PROFESSIONAL ACHIEVEMENTS

BACKGROUND

Energy is one of the essential needs of a functioning society. Worldwide, great disparities are evident among nations in their level of energy use and demands upon world's resources. Growing global demand for energy to power economic development and growth requires the development of cost-effective technologies for a more sustainable energy economy for any country to ensure that the local industry can compete successfully on the global scale. Research aiming at the creation and establishment of the technologies necessary to adapt the current energy system into a more sustainable, competitive and secure one is of great value for any country. The common denominator of my professional experiences during my career is related to the energy domain.

FROM INDUSTRY TO ACADEMIA WITH THE SAME COMMON DENOMINATOR: ENERGY

The energy industry relies on a variety of fields of expertise that spans from engineering to scientific disciplines. Although this highly interdisciplinary nature, a holistic approach is often challenging among energy practitioners due to their limited understanding outside their own expertise domain. The current challenge faced by the energy industry to meet the growing demand in a sustainable manner calls for a serious effort in bridging the gap between the different engineering disciplines and for a greater connection between science and technology. My research expertise belongs to the energy domain and exemplifies my effort in providing a holistic view to different problems within the energy domain. I have had the opportunity of contributing in different areas of applied mechanics spanning from solid mechanics to fluid dynamics to material science. Since joining Masdar my research has focused on both fundamental aspects of energy transfer such as nanoscale energy transport, conversion, and storage and the application of nanotechnology towards the development of novel power generation devices and/or systems based on energy sources. Often, I am faced with the question regarding how my industrial experience has influenced my current research interest and thus I will shortly explain how it all hangs together. Clearly the common denominator of my professional profile presented graphically in Figure 1 is related to the energy field.

My carrier starts at Schlumberger onboard of seismic ships where I was in charge for the pressure wave generator system made of different arrays of airguns see Figure 1. Every airgun releases high pressure air in to the water to generate a pressure wave that is used to survey the subsea earth crust in search for hydrocarbons. The system employed a set of submersed hydrophones to record the signature of the superimposed pressure wave one generates and the signature of the reflected wave. The subtraction of these two signatures and the manipulation of the obtained data provided geologists with the element to judge whether hydrocarbon could be found in a specific location. Although at a completely different length scale this approach contains many similarity with the approach I am currently relying on to investigate material properties at the Nanoscale.

The interest for localized properties on the overall behaviour of macrostructure summarizes the effort during my doctoral research. In my dissertation I outlined a strategy to account for local material models within structural analysis of entire mega-structures. The numerical tool based on the framework proposed in my research allows for the direct fracture mechanical assessment of entire pipeline and it has been employed in the development of the Ormen Lange field on the Norwegian continental shelf see Figure 1. The field is expected to be able to meet up to 20% of Britain's gas demand, for up to 40 years. The Ormen Lange field was developed without using conventional offshore platforms: 24 subsea wellheads are connected directly by two 762 mm pipelines to an onshore process terminal. Due to the fact that the field is situated in a location where seabed depths vary between 800 and 1,100 meters, common standards required very stringent integrity criteria for the laying process of pipelines. These criteria are often so conservative to be impossible to meet during operation. In this respect the results of my research was an enabling factor in carrying out fracture mechanical assessment of entire pipeline during the laying process and in providing more realistic criteria for the laying process.

After the end of my PhD and after establishing a small start up company LINKftr, I joined the Gas Technology group at SINTEF Energy Research. Within my position at SINTEF I was involved in many projects related to gas and oil transport and processing see Figure 1. I have also gained an insight into the material technology challenges associated with the transport of carbon dioxide back to the reservoir to improve oil recovery or to minimize carbon dioxide emission in the atmosphere. The low water content in the carbon dioxide gas is required to reduce the danger of corrosion, but the drawback of such a requirement lies in the need of a series of expensive drying processes. The best and cheapest solution to the problem requires an insight into the various phases of operations necessary.

