Draft Report

Inquiry into the State Underground Power Program Cost Benefit Study

1 July 2011

Economic Regulation Authority
WESTERN AUSTRALIA

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Disclaimer

Executive Summary

This is a draft report which provides draft findings on the overall costs and benefits of the State Underground Power Program (**SUPP**). The Authority invites feedback from interested parties on the draft findings by 12 August 2011. This inquiry is being undertaken in response to a request from the Treasurer in April 2010.

The SUPP, which was introduced by the State Government in 1996 following the severe storms that caused widespread damage to the overhead distribution network in Perth in 1994, involves the undergrounding of Western Power's existing overhead distribution cables in selected residential and commercial areas.

This program has been responsible for retrospectively undergrounding around 10 per cent of the electricity distribution network in the Perth metropolitan area. Just over half of the metropolitan area is now serviced by underground power, although this has largely been as a result of the requirement for new subdivisions to have underground power.

The program offers two types of projects:

- Major Residential Projects (**MRPs**), which are concerned with the conversion of overhead distribution lines to underground distribution cables in suburban areas. MRPs account for approximately 96 per cent of the SUPP project costs.
- Localised Enhancement Projects (**LEPs**), which account for the remaining 4 per cent of the SUPP project costs, aim to beautify urban gateways, scenic routes and tourism/heritage centres (particularly in regional towns), through the undergrounding of overhead distribution lines.

As the MRPs account for nearly all of the SUPP project costs, the Authority's draft report has focused on these types of projects. The costs of MRPs are currently recovered from local governments (generally through ratepayers) which contribute 50 per cent, while the State Government (Office of Energy) and Western Power contribute 25 per cent each.

Cost-Benefit Analysis

As requested in the terms of reference, the Authority has undertaken a Cost-Benefit Analysis (**CBA**) of the SUPP. As part of this analysis, the Authority has identified the costs and benefits of the program. Where practical, these costs and benefits have been quantified in dollar terms. The non-quantifiable costs and benefits provide important qualitative information about the SUPP and have been considered by the Authority as part of the analysis.

The Authority's analysis is summarised in Table 1 below. The table lists all of the costs and benefits of the SUPP that have been identified by the Authority, and identifies the groups that have paid for and benefited from the program (ratepayers/local governments, Western Power and the wider Western Australian community). Each of these costs and benefits are explained and discussed briefly in the section following the table. Where possible, the dollar value of the costs and benefits in present value terms[1] is provided in Table 1. As can be seen, it has been estimated that to date the SUPP has resulted in a positive total net present value (**NPV**) in the order of $480 million.

[1] This ensures that all flows of costs and benefits over time are expressed in the same manner in terms of their present value, as they occur at different points in time.

Table 1 Net Present Value of the Major Residential Projects (1996 to 2010)

Costs and Benefits	Ratepayers/local governments ($ million) [a]	Western Power ($ million) [a]	State Government (wider community) ($ million) [a]	Total ($ million) [a]
Quantifiable Costs				
Cost of SUPP projects	142	89	81	312
Total Quantifiable Costs	***142***	***89***	***81***	***312***
Quantifiable Benefits				
Avoided maintenance costs	-	22 to 43	-	**22 to 43**
Benefits to ratepayers captured in higher property values: • Improved amenity value • Improved street lighting	739	-	-	**739**
Reduced vegetation management costs	9*	**	-	**9**
Avoided vehicle collisions with distribution poles	-	**	***13***	***13***
Total Quantifiable Benefits	***749***	***22 to 43***	***13***	***784 to 805***
Net Present Value (Cost) (quantifiable benefits less quantifiable costs)	**606**	**–67 to –47**	**–67**	**472 to 492**
Benefit-Cost Ratio	**5.3**	**0.2 to 0.5**	**0.2**	**2.5 to 2.6**
Qualitative Costs				
Indirect costs	*nq*	*nq*	*nq*	-
Qualitative Benefits				
Improved reliability	*	**	***	-
Improved quality of electricity supply	*	*nq*	*nq*	-
Positive environmental effects	-	-	*nq*	-
Reduced electrical contact injuries	-	-	*nq*	-
Improved amenity value to wider community (non-residents of SUPP areas)	-	-	*nq*	-

Notes: (a) Dollar values are rounded to the nearest million. Totals may not add due to rounding.
nq = not quantifiable
* To the extent that this is a benefit to ratepayers, it is assumed to be largely captured in higher property values.
** These benefits are reflected in Western Power's avoided maintenance costs.
*** The benefit to the wider community includes a reduction in secondary impacts from long outages caused by severe weather events (such as loss of fresh water supply and fresh food).

Source: Authority's analysis and MJA analysis.

It should be noted that the results in Table 1 may not be an accurate prediction of any future net benefits, as the areas that have been part of the SUPP to date have been predominantly in suburbs with high property values, where ratepayers benefit more from SUPP than in areas with lower value properties. This is discussed further in section 6 of the report.

Cost of SUPP Projects

The costs to remove existing overhead lines and the installation of equivalent underground power cables in the Authority's CBA are based on the actual cost of all the SUPP projects that have been completed to date. As can be seen in Table 1, the estimated total cost of the SUPP in present value terms is $312.48 million.

The amounts of these total SUPP costs that have been paid for to date from each of the parties that currently fund the program are:[2]

- Local governments (largely through ratepayers) - $142.49 million (or 45.6 per cent of total costs);
- Western Power - $89.37 million (or 28.6 per cent of total costs); and
- State Government (wider community) - $80.62 million (or 25.8 per cent of total costs).

Avoided Maintenance Costs (to Western Power)

The costs that are avoided by Western Power when power cables are placed underground are associated with reductions in operating and maintenance costs[3] and costs of power outages. These avoided costs have been estimated based on analysis of four recent SUPP projects that have been undertaken by Western Power.

This analysis suggests that the NPV of the avoided cost component to Western Power is between 7 and 14 per cent of the four SUPP project costs.[4] The mean NPV of the avoided costs is estimated at 10 per cent of SUPP project costs. When the range of avoided cost savings is applied to all of the SUPP project costs to date, the quantifiable benefit to Western Power in present value terms is estimated to have been between $22 million and $43 million, as indicated in Table 1.

Benefits to Ratepayers Captured in Higher Property Values

There are a number of benefits to individual ratepayers when power is undergrounded in their area, such as:

- More reliable electricity services as there are fewer outages;
- Better quality of the electricity that is supplied (reduction in lights flickering and electrical appliances being damaged by any fluctuations in the electricity supply);
- Improved amenity value (the visual amenity and streetscapes of suburbs are improved when the poles and wires associated with overhead power are removed and more trees can be planted);

[2] The actual percentage contributions vary from the contribution rates set out in the SUPP for two reasons: the funding contributions in the pilot projects were different (each party funded 1/3 of the costs) and some projects have received additional funding of 15 per cent from Western Power and the State Government, which is available for eligible local governments in low income areas.

