A practical way to generate innovative and sustainable designs of chemical and biochemical processes is to develop methods to generate hybrid schemes and apply them to solve specific energy intensive separation problems. Process intensification plays a major role within the process synthesis methods where the primary process objectives are to satisfy targeted process performance parameters including process economics and environmental impacts. The phenomena-based technique employing a multi scale method operating at unit operation (unit-op), functional/task and phenomena level is suited for achieving targeted process intensification. This paper presents a detailed systematic framework to determine new, innovative and more sustainable intensified flowsheet alternatives using combined phenomena and predefined intensified hybrid schemes consisting of conventional techniques such as distillation, reaction, membrane etc. In these hybrid schemes, the specified process objectives, which cannot be achieved by a single unit-op are achieved by combining multiple unit-ops all operating at their highest efficiencies to achieve the desired separation together with the targeted performance parameters. An overview of the key concepts and step-by-step workflow of the phenomena-based intensification method for hybrid separation schemes is presented along with its implementation and highlighting as well, new improved solutions of published case studies involving chemical and biochemical processes.