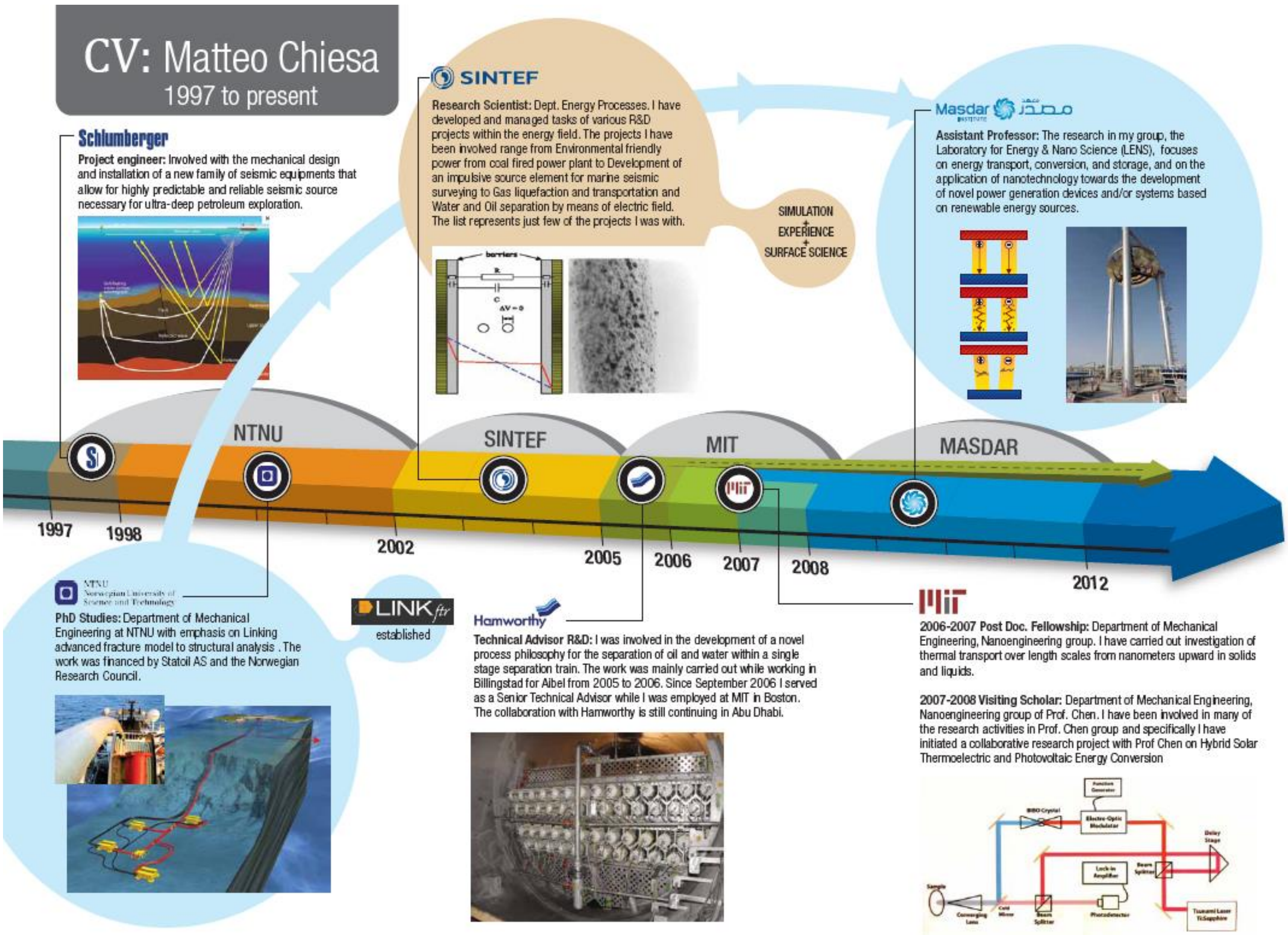

Figure 1 The different steps in the timeline of my professional development are illustrated graphically.

Another relevant project that highlights the great variety of projects I was involved with is related to water separation. The oil extracted from offshore reservoirs will normally contain a large and, during the reservoir lifetime, increasing percentage of water emulsified in the oil. I have investigated numerically and experimentally the effect that the combination of electric field and a moderate turbulent flow play in separating stabile water-oil emulsions reducing the need for chemicals. This reduction has a positive contribute in the environmental footprint of water-oil separation. Due to my research effort within oil and water separation I was offered a position at Aibel/Hamworthy where I have worked in the R&D team in charged for the development of Vessel Internal Electro-Coalescer (VIEC). The VIEC is made of a series of electrodes moulded into a dielectric matrix that needs to withstand mixtures with different content of water.

The material challenges faced during the development of the VIEC motivated my search for a Post Doc fellowship in the group of Professor Gang Chen at the Massachusetts Institute of Technology where I investigated, among other topics, the properties of thin films and novel insulating materials developed while working at Aibel/Hamworthy. Such materials are very important in order to employ a new process philosophy for the separation of oil and water within a single stage separation train in subsea application. In this respect patent protection for a series of products that can make this process philosophy possible by enhancing separation efficiency has been gained. The formative experience in Professor Chen laboratory convinced me to pursue an academic carrier aimed at facing the challenges faced by the energy sector by the manipulation of material properties at the nanoscale for the development of sustainable solution for our growing energy demand.