[3] These costs include storm repair costs and Western Power's maintenance costs to maintain street scapes and verges where it is Western Power's responsibility to do so.

[4] This was calculated using the following formula: Net benefit to Western Power = maintenance saved (net present value of actual savings to Western Power) + overhead replacement cost (net present value) – written down value of assets replaced.

- Safer street lighting for residents, as the new street lights that are installed are brighter and placed closer together; and
- Reduced vegetation management costs (ratepayers are responsible for ensuring that any trees or plants on their property are kept well clear of any overhead power lines and the costs of this maintenance would be avoided when underground power is installed).

The Authority has assumed that most of these benefits can be captured in the value of the properties that are located in areas with underground power. However, some of the benefits to ratepayers may not be fully captured in property values. For example, all of the benefits of having more reliable electricity services and a better quality of the electricity that is supplied may not be captured in higher house prices, particularly if people are not well informed about the extent of those benefits.

The Authority engaged Marsden Jacob Associates (**MJA**) to examine Perth property prices in suburbs that have participated in the SUPP as well as the suburbs that are still serviced largely by overhead power lines. MJA attempted to establish whether or not property values in areas with underground power are higher, or rose relative to the rest of the property market, because underground power was installed. A copy of MJA's analysis of house prices is available on the Authority's website.

MJA's analysis shows that the installation of retrospective underground power has had a positive and significant effect on property prices, which has on average been greater than the cost of installing underground power. However, the extent to which property prices have increased depended on the value of the property, with high value properties benefiting more from underground power than lower value properties. The analysis indicates that the increased property prices have ranged from $4,840 (for house prices between $300,000 and $499,999) to $29,590 (for house prices greater than $700,000).

MJA estimated that the mean value of underground power to ratepayers, as measured by increased house prices, is $9,962. Based on the mean value of $9,962, the value for all of the properties that have been part of completed SUPP projects to date is approximately $739 million in 2010 (present value terms).

The Authority considers that this is likely to be an underestimate of the benefits that have accrued to ratepayers in the analysis, since there are some qualitative benefits to ratepayers over and above those that have been estimated in dollar value terms through higher property values associated with underground power.

Reduced Vegetation Management Costs

The main benefit of retrospective undergrounding of power to local governments is the reduced tree pruning costs, as it is the responsibility of local governments to maintain vegetation on the land that it owns to make sure that it does not interfere with overhead lines. However, while there may be reduced tree pruning costs in the short term due to the removal of overhead lines, the trees need to be pruned again regardless after a period of time as part of the maintenance of streetscapes by local governments. Based on an annual tree pruning cost of $13.35 per lot over a nine year period, Table 1 shows that the reduced tree pruning cost to local governments in the CBA is estimated to be around $9 million in present value terms.

For the purposes of the Authority's analysis, ratepayers and local governments are treated as the same party in Table 1, as any benefits to local governments are assumed to benefit ratepayers through lower rates or improved services.

Avoided Vehicle Collisions with Power Poles

The Authority has attempted to quantify the benefits to the wider community that are associated with a reduction in vehicle collisions with power poles.

The Authority has estimated that the SUPP has resulted in a reduced number of collisions (around 30 accidents requiring hospitalisation and 55 accidents resulting in property damage have been avoided over a 15 year period). However, there is no information about the severity of the injuries or property damage. To quantify the benefits, the Authority has therefore assumed that one person per accident is hospitalised with severe injuries. The Office of Road Safety has estimated that the cost of a severe injury is $445,000. On this basis, Table 1 shows that the benefit to the wider community associated with fewer people requiring hospitalisation in present value terms is estimated to have been around $13 million since the SUPP was introduced around 15 years ago.

It is likely that this approach has overestimated the avoided injury costs associated with fewer vehicle collisions with power poles. However, any overestimation is likely to have been at least partly offset by the avoided costs of property damage, which have not been quantified.

Indirect (Qualitative) Costs of SUPP

There are some additional costs of underground power, referred to as indirect costs in the CBA, which the Authority has considered. These are the costs associated with:

- Soil erosion when overhead distribution infrastructure is removed and replaced with underground power; and
- The increased exposure to dig-ins when cables are placed underground, but these costs are likely to be at least partially offset by the reduced electrical contact injuries associated with overhead power systems.

As these indirect costs are difficult to measure, they have been listed as qualitative costs in Table 1. The Authority's view is that these costs do not have much of an impact on the overall results of the CBA.

Qualitative Benefits of SUPP

As can be seen in Table 1, many of the benefits arising from retrospective undergrounding of power are qualitative in nature, in particular the benefits that accrue to the wider community. The qualitative benefits that have been considered as part of the Authority's CBA are discussed next.

- Underground power results in more **reliable electricity services** due to fewer outages during normal weather and severe weather events, such as the storms that hit Perth in March 2010. There are qualitative benefits to the wider community to the extent that there is a reduction in secondary impacts (such as loss of fresh water supply and fresh food) from long power outages caused by severe weather events.
- There are **improvements in the quality of electricity supply** when power cables are placed underground. While some of the benefits to ratepayers associated with an improvement in the quality of electricity supplied are captured in higher house prices, the benefits to Western Power and the wider community cannot be quantified.

- Undergrounding existing overhead power cables also has a **positive effect on the environment**, for example through a reduction in the amount of pesticide and herbicide used to protect the power poles and maintain the verges;
- There is likely to be a reduction in **accidental live-wire contact**, which can occur when electricity workers or members of the general public come into contact with overhead cables. It is believed that there is less chance of live-wire contact when cables are placed underground, although there is a potential for people to dig into the underground cables, which offsets some of the benefits.
- One of the key benefits of undergrounding existing overhead power lines is the improved aesthetics, through the removal of poles and wires and the planting of more trees which **improves the visual amenity** and streetscapes of suburbs. While the benefits to ratepayers have been quantified through higher property prices, there is a component of this benefit which is of value to the wider community as well (when they visit areas that have underground power).

Results of the CBA and Distribution of Benefits

As indicated in Table 1, it has been estimated that to date the positive total quantifiable NPV of the SUPP is in the order of $480 million, with a benefit-cost ratio of around 2.5.

While there has been an overall positive NPV of the SUPP to the residents in Western Australia, the taxpayers and Western Power (and in turn Western Power's customers) appear to have contributed funding to the SUPP to a greater extent than they have benefited from it. As ratepayers have on average benefited more from SUPP projects (as indicated by higher property prices in areas with underground power) than they have paid to have it installed, they have been subsidised by taxpayers and Western Power's customers. This could be perceived as particularly inequitable as, for the SUPP program to date, the subsidy has gone largely to suburbs with higher property values, which derive the highest benefits.

The Authority has considered who should pay for the continued retrospective undergrounding of power and how much each party should pay, based on the proportion of benefits that has accrued to each party in the CBA of the SUPP to date. This has been difficult as the Authority has not been able to quantify a number of these benefits. The Authority would welcome any further information in submissions that would assist in the quantification of some of those benefits.

