, for whom she worked first in France for a year and then in the UK for 4 years. She moved to Brazil in 1998 where she had the opportunity to join Dell Computadores do Brasil Ltda. During her 3 years at the US company's Latin American HQ, she was part of the Brazilian SME Sales Team, starting at Sales Rep level, but quickly moving

on to Sales Coach & Team Leader positions. When moving back to Europe in 2002, she continued to live and breathe Dell's Direct Business Model, joining the Spanish SME Sales Team at the company's Southern Europe HQ in Montpellier (France). Sylvie moved one last time in 2003, this time to Italy where she has been working for Termomeccanica Pompe for 15 years. As a member of the Business Development & Promotion team, she elaborates the annual Marketing Plan & Budget together with the company's top management and is in charge of implementing the corresponding B2B digital and traditional marketing campaigns.

CFD plays a key role in the optimization of finger type slug catchers

A slug catcher is quite a complex piece of equipment, usually sized using simplified procedures. The drawback of this method is the need for conservative assumptions which hinder the achievement of a competitive design. CFD simulation provides a completely new design approach that can lead to significant savings in terms of investment cost and equipment footprint

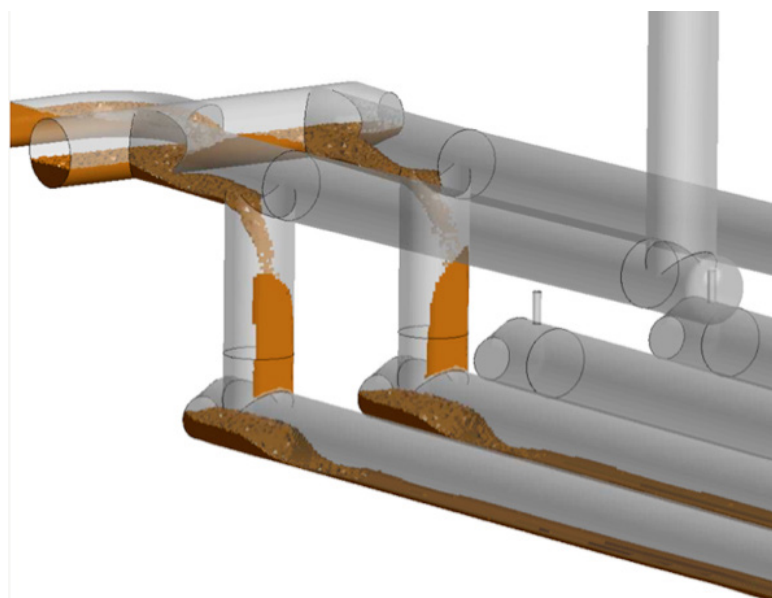
Francesco La Motta, Process Leader, Oil&Gas and Biogas Projects,
Alessandro Boffa, Senior Process Engineer,
OILTECH srl

A routine problem is the presence of liquids in pipelines that transfer untreated gas from gas fields to processing plants. In this case, the liquid arrival rate is irregular rather than constant. Intermittent flows can reach much higher peaks than average flows. Obviously, the downstream liquid processing facilities cannot be sized for these peak conditions and a liquid separator is required to separate these “liquid slugs”, accumulating them and slowly releasing them to the downstream gas processing plants. Slug catchers solve this problem by acting as a buffer for the liquid flowrate and providing a temporary storage for the volume of liquid when peak flow is reached.

The draining rate of a slug catcher is set to empty the equipment in time before the next liquid peak (or “slug”) arrives.

In a pipeline transporting natural gas and associated liquids (light condensates and/or water), the amount of liquid found at the pipeline outlet is determined by the following three factors:

- The continuous liquid production under steady flow conditions, depending on the gas-liquid equilibrium governed by composition and operating conditions.
- The intermittent or transient liquid production due to variation of liquid inventory inside the pipeline caused by a significant increase in



gas flow. For example, during the “ramp-up” phase at the pipeline start up, the higher gas velocity can contribute to part of the liquid accumulated inside the pipeline being carried over.

- The pigging operation displacing all the liquid from the pipeline into the slug catcher in a relatively short time.

Normally, pigging gives the maximum slug volume that must be taken into account for slug catcher sizing. The liquid volume accumulated in the pipeline and displaced during pigging mainly depends on:

- Composition
- Operating pressure and temperature

- Gas and liquid properties (density, viscosity, surface tension, etc.)
- Fluid dynamic (gas and liquid velocity)
- Pipeline geometry (pipeline length, elevation profile, presence of “pockets”, etc.)

Interaction between these factors is quite complex. Predicting slug volume is normally done using a dynamic mono-dimensional multiphase flow simulator which assesses the time-dependent behaviour of the pipeline. Transient modelling is essential to reduce the uncertainty of slug catcher design conditions and to reduce overdesign margins.

There can be different types of slug catchers depending on gas and liquid flows and slug volume.

If the slug volume is not very high (100 m³ is an approximate limit value), a horizontal vessel is the preferred choice. In practice, a horizontal two-phase separator is selected on account of a significant slug accommodation allowance between normal liquid level and high-level alarm. Occasionally, an alternative to this solution is a vessel with two horizontal barrels in a stacked configuration, connected by two or more downcomers. This solution has several advantages, especially in the case of high design pressure, by reducing vessel diameter.

When high slug volume occurs, the “finger-type” or “multi-pipe” slug catcher should be considered. In a “finger-type” slug catcher, the inlet stream is distributed into four or more parallel pipes (typically between 28” - 60” in diameter).

As a rule of thumb, the number of “fingers” depends mainly on the gas flow rate, while the finger length depends on the slug volume to be accommodated. Generally, each finger has a diameter equal to or larger than the arriving pipeline, ensuring that the gas, distributed among the parallel fingers, slows down. This, coupled with the slope of the fingers, promotes gas-liquid separation.

The first segment of fingers is focused on phase separation: the length of this “separation section” is sufficient to allow the liquid droplets that are greater than the limit size to fall into the liquid layer at the finger bottom in less time than that required for the gas to cover the length itself. At a distance from the inlet, equal to (or higher than) this calculated “separation length”, each finger is provided with a gas riser which collects the gas flowing towards the gas outlet header. The fingers are placed downstream of the gas risers and are intended to catch the liquid slugs. The fingers end in an outlet liquid header from which

liquid is drained to the downstream facilities. A slope (1% minimum) is required to promote liquid drainage from the fingers to the outlet.

There are a number of different designs for finger-type slug catchers. In what follows, some key solutions are listed together with their applications.

Three-Phase Slug Catcher

Sometimes, in addition to gas-liquid, separation of the aqueous phase (heavier) from the liquid hydrocarbon phase (lighter) is needed. This can be achieved in an additional section where liquid is accumulated, avoiding turbulence for a residence time adequate to reach HC-water gravity separation. This section could be an additional liquid header installed below the main one, or an additional secondary bottle installed below the other bottles, dedicated to liquid-liquid separation.

Double-Level Slug Catcher

The double-level slug catcher is an alternative solution allowing for the reduction of the total length of the slug catcher. The equipment consists of two sections at two different levels: fingers in the upper section are dedicated to gas-liquid separation, while fingers in the lower section are designed for slug accumulation. Downcomers connect the upper to the lower section for liquid falling.

Secondary “Fingers” or “Bottles”

In some cases, the slug volume to be accumulated can be so large that it requires a total finger length exceeding the space available for the slug catcher installation. Under these circumstances, the slug accommodation capacity can be increased by adding a certain number of “secondary” fingers to the “primary” fingers. “Primary” fingers are those connected to the inlet stream and composed of the “separation length” (where gas flow occurs) and “accumulation length” (where slug is stored), while the “secondary” fingers are only connected to the liquid outlet header so that they can be filled from the liquid header, providing additional capacity for slug storage.

Slug Catcher Design Criteria

As previously discussed, many design alternatives are available. Based on input data, designers must find the best solution for optimal sizing and cost reduction. Perhaps, more than for other types of equipment, designers of slug catchers can



Figure 1 - Particle Tracks

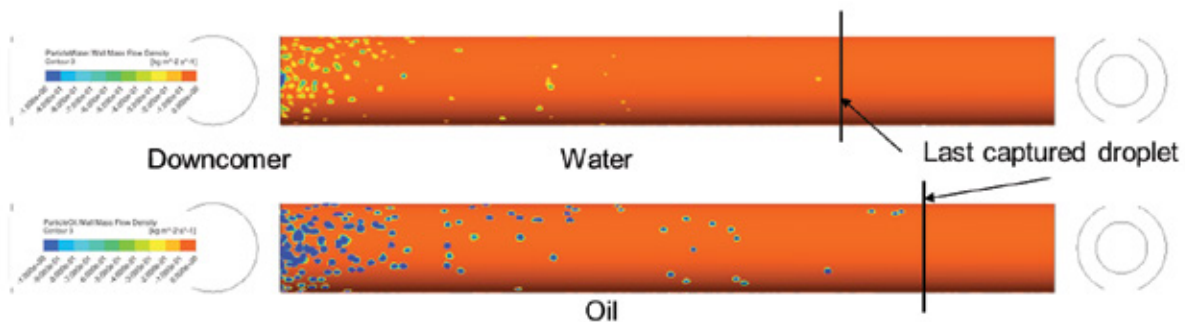


Figure 2 - Separation Path Length

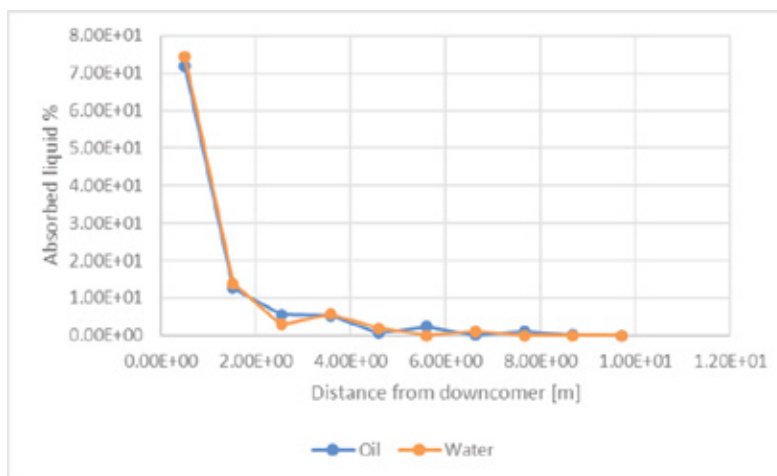


Figure 3 - 150 microns Droplet Separation

significantly reduce construction costs by making the right design choices.

Keeping in mind that careful analysis is given to each individual case, the main criteria for competitive and effective design are indicated below:

1. Number of primary bottles will be set to handle the gas flow rate with the separation section of proper length (the lower the gas velocity, the shorter the separation length). Odd numbers of primary bottles must be avoided.
2. For a given total number of bottles, the bottle diameter should be minimized, especially for high design pressure cases. A good design should try to utilize all the available space for equipment installation.
3. Avoid selecting a bottle diameter with low market availability.
4. The double-level slug catcher has the advantage of limiting the total footprint length, but the total cost of the equipment might be higher. In particular, the cost of supporting equipment may be higher.
5. The slopes of the separation section and the accumulation section will be selected to limit total bottle length.
6. To match the required slug accommodation capacity, secondary bottles can be considered

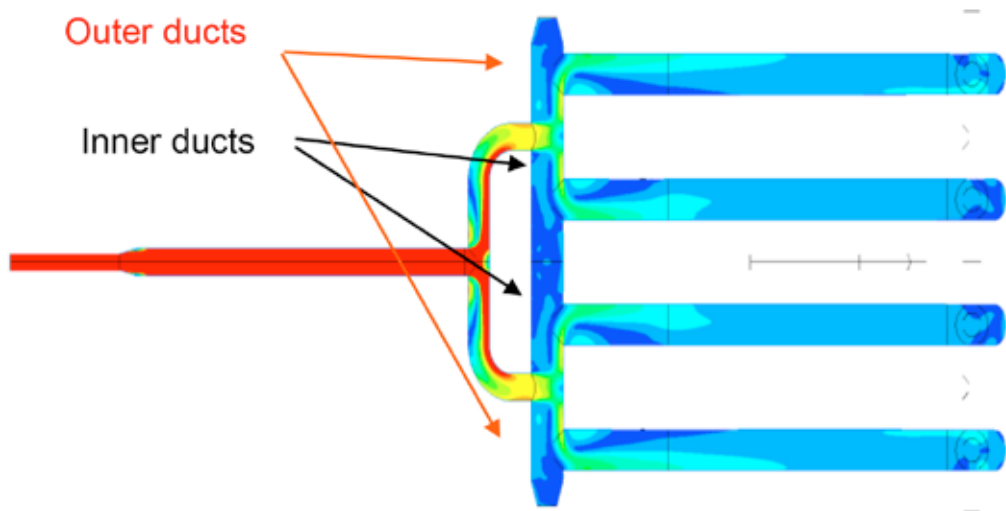


Figure 4 -
Flow Distribution

to limit the total equipment length within the maximum permitted.

7. A balance line will be carefully designed between liquid and gas outlet headers to allow installation of liquid level instrumentation.
8. In the case of solid presence in the feed, special features can be provided for de-sanding, cleaning and maintenance of the liquid outlet header.

CFD simulation is the state-of-the-art tool for the design of finger-type slug catchers

The hydraulics of finger-type slug catchers is extremely complex because it involves multiphase flow in transient conditions. Simplified approaches generally introduce approximations that do not allow a reliable estimation of

equipment performance. In addition, CFD analysis enables a deeper understanding of the behaviour of some sections of the separator subject to unusual flow conditions, e.g. liquid and gas phases that move and accelerate in opposite directions.

CFD analysis allows for the evaluation of liquid/gas separation efficiency by predicting the path of liquid droplets entrained in the gas phase.

Figure 1 shows an example of such a verification: CFD simulation calculates the path of 150-micron droplets as a function of gas and liquid density and viscosity. CFD calculations may also be correlated with a broad set of operating parameters and therefore they may be employed for generating sensitivity studies. **Figure 2** and **Figure 3** show the separation length calculated by CFD simulation for water and hydrocarbon droplets of 150 microns in size. Therefore, separation performances can be accurately calculated, thus reducing the degree of

Oiltech Expertise

Over the last 15 years, OILTECH has been in charge of the design of around 30 finger-type slug catchers, with more than 10 reaching the construction phase and then successfully put into operation.

OILTECH is highly experienced in dealing with different types of equipment: one-level and two-level equipment, two-phase and three-phase separation, with and without secondary bottles. OILTECH has developed the basic design for all these projects. With regard to other areas of expertise, OILTECH has taken care of detailed engineering, including mechanical design, stress analysis, vibration studies, piping design steel structures, instrumentation and project coordination.

The CFD simulation samples that are described herein refer to the executive design of a Slug-catcher which was recently completed and which is currently under construction.

uncertainty of process performances that have to be covered by contractual guarantees.

The slug catcher inlet manifold plays an important role in the operation of slug catchers because its design ensures an even distribution of fluids to the primary bottles. CFD simulation allows a careful study of the velocity profiles in the manifold branches and hence a better design.

