

# Unique Cooperative Project Brings Benefits for All: the EnergyAustralia Digital Cadastre Upgrade Project

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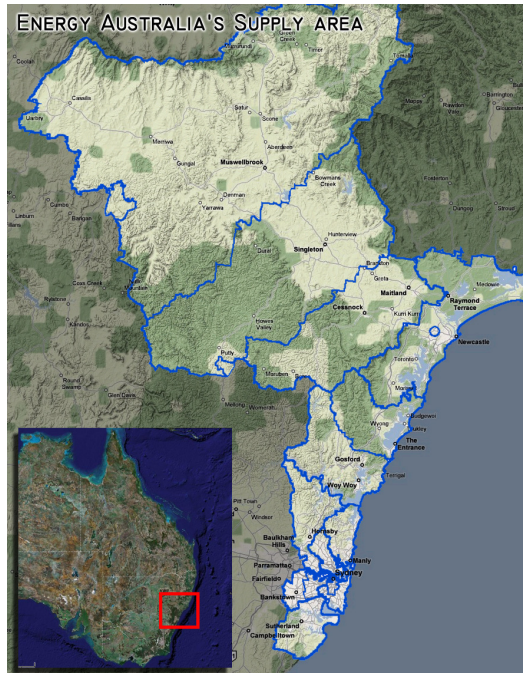
## User Article

EnergyAustralia operates Australia's largest distribution network and supplies more than 1.5 million customers across an area spanning 22,000 km<sup>2</sup> (8,494 m<sup>2</sup>) which ranges from Waterfall in south Sydney to the Upper Hunter Valley in the north. EnergyAustralia's network includes:

- More than 500,000 poles,
- Some 28,000 substations and kiosks
- More than 46,000 km (28,580 miles) of underground cable and overhead line

The area is administered by more than 40 local government authorities, and the related Digital Cadastre Database (DCDB) contains almost 1.3 million land parcels.

For several years, unacceptable positional inaccuracies in the DCDB have caused safety concerns and hampered attempts to improve the efficiency of GIS processes in EnergyAustralia. These inaccuracies have also been an impediment to planning, maintenance, and construction activities, while exposing the business to risk, particularly where the GIS products have to be integrated with GPS data or ortho photography. EnergyAustralia therefore decided to tackle the challenge of improving the accuracy of its DCDB.



*EnergyAustralia's supply area, showing regions of overlap with Sydney Water and Hunter Water.*

### Improving the Accuracy of the DCDB

The project was planned in three stages:

- Stage 1—EnergyAustralia was able to leverage work already completed by Sydney Water and Hunter Water, two other utilities in their service area, by adopting the utility's DCDBs and realigning the position of network assets to the new landbase.
- Stage 2—a spatial adjustment of the landbase for the Central Coast was completed as part of a cooperative project between

EnergyAustralia, New South Wales Land and Property Information (NSW LPI) and the two local government authorities in that region.

- Stage 3— This commenced in July 2008 and will address accuracy concerns in Hunter Valley. This stage will follow a similar approach to that taken in the Central Coast and is also expected to deliver significant benefits for all participants.

While EnergyAustralia has much in common with other electricity utilities, the scale of this undertaking, as well as the significant level of input required between various government agencies and private industry, required development of a cooperative approach to improving landbase accuracy.

### Business Imperatives for Action

Demand for spatial accuracy in GIS has continued to increase, as improvements in technology led to new data applications and changing expectations of stakeholders. For EnergyAustralia, misalignment of the landbase was having a detrimental impact on operations in many business areas. The primary drivers for this Project were to:

1. Improve safety for EnergyAustralia staff and the

- general public.
2. Reduce the effort involved in integrating accurate survey data with a less-accurate DCDB.
3. Minimize potential legal issues arising from spatial inaccuracies.
4. Reduce delays in decision due to a lack of confidence in the accuracy of the GIS.
5. Capitalize on opportunities to employ automated data capture methods.