Local Governments (Ratepayers)

The funding contribution from local governments (through ratepayers) should reflect the quantifiable benefits that they receive from underground power through increased property values. Based on the quantifiable benefits to local governments and ratepayers of approximately $749 million in present value terms as a proportion of the total benefits of the SUPP (which ranged from $784 million to $805 million in present value terms), the contribution from local governments (through ratepayers) should be between 90 per cent and 95 per cent. However, after taking into consideration the qualitative benefits to Western Power and the wider community, the Authority's view is that the contribution from ratepayers should be adjusted by reducing the amount that local governments/ratepayers could pay to between 75 and 90 per cent.

Western Power

Western Power should contribute funding equal to the value of its avoided costs. In the Authority's CBA, Western Power's quantifiable avoided costs ranged from $22 million to $43 million in present value terms. In addition to these quantifiable benefits, Western Power receives non-quantifiable benefits from its avoided costs when there is an improvement in the quality of the electricity that is supplied. Based on the total benefits to Western Power, as a proportion of the total benefits of the SUPP ($784 million to $805 million), Western Power's contribution could be between 5 and 15 per cent. Western Power should ideally determine the costs that are avoided when underground power is installed in a particular area, to determine how much it should contribute to the total costs of each project on a project by project basis.

State Government (Wider Community)

The State Government's funding contribution should be based on the benefits to the wider community. Based on the quantifiable benefits of approximately $13 million in present value terms as a proportion of the total benefits of the SUPP, which ranged from $784 million to $805 million in present value terms, and the qualitative benefits to the wider community, the State Government contribution could be somewhere between 5 and 10 per cent.

This proposed share of funding is consistent with previous findings by the Independent Pricing and Regulatory Tribunal of New South Wales and the Putting Cables Underground Working Group. They found that the quantifiable benefits to the wider community were modest and that any funding from State Governments should reflect this.

The existing funding shares of the SUPP and the Authority's proposed contribution shares are summarised in Table 2.

Table 2 Existing and Proposed Funding Shares for Retrospective Underground Power

	Local Governments/Ratepayers	Western Power	State Government (Wider Community)
Existing funding shares	50	25	25
Authority's proposed funding shares	75-90	5-15	5-10

Implementation

The Authority's view is that the State Government may no longer be required to deliver a retrospective underground power program such as the SUPP. Local governments would ideally be able to purchase underground power directly from Western Power on behalf of ratepayers. Western Power would still contribute funding that reflects the benefits received. The State Government's contribution to the total costs per annum would reduce the amount that ratepayers would have to pay and could be provided to Western Power as an annual subsidy payment in the absence of a formal government program.

Western Power's Underground Power Program Team already provides underground power services to local governments on behalf of its residents outside of the SUPP and the Authority believes that this service could be expanded if the SUPP was to finish.

The Authority is particularly interested in feedback on whether or not the State Government should continue to deliver this program.

In regard to the Authority's view that ratepayers should fund a greater proportion of the costs to have underground power installed than they currently do, an inequity is created between those who have already received a substantial financial contribution from the State Government to retrospectively underground power in their area and those that are yet to do so.

This inequity is amplified since the State Government has so far subsidised the installation of underground power in some of Perth's wealthiest suburbs (on average).[5] Consequently, there may be equity grounds for the State Government to continue its funding contribution at a higher level than the proposed 5 to 10 per cent, in particular for project areas in low-value suburbs, as long as the majority of the ratepayers in a project area are willing to pay for their share of the costs.

In other words, since the benefits of the SUPP to ratepayers depend on property values (with high value properties benefiting more than lower value properties) and given that many of the remaining areas with overhead power lines are in lower value suburbs, it may be equitable for any State Government contributions in the future to be directed towards lower value suburbs.

While the Authority was not requested to consider equity issues in the terms of reference, it recognises that there are inequities associated with the current program as well as with some of the draft findings in this report. These equity issues will need to be considered by the State Government as part of its broader review into the future of the SUPP.

Inquiry Process

The Authority published an issues paper in June 2010. The submissions on the issues paper have helped to formulate these draft recommendations. The Authority now welcomes a further round of submissions on the draft recommendations, with submissions due by 12 August 2011. The final report will be delivered to the Treasurer by 30 September 2011 and the Treasurer will, in accordance with the *Economic Regulation Authority Act 2003*, have 28 days to table the report in Parliament.

[5] Based on 2006 Census data from the Australian Bureau of Statistics, 31 per cent of households in suburbs that have participated in the SUPP were classified as high income households (with weekly wages above $2,500). In comparison, only 15 per cent of households in all of the Perth metro area were classified as high income households. Of the 33 suburbs that have been participants of the SUPP and included in the Census income data, 27 suburbs had a larger proportion of high income households compared to the Perth metro average (of 15 per cent), with many of these suburbs consisting of between 30 per cent to 65 per cent of high income households.

Summary of Draft Findings

Costs of Underground Power

1) There are two types of costs associated with retrospective underground power:
   - the upfront costs of removing overhead distribution infrastructure and all of the direct costs to place the infrastructure underground; and
   - the indirect costs of any negative effects when the infrastructure is placed underground, such as soil erosion or accidents when people dig into underground cables.
2) To the extent that it is possible, the optimised approach to retrospective undergrounding of power (where the overall network design is examined and replaced with a new, redesigned underground network with an aim to 'optimise' the network) should be adopted by Western Power, which should continue to fund any major improvements to the network during the installation of underground power.

Benefits of Retrospective Undergrounding of Power

Benefits to Western Power

3) There are quantifiable benefits to Western Power associated with the retrospective undergrounding of power through avoided operating and planned and unplanned maintenance costs. These avoided costs include lower vegetation management and storm repair costs for Western Power.
4) The avoided maintenance and network upgrade costs to Western Power that are associated with supply quality improvements when distribution infrastructure is placed underground have not been quantified.

Benefits to Local Governments

5) There is a short term, quantifiable benefit to local governments as a result of a reduction in tree pruning costs when overhead power lines are replaced with underground power.

Benefits to Property Owners (Ratepayers)

6) The SUPP has resulted in reliability improvements, due to the lower number of outages that affect electricity customers living in suburbs with underground power.
7) The benefits associated with the lower number of outages affecting electricity customers do not appear to be offset by the costs imposed by a longer duration of outages.
8) Retrospective undergrounding of power is likely to improve the quality of the electricity supply to customers, although quality improvements vary significantly between areas.
9) Property owners benefit from an improved amenity value when existing overhead distribution lines are placed underground.
10) There is a short term benefit to property owners as a result of a reduction in their own tree pruning costs when overhead power lines are replaced with underground power.
11) Residents will benefit from safer local communities due to the installation of new street lights when power poles are removed.
12) Most of the benefits that accrue to property owners are assumed to be capitalised into higher property values.