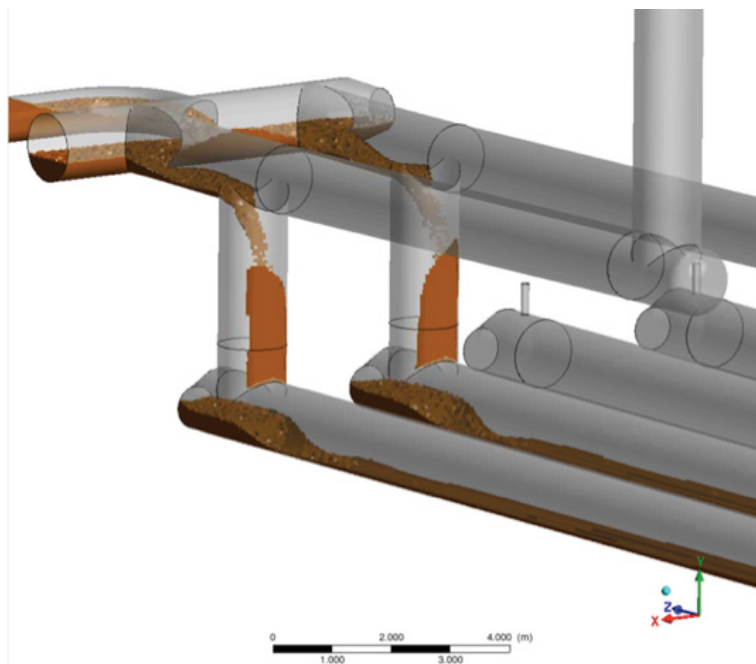
The results of the study relevant to a typical inlet manifold are shown in **Figure 4** which illustrates the liquid velocity profiles during slug arrival.

In this specific case CFD simulation demonstrates that the loads of outer and inner “bottles” are similar, with a range of a $\pm 10\%$, as shown in **Table 1**.

Duct no.	Mass Flow Split
1 – Outer duct	26.6 %
2 – Inner duct	23.4 %
3 – Inner duct	23.4 %
4 – Outer duct	26.6 %

Table 1 – Calculated Finger Flow Distribution

Downcomers, when used, will be checked to prevent “choking” in order to guarantee regular operations. The hydraulics of downcomers is challenging because of the



two-phase flow in opposite directions and the transient conditions they are subject to: liquid waves fall from the upper level to the storage bottles while the disengaged gas moves upwards. CFD simulation represents a powerful tool for validating the sizing of downcomers and ensuring that liquid and gas streams do not cause any flooding phenomena during the arrival of liquid slug or in the case of other transient conditions. The results of a simulation involving a double-level slug catcher are shown in **Figure 5**.

Figure 5 - Downcomer Flow Dynamic



Francesco La Motta

Francesco graduated in Chemical Engineering at the University of Naples “Federico II” in 2014. After completing a PhD program at the same University in

2017, he joined OILTECH as a Process Engineer. He is currently working as Process Leader, in charge of O&G and biogas projects.



Alessandro Boffa

Alessandro holds a master’s degree in Chemical Engineering from the Polytechnic of Milan, where he graduated in 2015. After working in the plastic & resin sector, he joined OILTECH as a Senior Process

Engineer in 2017. He has been involved in the process design of numerous upstream and midstream Oil & Gas projects.

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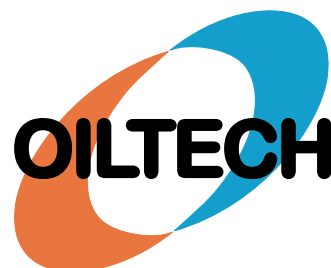
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Wet electrostatic scrubber (WES) development for the abatement of submicronic particles

A new modern electro-filter technology jointly developed in recent years to fight PM emissions

Luigi Amato, Project Leader, R&D

Matteo Giavazzi, Head of Operations and Technology Development, Air Pollution Control Division, Boldrocchi Group

Francesco Di Natale, Professor of Unit Operations and Sustainable Process Design, University of Naples Federico II

Increasingly frequent alarms due to the outbreak of threshold limits for fine particles in the atmosphere have been recorded in recent years. Particulate matters (PM) consist of solid or liquid particles suspended in the air having many shapes, sizes and chemical composition (10 nm – 100 μm). The largest of these can also be seen with the naked eye, whereas others can only be seen through powerful microscopes. These suspended particles come from different sources such as natural phenomena or anthropic processes as combustion processes, industrial emissions, household activities, etc.

Generally, particulate matters are classified according to their size: coarse or PM_{10} (2.5-10 μm), fine or $\text{PM}_{2.5}$ (<2.5 μm), submicronic (PM_1) and ultrafine (UFP, <0.2 μm). Usually, PM_{10} and $\text{PM}_{2.5}$ are used to define air quality, but recent studies have revealed the high toxicity of submicronic powders, suggesting the need to consider them as responsible for a significant risk to exposed people. Toxicological studies have long understood how toxicity depends on the surface area and the size of the particles, rather than their mass. Ultrafine particles can cross cellular membranes reaching blood circulation and giving rise to severe damages to many organs (**Figure 1**)

This recognised toxicity is the reason why the most advanced regulations on particulate control, i.e. those in force for motor vehicles, limit both the mass and number of particles emitted, as it was considered the best way to hold emissions within acceptable toxicity limits.

Current regulations for stationary combustion sources,

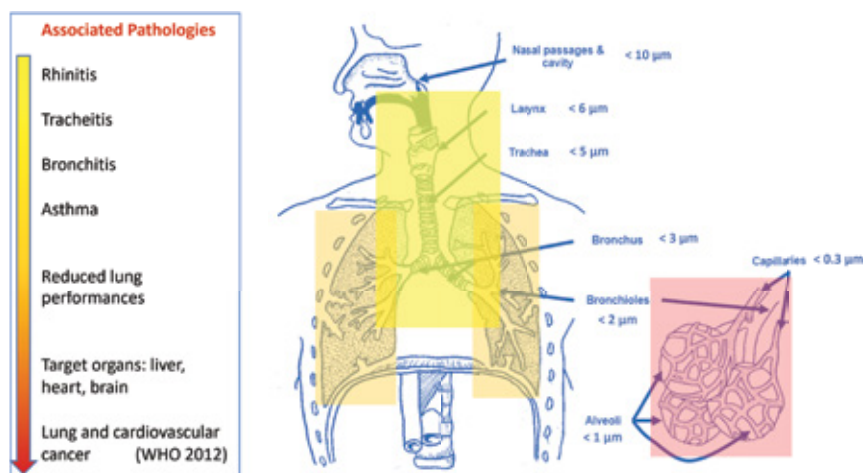


Figure 1 - Diseases correlated to the level of particles penetration into the respiratory system.

as power plants and industrial activities, and air quality standards exclusively refer to the mass of $\text{PM}_{2.5}$ and PM_{10} , despite the danger of the finest particulate matters. Although the restriction of the particulate mass concentration is not enough to limit the toxicity significantly, the governmental entities comprehend the existence of a technological limitation in capturing a high number of submicronic particles with existing commercial solutions, especially if the economical competitiveness of industrial applications has to be preserved.

Electrostatic precipitators and Wet Scrubbers for PM removal

Two of the most consolidated technologies for particulate abatement in the industrial field are electrostatic precipitators and wet scrubbers.

“A new wet electro-filter technology called “WES” has been developed in recent years and is being tested on a pilot scale for the abatement of submicronic particles

Electrostatic precipitators (ESPs) have been widely used since the middle of the 20th century. In the ESP, the dust suspended in the gas is electrically charged as the effect of a high-intensity electric field. The charged particles deviate towards the collection electrodes, as the effect of the electric field. The greater the surface charge induced on the particles, the greater the electric force that moves the particle towards the collector, hence increasing the probability of capture. Oils, particles with electrical resistivities and densities outside of the optimal range, as well as particles finer than 500 nm are hard to capture in an ESP.

Spray towers, or “Wet Scrubbers” (WS) represent the most versatile strategy for the combined abatement of particulates, oils and acids. The particle capture, in WS, is based on the hydrodynamic interception of particles against the droplets, which allow high particle abatement efficiency for particles having enough inertia, like those in the micrometric range or for nanometric particles subjected to an appreciable Brownian motion. Particles that impact the liquid droplets, coming from the sprays, are most likely trapped in the liquid phase, hence cleaning the gas. The most important parameters for WS design are the drops size and velocity and their volumetric density, which determines the probability that particles in the gas come into contact with the droplets. As a consequence, the design of the contact chamber and the spray properties are thus critical parameters for WS design.

The capture efficiency decreases significantly for

submicronic and ultrafine particles, for both electrostatic precipitators (ESP) and wet scrubbers (WS). A new wet electro-filter technology called “WES” has been developed in recent years and it is being tested on a pilot scale for the abatement of submicronic particles.

WES as a combination of ESP and WS

Since 2013, the Environmental Division of Boldrocchi S.r.l. is performing intensive research and development activities to develop innovative and high-effective technologies for the removal of submicronic and ultrafine dust. The company is developing a Wet Electrostatic Scrubber (WES) in partnership with the University of Naples Federico II.

The WES synergically uses the main points of strength of ESP and WS, i.e. the effective use of the electric field to move particles regardless of their low inertia and the availability of a distributed collector that is unaffected by the physical nature of the particles. In a WES unit, the gas enters first a section called Particle Charging Unit (PCU), where it is exposed to an optimised corona discharge at medium electric potential (15-20 kV). Low current intensity micro-discharges, of the order of nano or microamperes, increase the surface charge of the particles that are passing through the PCU. The particles charging is optimised to achieve the desired particles charging in a compact unit, with a residence time that is 4-5 times smaller than the ESP.

The charged particles leaving the PCU enters a contact chamber, where they meet charged droplets that are generated by electrified sprays (Droplets Charging Unit, DCU). Further to the directional interception and the inertial impact, another phenomenon contributes to the capture of the particles in the WES: if particles and droplets have opposite charges, they are electrically

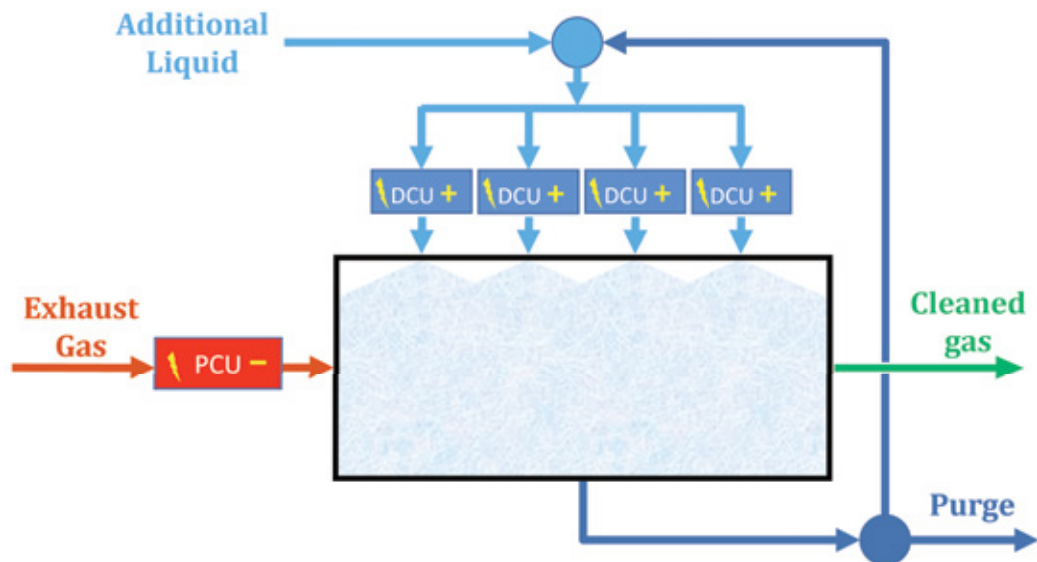


Figure 2 - Block Diagram of a closed-loop configuration of a horizontal cross-flow closed-loop WES unit

attracted to each other by improving the dust removal. The block diagram of a closed-loop WES configuration is shown in **Figure 2** where a partial (>95%) recirculation of the liquid is included and additional water and purge streams are included to preserve system functioning and optimise particles capture performance.

Figure 2 refers to the horizontal crossflow unit, that is currently adopted by Boldrocchi, but the WES can be designed using other configurations to optimise space occupancy and system performances for different industrial conditions.

The electrified spray (ES) allows the generation of droplets having a defined surface electric charge. The droplets charge also take place at medium electric potential with extremely low energy consumptions. The charged droplets offer the double advantage of giving rise to the electrostatic interactions that increase the trapping of particles and of enhancing the dispersion of droplets in the contact chamber. In the WES, particle penetration decreases up to 20 times compared to conventional WS operated at the same liquid-to-gas ratio^{1,2}, and at least halves that of a conventional ESP. Further studies have also shown that the absorption rate of acid gases is 15% faster for WES compared to WS thanks to the electrostatic interactions between charged droplets and acids molecules^{2,3,4}.

In 2016, Boldrocchi company, together with the University Federico II built the first WES on a pilot-scale for the gas treatment (up to 10,000 Nm³/h) from industrial processes (e.g. incinerators, cement factories, steel mills, etc.). Similarly to **Figure 2**, the plant was a horizontal cross-flow unit, which operated with a liquid/gas ratio between 1 and 2 kg/kg.

In a first configuration, the WES was intensively tested from 2017 to 2019 in the Company's test room, using a model gas consisting of air enriched with test dust made of an inert mixture of sand and salt. The dust distribution was in the desired submicronic range (90-500 nm with a median of about 150 nm), and the electrosprays were fed with tap water. More than 70% of the dust finer than 200 nm was removed, while the percentage increased up to 98% for larger particles, at the fixed L/G ratio of about 1.5 kg/kg. The electrical consumption of the loading units of the WES was approximately 20 mWh/Nm³, against the 500 mWh/Nm³ typically observed for ESP, with a pressure drop measured on the chamber of less than 0.7 mbar (**Table 1**).

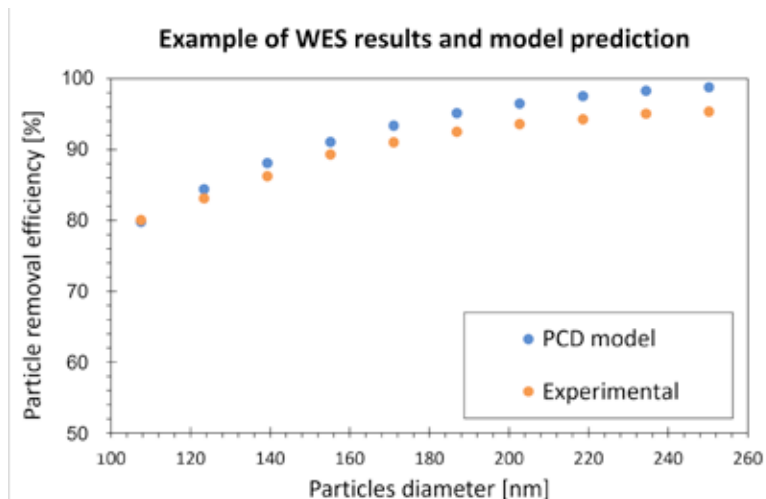


Figure 3 - An example of a comparison between the experimental and model prediction of the particle removal efficiency in the WES process.



