

CSIRO Cluster Project 2 – Grid Planning and Co-optimisation

Milestone 1a :

Detailed Project Plan finalised and signed-off by the Cluster Management Committee

The University of Newcastle

March 2013

1. Overview

The project has been proceeding as planned. This document outlines the detailed project plan for the overall project for signing off by the Cluster Management Committee following the original agreed milestones of achievement as shown in Table 1 below.

Table 1. The original Milestones of Achievement

Milestone	Deliverable	Delivery date
1a		1/03/2013
	Detailed Project Plan finalised and signed-off by the Cluster Management Committee.	
1b		1/06/2013
	Develop electricity and natural gas network models covering both system and economic aspects	
2		1/09/2013
	Test run the models with bench mark systems or baseline scenario, as well as other multiple scenarios in coordination with other project teams, and identify improvements (as detailed in item 10 above).	
	Report for full Financial Year (Year ending 30 June)	

3		1/03/2014
	Develop network model constraints	
4		1/09/2014
	Complete formulation of the co-optimisation problem	
	Report for full Financial Year (Year ending 30 June)	
5		1/03/2015
	Develop demand side model which provides spatial and temporal aggregation of the demand side in a form suitable for utilisation by the framework	
6		31/12/2015
	Develop the overall network co-optimisation framework with advanced optimisation methods	
	Report for full Financial Year (Year ending 30 June)	
	Complete final end of cluster report detailing the research findings	

2. Detailed Plan

Milestone 1

MS1a: Detailed Project Plan finalised and signed - off by the Cluster Management Committee

This document satisfies the requirement of Milestone 1a

MS 1b: Develop electricity and natural gas network models covering both system and economic aspects. (Due 01/06/2013)

Under Milestone 1b, the electricity and natural gas network models will be developed to cover both the power system and the economic/electricity market aspects. This will include the following:

- (1) Power system models (generators, power flow equations, line flow limits, etc) in Matlab and professional software format, such as PSS_E or DiGSILENT Power Factory;

- (2) Natural gas models (gas flow equations, compressors, underground storage, etc) as part of the overall economic / electricity market model in Matlab and professional software format, such as Plexos and/or Prophet;
- (3) Appropriate measures for both power system and natural gas network for planning purposes. This will include a comprehensive reliability measure suitable for both the power system and gas system usage; the measure should also be applicable for utilisation in market benefit analysis for planning.

Milestone 2

MS 2a: Test run the models with benchmark systems or baseline scenario, as well as other multiple scenarios in coordination with other project teams, and identify improvements. (Due: 01/09/2013)

- (1) Both benchmark power systems and natural gas networks will be developed for testing purpose: The benchmark power systems may include standard IEEE benchmark systems and the Australian NEM systems. The gas network will include benchmark systems for testing and development, and a gas network model representing the Australian NEM's gas network.
- (2) Scenarios concerning the penetration of natural gas generation will also be formulated: Scenarios should be developed to cover a sufficient wide range of possibilities for future grid development, including business as usual, different levels of probability of exceedence, as well as extreme cases such as 100% renewable. This will be developed together with inputs from P1 and P3.

MS 2b: Report for Financial Year 2012 - 2013. (Due: 01/09/2013)

Milestone 3

MS 3: Develop network model constraints (Due: 01/03/2014)

- (1) Develop data mining based methods for network model simplification and constraints formulation: this milestone include data mining based algorithms for generic constraints development as well as application of the developed data mining based methods for Australian NEM and benchmark system constraint development. Data generated from the simulations out of P1 will be used as the input (partial) to the development of the constraints for this project.
- (2) A number of data mining based techniques will be explored for this milestone, this may include: pattern discovery, SVM and other algorithms.
- (3) The constraints will be useful for market simulation and operational dispatch of the power system. They include constraints imposed for the power system such as voltage stability constraint, thermal limits, angle stability, transient stability etc.

Milestone 4

MS 4a: Formulation of the co-optimization problem (Due: 01/09/2014)

- (1) Investigate model simplification in a number of special situations: This will be in line with the scenarios developed in Milestone 2. Model simplification methods will be recommended.
- (2) Develop advanced optimization techniques based on simplified models and mathematical programming techniques: This will include exploration of advanced numerical optimisation involving nonlinear optimisation as well as computational intelligent based approaches. Mathematical programming techniques will be part of the research under this milestone as well. This may include calculus of variations, global descent, robust optimization, etc.
- (3) Cloud computing based optimization techniques for handling large-scale systems: Given the nature of complexity involved in system simulation, market simulation and optimisation of the planning problems, the computational cost will be very high. We will explore advanced computational options ranging from cloud computing and grid computing to achieve high computational efficiency, and therefore meet the industrial practice needs better.

MS 4b: Report for Financial Year 2013 - 2014. (Due: 01/09/2014)

Milestone 5

MS 5: Develop demand side model which provides spatial and temporal aggregation of the demand side in a form suitable for utilisation by the framework (Due: 01/03/2015)

- (1) Develop aggregation models of demand response, and investigate its impacts on power system planning: The project team will utilise the data provided by CSIRO and collected from other potential sources to develop models of demand response. The impact of demand response will be evaluated with the network model developed in previous Milestones.
- (2) Investigate driving behaviours of electric vehicles, develop its aggregation models: Electrical vehicles are another distinct new component in future grid. It can be regarded as load when charging or as energy storage to provide needed energy or power generation support when being discharged. With the expected growing number of EVs, it is important to evaluate its potential impact on future grid co-planning. The aggregation models of EVS will be developed at this milestone.

- (3) Co-planning of power system and electric vehicle charging facilities: The EV model developed in steps (1) and (2) will be incorporated into the power system model for co-planning analysis.

Milestone 6

MS 6a: Develop the overall network co-optimization framework with advanced optimization methods(Due: 31/12/2015)

- (1) Formulate co-optimization models considering power system, gas network, demand response and EV charging facility: this is to integrate the individual development of the project to form the overall model for co-optimisation and planning.
- (2) Develop advanced optimization techniques for solving the co-optimization models: advanced optimisation techniques will be explored and used to solve the formulated co-optimisation planning model.

MS 6b: Report for financial year 2014-2015 (Due: 31/12/2015)

MS 6c: Complete final end of cluster report detailing the research findings (Due: 31/12/2015)

3. References/ Initial Studies

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