13) There is a difference in the value of underground power between properties depending on the value of the property. The Authority's analysis indicates that owners of high value properties benefit more from the SUPP program than owners of properties of lesser value.

Benefits to the Wider Community

14) There is a benefit to the wider community when overhead power lines are placed underground, through:

- improved energy security during severe weather events, including a reduction in secondary impacts on the provision of essential services;
- improved amenity values to non-residents of SUPP areas;
- avoided costs to the community as a result of fewer vehicle accidents when underground power is installed; and
- reduced environmental impacts.

Cost Benefit Analysis of the State Underground Power Program

15) The provision of retrospective underground power services has public good characteristics in that it is not possible to supply this service to an individual. Collective action by a group is required to purchase retrospective underground power in the absence of Government intervention.

16) There are no alternatives that would result in the same benefits as the retrospective undergrounding of power.

17) In cost-benefit terms, the total quantifiable net present value of the SUPP to Western Australia has been between $472 and $492 million to date, with a benefit-cost ratio of around 2.5.

18) Most of the benefits associated with the SUPP have accrued to ratepayers as measured through higher property values.

Distribution of Benefits

19) There may no longer be a need for the State Government to be involved in the delivery of retrospective underground power, as local governments should ideally be able to purchase this service directly from Western Power.

20) The amount that each of the beneficiaries are asked to contribute to recover the costs of retrospective underground power should ideally be based on the cost for each project, as the costs and benefits are likely to vary for each project area.

21) The costs of retrospective underground power should be recovered from the following beneficiaries, based on the proportion of quantifiable and qualitative benefits that they each receive:

- Local governments (through ratepayers) could contribute between 75 and 90 per cent;
- Western Power could contribute between 5 and 15 per cent, depending on its avoided costs when a particular project area is undergrounded; and
- The State Government could contribute between 5 and 10 per cent.

Equity Issues

22) The current funding arrangement of SUPP projects has resulted in some inequities. As ratepayers have on average benefited more from SUPP projects than they have paid to install underground power retrospectively, ratepayers have been subsidised

by taxpayers and Western Power customers, who have paid more than they have benefited from SUPP projects.

23) Any future funding arrangements should minimise the extent to which one group of beneficiaries subsidises another.

24) It may be equitable for any future State Government contributions to continue at a higher level than the proposed 5 to 10 per cent if the subsidy is directed towards areas with lower property values. However, projects should only proceed if ratepayers are willing to pay their share (after taking into account any Government contributions).

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1 Introduction

On 23 April 2010, the Treasurer of Western Australia gave written notice to the Economic Regulation Authority (**the Authority**) to undertake an inquiry into the overall costs and benefits of the State Underground Power Program (**SUPP**). The cost benefit study is limited to the undergrounding of power in the South West Interconnected System.

The inquiry has been referred to the Authority under section 32(1) of the *Economic Regulation Authority Act 2003*, which provides for the Treasurer to refer to the Authority inquiries on matters related to regulated industries (gas, electricity, rail and water).

1.1 Terms of Reference

The terms of reference for the inquiry, which are presented in **Appendix A**, require the Authority to have regard to the following:

- The costs of undergrounding the overhead electricity network.
- A comparison of the costs associated with maintaining the current distribution network compared to undergrounding.
- The types of costs which are avoided as a result of undergrounding the overhead electrical distribution system.
- Identification and quantification (where possible) of all costs and benefits of underground power.
- An analysis of the distribution and timing of benefits, including an appraisal of who benefits and the overall public benefit to the wider community.

In particular, the Authority is to report on what the appropriate share of funding is between the State Government (representing the broad community benefits), the individual households (representing private and local community benefits) and the Network Operator (representing network benefits).

In undertaking the inquiry, the Authority recognises section 26 of the *Economic Regulation Authority Act 2003*, which requires the Authority to have regard to:

- the need to promote regulatory outcomes that are in the public interest;
- the long-term interests of consumers in relation to the price, quality and reliability of goods and services provided in relevant markets;
- the need to encourage investment in relevant markets;
- the legitimate business interests of investors and service providers in relevant markets;
- the need to promote competitive and fair market conduct;
- the need to prevent abuse of monopoly or market power; and
- the need to promote transparent decision making processes that involve public consultation.

The Treasurer has amended the reference twice to extend the due date for the delivery of the final report from 23 April 2011 to 30 September 2011.

1.2 Background to the Inquiry

The SUPP was established by the State Government in 1996, following the severe storms that caused widespread damage to the overhead distribution network in Perth in 1994. Since the program began to replace existing overhead distribution lines with underground cables, 68 projects have been completed and, together with the requirement for new subdivisions to have underground power, just over 50 per cent of the metropolitan area is now serviced by underground power. This is largely as a result of the underground power that has been installed in new subdivisions, which has accounted for approximately 40 per cent of the distribution network being underground.

A fourth round of projects is currently underway and the round five projects were announced by the Minister for Energy in December 2010. The Office of Energy (**OoE**) is carrying out a major public review of the SUPP before the State Government commits to any further funding for the SUPP beyond round five. As part of this review process, the Minister for Energy sought and obtained the Treasurer's agreement to refer an inquiry to the Authority to undertake an independent cost benefit study of the SUPP.

This broader review by the OoE will investigate anticipated costs for future rounds of the program, identify priorities for undergrounding of power with respect to extreme weather events, and improve the equity and affordability of the SUPP.

1.3 Review Process

The recommendations of this inquiry will be informed by the following public consultation process:

- The Authority published an issues paper on the inquiry on 28 June 2010 and invited submissions from stakeholder groups, industry, government and the general community on the matters in the terms of reference. The due date for submissions was 6 August 2010.
- 16 submissions were received in response to the issues paper, which are published on the Authority's web site.
- The Authority has consulted with its Consumer Consultative Committee (**ERACCC**), and will be consulting further with the ERACCC over the course of the inquiry.
- Following consideration of submissions, the Authority has developed a draft set of recommendations, presented in this draft report. Public submissions on the draft report are invited by 12 August 2011 (see section 1.4 below on how to make a submission).
- The final report for the inquiry is to be delivered to the Treasurer by 30 September 2011 and the Treasurer will, in accordance with the Act, have 28 days to table the report in Parliament.

In accordance with section 45 of the Act, the Authority will act through the Chairman and members in conducting this inquiry.

1.4 How to Make a Submission

Submissions on any matter raised in this draft report or in response to any matters in the Terms of Reference should be in both written and electronic form (where possible) and addressed to:

Inquiry into State Underground Power Program Cost Benefit Study
Economic Regulation Authority
PO Box 8469
Perth Business Centre
PERTH WA 6849

Email: publicsubmissions@erawa.com.au
Fax: (08) 9213 1999

Submissions must be received by 12 August 2011.

Submissions made to the Authority will be treated as in the public domain and placed on the Authority's website unless confidentiality is claimed. The submission or parts of the submission in relation to which confidentiality is claimed should be clearly marked. Any claim of confidentiality will be dealt with in the same way as is provided for in section 55 of the *Economic Regulation Authority Act 2003*.