Figure 4 - WES installation in a Waste to Energy (WTE) plant

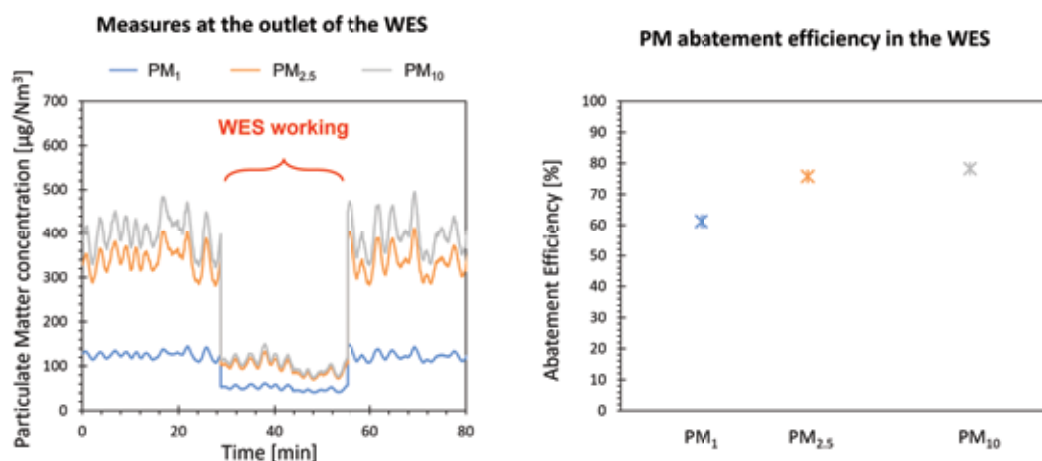
This setup was thoroughly analysed and a dedicated proprietary physico-mathematical model was developed to support the design and optimization of industrial WES units. The model approximated the results from experimental tests with an accuracy above 90%, as is shown in **Figure 3**.

In 2021, the Company installed the pilot-scale WES in a recirculation line of a waste-to-energy (WTE) plant in Italy (**Figure 4**). The exhaust gas cleaning train of the plant used a fabric filter unit for PM removal that guaranteed the emission of the particles always below

Gas Flow rate	L/G ratio (Liq-uid/gas)	Particle size	Efficiency	Electrical consumption	Pressure drop
5500 Nm ³ /h	1.5 kg/kg	< 200 nm	> 70%	20 mWh/Nm ³	0.7 mbar
		> 200 nm	< 98%		

Table 1 - WES performances on model gas

Figure 5 - Performances on WTE flue gas after the fabric filter: reduction of the PM concentration (left) and abatement efficiency (right)



2 mg/Nm³. The recirculation was introduced after the fabric filter unit and reinject the gas before the fabric filter, to allow compliance of the emissions and preserve the representativeness of the emission control system placed before the plant stack. The WES was installed as a retrofit for the abatement of the submicronic particles that were around $2\text{-}5\cdot 10^5$ #/cm³, consistently with the low particulate emissions at the chimney of incinerators equipped with a similar exhaust gas cleaning train. The treated gas stream was 4500 Nm³/h and the liquid-to-gas ratio was slightly below 1 kg/kg.

Despite the very low particles concentration and the very low liquid-to-gas ratio, which reduce the removal efficiency, the WES unit allowed reducing the emissions by more than 80%, for PM₁₀, 75% for PM_{2.5}, and 60% for PM₁, with a reduction of particles number above 70% for particles finer than 50 nm (Figure 5).

Due to the low concentration of pollutants (PM and acids) at the WES inlet, the system operated in a closed-loop mode, with a total water consumption below 0.02 kg per kg of treated gas. Besides, the maximum power consumption for the loading WES units was 25 mWh/Nm³ and the pressure drop was of 0.5 mbar.

Tests will be performed in the next months to further explore the performances of the WES unit for this application, thanks to better integration with the existing fabric filter unit aimed to optimise the particle capture.

Conclusions

WES will find application in many industrial sectors, where low concentrations of submicronic and ultrafine particles are required. Low energy consumption and low-pressure drops allow an easy integration within existing gas cleaning trains either for newbuilds and retrofit conditions. Furthermore, the high capacity of

particles and acids removal at low temperatures makes the WES system particularly suitable as a revamping of low-efficiency wet scrubbers for the removal of fine, submicronic and ultrafine particles.

After the successful completion of the pilot-scale tests, Boldrocchi company will be ready to commercialize the WES technology for industrial application in 2022, with extension to other sectors in the following years. In particular, Boldrocchi is part of a joint venture with other companies for the building, installation and experimentation of a pilot-scale WES unit for marine diesel engine exhaust gas treatment, that will be put in operation in the first half of 2022.

“Following the successful completion of the pilot-scale tests, Boldrocchi will be ready to commercialize the WES technology for industrial applications in 2022

(Endnotes)

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Luigi Amato

Luigi Amato is a chemical engineer with 4 years of experience in chemical and electrical processes for pollution control. He is a R&D engineer in Boldrocchi Group where he is working on the research and industrialization of innovative and low-cost technologies (e.g. WES and non-thermal plasma) for the abatement

of pollutants (particulate matters, acids, NOx). Luigi got a master's in chemical engineering in 2017 and he obtained the PhD in 2021. He is leading projects in the sector of air pollution control with other companies and university partners (i.e. University of Naples Federico II and the Brunel University of London).



Matteo Giavazzi

Matteo Giavazzi is responsible of operations and technology development in Air Pollution Control Division of Boldrocchi Group. He started his career in automotive industry with FCA environmental research team; afterwards he focused professional activity in manufacturing industry. Over the last 20 years, he has held varying roles in environmental process engineering

for industrial plants and project management. He is a specialist in environmental problems analysis, with particular reference to air pollution from industrial sources. Giavazzi has a Master's degree in Environmental Engineering from the University of Pavia, Italy; he collaborates with Chemical Engineering Department of Naples University "Federico II".



Francesco Di Natale

Francesco Di Natale is a Chemical Engineer and a Professor of Unit Operations and Sustainable Process Design at the University of Naples Federico II. He has more than 20 years of experience in the development of sustainable technologies for pollution control and recovery of added-value chemicals (precious metals, combustion nanoparticles...) from waste streams. He is specialized in the design of multiphase-flows (absorbers,

adsorbers, fabric filters, fluidized bed units) and electrical-driven (chemi-electrohydrodynamics and cold plasma technologies) processes. His typical field of application is in the treatment of gas and water streams produced by industrial and civil processes and by internal combustion engines, as well in the filtration of bioaerosols.



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The “Ever Given” grounding in the Suez Canal from the perspective of project cargo

How to avoid the problems and the financial and legal consequences that such a marine incident might cause to the shipments for the EPC General Contractors

Enrico Salvatico,
Partner, Studio Legale Mordiglia
Head of ANIMP's Transportation Section

The sea carriage is by far the means of transport most utilized by the players of the industrial plants industry, namely the EPC Contractors and the International Freight Forwarders, to get all the necessary materials and supplies

(the “Project Cargo”) reaching the project sites around the world. Despite the great improvement in the shipowners’ risk management and loss prevention policies, incidents like the one recently occurred at the large containership “Ever Given” whilst transiting the Suez Canal are always possible and often have big impacts on the projects development. It is therefore worth making a practical exercise and try to imagine what problems such an incident might have caused to said industry, focusing on specific issues arising from

It is worth investigating and trying to imagine what problems such an incident might cause to the EPC General Contracting industry, focusing on specific issues arising from the use of different contracts for the ships employment

the use of different contracts for the ships employment (the “Charterparties”).

The facts of the “Ever Given” case are well known and it is not necessary therefore to repeat them here.

As far as we know, no project cargo was carried on board the “Ever Given” and we should therefore concentrate our attention on the position of Project Cargo being carried on the ships which were delayed because of the impossibility to access the Suez Canal (the “Delayed Ships”).

Project Cargo is not generally carried on container vessels under a liner bill of lading. The Hague-Visby Rules would not therefore come into play (except to the extent that they are made applicable by a Paramount clause in the relevant charterparty). Even if they were applicable, the Hague-Visby Rules would not provide any answer to the questions arising from delay. The Hague-Visby Rules in fact deal with the liability of carrier only in respect of loss or damage of

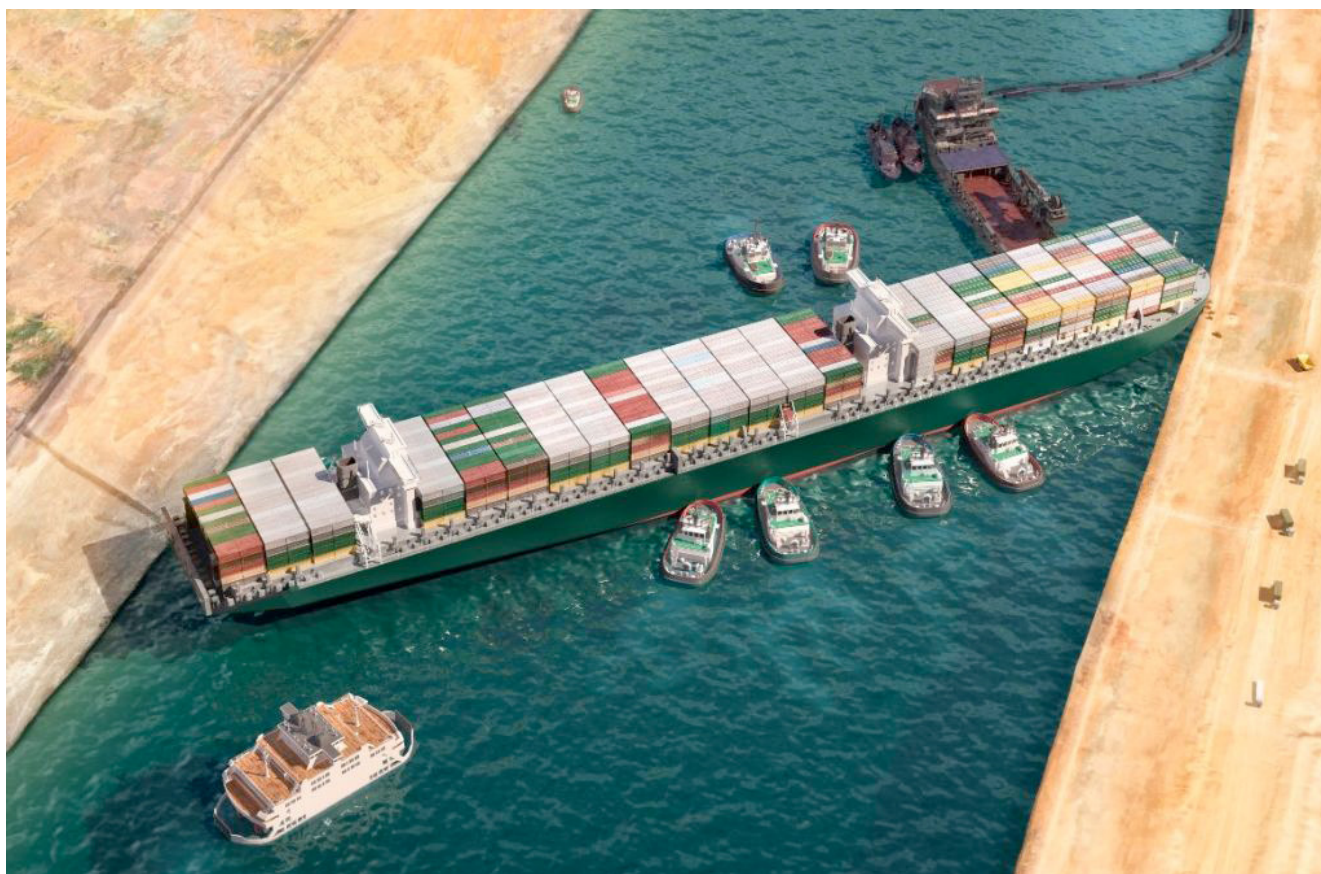
the cargo, but do not include any provision in respect of delay. On the other hand, Project Cargo is, by its nature, not subject to physical deterioration as a consequence of a prolonged duration of the voyage.

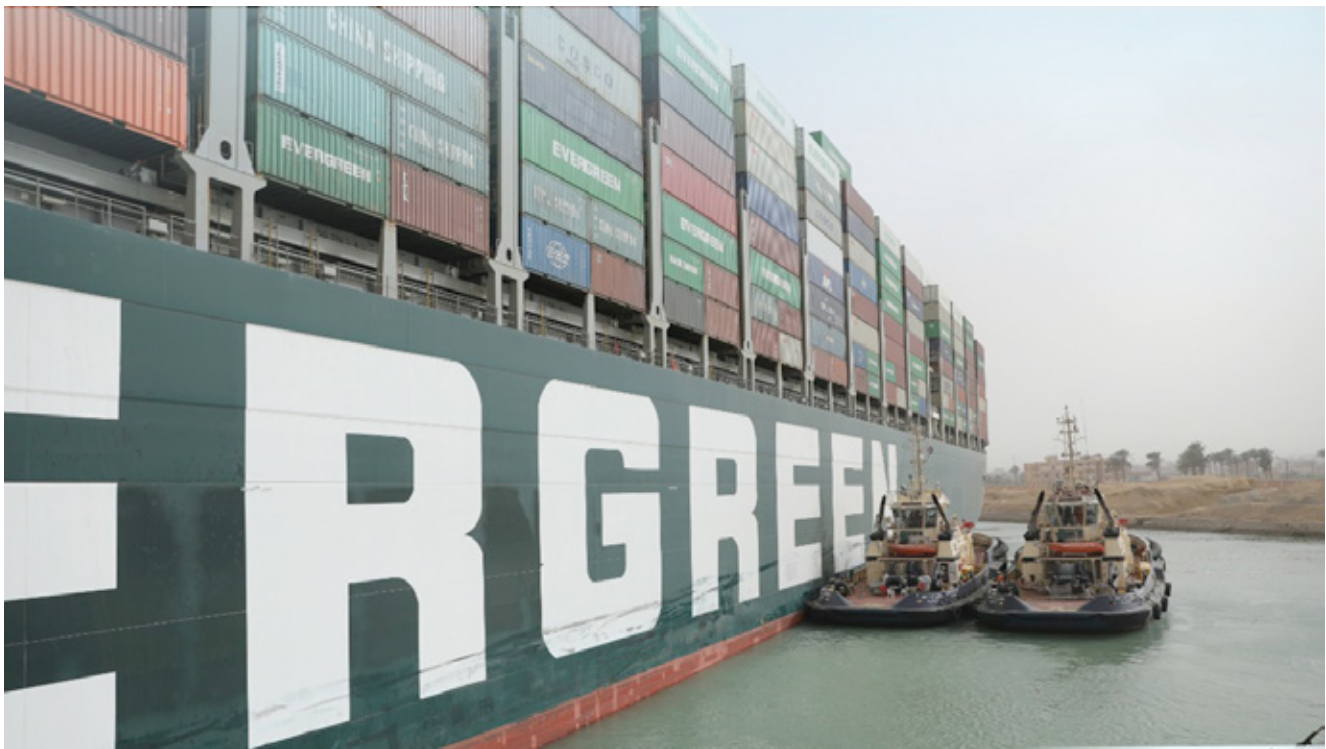
Project Cargo is generally carried on the basis of a specifically negotiated Charterparty and the most common standard forms are the HEAVYCON and HEAVYLIFTVOY of BIMCO. The time factor can be crucial for Project Cargo, because delay in delivery of a component can have a negative impact on the whole construction.

