An issue that cannot be argued today is the fact that modern, highly advanced both technologically and economically, societies are unable to function effectively, achieve their goals or satisfy the legitimate needs of the population without access to near limitless sources of energy. The successive technological and economic development means that the needs of humanity in this area are constantly growing. Another factor determining the rise of demand in this matter is the constant exponential increase in the global population. As a result, the current important challenge for science is to design and successfully achieve the task of acquiring energy as well as store its excess for future use. This means that science must find an answer to the question of where are the sources of near limitless energy, which are suitable for long-term storage and immediate use. The guaranteed ability of using these stored energy resources on-demand are necessary of a highly developed technologically and economically advanced society. Simultaneously, the increase of people's awareness the need to care and protect the natural environment mean today's social demands on the production, storage of energy must change significantly in relation to the previous energy production philosophies of the latter centuries. Today the regulations are more rigorous, and the basic conditions for the production and storage of energy must be safe for the natural environment.

A pressing issue is that modern energy generating technologies must meet stricter requirements for being clean, renewable and efficient in order to meet this impending energy demand. These renewable and/or "carbon neutral" technologies include hydro power, wind power, nuclear power, photo-voltaics, concentrated solar power, and geothermal power. The last four sources of energy can typically produce excess amounts of heat which is lost to the local environment as waste heat. Thermal energy storage is one method by which the waste energy can be stored in classical thermal batteries. The energy is stored in the forms of: **Sensible Heat**, which is dependent on the heat capacity of the material, **Latent Heat** which involves melting or crystallization of a substance or **Thermochemical Heat** from reversible chemical reactions. The newest technological concept for thermal energy storage includes the thermal energy consuming effect of pushing a non-wetting liquid into a nanoporous material (so called molecular springs system). The extrusion of the non-wetting liquid from the nanoporous material releases the heat. This process is reversible, making it a renewable cycle.

The proposed idea is to attempt to fuse two methods (well-known latent heat and innovative intrusion-extrusion methods) in order to develop a new concept with an increased thermal energy storage capacity. The innovation of this prospective technology comes from utilising the best properties from each system. From the sensible heat storage mechanism it is possible to choose high heat capacity solids which melt and become a high heat capacity liquid which can be used for the heat energy storage. While maximum enthalpy of solid-liquid phase transition will be used as a latent heat storage. The next exploitable characteristic is the energy storage mechanism by forced intrusion of the non-wetting liquid into a nanoporous solid driven by the rise in temperature within a fixed volume. This induces the expansion of the non-wetting liquid into the pore and stores the thermal energy. Reversibility of this expansion of liquid into the pore is extremely difficult and the major crux of the problem. Finding the appropriate, figurative and literal, "solution" and the mechanism will allow for the increased thermal energy storage capacity.

To understand the mechanism behind temperature provoked intrusion-extrusion of non-wetting liquid into/from nanoporous materials and to maximize corresponding thermal effects, we must first understand the interactions between the combination of non-wetting liquid and nanoporous materials. The purpose is to optimise the performance of a new thermal energy storage methods. This technology is to work in conjunction with the matured renewable energies technologies as storage devices, for example, for thermal energy from concentrated solar energy plants. It will be with these symbiotic applications which will drive the creation of new enterprises which will improve the local and national economy. Thermal energy storage can be adapted to work with the current generation power plants for energy/heat recovery from flue gas and cooling towers from coal-fired power plants and nuclear power plants. The last example is its potential application to design new home heating/storage technologies (thermal battery). The outcome of this project has the potential to revolutionise the energy storage market by adding new knowledge and technology.