The receipt and publication of a submission shall not be taken as indicating that the Authority has knowledge either actual or constructive of the contents of a particular submission and, in particular, where the submission in whole or part contains information of a confidential nature and no duty of confidence will arise for the Authority in these circumstances.

Further information regarding this inquiry can be obtained from:

Sara Procter
Assistant Director
References & Research
Economic Regulation Authority
Ph: (08) 9213 1900

Media enquiries should be directed to:

Greg Watkinson
Chief Executive Officer
Economic Regulation Authority
Ph: (08) 9213 1900

2 Overview of the State Underground Power Program and Summary of Underground Power in the Eastern States and Overseas

The SUPP, which was introduced by the State Government in 1996, involves the undergrounding of Western Power's existing overhead distribution lines in residential and commercial areas. A group within Western Power, the Underground Power Program Team (**UPPT**), coordinates project implementation on behalf of the Underground Power Steering Committee (**Committee**).[6] This Committee, which is responsible for the management of the SUPP, includes representatives from the OoE, Western Power and the Western Australian Local Government Association. An independent probity auditor also provides advice to the Committee and ensures that all of its processes are transparent and equitable.

The program offers two types of projects:

- Major Residential Projects (**MRPs**) are concerned with the conversion of overhead distribution lines to underground distribution cables operating at 33,000 volts or less in suburban areas, with the key aim to improve electricity reliability. MRPs account for approximately 96 per cent of the SUPP project costs.
- Localised Enhancement Projects (**LEPs**), which account for the remaining four per cent of the SUPP project costs, aim to beautify urban gateways, scenic routes and tourism/heritage centres (particularly in regional towns), through the undergrounding of overhead distribution lines.

As the MRPs account for nearly all of the SUPP project costs, the Authority's draft report has focused on these types of projects.

2.1 Objectives of Major Residential Projects

The SUPP was established to improve the standard of electricity supplied to households. More specifically, the goals of the MRPs were to improve:

- the energy security of Western Australia's electricity distribution system; and
- the standard of electricity supply to consumers by addressing reliability issues in areas with existing overhead power lines.

However, new objectives were adopted in the early 2000s, which are to achieve:

- Efficient retrospective installation of underground power, contributing to improved energy security of the electricity distribution system, system reliability and cost savings in terms of maintenance and reduced distribution losses.
- Significant contributions to local communities, including enhanced streetscapes and visual amenity of public places, improved property values and improved safety.[7]

[6] Underground Power Steering Committee, October 2009, *Underground Power Program: Major Residential Projects Round Five Guidelines*, p2.

[7] Underground Power Steering Committee, October 2009, *Underground Power Program: Major Residential Projects Round Five Guidelines*, p2.

2.1.1 Submissions on Program Objectives

The Western Australian Local Government Association (**WALGA**) submitted that there have been major changes in State Government energy and environmental policies since the SUPP was established in 1996. As a result, WALGA recommended that the objectives of the SUPP should be re-examined within the broader State Government policies including energy and environmental policy objectives.[8] WALGA suggested that the Authority should also evaluate the implications to the overall SUPP and its objectives of broadening the scope of the program to include the outer suburbs (e.g. those in the Darling Range) and the undergrounding of electricity distribution infrastructure to accommodate road expansion and upgrade works.[9]

2.2 Achievements of the SUPP

The Government of Western Australia set a long-term goal in 1996 to have at least half the houses in Perth supplied by underground power by 2010, which was achieved in January 2010. This has in part been due to the program but more so as a result of a planning requirement that all new residential subdivisions since 1992 must have underground power.

Since the SUPP began in 1996, 68 projects have been completed, providing underground distribution systems to over 76,000 properties. To date, 39 MRPs and 29 LEPs have been completed at a cost of approximately $312 million in present value terms.

Three rounds of SUPP projects, and a round of pilot projects, have been completed so far, with the fourth round of projects currently under way. These projects are listed in **Appendix B**. The following short listed round five MRPs, valued at more than $77 million, were announced by the Minister for Energy in December 2010:

- Wilson East (City of Canning)
- Coolbellup East (City of Cockburn)
- Hamilton Hill (City of Cockburn)
- Ardross West (City of Melville)
- Shoalwater (City of Rockingham)
- Salter Point (City of South Perth)
- Coolbinia (City of Stirling)
- Ashfield (Town of Bassendean)
- Lathlain North (Town of Victoria Park)
- Lathlain South (Town of Victoria Park)

These ten MRPs will provide underground power to an additional 8,200 households in Perth.

[8] WALGA's submission on the Issues Paper, p1.

[9] Ibid, p10.

2.3 Existing Funding Arrangement

The SUPP is currently funded from a number of sources, based on a beneficiary pays system (where costs are recovered from the parties that benefit from underground power). The existing funding arrangement is based on a mixed funding approach and government involvement. Since 1999-2000, the MRPs have been funded 50 per cent by local governments (generally through levies on ratepayers), 25 per cent by the State Government (OoE) and 25 per cent by Western Power. The funding arrangement for the pilot projects saw equal sharing of the costs, with local governments, the State Government and Western Power paying one third each.

The program does not specify to local governments how they fund their share of the costs, but local governments often pass on the costs to ratepayers in each project area, after surveying ratepayers' willingness to pay. Most local governments base the charges to ratepayers on the gross rental value of a property, which means that ratepayers in the same area pay different amounts for a SUPP project.

Additional funding of 15 per cent from the State Government is available for eligible local governments in low income areas, as defined by the Socio Economic Index for Areas developed by the Australian Bureau of Statistics (**ABS**),[10] which reduces the amount local governments have to pay to 35 per cent of the total cost of a project.

The funding arrangement for LEPs is different, with a maximum of 50 per cent being funded by Western Power and the State Government, up to an amount of $250,000 per LEP. This dollar cap means that the local governments often fund more than 50 per cent of the LEPs. Approximately 4 per cent of the annual SUPP budget of $20 million is spent on the LEPs.

The State Government and Western Power currently contribute about $5 million each year to the SUPP, with local governments contributing around $10 million a year. Western Power manages the payment schedule process between the various parties to a project agreement. The agreed payments from the Government are made twice a year via the OoE, and each month Western Power provides updated information on the draw-downs on the funds it holds on behalf of the State Government. Payments from the participating local governments to Western Power are made more frequently in accordance with the agreements for each project.

In the 2011-12 State Budget, which was released on 19 May 2011, the funding for the SUPP from the State Government and Western Power was doubled to approximately $10 million from each in 2011-12 and 2012-13, and the contribution from local governments will increase from around $10 million to almost $20 million per year in those years as well. This reflects the overlap of round four and five of the SUPP (round four is expected to be completed in 2011-12 and round five is expected to commence in 2011).