It is therefore no surprise that both charterparty forms contain detailed provisions regarding delay in the various stages of the voyage, although, as we shall see, such provisions appear to protect the Owner rather than the Charterer.

In the following paragraphs, we shall consider the issue of delay in four contexts: (i) the cancelling date, (ii) the transit time, (iii) canal transit, (iv) demurrage.

A Delayed Ship could have encountered the obstacle of the blocked Suez Canal during its approach voyage to the loading port. Both cl. 8 of the HEAVYCON and cl. 6 of the HEAVYLIFTVOY provide that if the vessel is not ready to load within the Cancelling Date, the Charterer is entitled to terminate the contract; this right to terminate applies





irrespective of the reasons why the vessel missed the Cancelling Date and therefore even if delay was due to a circumstance beyond the control of the Owner.

If the contract is terminated by the Charterer, however, “the Owner shall not be responsible for any loss or damage whatsoever incurred by the Charterers” (cl. 8.h of HEAVYCON; cl. 6.g of HEAVYLIFTCON is very similar).

The HEAVYCON form has no specific provision regarding transit time and only states that “The Owners shall perform the voyage with due dispatch, unless otherwise agreed” (cl. 2.b). The HEAVYCON form then has a “knock for knock” liability clause (cl. 22) whereby “the Owners shall not be responsible for .. any liability consequent upon delay of cargo”. Cl. 23 further excludes any liability for consequential damages, including “loss of use, loss of profits, shut-in or loss of production”.

The HEAVYLIFTVOY, to the contrary, gives the parties the option to fix in Box 21 a transit time and a daily damage rate or, in Box 22, a date of arrival at the discharge port and the related daily damage rate. Box 21 and 22 then refer respectively to cl. 2.d or 2.e, stating that if the agreed transit time is exceeded, or the discharge date is missed, “for any reason within the Carrier’s control”, liability will be limited to the agreed daily rate. In the circumstances the blockage of the Suez Canal because of the “Ever

Given” incident would not be considered “within the Carrier’s control” and therefore there would be no liability by the Owners.

The two charterparty forms have a specific clause dealing with “Canal Transit” (respectively cl. 15 in the HEAVYCON and cl. 22 in the HEAVYLIFTVOY). The clauses are very similar and we shall analyze cl. 15 of the HEAVYCON. Sub-clause (a) provides that the transit in the canal shall count as free time and, if the stipulated free time is exceeded, Charterers shall pay for such extra time at the demurrage rate.

“In conclusion, the provisions of both the HEAVYCON and HEAVYLIFTVOY standard forms appear to be significantly unbalanced in favour of the Owners of the Delayed Ship

Sub-clause (c) is particularly relevant in connection with the “Ever Given” incident, as it states that “should the transit of the canal be made impossible for reasons beyond the Owners’ control, the Charterers shall pay for all extra time by which the voyage is thereby prolonged” at the demurrage rate. Sub-clause (d) further gives the Owners the option “at their sole discretion” to discharge the cargo at the nearest port, with such discharge to be “deemed due fulfilment of the charterparty”.

Once the obstruction of the Suez Canal created by the grounding of the “Ever Given” has been removed,

the Delayed Ships would proceed to the discharge port where, because of the great number of ships suddenly “released”, they might find congestion and have to wait for their berth. The demurrage clauses in the HEAVYCON (cl. 13.a) and in the HEAVYLIFTVOY (cl. 12) provide that time lost for congestion or for waiting for the berth shall count as laytime; thus the risk of delay is shifted upon the Charterer.

In conclusion, the provisions of both the HEAVYCON and HEAVYLIFTVOY standard forms appear to be significantly unbalanced in favour of the Owners of the Delayed Ship. Hence, in order for the EPC Contractors and/or the International Freight Forwarders acting as Charterers to try and avoid the problems that a marine incident like the “Ever Given”

In order for the EPC Contractors and/or the International Freight Forwarders acting as Charterers to try and avoid the problems that a marine incident like this one might cause them, it is highly recommendable that they pay the utmost attention to the provisions of the Charterparty they intend to use and possibly negotiate appropriate amendments

might cause them, it is highly recommendable that they pay the utmost attention to the provisions of the Charterparty they intend to use and possibly negotiate appropriate amendments.



Enrico Salvatico

Enrico Salvatico, Partner of Studio Legale Mordiglia and current President of the Logistics, Transports and Freight Forwarders Section of ANIMP, has a wide experience in shipping and transport law, covering casualties, charterparties, bills of lading and CMR disputes, ship and yacht sale & purchase as well as cruise ships and passengers transportation. He assists ship owners and P&I Clubs in administrative inquiries and legal disputes arising from marine incidents involving personal injuries, cargo claims, marine pollution, ship total loss and wreck removal.

Enrico specializes in the field of “Project Cargo” shipments, offering advices and assisting both the EPC Contractors and the International Freight Forwarders in all the stages of projects implementation around the world, including drafting contracts and tailored

insurance covers as well as handling complex litigation cases in multiple jurisdictions. Enrico’s expertise in that field emerged in the assistance given to a leading International freight forwarder in the management of the Panama Canal Lock Gates Project and the relevant complex contractual issues and litigations.

Enrico developed an expertise also in the marine and ports state property concessions affairs, assisting primary shipyards in public tenders and litigation before the administrative courts.

Enrico has been involved in the handling of major casualty cases over the last years like the Costa Concordia incident, following relevant investigations, dealing with national authorities and international organisations such as IMO for the regulatory aspects and handling the claims filed by the State bodies.



The green model of circular districts

“Waste is the new oil” explains Fabrizio Di Amato, Chairman of Maire Tecnimont, in this interview.

“By implementing mechanical recycling of plastics and promoting chemical recycling, we are shaping an economy designed to regenerate itself, Simultaneously helping the reconversion of industrial sites in the petrochemical and steel industries”

Along the path to get out of the Covid-19 emergency and relaunch the economy, the strategies that look toward the sustainable goals of the United Nations shift the focus from a linear economy to a circular one, based on a system designed to reuse materials in subsequent production cycles, reducing waste and the supply of virgin raw materials to an absolute minimum.

«By implementing the mechanical recycling of plastics, and promoting the chemical one at the same time, we are able to shape an economy designed for self-regeneration - explains Fabrizio Di Amato, Chairman of Maire Tecnimont -. This is in essence an existential transformation». According to the report of the World Bank “What a Waste 2.0”, every year we generate about two billion tons of waste. «If we don't take urgent action by 2050, with the increase in global population

and urbanization, global waste will increase by 70%, with a production of 3.4 billion tons.

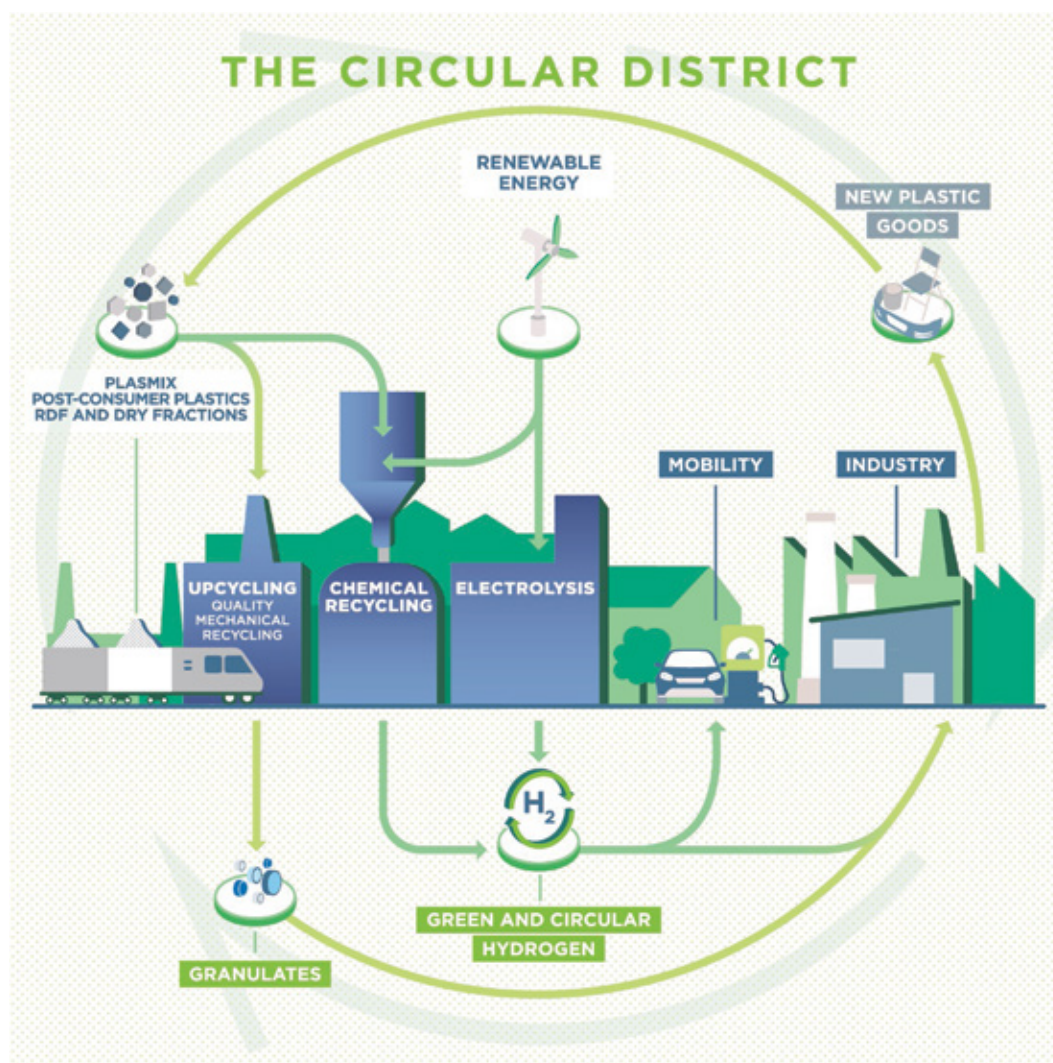
By implementing the mechanical recycling of plastics, and promoting the chemical one at the same time, we are able to shape an economy designed for self-regeneration

Waste is the new oil, although for decades the cost to dispose of it has been high, both in economic and environmental terms. Now with the new project of the Circular Districts, thanks to its proprietary technologies, NextChem - a Maire Tecnimont group company that was conceived from the concept of energy transition, circular economy and green chemistry - is able to produce new products and raw materials for industry from waste, contributing to the reduction of emissions. Di Amato explains: «During the States-General of Economy held in Italy in June 2020, we presented NextChem's Circular District model, which represents a solution for both reducing the amount of waste disposal as well as for the green conversion of industrial sites in the petrochemical and steel industry, traditionally based on resources and raw materials of fossil origin».

The model integrates technologies allowing for a quality mechanical recycling of plastic waste and for the chemical recycling of plasmix and RDF through a chemical conversion process that makes it possible to obtain synthesis gas from which compounds such as hydrogen, methanol and ethanol are produced, the latter which at the moment is completely imported from abroad in our country. In addition, the district can also integrate green hydrogen production technologies through electrolysis from renewable resources.

Thanks to its proprietary technologies, NextChem is able to produce new products and raw materials for industry from waste, contributing to the reduction of emissions

«With the Circular Districts not only do we significantly increase the recycling rate of our country, but at the same time we reduce the emissions altering climate, promote sustainable mobility, create jobs, professional growth and new opportunities for the territory and the companies in the sector. In addition to meeting the objectives of the National and International (EU) Action Plans on the subject, the solution overturns the concept





The model developed by NextChem

The valorization of consumption waste, the extension of the life cycle of products, the use of secondary raw materials for recycling and the use of energy from renewable resources all contribute to the definition of a model of sustainable development for the environment and economic growth. The model developed by NextChem includes an integrated platform of green chemistry technologies and, more precisely, quality mechanical recycling (Upcycling) of plastic waste, chemical recycling of plastic waste and dry waste and production of green hydrogen through electrolysis.

Fabrizio Di Amato

of waste as a problem to be disposed of, since it replaces the chemistry of coal and oil with a chemistry based on the recovery of resources that would otherwise be discarded. A sustainable solution from an environmental, social and economic standpoint, of which Italy can become a leader in Europe, winning the challenge of change».

The patented Upcycling technology makes it possible to obtain perfect circularity, transforming post-consumer plastic waste into high quality polymers (and able to replace virgin plastic). While DownCycling – that is, simple recycling - gives waste a chance to be reused in “poorer” products, Upcycling gives the original characteristics of a virgin material back to the recovered plastic, increasing its environmental and



economic value. Di Amato explains: «In Italy we have already implemented this technology in an industrial plant in the province of Brescia. Managed by MyReplast Industries (a subsidiary of NextChem) the Bedizzole plant is currently one of the largest and most advanced in Europe: in one year we have transformed 40 thousand tons of recycled polymers, equal to the plastic consumption of one million people. This activity has made it possible to save 270,000 barrels of oil per year, equivalent to about 8,500 tons of CO₂».

With the Circular Districts - says the Chairman - not only do we significantly increase the recycling rate of our country, but at the same time we reduce the emissions altering climate, promote sustainable mobility, create jobs, professional growth and new opportunities for the territory and the companies in the sector

As previously mentioned, the Circular District model is particularly suitable for the green conversion of traditional industrial sites with processes based on the use of raw materials derived from fossil resources, which would be replaced with feedstock derived from renewable and circular resources.

«The contribution to the decarbonization and green conversion of brownfield industrial sites - says Di Amato - began with a project in collaboration with ENI for the Venice refinery with the aim of producing Circular Hydrogen. Another project involves the refinery of Livorno, where we will produce methanol again using the same process, while in Taranto the Circular District model designed for the territory foresees the partial replacement of feedstock deriving from fossil resources, currently used by the industries of the industrial sector. The production of Circular Gas will be

The valorization of consumption waste, the extension of the life cycle of products, the use of secondary raw materials for recycling and the use of energy from renewable resources all contribute to the definition of a model of sustainable development for the environment and economic growth

placed in a context of industrial symbiosis, thanks to an industrial district of excellence in which the infrastructure, facilities and skills of the former Ilva steel plant and the Eni refinery remain».



