Main

Introduction:

At high level, energy systems - and related *predictive* and *prescriptive* business analytic (BA) problems - can be divided into two broad classes: **Electrical Energy Systems** (EES) and **Energy Commodities Systems** (ECS, mainly oil and natural gas). In the following two tables for both EES and ECS is presented a cross categorization about **time horizon** (*Strategic*, *Tactical* and *Operational*) versus **types of optimization problems** (*Planning*, *Production*, *etc.*). Sometimes in medium (tactical) and long term (strategic) the goals are similar (but not identical). Sometimes instead - as in the case of planning - these goals are inherently strategic and no medium (or short term) activities are considered. Also, some problems can be seen from different angles, and depending on the actual structure of the electricity or gas system or markets. For instance, in production optimization problems for electricity markets, network can be disregarded (or pretty much simplified) but if network management is considered, power plants cannot (unless a **static** Load Flow is of interest). Finally we observe that while many of these problems could be considered as a single bigger problem, very often in scientific literature - as well as in the industry practice - they are decoupled in a top-down or bottom-up approach depending on the focus, the goals, data availability and ultimately on the ability of the modelers. As just one example, take a large utility, its long term gas portfolio optimization is coupled with fossil fuel power plants usage maybe in an electricity market environment.

The present Wiki has been envisioned with three main goals:

1. being a nimble while comprehensive resource of several real life business problems with a categorized set of pointers to many relevant *prescriptive* problems for energy systems;
2. being a balanced mix of scientific and industrial views;
3. being so that it will evolve over time in a flexible and dynamic way giving, from time to time, a more scientific or industrial - or even political in a broad sense - weighed perspective.

Each cell of the following two tables, where the cross categorization is meaningful, is then linked to external pages where relevant problems are presented.

A general knowledge of the underlying energy markets may be necessary to understand several of the terms involved in the description of the problems.

Electrical Energy Systems

Horizon /Problems:	Production and Demand Management	Network and Storage	Maintenance	Finance, Regulations, Politics and Market Design
Strategic/ Long Term	• Strategic Planning • Energy Generation Capacity Expansion Planning (GEP) • Co-optimized GEP and NEP • Long term Unit Commitment (UC)	• Strategic Network Management • Transmission Network Expansion Planning (NEP) • Distribution Network Reinforcement Planning (DNRP) • Distribution Network Expansion Planning (DNEP) • Energy Storage System (EES) siting and sizing	• Strategic Maintenance • Power plants long term maintenance • Transmission and Distribution network long term Maintenance	• Long Term electricity bilateral contracts • Energy System Analysis • Energy Policy Analysis • Multilevel Modeling of Market Design • European Electricity and Day-Ahead Markets • Electricity market: Demand Response and price optimization
Tactical/ Medium Term	• Medium-term Unit Commitment (UC) • General Unit Commitment	• Use of Storage • Electric Vehicles • Deferrable Loads • Provisional management	• Medium term Maintenance • Scheduled Maintenance	• Pricing problems • Derivative Pricing in Electricity Markets

Operational / Short Term	• Operational-Production
	• Monopolist: short term UC
	• Market: max profit short Term UC
	• Unit Commitment under uncertainty
	• UC scheduling
	• Energy markets
	• Balancing markets and non programmable (renewable) power coordination
	• Single Bus Economic Dispatch (SBED)
		• Security of Transmission
		  • Optimal Power Flow (OPF)
		  • Security constrained OPF
		  • N-k security problems
		• Optimal Transmission Switching (OTS)
		• Optimal Network Islanding & Restoration
		• Smart grids operations
			• Nuclear Reloading Pattern optimization	• Combined gas and power optimization
				• TSO: Balancing Markets Clearing
				• MO: Energy Markets clearing
				• GenCo: Max Profit ED/UC

General purpose solvers

Energy Commodities Systems

Horizon /Problems	Production and Demand Management	Network and storage	Finance and Regulations

Strategic	• Optimum wells placements
	    • Oil wells placements
	    • Gas wells placements
	• Optimization of the gas-lift process
		• Gas pipelines design
		• District Heating Network design
		• Optimal design of Energy Hubs and CCHP systems
			• Evaluation of European Gas Market Designs
			• Take or Pay (ToP) oil contracts
			• Take or Pay (ToP) gas contracts

Tactical			
Operational	• Total gas recovery maximization • Optimal scheduling of Energy Hubs and CCHP systems • The Pooling Problem	• Operational-Network and Storage Management • Gas network flow optimization • Gas storage operation optimization • Optimal Operation of District Heating Systems	• Gas balancing markets

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