

Optimisation et commande des modèles énergétiques pour un développement soutenable

Nadia Maïzi, Centre de Mathématiques Appliquées, CMA Nice

The CMA, the Center for Applied Mathematics belongs to the UMS (Mathematics and Systems) department of MINES ParisTech which was rated A at the AERES evaluation. Research and teaching activities at the Centre for Applied Mathematics concern Optimization, Decision-making Support and Control. They are led in close collaboration with industrial partners in the fields of climate, economics, markets and energy. The centre has strong collaborations with INRIA.

Since 2003, a special focus has been given to planning and optimization through a dedicated prospective approach. Goaded by the climate problem and economic globalisation, the energy issues provided the opportunity for a methodological reappraisal which inspired and accelerated a dialogue between engineers and economists. Extending this movement to other sustainable development issues can only make more obvious the current lack, in France, of a capability to lastingly develop modeling tools and of a training "for and by" the prospective approach. Past efforts were led in a real structural instability and, nowadays, the human factor appears to be the limiting parameter to recreate a tradition linking numerical prospective, economic calculation, public economy and strategic thinking.

The Centre for Applied Mathematics, backed by the French Energy Council, since 2003, has been working on the development of a MARKAL/TIMES model. MARKAL/TIMES is a long-term planning tool that generates normative information based on analyses of scenarios reflecting different policies, measures or incentives concerning all economic sectors. This approach involves the constrained optimization of a system describing energy flows associated with a given geographic zone and is based on modelling optimization problems. Some key research topics are operational flexibility of electric systems, impacts of large wind power shares, low carbon energy systems and development of renewable energy sources.

The CMA's "planning and optimization" research project enjoys national and international recognition, highlighted by the following:

- Selected by the French Strategic Analysis Council (reporting to the Prime Minister) as part of work done by the Energy Commission, to evaluate scenarios for France with the target of quartering CO₂ emissions by 2050.
- Invited to the United Nations conference on climate change (UNFCCC) in Nairobi in November 2006, to present the anticipatory approach proposed by the CMA in partnership with Schneider Electric, in 2007 in Bali, in 2009 in Copenhagen, in 2010 in Cancun.

In addition, through numerous collaborations, the project is associated with:

- Academia: partnership with CIRED (EHESS/ENPC/CNRS laboratory)
- The industrial sphere: partnerships with EDF (three PhDs underway), association with SCHNEIDER Electric, TOTAL, ADEME, EDF and RENAULT, in the scope of the Chair on Modelling and Forecasting for Sustainable Development.
- The institutional world: IFP partnership coming under the TUCK Foundation
- Europe: partner on several European projects – NEEDS, RES2020, OPTIMATE.

In order to reinforce and perpetuate our "planning and optimization" research activities, two main projects are associated:

- The ParisTech Chair Modeling for Sustainable Development created by the CMA in 2008 : www.modelisation-prospective.org
- The Master's course on Optimization of Energy Systems for which CMA is responsible since 2000 of www-ose.cma.ensmp.fr