At the end of September 2020, the Alliance for the Circular Economy comprising 17 companies (including NextChem) presented a position paper for the development of a circular economic model. According to the Alliance, a unique opportunity has arisen today to relaunch a coordinated and decisive commitment to a new development model. «The Covid-19 crisis - explain the companies - reinforced what the climate crisis predicted and showed how systems (natural, economic and social) are strongly interconnected: pursuing a circular economic model is not only an obligation but an opportunity to relaunch the overall competitiveness of the country». The vision of the Alliance calls for a circular development that starts from the enhancement of Italian excellence, and which will be realized, on the one hand through the support of companies to promote sustainable innovation, and on the other hand through the involvement and support of the supply chains, in order to extend the useful life of products and maintain their value. «Networking with the companies of the Alliance for the Circular Economy - concluded Di Amato - allows us to compare these issues from a broader perspective. The aim is to provide a stimulus for these issues to grow in the economic world and in civil society».

Chemical Recycling

The technological solution developed by NextChem, integrating several established technologies, combines two objectives, circular economy and decarbonisation. On one side it provides for the domestic production of chemicals that are currently imported from abroad. On another side, it allows the green relaunch of brownfield industrial sites, with positive consequences for the sector industries and employment.

A central element of the technology platform is the chemical conversion of hydrogen and carbon contained in Plasmix (the waste discarded from sorted plastics) and RDF (Refuse Derived Fuel consisting of plastics



and other dry material separated from organic matter) into a valuable chemical product, synthesis gas. This gas is obtained through a process of partial oxidation, followed by a subsequent purification phase, which does not produce pollutants: for this reason, it can be considered a “Circular Gas”, as it comes from post-consumer materials that are recovered in this way.

The Bedizzole plant is currently one of the largest and most advanced in Europe: in one year we have transformed 40 thousand tons of recycled polymers, equal to the plastic consumption of one million people



Circular Gas can be used as it is, due to its reductive qualities, in production processes such as steelmaking and as a replacement for synthesis gas produced from methane or coal derivatives (such as carbon dust), reducing the emissions altering climate generated and with a lower cost. Circular Gas can also be used as a base for the production of “circular hydrogen”, or methanol, or ethanol, or a variety of other chemical compounds essential for industry. These “circular” chemicals reduce the need to extract fossil fuels, reducing imports, contributing to decarbonization and recycling, and providing low-carbon fuels to the transport sector, a sector that has a significant impact on global CO2 emissions.

As part of the “Waste to Chemicals” technology, conversion plants are currently being designed in Italy, one for the production of circular hydrogen for the Eni refinery in Venice and one for the production of circular methanol for the Eni refinery in Livorno. A plant for the production of synthesis gas and circular hydrogen at the Eni refinery in Taranto is also currently under study.

Interview from the issue No. 6 of “EVOLVE”, the Magazine of Maire Tecnimont.



Fabrizio Di Amato

Fabrizio Di Amato, Chairman of Maire Tecnimont, born in 1963, he graduated in Political Sciences from Sapienza University of Rome and received an honorary master’s degree in Chemical Engineering from Politecnico of Milan. He is the Chairman and majority shareholder of Maire Tecnimont Group, one of the main engineering contractors engaged in the transformation of natural resources globally (plant engineering with technological and executive expertise), with a strong commitment to industrializing the green chemistry and energy transition sectors.

He began his career as an entrepreneur at the age of 19 by setting up his first company with three employees. He built up the Maire Tecnimont Group over three

decades, with Italian engineering know-how at the heart of this entrepreneurial project. The Group today operates through 50 companies in 45 countries owns approximately 1,700 individual patents and has more than 9,000 professionals all over the world. Fabrizio Di Amato was awarded the decoration of “Cavaliere del Lavoro”, and he is member of Assolombarda, of the General Council of Unindustria as well as of the Executive Committee of Assonime (Association of Joint Stock Companies incorporated in Italy). Committed in promoting an integrated relationship between industry and university, Fabrizio Di Amato has always supported cooperation programs between the Group and some of the most prestigious Italian universities.

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of research, professional skill, know-how. The turbine is where all begins: the heart of any power plant, the moment of transformation, creating the energy that fuels our homes.

Ansaldo Energia's latest new gas turbine is the GT36. Not just a jewel of technology: the GT36 is at the present the biggest gas turbine ever built in Italy.

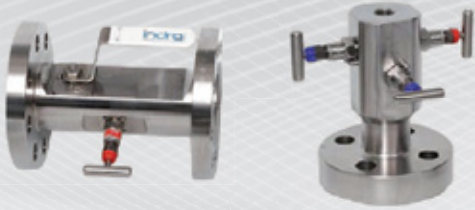
The 50Hz version of Europe's most powerful turbine can supply enough electricity to nearly 250,000 apartments. Designed to minimize emissions, Ansaldo Energia's new turbine is already set up to burn hydrogen, the clean fuel of the future.

**ANSALDO
ENERGIA**

Ball & DBB Split body Floating, Trunnion & Actuated Valves



Integral one piece Floating Ball & DBB Valves



Sampling & Injection DBB Valves



Instrumentation Valves & Manifolds



**Monoflanges Valves
Slim line SB - SBB - DB - DBB**



Customized configuration



Application



Oil & Gas



Petrochemical



Off-Shore Platforms



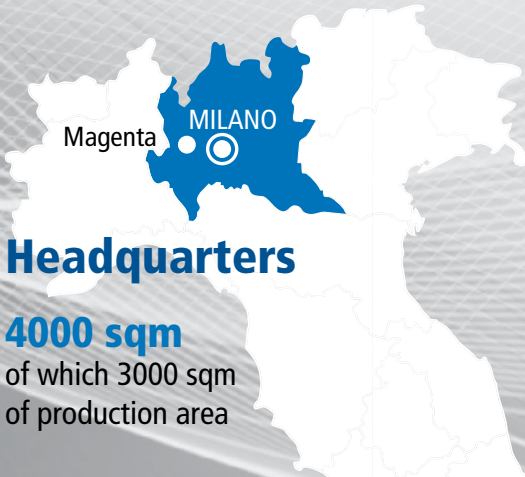
LNG



Hydrogen



Energy



Headquarters

4000 sqm
of which 3000 sqm
of production area

Standard and special materials

- SS 316/316L Nace
- Duplex F51
- SuperDuplex F53/F55
- A105
- LF2
- Monel
- Alloy 625/825
- Hastelloy C276
- Titanium
- 6MO
- Others on demand

Engineering

Manufacturing

3D Checking

NDT Testing

Bunker " High Pressure Test"

100% Pressure Testing



From organic waste to biomethane, bringing carbon back to the soil

A success story of the circular economy in the UK

Bjorn Blankespoor, Head of International Sales, BTS

Anaerobic digestion (AD) is a natural process where bacteria decompose organic waste in the absence of oxygen to produce biogas (a renewable fuel) and digestate (an organic soil fertilizer, amendment, or additive). The process allows for recycling excess organic waste, creating renewable energy, and returning nutrients and carbon back to the soil all have significant impacts on reducing greenhouse gas (GHG) emissions, making AD a vital tool in reversing the effects of climate change.

Biogas produced through AD uses organic sources that consume carbon dioxide from the atmosphere during photosynthesis, making it a truly renewable fuel. When one considers the cumulative effects - diversion from landfills, the offsetting the use of fossil fuels, and the recycling of nutrients and carbon back to the soil - AD is a carbon-limiting technology that can reduce atmospheric GHG concentrations.

“Biogas produced through AD uses organic sources that consume carbon dioxide from the atmosphere during photosynthesis, making it a truly renewable fuel

Biogas can also be refined into renewable natural gas (RNG), which is fully interchangeable with conventional, fossil fuel-based natural gas and has the potential to displace over 40% of conventional natural gas usage in transportation. Fueling vehicles with RNG could prevent 5 tons of GHG emissions annually, per each

passenger cars fueled with biomethane.

AD prevents organic waste from rotting in landfills and emitting harmful methane into the atmosphere. Unlike open-air landfills and even composting facilities, AD processes organic waste in a closed environment, capturing and containing all emissions in the end-products of biogas and digestate and, preventing those emissions from being released into the atmosphere.

Digestate, an often-overlooked end product of AD, is an organic soil amendment that replaces synthetic fertilizers and sequesters carbon back into the soil. Digestate improves the soil health of our farms and communities by recycling nutrients and carbon in organic waste back into the soil.

Reducing emissions from the energy, waste, and agriculture sectors is crucial in our global fight against climate change. The protection of our biosphere and the advance innovative technologies go hand-in-hand. The result is the creation of a circular economy diverting organic waste from landfills, generating environmentally friendly fuel, and producing an organic soil amendment that offsets the use of synthetic fertilizers and locks atmospheric carbon in the ground.

AD facilities have three stages: feedstock receipt, the digestion process, and end-product utilization (see **Figure 1**).

The resulting products of digesting feedstocks in an AD facility is biogas and digestate. Methane is the primary constituents of biogas, which can be refined into renewable natural gas (RNG) by removing its non-methane components.

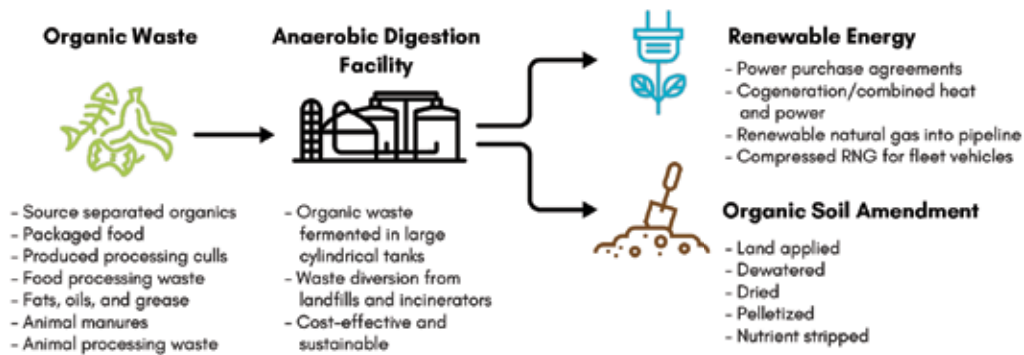


Figure 1 - General process of AD

Digestate is heat treated to kill any dangerous pathogens and can be used as an organic soil amendment without further processing, or the digestate's value can be increased by drying it, removing certain nutrients, and pelletizing.

The RNG from AD facilities is pipeline-quality and fully interchangeable with conventional natural gas - it is the only renewable energy source that can be used with existing natural gas-pipeline infrastructure.

This is a crucial distinction of RNG, as it enables both the political and economic sphere to transition to a sustainable fuel base by leveraging existing pipeline infrastructure. Like conventional natural gas, RNG can be used as a transportation fuel in the form of compressed natural gas (CNG) or liquefied natural gas (LNG).

The RNG present in the Biogas is extracted and concentrated via a biogas upgrader process separating.

Carbon dioxide, Water, Hydrogen Sulfide and Particulate CO₂ and Water can be re-cycled.

This form of renewable natural gas RNG is ideal for

heavy-duty vehicles (HDV) due to its high energy density. HDVs require about five-times more power than passenger vehicles to achieve viable operating mileage.

To supply this power, an HDV can either rely on fuels or batteries. Unfortunately, even the most advanced batteries cannot compete as they have a 30-to-50-times smaller energy density than RNG. For an average HDV, this equates to a battery size of around 800-1000kWh to deliver 800km (500 miles) of range and, at current energy densities of state-of-the-art batteries, the necessary battery weight would be around 5,000-6,000kg, which decreases payload capacity. In fact, for equal ranges, battery-powered trucks can carry ~40% less payload than trucks powered by fuels.

The second end-product of AD is digestate, which is an organic soil amendment that consists of broken-down organic matter. Digestate is similar to compost in chemical and physical composition, but it is produced in an anaerobic environment rather than the oxygen rich environment needed for compost.



BTS Biogas post-treatments

- BIOdry**
 - Transforming slurry into a valuable fertiliser by drying
 - Output: dry matter and ammonium sulphate
 - Additional source of income
- NITROstrip**
 - Nitrogen reduction 55-75% -> minor spreading area
 - Suitable for plants fed with a lot of slurry
 - Output: ammonium sulphate
- BIOpellet**
 - BTS technology for digestate pelleting
 - High economic value and easy management
 - Solubility and slow release of nutrition
- COMPOfert**
 - 80% digestate reduction in weight
 - Excellent product as bedding material
 - Good organic fertilizer
- NPKlean**
 - Fertilizer rich in NPK
 - Additional source of income
 - Pure water, no discharge costs



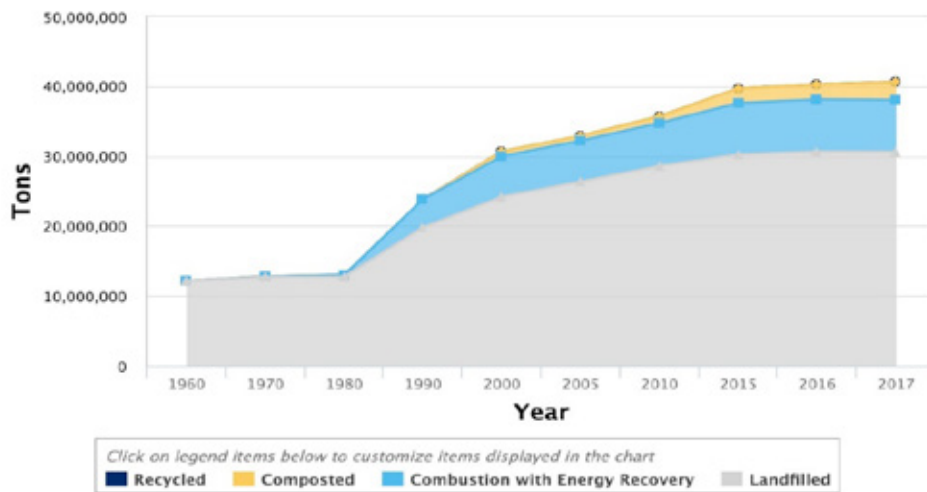


Figure 2 - Food waste production and management techniques from 1960-2017 in USA.

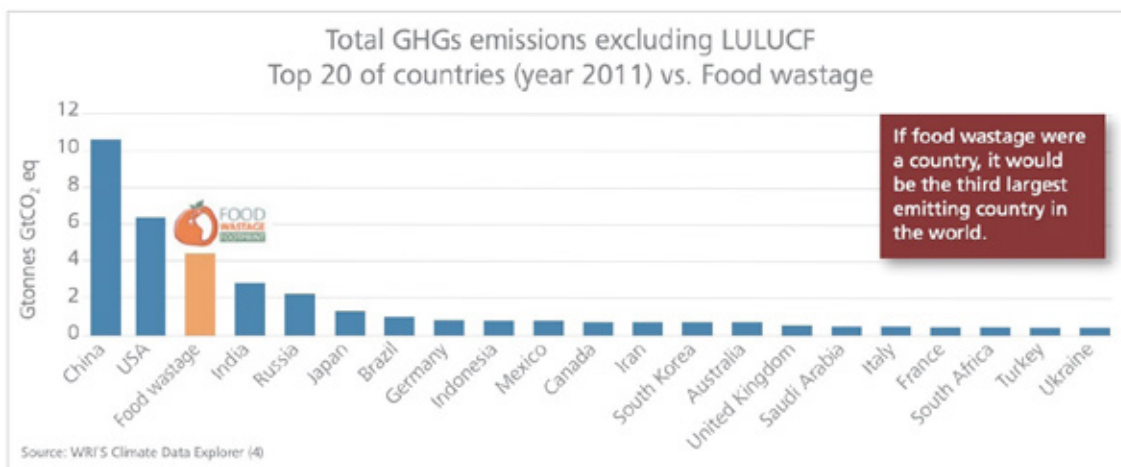


Figure 3: Total emissions from food waste compared to the top 20 GHG-emitting countries

Digestate typically has more nutrients and less carbon compared to compost and digestate has a higher moisture content than compost. Like compost, digestate can be used as a plant nutrient source in lieu of damaging synthetic fertilizers.