*Current landbase parcel locations in blue overlaid on ortho-rectified imagery. This illustration highlights the magnitude of the discrepancy in some parts of the EnergyAustralia supply area.*

While many benefits accrued as a result of this project, the safety of staff and third parties remained the primary driver. The safety of maintenance crews can be dependent upon the quality of information stored on the location of underground assets. The general public also relies upon accurate information from services such as Dial Before You Dig for safe and efficient development of the built environment. Any positional error greater than 0.5 m (1.64 feet) may compromise the safety of staff and the general

public when work is being carried out on, or adjacent to, the electrical network.

Improving the efficiency with which other spatial data can be integrated with the GIS was another key objective for this project. Increasing use of GPS has the potential to significantly improve the efficiency with which network maintenance operations are conducted. However, any gains will be limited by the availability of accurate existing spatial information to which the GPS measurements can be related. There is also an increasing requirement to integrate accurate spatial data from “other” sources and in different formats with the GIS. As EnergyAustralia worked through the data and technology issues, spatial mismatching between datasets emerged as a significant problem.

Increased spatial accuracy will reduce the effort required to relocate assets and minimize the costs associated with engineering design, construction and maintenance. It will also reduce delays in decision making resulting from a lack of confidence in the GIS and minimize legal exposure arising from problems created by spatial inaccuracies.

### **The Cooperative Project**

In 2006, EnergyAustralia initiated a cooperative arrangement with Gosford City Council, Wyong City Council, and LPI NSW to utilize accepted survey methods to perform a spatial adjustment of the Central Coast region. The objective was to improve the accuracy of property boundaries to

less than 3.0 m (9.84 feet) in rural areas and 0.3 m (0.984 foot) in urban areas.

Each one of these agencies held a different part of the source material “puzzle” so it would have been impossible for any one of them to complete this type of undertaking in isolation. Bringing everything together in a project of this scale demanded strong leadership and a unique approach.

EnergyAustralia managed the project, collating available source data and coordinating the efforts of all parties to the agreement. EnergyAustralia funded the spatial adjustment work, which was outsourced to a Melbourne-based company called we-do-IT. LPI NSW contributed source data that included access to the NSW survey control database, high-resolution ortho-rectified digital imagery, and traverse data where available in the area. The local government authorities also provided critical source material, which included the most up-to-date deposited plans and a significant number of “survey accurate” land parcels that had been adjusted during a previous project to upgrade the DCDB.

A critical part of the project has been the development of a relationship between all parties for the maintenance of the DCDB. The rate of growth across the Central Coast, one of the fastest-growing regions in NSW, has long presented a significant problem for the effective maintenance of the DCDB. This project enables each organization to operate under a memorandum of agreement for the sharing of updated information

and allows for the ongoing maintenance of accurate and current spatial information.

## The Adjustment Process



GPS being used to capture the position of a new joint.

When the available source data had been collected and evaluated, EnergyAustralia worked with we-do-IT to develop a process for adjusting the landbase to its new position. This was a four-step process:

### Identification of the Shift Required

Aerial photography, original survey information and GPS control points were used to identify the magnitude of shift required in the DCDB. Ortho-rectified aerial photography, which allowed identification of parcel corners on the landbase and on the imagery, was used to generate vectors describing the required shift. Unfortunately, this technique was not viable in areas with extensive tree cover or poorly marked boundary lines. In these areas, original survey information combined with GPS coordinates for permanent marks was

used. This process required the identification of permanent marks for which accurate coordinates were available and using these to calculate accurate coordinates for vertices on the land parcels.



Shift vectors created from aerial photography.

### Constrain the Shape of the Landbase Parcels

The shift to the landbase was not uniform across the supply area. This variation was due to original mapping scale accuracy limitations, anomalies

in the landbase, and changes in quality and accuracy of survey information. When shifting the landbase there were also specific geometric properties such as right angles that had to be maintained. These were identified and listed as constraints on the adjustment process. By applying constraints, it was possible to maintain the existing shape of the landbase while applying the shift.

