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Enhancing and Preparing TIMES for High Performance Computing (HPC)

Semi-annual ETSAP Workshop, Madrid, 17 Nov. 2016

- Research topics become more and more demanding in terms of data and complexity
- TIMES-based models increase in size and complexity:
 - Higher time and spatial resolution
 - Increasing number of processes/commodities/user constraints
 - Linear approx. of non-linear equations that require MIP approaches
 - Increasing number of complex modelling mechanisms, via TIMES extensions
 - Coupling with other models, where long TIMES solution times are not acceptable
- TIMES is mostly run on desktop PCs using windows OS
- Research project Beam-ME deals with the question to run large LPs and MIPs on HPC, but TIMES-based models are not particularly in focus (yet)

Problem: What are the challenges?

- Running complex TIMES models on standard PCs challenges the hardware
 - Memory bottlenecks, long computational times
- Also large Windows-based dedicated high performance computing resources (blades) seem to be unable to achieve significant improvement in performance for specific problems that rely on single-thread processor power :
 - They are built using 2-3 nodes (processors) with 12/36 logical cores
 - But single-core power performance decreases when all logical cores are used simultaneously
- High-performance computing centres (e.g. CSCS in Lugano, HLRS in Stuttgart), provide clusters of nodes (processors), with large computation capacities, but they can't be used straight forward for TIMES calculations :
 - They run on Linux OS
 - GAMS needs to advance to run on these clusters and gain from parallelism
 - Solvers need to be able to run on nodes
 - Issues with licensing and flexibility in cluster use

- What modifications are necessary to use TIMES code on clusters running on Linux OS?

ETSAP-initiated project to search for solutions

- ETSAP project that aims at preparing TIMES for running LP on HPC:
 - Checking the TIMES code and improving where necessary that it can be used on Linux OS
 - Eventually testing complementary software that transforms MS Windows programming code to Linux
 - Define necessary model data transfers to/from a Linux system (how is a model transferred best to/from? dd-files or mps matrix or ...)
 - Guidelines describing the process to allow all interested TIMES modellers to use Linux systems
 - GAMS will be contacted for technical assistance if necessary
- Link to Beam-ME project
 - GAMS is member of Beam-ME project team
 - PSI and UCC are in advisory board
 - Link to projects which aim at running LP model on HPC

- Project partners involved:
 - PSI
 - UCC
 - GAMS with technical support
- Deliverables:
 - Modified TIMES code (only if necessary and only for ensuring compatibility between Windows and Linux file systems)
 - Guideline on how to transfer TIMES models to Linux Systems
 - Link to Beam-ME project and generate spill-overs where possible
- Relevance to the Annex XIII topics:
 - Address research and development objectives of Annex XIII by facilitating and supporting computation of complex state-of-the art of energy system models.
 - Making TIMES-based models able to run in both Windows and Linux platforms is the first step towards making TIMES ready for High Performance Computing.

- Estimated costs: 10 970 €

Personel Costs				
Tasks	Estimated Person-Days PSI	Average Cost per Person-Day	Total Cost	Estimated Person-Days UCC (co-funded)
1. preparing Linux system with GAMS/CPLEX	0.5	€910	€455	0.5
2. adopting TIMES for running on Linux OS	2.0	€910	€1'820	2.0
2. testing TIMES and running on Linux OS	1.5	€910	€1'365	1.5
4. documentation / guideline	1.0	€910	€910	1.0
5. technical support*	2.2	€910	€2'000	
			Total= € 6'550	

* The technical support runs through all project's tasks and it is conditional upon finding a qualified partner
 Otherwise the amount of 2000 EUR will be returned to ETSAP.

Other Expenses	Estimated Costs
Travel	
exchange UCC/PSI	€ 2'500
2 GAMS/CPLEX (cross-platform) licences	€ 1'920
Total	€ 4'420

Total Project Cost	€ 10'970
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Expected Benefits for ETSAP:

- Enhanced usage of model tools
- ETSAP members benefit from low transaction cost when using HPC in future
- Facilitation of usage of better hardware performance for TIMES modelling (Linux)
- Enhancing the user basis through availability of TIMES on non-Windows OS
- Collaboration between ETSAP teams

PSI Energy Economics:

www.psi.ch/eem

UCC:

<https://www.ucc.ie/en/energypolicy/>