The digestate is approximately 85-90% of the input biomass and is sent to a separation process to remove the liquid portion from the solid portion. There are different post treatment processes that will produce fertilizer in powder or pellets, ammonium sulphate, compost, pure water. In that way we have a smooth disposal of the digestate with additional revenues and an increasing of the circular economy.

All of the nutrients contained with the feedstock of AD, including nitrogen, phosphorus, and potassium (collectively known as NPK), are embodied within digestate, so it can be used as a soil amendment in agriculture, landscaping, storm water management and consumer-based horticulture.

Moreover, introducing digestate into the soil is an

important part of the carbon sequestration mechanism as the carbon within the feedstock of AD is embodied in the digestate. Thus, adding digestate to soil effectively puts the carbon within plants back into the soil, which closes the carbon cycle.

The Food waste has steadily increased in the many countries with most of all food waste going into landfills.

AD is not only producing renewable fuel, but it is also diverting emissions from food waste that would have been sent to landfills. The Food and Agricultural Organization (FAO) of the United Nations quantified that global food waste produces around 4.4 GtCO₂ annually, or around 8% of total anthropogenic greenhouse gas emissions. If food waste were its own country, it would thereby be the third largest emitting country in the world, after China and the United States (see **Figure 3**).

Removing food waste from landfills we remove the methane emissions. Considering that methane, compared to CO₂, has a 28x higher global warming

potential, reducing methane from landfills can greatly abate the adverse effects of climate change.

Success story

The Plant at North Yorkshire, UK

In 2016, BTS has successfully constructed and commissioned the South Milford, a new generation anaerobic digestion plant to take 70,000 – 100,000 tons of blended food and green waste per annum to generate 500 KW of electricity, and 4.2 million of Sm³ of Biomethane, plus 50,000 tons of Liquid Pasteurized Digestate.

“In 2016, BTS has successfully constructed and commissioned the South Milford, UK, a new generation anaerobic digestion plant

It is a gas to grid plant, enabling the biomethane to be injected directly into the gas network, maximizing the carbon efficiency being negative GHG.

The impact on the environment can be seen in the figure 19.

The success of this project is based on the following factors:

- BTS capability in understanding and managing the challenges of anaerobic digestion plant:
- Identify the best anaerobic process for the available feedstock
- Proven design and construction methodology that has reduced the overall EPC to 12 months
- Plant operation and maintenance skills that allows 8,500 hours of availability per year

Technical data

Execution Period:

- 01/ 2016 – 12/2016

Plant feedstock

- 100% organic waste and industrial food processing leftovers

Plant input:

- 40.000-60.000 t/y liquid food waste
- 10.000-20.000 t/y solid food waste
- 10.000 - 20.000 t/y green waste

Plant output:

- 7,538,000 Sm³/y biogas to generate:
- 500 KWH of electricity
- 4,200,000 Sm³/y of biomethane for Gas to Grid Injection
- 50,000 tons/y of pasteurized liquid digestate

Process temperature:

- Mesophilic

Heat utilization:

- Fermenter's heating, Upgrading unit, Pasteurization system

Plant Excellencies

Short execution period

The compact design of the plant and the standardization and container assembled solution for the process equipment allows to reduce dramatically the time of the electromechanical erection that together with the early start of the civil work allows a cycle time of 12 months from the coming into force of the contract to the plant ready to accept the biomass.



Figure 4 - South Milford AD plant (UK) – After 9 months from the start of the Project

Compact Layout (200mt x 150 mt)

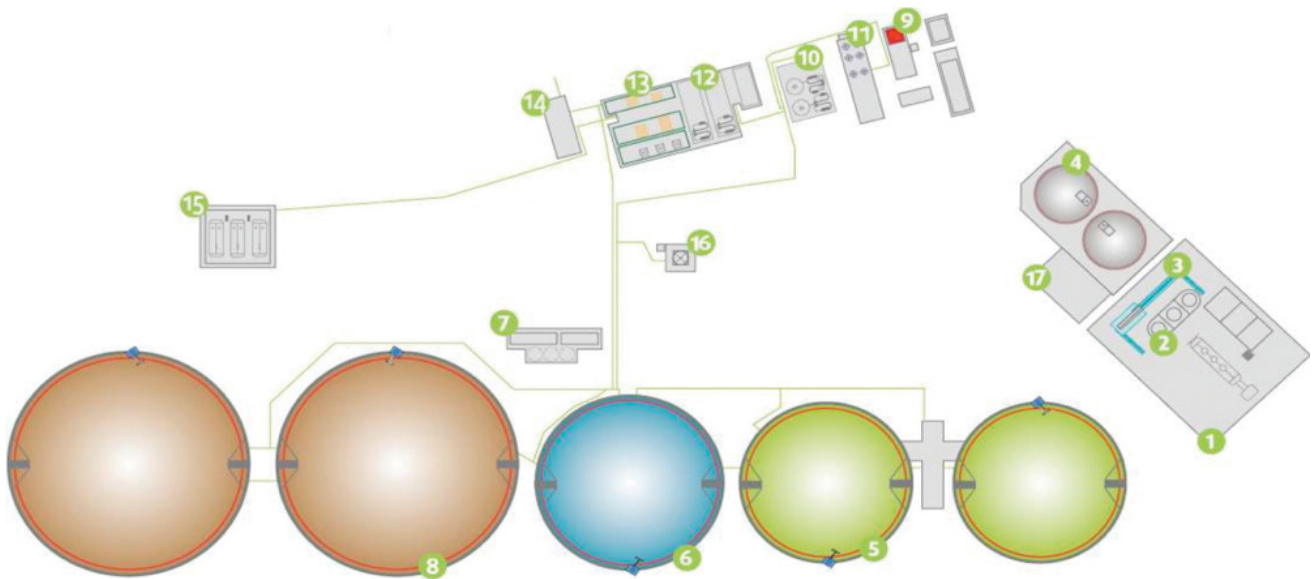


Figure 5 - South Milford AD plant (UK) – lay-out

Legend:

- | | |
|--|------------------------|
| 1. Intake Building and Unloading Station | 10. Gas Treatment |
| 2. Feeding system | 11. CHP |
| 3. Biomix | 12. Compressor |
| 4. Prre-Tank | 13. Membrane Upgrading |
| 5. Fermenter | 14. Grid Entry Unit |
| 6. Post-Fermenter | 15. Propane Tanks |
| 7. Pasteurization Unit | 16. Gas Flare |
| 8. Final Storage | 17. Biofilter |
| 9. Boiler | |



Figure 6 - South Milford AD plant (UK Completed)

Environment friendly

To minimize the impact on the environment, special attention have been paid in the design of the plant. The feedstocks are unloaded in a closed building at negative pressure, the pre-treatment is managed in closed tanks with a biofilter to eliminate the odors

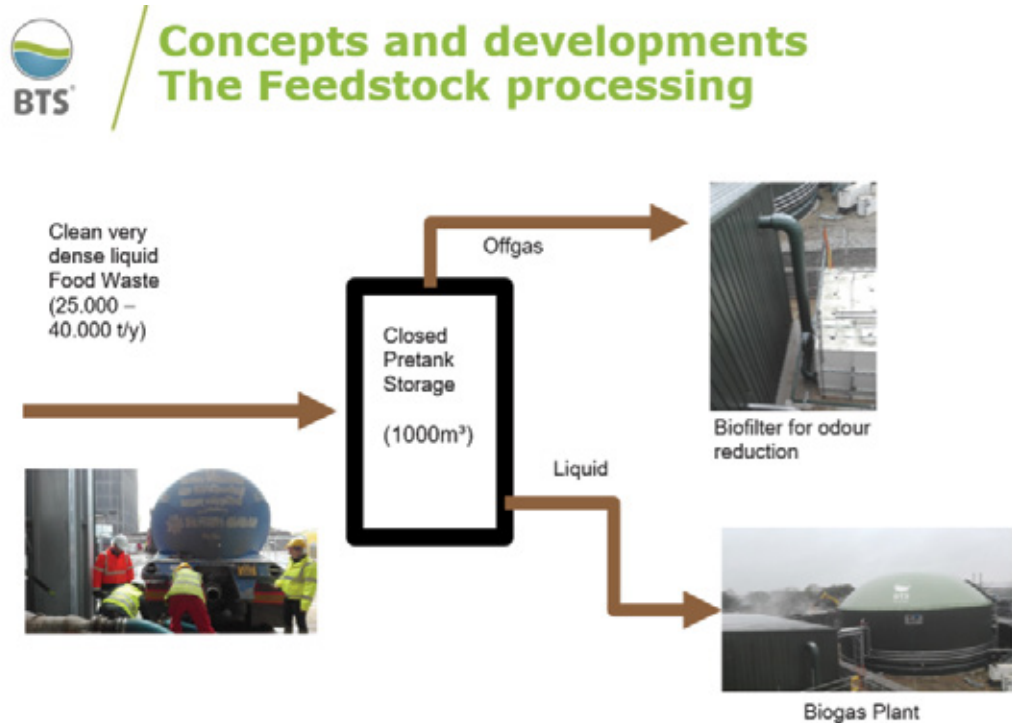


Figure 7 - South Milford AD plant (UK) – Pre-treatment in closed tanks with Biofilter

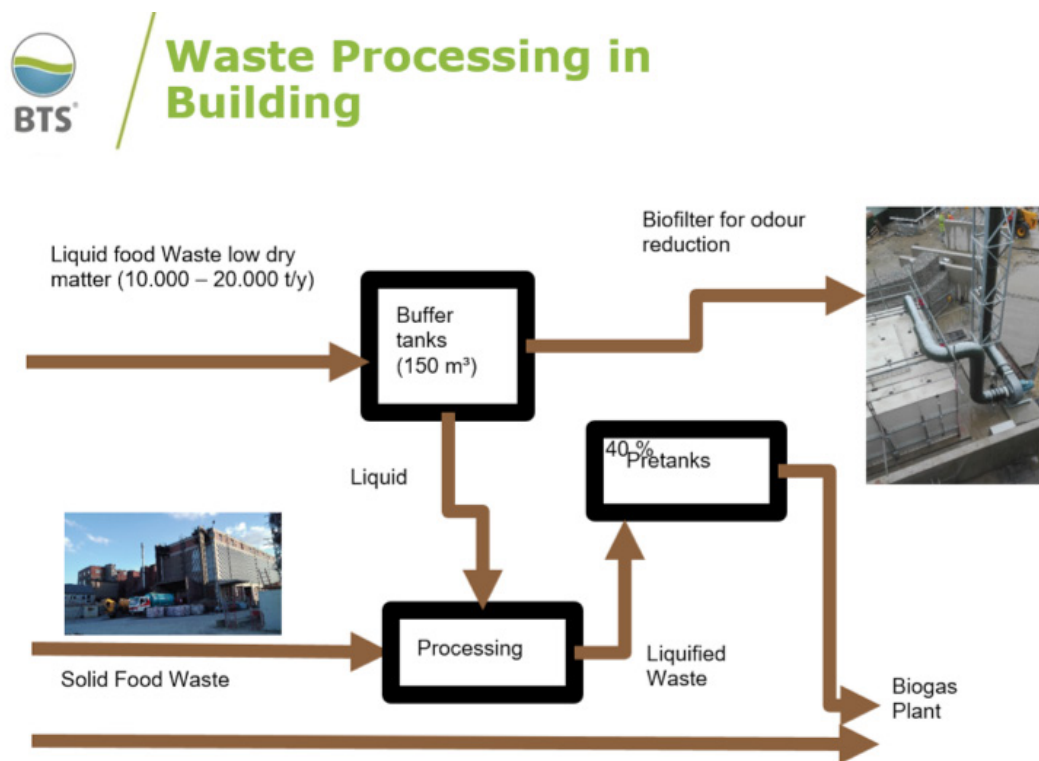


Figure 8 - South Milford AD plant (UK) – Waste processed in Closed Building

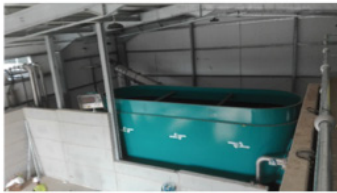


Waste Processing in Building

Open Buffer tanks



Feeder



Processing



Pipework and Pumping



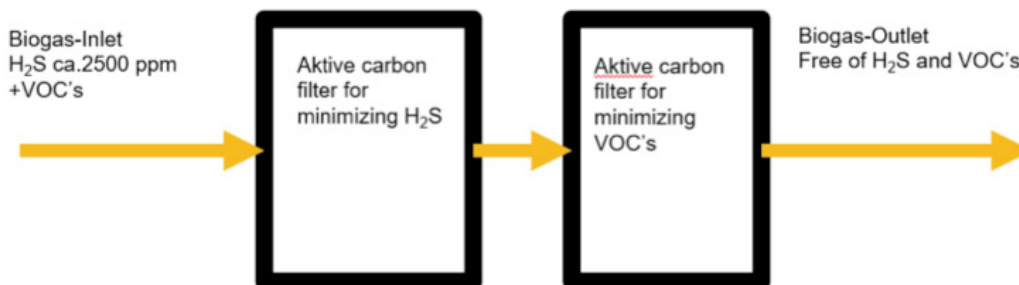
Figure 9 - South Milford AD plant (UK) – Waste processed equipment in Closed Building

Emissions Reduction - Biogas treatment for H₂s and VOCs removal

The Biogas is treated passing through Carbon Filters to remove the H₂s and the VOCs to comply with the strictest environmental codes.



Emission Reduction



VOC's = volatile organic compounds
H₂S = Hydrogen sulphide



Figure 10 - South Milford AD plant (UK) – Equipment for emission reduction

Upgrading to Bio-methane

The upgrading system allows to extract the bio-methane from the biogas. BTS has developed an efficient temperature control for the plant, additional membranes, and bigger heat exchanger to optimize the process.

The Biogas is compressed to 16 bars, cooled down in the heat exchanger and the heat is recovered and sent to the digesters.

Further on, the biogas is passing through a bundle of

hollow fiber membranes that have different grades of permeability.

High grade for the CO₂, H₂O and 'NH₃, lower grade for the 'H₂S and O₂ and extremely low grade for the N₂ and CH₄. In that way it is possible to separate the CH₄ (biomethane) present in the biogas from the other components.

The upgrading equipment are fitted in 5 containers pre-assembled that allow a compact lay-out and a fast and reliable erection.