2.4 Retrospective Undergrounding of Power in Other Jurisdictions and Countries

Some level of retrospective undergrounding of power occurs in other Australian jurisdictions, although the Northern Territory is the only other jurisdiction that has a large scale government program to underground power in residential areas.

[10] Australian Bureau of Statistics, 2006, *2039.0 - Information Paper: An Introduction to Socio-Economic Indexes for Areas (SEIFA)*.

In New South Wales, a large part of the distribution network has been undergrounded by the distribution network service providers (**DNSPs**), as it is often a requirement by local governments that new urban developments have underground power. DNSPs or other parties can also initiate underground power projects in areas with existing overhead distribution lines. For example, a DNSP may initiate an underground power project in an area where the supply reliability is below an acceptable standard. If a third party initiates a project, the DNSP may either share the costs or require the third party to pay for all of it. This depends on the amount of benefits that the DNSP would acquire from the undergrounding project, such as improved reliability and reduced maintenance costs.[11]

Victoria does not have a formal government program for undergrounding power in residential areas, although local governments tend to initiate projects for undergrounding of distribution lines for main roads and public spaces to benefit the local community. In most of these cases, local governments charge their ratepayers some or all of the costs associated with an undergrounding project. A Powerline Relocation Scheme has been in place in Victoria since 1995, where the Victorian Government funds up to 50 per cent of the cost of undergrounding powerlines in places of high traffic or pedestrian activity for visual amenity reasons.[12]

The Victorian Bushfire Royal Commission's final recommendations, which were released on 31 July 2010, included the following recommendation in relation to electricity-caused fires:

> The State amend the Regulations under Victoria's *Electricity Safety Act 1998* and otherwise take such steps as may be required to give effect to the following:
>
> - the progressive replacement of all SWER (single-wire earth return) power lines in Victoria with aerial bundled cable[13], underground cabling or other technology that delivers greatly reduced bushfire risk. The replacement program should be completed in the areas of highest bushfire risk within 10 years and should continue in areas of lower bushfire risk as the lines reach the end of their engineering lives; and
> - the progressive replacement of all 22-kilovolt distribution feeders with aerial bundled cable, underground cabling or other technology that delivers greatly reduced bushfire risk as the feeders reach the end of their engineering lives. Priority should be given to distribution feeders in the areas of highest bushfire risk.[14]

It is understood that the Victorian Government is still considering this recommendation.

In Queensland, as in most other jurisdictions, local governments require that powerlines for new residential subdivisions be placed underground. The developer pays the additional costs associated with undergrounding, which is then passed on to the people who purchase a block of land.

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[11] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy*, p3.

[12] Department of Primary Industries (Victoria), *Powerline Relocation: An Assistance Scheme for Local Areas*, p3.

[13] A SWER line is a single conductor that may stretch for tens or even hundreds of kilometres, with a number of distribution transformers along its length. At each transformer, such as a customer's premises, current flows from the line, through the primary coil of a step-down transformer, to earth through an earth stake. From the earth stake, the current eventually finds its way back to the main step-down transformer at the head of the line, completing the circuit. Aerial bundled cables are overhead power lines using several insulated phase conductors bundled tightly together, usually with a bare neutral conductor. This contrasts with the traditional practice of using uninsulated conductors separated by air gaps.

[14] 2009 Victorian Bushfires Royal Commission, July 2010, *Final Report Recommendations*.

South Australia does not have a formal government program for undergrounding power in residential areas, but a Power Line Environment Committee was established in 1990 to assess submissions from local governments for funding projects to underground power lines. These projects mostly involve the undergrounding of power in areas of high public use, such as city centres, high traffic areas and popular tourist locations. The current funding arrangements are for ETSA Utilities to fund two thirds of the cost of an undergrounding project, and the local council that is directly affected by the undergrounding work to fund the remaining one third. ETSA Utilities recovers its costs through its distribution tariffs that are charged to all of its electricity customers.[15]

As mentioned above, the Northern Territory has a government program in place to replace existing overhead distribution lines with underground cables in urban residential areas of Darwin (approximately 9,000 properties). It is expected that it will take another 20 years or so before this program is completed. The Northern Territory Government funds the majority of the costs, with Power and Water (the publicly owned electricity and water utility) and other participating service providers funding the remainder on a commercial basis (based on savings from the reduced maintenance costs to the service providers). All the urban residential areas in Darwin that have been developed since the late 1970s have underground power. As a result of this policy and the underground power program, around half of Darwin customers are now supplied by underground power.

There are no large scale, formal government undergrounding programs in Tasmania or the Australian Capital Territory. However, it is understood that a review is currently underway to examine whether or not the existing overhead lines should be replaced with underground cables in Canberra.

2.4.1 Europe

In 2003, the Commission of the European Communities undertook a review of the situation of undergrounding overhead electricity lines in Europe and investigated the possibilities for proposing a co-ordinated new action in this regard. In regard to low voltage and medium voltage networks, most of the countries in the European Union had placed more than two thirds of their networks underground by 2003, while the other countries had placed at least 15 per cent of their networks underground. [16]

The Netherlands, which concluded in the 1970s that underground power would solve many of the then problems with the electricity networks, such as reliability and limited space, has undergrounded all of its low and medium voltage networks. Since the 1970s, various developments in the manufacturing of cables and their accessories combined with more efficient installation methods have resulted in significantly reduced construction costs of underground power in the Netherlands. However, underground cables were still more expensive than the equivalent overhead lines.[17]

In France, where storms in 1999 destroyed significant parts of the electricity system causing many blackouts, a new policy was implemented to underground significant parts of the French electricity system to secure supply availability under adverse weather conditions.[18] In the United Kingdom, where the electricity distribution system is similar to

[15] Essential Services Commission of South Australia, January 2001, *Approach to Electricity Undergrounding from 2005 – Final Report*, p1.

[16] Commission of the European Communities, December 2003, *Background Paper: Undergrounding of Electricity Lines in Europe*, p4.

[17] Ibid, p3.

[18] Ibid, p3.

Australian distribution systems, 81 per cent of low and medium voltage networks had been undergrounded by 2003.[19]

2.4.2 United States

In the United States, electricity distribution utilities provide underground power to nearly all new residential and commercial developments, and it is often an option that is offered to new stand-alone customers. Utilities recover the costs of undergrounding through incorporating the cost into the electricity tariffs or by charging a connection fee for underground power.[20]

In regard to retrospective undergrounding of power, all of the utilities surveyed by the Edison Electric Institute have policies and procedures for retrospective undergrounding. In most cases the utilities charge a fee to customers for the replacement of the overhead infrastructure with underground infrastructure. These charges are often equal to the cost of installing the underground power plus the cost of removing the overhead infrastructure, minus the salvage value of the removed infrastructure. In most cases, customers are also responsible for the work and costs to connect to the underground power network.

Some electricity utilities also have special policies for underground power requests from local governments. In high density urban areas where electrical load is high, utilities and local governments may work together to offset some of the costs of the undergrounding (with the local government providing land and space for underground power infrastructure, as well as undertaking some of the work associated with placing cables underground).[21]

[19] Ibid, p4.