### Calculate New Location for the Landbase

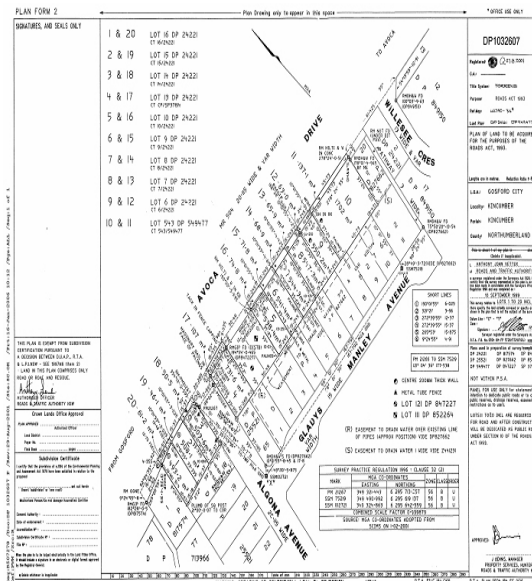
This took into account the shift to be applied and the constraints that had been specified on the shape of the landbase. The shifts have the highest priority, and the constraints have progressively lower priority in the adjustment process. The adjustment process was able to balance these requirements using least squares, which aimed to minimize the impact on the specified constraint while applying the shift.

### Quality Assurance and Quality Checking

The adjustment process produced statistics that could be used to identify shifts that were in error, perhaps due to a mistake in the original capture process, or where a constraint could not be met, for example where the existing landbase was in error.

To date, this project has updated the records relating to the position of the following distribution network assets:

Land parcels updated to a more accurate location – 705,611  
Assets updated to a more accurate location



Using original survey data to generate shift vectors.

Conductors in Total	545,311
HV Cables	38,611
HV Lines	20,806
LV Cables	156,690
LV Lines	326,285
Auxiliary Conductors	2,919
Poles	120,132
Pillars	16,883

## Business Benefits

Improving the accuracy of the EnergyAustralia GIS landbase has delivered a number of significant benefits to the business. The resolution of safety issues was the primary driver for this project, and it is estimated that over a period of five years EnergyAustralia will accumulate a net benefit in excess of \$1 million ( US\$ 0.81 million).



*This portrays the landbase before and after the adjustment process.*

EA accuracy requirements,  $\pm 0.3$  m (0.98 foot) in urban areas and 3 m ( 9.84 foot) in rural areas, have been achieved in areas where the adjustment of landbase and assets has been completed. This has allowed the following improvements in productivity:

- The smooth integration of data from multiple sources. Data sources include CAD files,

ortho-rectified imagery, DPs and GPS.

- Greater efficiency in the management of network assets, including the following functions:
  - Locating underground assets (increasing use of GPS).
  - Engineering Design, Construction, Maintenance, and Outage Management.

The project has reduced costs linked to integration of accurate survey data, minimized legal costs associated with the provision of inaccurate data and simplified the integration of accurately recorded network assets (particularly underground).

Other intangible benefits that have been realized as a result of this project include: -

- Reduced legal exposure for the business
- Increased utility of the EnergyAustralia GIS
- Improved services to internal and external clients
- Improved ability to share data with other organisations
- Utilisation of advanced field recording technologies
- Data not bound to the DCDB and specific application platforms

## Lessons Learned

Local government, utilities, and NSW LPI all have a keen interest in the creation and maintenance of an accurate and up-to-date DCDB. Significant benefits and efficiencies can be accrued through this cooperative approach.

It proved critical that data requirements and availability were determined as early as possible

in the project. Where necessary, plans for the acquisition/creation of additional data must be fully integrated in the overall project plan.

Deposited plans provide the most accurate source of point information, but in rural and semirural areas they are unlikely to provide sufficient density on which to base the spatial adjustment. In most areas it was necessary to rely upon aerial photography to supplement the control network. Be aware that “occupation” rather than legal boundaries may be measured where imagery is used to generate shift vectors.

Under current arrangements, the cooperation of local government is critical in order to maintain an up-to-date cadastre. EnergyAustralia relies upon local government for the maintenance of its proposed cadastral layer in the GIS. Joint endeavours require strong and focused leadership and good communication with all stakeholders.

## Summary

The project has delivered significant benefits in the areas of data capture, information sharing, and service delivery for EnergyAustralia, NSW LPI and the local government Authorities of the Central Coast. There have been real improvements in efficiency that have reduced costs and provided more timely access to asset information that is critical to the operation of the business. However, perhaps the most significant outcome was further improving safety for EnergyAustralia’s maintenance staff and members of the public relying on GIS data.