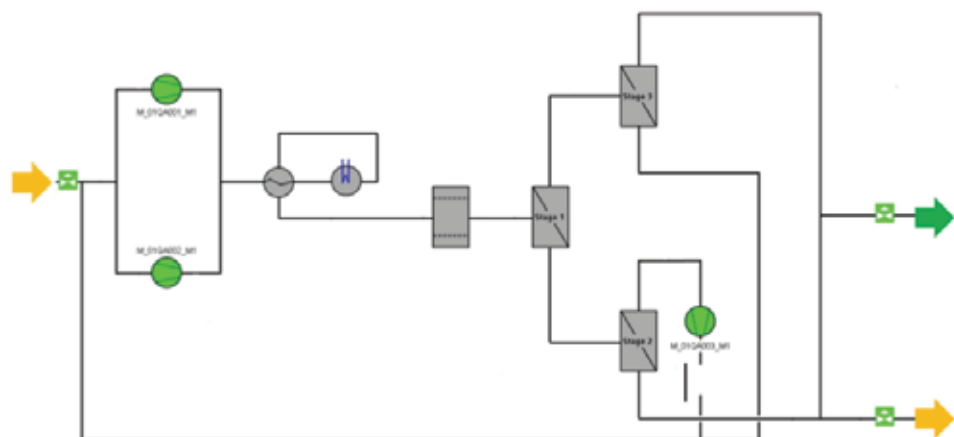


Figure 11 - South Milford AD plant (UK) – Compression -Cooling – Separation Through Membranes



Upgrading

CH₄ = Methane
CO₂ = Carbon dioxide

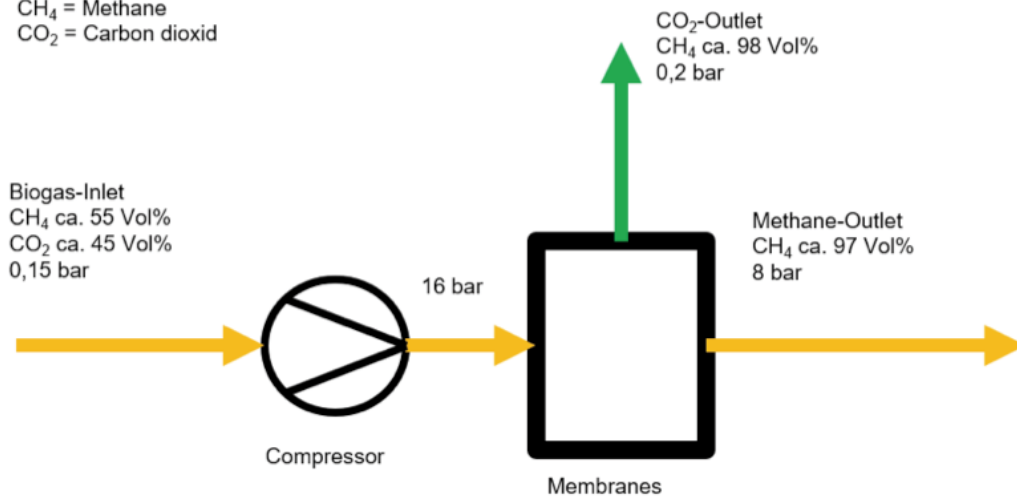


Figure 12 - South Milford AD plant (UK) – Inlet – Outlet Figures



Upgrading – External container 1 to 5



Figure 13: South Milford AD plant (UK) – Compact upgrading lay-out



Upgrading – Container 1



Figure 14: South Milford AD plant (UK) – Compressor



Upgrading – Container 2



Figure 15: South Milford AD plant (UK) – Compressor 2



Upgrading – Container 3



Figure 16: South Milford AD plant (UK) – Active Carbons



Upgrading – Container 4

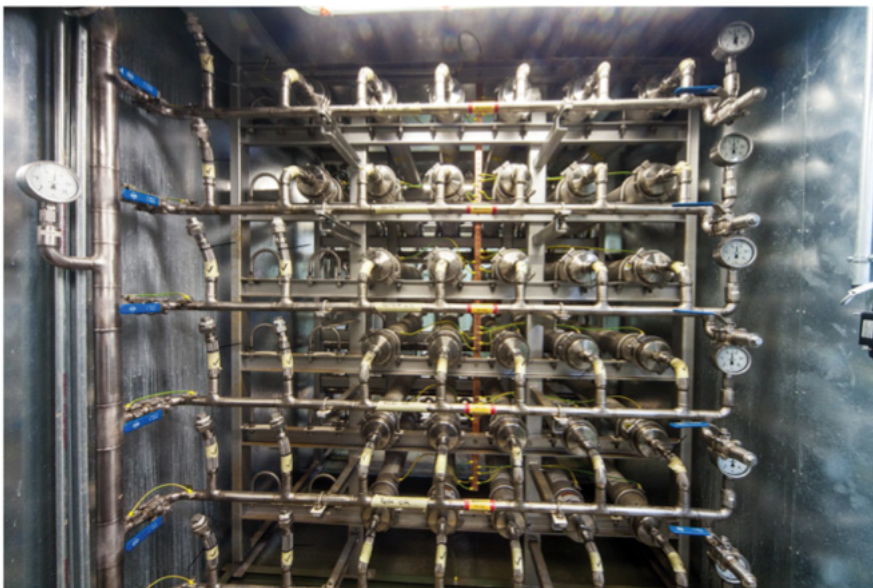


Figure 17: South Milford AD plant (UK) – Membranes



Figure 18: South Milford AD plant (UK) – Methane outlet

Impact on the environment

The Milford plant manage approximately 100,000 tons/y of organic waste with the following benefits of the environment:

The use of 275,000 MMBtus of carbon negative biogas from pical AD facility can help to:

Mitigate **12,793 tons of CO₂-eq** from the atmosphere.

Remove **2,240 passenger cars** out of the streets.

Make available **13,779 Acres of forest** that would have been required to absorb the same carbon emissions.

Recycle **100,000 tons of organic waste per year** that would have been thrown away, equivalent to food waste from **588,235 people**.

Figure19 - Environment Impact ¹

Conclusions

The Plant is in operation since five years, since there, 400,000 tons of waste have been transformed in 16 million Nm³ of biomethane and saving 50,000 tons of CO₂. The project is financially sustainable and profitable, The O&M is running smoothly and easily.

Other similar projects are under development and construction in the USA in Maryland and in Delaware to be, hopefully, other success stories...

“Other similar projects are under development and construction in the USA

“The Plant is in successful operation for five years



WHERE ECOLOGY MEETS ECONOMICS -
FROM FINANCE TO BUILD TO OPERATIONS

EXPO DUBAI 2021

Endnotes

- 1 *Anaerobic Digestion - Richard Ling; Alexandros Karaiskakis, Vinie Bevivino*
- 2 *Sources of Greenhouse Gas Emissions | Greenhouse Gas (GHG) Emissions | US EPA*
- 3 *Fact Sheet | Biogas: Converting Waste to Energy | White Papers | EESI*
- 4 *Alternative Fuels Data Center: Renewable Natural Gas Production (energy.gov)*
- 5 *Alternative Fuels Data Center: Renewable Natural Gas Production (energy.gov)*
- 6 *Battery Comparison of Energy Density - Cylindrical and Prismatic Cells (epectec.com)*
- 7 *<https://science.sciencemag.org/content/sci/360/6396/eaas9793.full.pdf>*
- 8 *Managing Energy in Fertilizer Production and Use (stanford.edu)*
- 9 *Food: Material-Specific Data | Facts and Figures about Materials, Waste and Recycling | US EPA*
- 10 *FWF_and_climate_change.pdf (fao.org)*



Björn Blankespoor

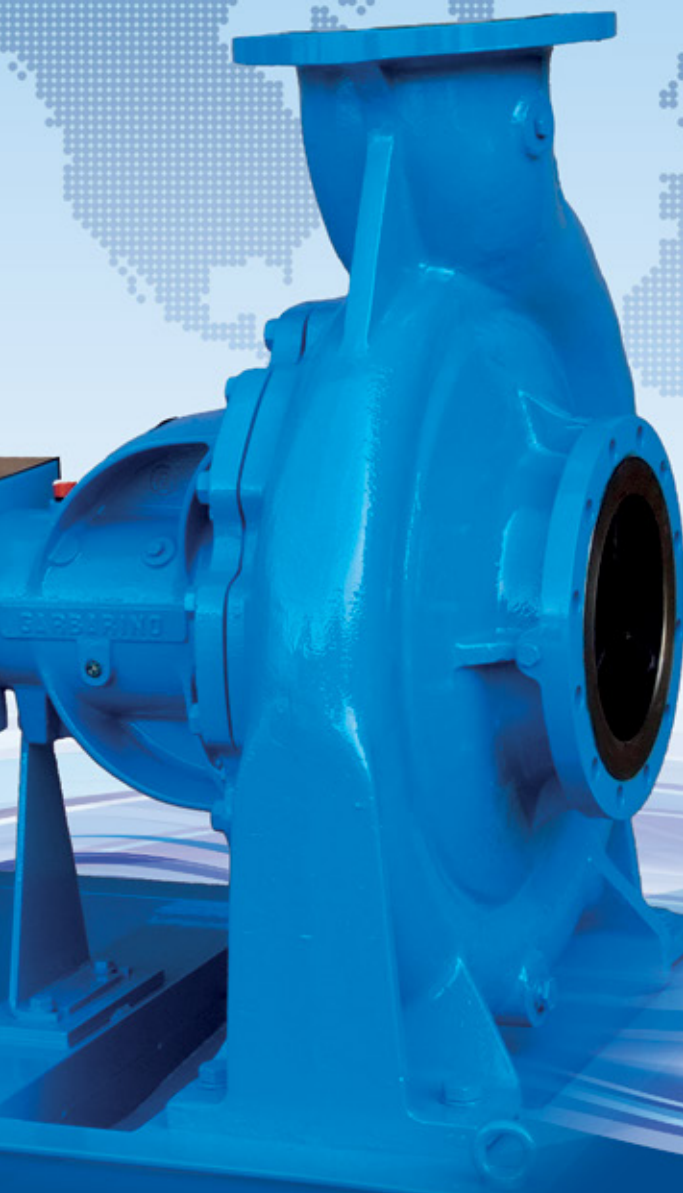
Björn Blankespoor, Head of the International sales following a Team strategically located all over the World. He started as Sales Manager since 2010 and followed the International markets. In 2015, Björn was appointed

as Managing Director of the UK based branch in Garforth (Leeds), developing the market with over 25M€ turnover.



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A revolution for recruiting in the industrial world

From Profile Middle East's experience to Rec-Place by Hevor

Matteo Colombo, CEO of Profile Middle East, President of Hevor
UAE Representative for the Internationalization Division of ANIMP

With support from:

Fiorella Fiorini, SDWWG

For the firms in the industrial domain, it is not easy to recruit new professionals with the right experience and within the times required by the project. Research is nowadays handed over to the HR agencies and seldom to job gateways that follow a general guideline, with limited resources. This means high cost and often delays with the process.

What makes the process longer and more inefficient is the research of international positions, which is also a characteristic of the field. This is because other than long periods also other issues sum up, such as low knowledge of the local dynamics. The process of personnel selection has been made smoother and more vigorous thanks to digitization. Although some difficulties have been overcome, there are still topics that have not been solved - such as timely matters and costs - and are still causing for the system to be overall unproductive.



Profile Middle East and its “sister business”

Profile Middle East is facing the same issue in its foreign and Italian branches. Founded in 1999 in Abu Dhabi, *Profile* is a multi-skilled firm that has started by quickly becoming rooted in the country to what it is today: a focal point for Italian and foreign firms that operate in the same field. This success is thanks to its ability of creating custom made solutions, that respect quality, performance, time limits and budget.

“Profile Middle East is a multi-skilled provider of technical advice and human resources for the industrial domain in the Middle East and the rest of the world

Thanks to its growth *Profile Middle East* was able to open new branches in different countries such as Italy, Romania, Mexico, Switzerland and widen the services provided, both in the sense of vertical integration and diversification of supply. The group has recently



celebrated its 20th anniversary and can rely on 50 employees and more than 500 technical advisors that work on different projects and are widespread across different countries.

Amongst *Profile's* sister companies recently established, *Technometer Middle East*, founded in 2015, is committed to aerial technology services, inspections, topography, and drone surveys. In 2021

Profile's expertise and experience gave birth to a new digital company named *Hevor*, which takes care of the difficulties when selecting the staff in the industrial sector by revolutionizing the dynamics and completely changing the game.

Hevor's Rec-Place: a winning business model for the first digital hub for recruitment

Rec-Place was created last summer thanks to a Hevor's strong intuition. It is the first global recruitment hub, one of its kind. It links the advantages that can be drawn from work portals to those drawn from HR

agencies, it fosters dialogue and efficient interaction between the recruiter and the contractor.

“In 2021 Profile's expertise and experience gave birth to a new digital company named Hevor's Rec-Place, which links the advantages that can be drawn from work portals to those drawn from HR agencies

With Rec-Place the selection process has moved in a shared virtual environment where firms and recruiters can interact with each other from anywhere and at any given time.

Recruiters that adhere to the platform are qualified professionals, certified by Rec-Place, and can be found all over the world. They are specialized in the recruitment/selection of industrial profiles, thus it makes them knowledgeable regarding the dynamics between demand and offer that are typical of each markets of belonging. They identify the best candidates, in their respective geographical areas, within their network of contacts, which are thoroughly sectioned. They take action quickly when the candidate search is in line with the market and/or their geographic region and are in fact challenged to identify the best candidates in the marketplace within a very short time frame.

The companies that entrust Rec-place know that the selection won't only be quicker than it usually is, but they are assured knowing that it will be extremely more accurate because conducted by professionals on a global scale with a strong knowledge of the market they operate in. Membership of the service is free, and the advantages are also interesting in terms of costs, to be incurred only when the selection is successful, the company is satisfied with



the resource identified and knows it can hire it.

The spirit and the vision of an initiative, such as Rec-Place, are perfectly aligned with this year's Expo of Dubai's theme, "Connecting minds and creating the future". The global pandemic has allowed the world to see how collaborating, fortifying the network of relationships and promoting the exchange of information - even remotely - can offer unexpected opportunities in the world of work, creating extremely positive synergies. The Rec-Place project had already been in the works for some time, but it was the pandemic that accelerated its realization, because of the answers it can provide to the many critical issues that have arisen in the industrial world in this period. Rec-Place can respond efficiently to the need to identify technical resources quickly and

remotely with experience in the countries of the projects.

"The spirit and the vision of the initiative, such as Rec-Place, are perfectly aligned with the theme of the next Expo in Dubai "Connecting minds and creating the future"

Rec-place is a simple but revolutionary idea, able to respond to the real problems of the world of work. For 20 years we have been recruiting technical profiles for the industrial world, but today the needs of customers have changed: they need a global, digital and reliable tool, able to combine the efficiency of technology with the effectiveness of the human relationship.