[20] Edison Electric Institute, December 2009, *Out of Sight, Out of Mind Revisited: An Updated Study on the Undergrounding of Overhead Power Lines*, p29.

[21] Ibid, pp29-30.

3 What is Cost-Benefit Analysis?

Cost- benefit analysis (**CBA**) is a decision making tool, which is often used by governments to determine whether or not regulation is warranted, as well as to assess whether or not particular projects or programs should be funded.

CBA compares the costs and benefits of a project, program, decision or a regulation, in money terms where possible (quantitative information). Costs and benefits are valued from the perspective of the society as a whole rather than a particular person or group. Where costs and benefits cannot be valued in money terms, it is still necessary to consider these as part of the analysis (qualitative information).

The quantitative costs and benefits are generally adjusted for the time value of money,[22] to ensure that all flows of benefits and costs over time are expressed in the same manner in terms of their present value (costs are often incurred upfront while the benefits tend to accrue over time).

CBA is not the only tool available for evaluation of government activities, and should not replace common sense. Additionally, it is not without its limitations. For example, it does not readily take equity or distribution of costs and benefits into account, which could be key drivers of government programs. Nevertheless, it is a powerful piece of information in any evaluation process.

The need for government involvement in the market should generally only occur as a result of a market failure, such as the need to provide goods or services with public good characteristics, or when the consumption of goods and services has an impact on a third party (an externality) which requires regulation. Identification of a market failure is a key step in conducting a CBA of a government project or program.

- The characteristics of a public good are that it is not possible to exclude individuals from the consumption of these goods, and the use of those goods by one person does not prevent others from using them. One of the most commonly cited examples of a public good is national defence, which is a good consumed by all Australians from which no-one can be excluded and one person‘s consumption of it does not reduce another‘s.
  - Public goods can also have benefits that are limited to a local population. For example, the improved aesthetics of a suburb following the undergrounding of overhead power lines and removal of power poles have local public good characteristics because they are mainly of benefit to the local community.
- An externality exists whenever the decision of one party impact on the well-being of a third party and these can be either positive or negative. For example, underground power improves the well-being of the wider community to some extent through greater public amenity value and a reduction in motor vehicle accidents involving power poles.[23]

[22] As long as interest rates are positive, the time value of money adjusts for the fact that a dollar today is worth more than a dollar in the future.

[23] An example of a negative externality is traffic congestion where one person‘s decision to use a road can impact on the time it takes another person to complete a journey.

– Sometimes externalities can be internalised by requiring the decision maker to take into account the impacts on third parties when they make their decision.[24]

3.1 Authority's Cost-Benefit Analysis of the SUPP

The remainder of this report is concerned with the Authority's CBA of the SUPP and how the CBA results will establish what the appropriate funding arrangement should be to recover the costs of the SUPP or any other future retrospective undergrounding of distribution electricity cables. The focus of the CBA is on the MRPs, as these are the key focus of the SUPP.

In section 4, the Authority considers what the direct and indirect costs of retrospective underground power are for the Perth metropolitan area. This includes an examination of the current selection and evaluation processes for SUPP projects.

This is followed by a discussion of the benefits of retrospective underground power that accrue to different groups, or beneficiaries, in section 5. For example, the terms of reference suggested that the SUPP has provided benefits to Western Power, individual ratepayers and the wider community.

The costs and benefits that are found to be relevant to the SUPP are then combined in the Authority's CBA of the program to date in section 6, to establish what the Net Present Value (**NPV**) or Net Present Cost (**NPC**) of the SUPP has been. In addition, the Authority will estimate what the NPV or NPC has been for each of the beneficiaries that are identified in section 5.

[24] The point of internalising an externality is to make sure that efficient decisions are made. Unless positive externalities are taken into account prices may be set too high, with the result that fewer goods and services are produced and sold than is optimal. Conversely, ignoring negative externalities can lead to over-production or over-consumption

4 Costs of Retrospective Undergrounding of Power

The terms of reference for the inquiry require the Authority to have regard to:

- The costs of undergrounding the overhead electricity distribution network, including the impact on costs of the current process for selecting and assessing projects.
- A comparison of the costs associated with maintaining the current distribution network compared to undergrounding.

4.1 Background

There are two types of costs associated with retrospective undergrounding of power:

- the upfront costs of removing overhead cables and all of the direct costs to place cables underground; and
- the costs of any negative impacts that arise when cables are placed underground.

These different costs, and feedback from stakeholders about these costs, are discussed in sections 4.2 and 4.3.

Halcrow Pacific Pty Ltd (**Halcrow**), who was engaged by the Authority to provide technical advice, has considered the costs of the SUPP. As part of its review, Halcrow undertook a detailed review of the Como East SUPP project budget to determine the appropriateness of the costs that were included. Halcrow also considered Western Power's maintenance costs for overhead power lines and underground cables, based on information provided by Western Power.

In the issues paper, the Authority outlined the evaluation and selection processes for major residential projects and localised enhancement projects. The Authority sought feedback from stakeholders on the existing evaluation and selection processes, in particular comments on whether or not they have an impact on the cost of the SUPP projects. These processes are summarised and discussed in section 4.5 below.

4.2 Upfront Costs of Underground Power

This section considers the upfront costs of underground power, which are:

- Removal of existing overhead infrastructure (poles, cables etc);
- Boring[25] or trenching[26];
- Installation (labour) and materials;
- Service connections to residences;
- Reinstatement of lawns, footpaths etc;

[25] Directional boring is a steerable trenchless method of installing underground pipes, conduits and cables in a shallow arc along a prescribed bore path by using a surface launched drilling rig, with minimal impact on the surrounding area.

[26] Trenching involves a narrow, deep trench in which cables are direct buried relying on the burial depth for protection.

- Installation of new streetlights; and
- Transformers and other underground power related infrastructure.

The largest upfront cost of undergrounding is the removal of existing overhead infrastructure and installation of equivalent underground infrastructure. Western Power uses a direct burial system to place power cables underground, mostly through trenching, although in some areas boring has been used. The other costs listed above, such as the costs of service connections to residences, can also be substantial in some cases.

The construction of underground distribution systems tends to be more expensive than overhead distribution systems. In the US, cost data for electricity utilities indicates that the cost of underground construction can be five to ten times more expensive than overhead construction.[27]

Western Power has provided a comparison of the estimated costs of installing a new overhead distribution system versus a new underground distribution system in Bentley East (part of round four of the SUPP). It is estimated that it would cost approximately $8.2 million to replace the existing overhead distribution system with an underground distribution system, compared with around $6 million to replace the existing overhead distribution system with a new overhead distribution system. This suggests a much smaller cost differential between overhead and underground systems than what was indicated by cost data for electricity utilities in the US.