Matteo Colombo

Matteo Colombo, CEO of Profile Middle East, and President of Hevor, started his career working for Eni since a very young age allowing him to gain significant experience in several geographic areas. A sharp eye for details supported by strong technical and managerial expertise let him finally undertake the entrepreneurial experience, taking over an inactive company in the United Arab Emirates, an area with a huge potential and constantly developing. Profile Middle East, which has recently celebrated 20 years since its foundation, is nowadays strongly linked to the territory and recognized

as reliable business partner by local and Italian companies, institutions and associations operating in the industrial field. Matteo holds several roles within important associations such Vice President of the Italian Chamber of Commerce in the UAE, Vice President of the Italian Business Council of Abu Dhabi, Head of the Expo Committee of Assafrica & Mediterraneo - Confindustria, Local Representative for the Fuori Expo project by Fondazione Politecnico di Milano and Regione Lombardia, and finally UAE Representative for the Internationalization Division of Animp.



ShipLift: the modern system for building and maintenance of vessels & mega yachts

Are you curious about how the ShipLift system work?
Do you want to know what advantages this new Mega Yachts lifting system can bring?
If the answers are yes, you must read this article

Franco Pedron, Sales Director
Scandiuzzi Steel Constructions SpA



**SHIP LIFT
IN ACTION**

SCANDIUZZI
STEEL CONSTRUCTION SpA



We would like to start this article by showing the reasons behind the choice to invest in this new equipment in your yard..

The first could be that, an avant-garde technology will improve the yard's infrastructure in a manner that will consolidate and increase the production capacity of the shipyard. Also comparing to the competitors of the yacht refit sector, the investment on this modern system allows to be competitive and with an established technological level in house.

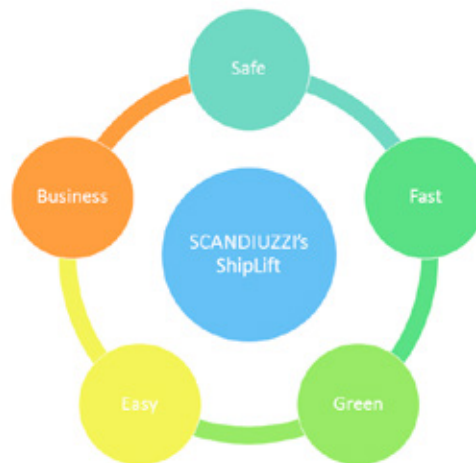
We think that the focus on technology combined with experience is the perfect mix to consolidate its position in the market and the investment in the ShipLift is the proof. The greatest innovation precisely, lies in the possibility to perform the refit and maintenance work of mega yachts that would be otherwise docked in the dry-dock, on ground because they are haul from water and stocked above the shipyard area. Indeed, the ShipLift permits to execute the extraordinary operations of launching and hauling faster than ever and so for more mega vessels, always in compliance with the most stringent safety rules.

Secondly, all the operation's chain respect the safety standard and is guarded, so the operator can check and stop the activities whenever wants. Normally we plan a central command unit in the command tower in order to manage in full control all the operation; all the devices are electronically controlled by the software system, automatically adjusted to guarantee a synchronous movement and easily switched to manual mode in case of emergency.

Thirdly, the mode of operation is very easy to learn and for any problems, you can request remote assistance. The customer is given, after a period of coaching, an operating and maintenance manual for the machine, which explains step-by-step the operation and the periodic maintenance to be carried out. As mentioned above, in addition to simple supply Scandiuzzi is able to offer "customer assistance", which is very important, especially for the first period, to support the clients also with remote assistance.

Finally, with a new Ship-lift, you will reduce the environmental impact resulting from other operations, so it is also eco-friendly no impact on the marine environment. For the last project that we realized we follow the design of a zero-emissions project, as the complete system was powered electrically by the shipyard. The environment matter is very important for Scandiuzzi, certified ISO 14001, and we try to support this philosophy in every work we made.

Summarizing, the investment on a new ShipLift assures innovation technology, speed and safe operation, suitability and environment support, and will increase the competitiveness.



What services does Scandiuzzi offer?

Starting from client's needs, Scandiuzzi follows the ShipLift project from design to installation on site; we can count on strong capacity and experience in the steel constructions and a pool of experts in electric-instrumental components that give us the chance to be a step ahead.

Scandiuzzi designs, fabricates, assembles and installs complete ShipLift system.

This equipment can be adapted to the yard's peculiarity and client's need, so we design taylor made technology with lifting capacity from 2.000 Ton up to needs. Once the needs have been defined, the project is created with the relevant calculation studies in accordance with general and specific construction standards.

The fabrication and assembly activities are performed in our three workshops located in the north and south of Italy. In addition, in Brindisi – south of Italy - Scandiuzzi has also a dedicated docking area available for big equipment assembly and delivery.

For example for our last ShipLift project, we decided to





Above the maps of the Brindisi Port, the area highlighted in red is the area dedicated to Scandiuzzi



Picture of winches under constructions

deliver in one piece the lifting steel rigid platform about 20x90 m, so we completed the assemble activities in the dedicated area of the Port of Brindisi and load it on the vessel for the delivery.

On these premises, we guarantee to the client the good realization of complete ShipLift system that deals with every customer's request.

Here below we will try to describe you more in deep this innovative system for the marina yards.

When the ShipLift can help you?

The modern system for hauling and launching activities of Vessels and Mega-yachts is the ShipLift.

This is an innovative technology - designed by Scandiuzzi - defined as a software-controlled handling equipment able to manage in safety manner all the dock activities for mega-yachts from 2.000 Ton in weight.

As already anticipated, the innovation technology of the Shiplift has revolutionized the maintenance and refit works performed on the mega yachts and vessels.

Previously, the most utilized way of intervention in these large ships was the dry-dock, i.e. an area from which water can be removed to carry out repairs. This technique restricts the possibility of working on as many vessels as the number of dry-docks available. While thanks to the ShipLift even large vessels can be lifted out of the water and repaired above the yard in a completely safe and energy-saving manner.

You can well understand how this modern technology has revolutionized the refit sectors for mega yachts.

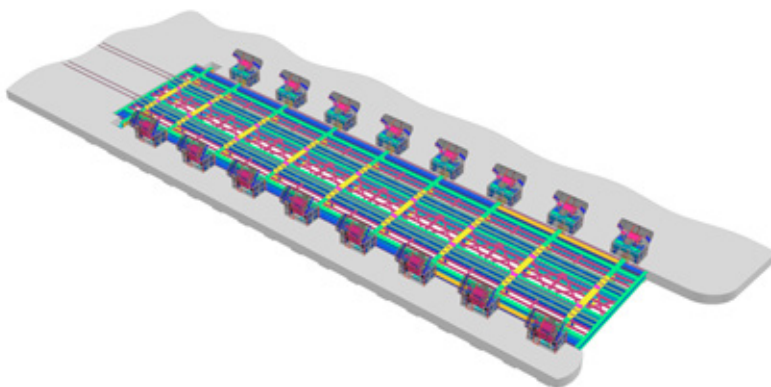
Scandiuzzi provides to his clients turnkey & customized solutions for any dock. Indeed the elements, which composed the System, could be different, every clients has specific needs and Scandiuzzi's project team can find the best technical-economical solutions in compliance to the clients' goals.

What elements compose the ship-lift system?

The ShipLift system, as can be guessed from its compound name, can be described as a lift for large ships, where there is a submersible metal platform that lifts the ship out of the water through the winches placed on the sides of it.

We can list as main components the steel platform (whose structure can be different as rigid or not), the winches installed along each side of the dock (which numbers and capacity are linked to the needs), the land carrier (transported by rail or wheels) and the software to manage the operations.

These elements are essentials for the operation of the Ship-Lift, but the number and dimensions of them are variable and it is on Scandiuzzi's engineering to study each single project and test the capacity of it in compliance with the most strict safety standards. About the software controlled system, it ensures the safe and synchronized hauling and launching activities. Indeed the software is designed to automatically



Above a 3D image caught from the study carried out in our last project



Overall picture of the ShipLift system

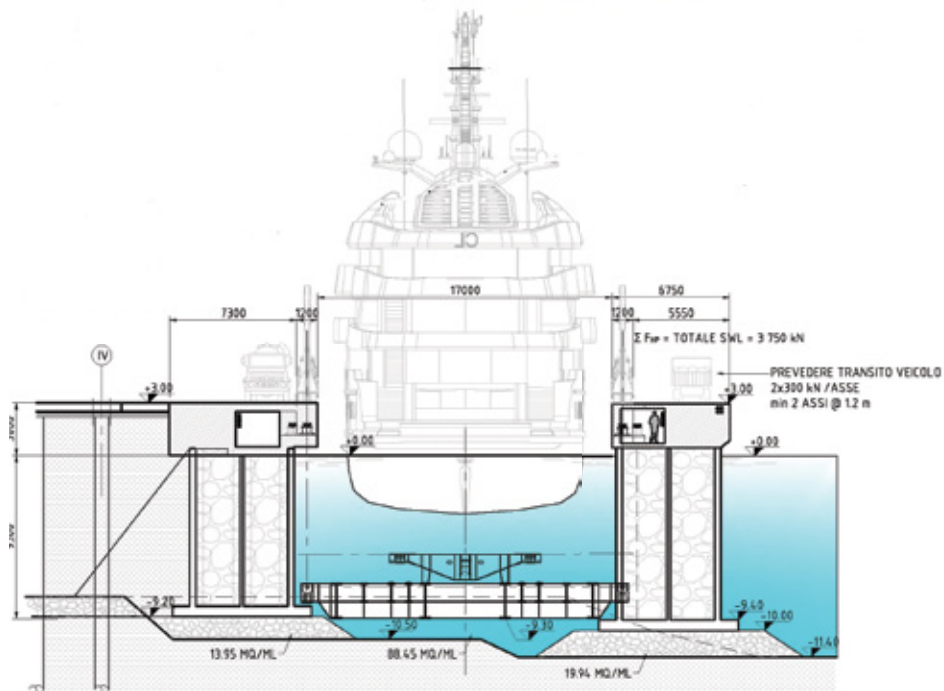
adjust the movement for lifting and launching synchronism movement; moreover, it can be switched to manual mode in emergency case.

Thanks to electronic sensors, it controls and notices:

- the instantaneous hoisting speed;
- the load intensity;
- the actual run stroke;

Scandiuzzi designs, tests and installs a customized software for every Ship-Lift project. We can list some functionality of it, for example it is possible to turn on the electric platform (to lower or to lift it), check in real time the load intensity or effort of every winches and take action for, stop the hauling/launching activities for any emergency. Moreover, in case of anomaly, in remote the technician can access to the system and act to solve the problems.





ANIMATION OF THE SHIPLIFT OPERATIONS



How operate a Ship-lift?

In the following, we will try to explain briefly the steps that take place during the lifting and launching operation of mega yachts.

In order to lift up a mega vessel, the first phase is to submerge the platform up to the sea bed draft height and after the vessel can move to moor inside the dock. Mooring can be assisted by cabstains winches installed along the dock walls.

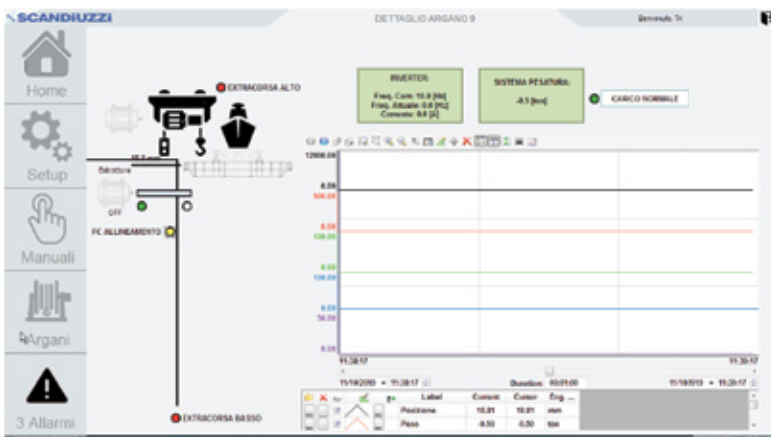
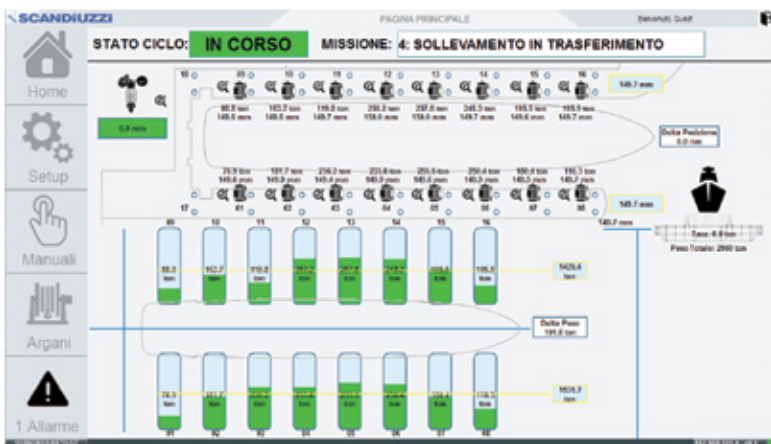
Afterward vessel mooring, platform rises until the keel blocks and engages the ship.

Now the vessel is secured and can be lifted up to quay elevation by winches and transported on the yard by land carrier system.

After the steel platform is secured by blocks; the land carrier can drive in platform below the mega yacht and engages the trestles by hydraulic jacks.

With this condition accomplished, the land carrier transports the vessel to the destination yard's slot.

Launching procedure is as above reversal.



Above Two example of the screen's software controlling the ShipLift operations

Conclusions

"You should know that, the realization of the ShipLift project was a big satisfaction for our company" – starts Franco Pedron, Sales Director of Scandiuzzi – "we started our history in 1978 as small steelwork manufacturer and then the years pass and Scandiuzzi's company grows. We acquired several experience in the steel construction from power to oil & gas sector, and later, also the naval sector became a knowledge." Scandiuzzi has crossed many challenges, but we think that the philosophy that has always distinguished us is that we have been able to meet the challenges of the future. The ShipLift was a challenge overcame and we are ready to start a new.



Franco Pedron

Franco Pedron, the Sales Director of Scandiuzzi Steel Constructions SpA, a company founded in 1978 by Cav. Scandiuzzi and now among the leading company in the sector of steel constructions for design, fabrication and erection on site.

The company realizes turnkey projects ensuring quality and timely delivery thanks to a well-qualified engineering, procurement and construction departments,

coordinated by project management experts.

The company is based in Italy in three workshops located in the north and south region. In Brindisi (South of Italy) there is a preassembling and loading yard of about 15,000 sq.m. with direct mooring to ships and barges, which is used to perform modularization of equipment and loading of manufactured goods on outbound vessels.

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INDUSTRIAL PLANTS

September 2021

Special issue of "Impiantistica Italiana", n. 4

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Graphic Design

STUDIO BART Milano

Printer

Litotipografia S.M.
20032 Cormano (MI)



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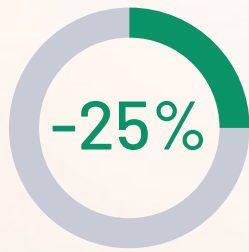


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