4.2.1 SUPP Costs

The two largest cost components associated with undergrounding distribution lines as part of the SUPP are contract labour costs and the cost of materials. Another cost included in the SUPP project costs is project management costs, which represent approximately 10 per cent of the annual project costs (which are currently $20 million). This includes funding for the underground power project team in Western Power and the Executive Officer of the steering committee in the Office of Energy.

Contract labour costs make up approximately 55 per cent of all underground power project costs. The actual undergrounding of cables is undertaken by private contractors, who are selected through a competitive tendering process undertaken by the UPPT. Contracts are developed on a fixed price basis, using a schedule of rates. In addition to the drilling and trenching for street services and house services, contractors are employed to undertake interface works, demolition works and install street lights. This can be undertaken by the same contractor or by other contractors, depending on the tendered prices for the different parts of the projects. The contractors are selected at the beginning of each round of projects.

Labour contract prices may be impacted by the availability of skilled labour, especially jointers[28], the hardness and geology of the ground, and other complicating factors, such as traffic management (which can extend the duration of a contract).

The cost of materials makes up the remaining 35 per cent of all underground power project costs. Western Power purchases and supplies all of the materials for the underground power projects, including the underground power cables, transformers, switchgear and standard street lights. This aims to achieve economies of scale in

[27] Edison Electrical Institute, December 2009, *Out of Sight, Out of Mind Revisited: An Updated Study on the Undergrounding of Overhead Power Lines*, p25.

[28] Jointers join insulated electric power cables installed in underground conduits and trenches and prepare cable terminations for connection to electrical equipment and overhead lines.

purchasing, which is one of the advantages of Western Power undertaking the projects instead of local governments.

Currently, only Western Power's transmission network telecommunication cables are included in the project cost if these are co-located with the overhead distribution cables. No other cables, such as Telstra cables, are included in the SUPP project costs. However, the rollout of the Australian Government's National Broadband Network (**NBN**) could have implications for the delivery of SUPP projects in the future. Western Power is having discussions with NBNCo, the company which is responsible for the roll out of the NBN, regarding the possible co-location of underground power cables and NBN infrastructure.

To assist ongoing discussions with NBNCo, Western Power is developing a cost model to include NBNCo's telecommunications 'pipe and pits' (underground ducting) as part of SUPP. A preliminary review with the SUPP contractors indicates potential 'pipe and pit' installation costs savings of between 20 to 50 per cent for key work categories. This presents an opportunity to share the benefits with NBNCo and reduce the SUPP costs.

NBNCo's design and material supply capability are key issues that need resolving as they will affect the cost and schedule of undergrounding cables. Achieving seamless integration of NBNCo work into SUPP is critical to leveraging off this opportunity, based on Western Power's previous experience with co-location of telecommunications assets (i.e. Western Power's subsidiary Bright Communications).

The Town of Bassendean is pursuing rollout of NBNCo with SUPP for the round five Ashfield Project (starting in early 2012). However, NBNCo has indicated that it would like to trial the co-location with the earlier round five Lathlain project.[29]

No other costs to Western Power are currently included in the costs of underground power, such as the costs associated with the early retirement of overhead network assets, prior to their effective expiry lives, although the SUPP selection process does allow focus on areas near retirement with the greatest power reliability and quality problems. However, the cost of existing assets and any reduction in their value is not relevant to a forward-looking CBA.

As outlined in the issues paper, all of the SUPP costs vary from project to project depending on residential density, block frontage, ground conditions, traffic management requirements (and in some cases street or verge topography). The costs of a project are based on the costs to underground an entire area rather than on any specific site costs of the different properties in an area. The total costs of each round of the SUPP are provided in Table 4.1 below, for both MRPs and LEPs.

[29] Information provided by Western Power.

Table 4.1 Costs of SUPP Rounds (MRPs and LEPs) over Time ($ million, nominal)

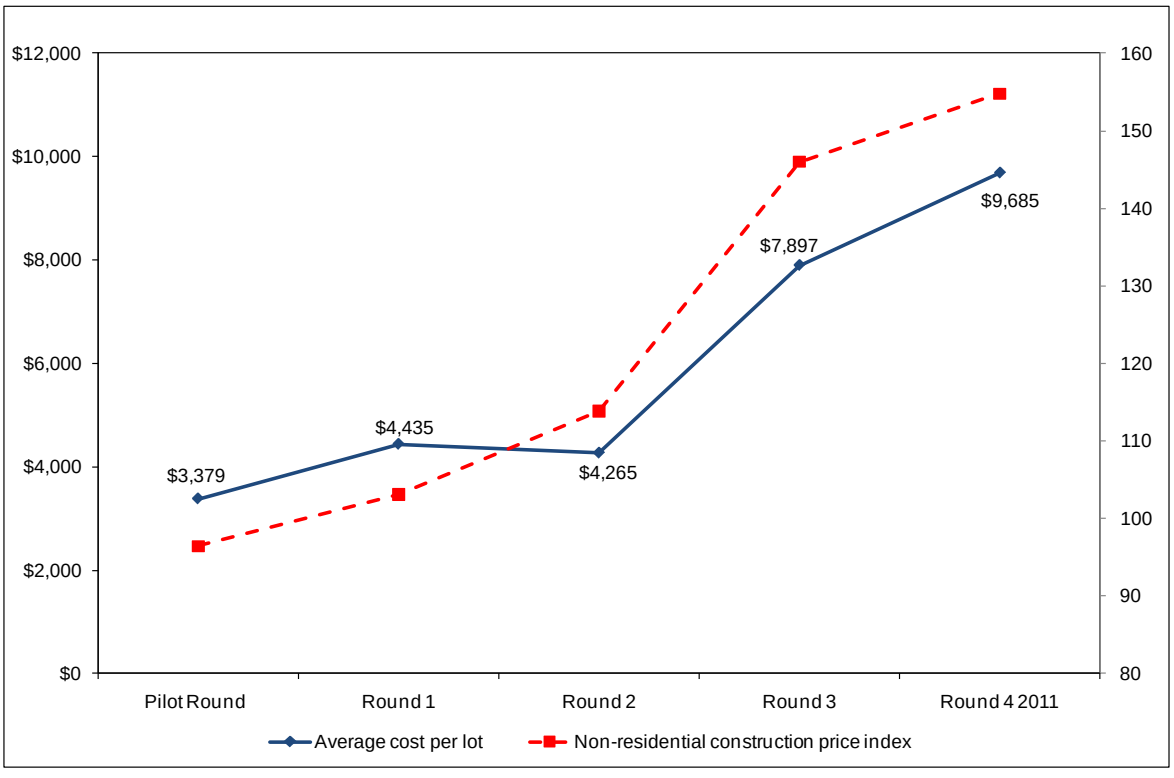
Program Rounds	Period	Total Costs ($ million)
Pilot projects	April 1996 - June 1999	21.19
Round 1 MRPs	September 1998 - February 2003	31.50
Round 1 LEPs	February 1999 - November 2001	1.09
Round 2 MRPs	May 2000 - July 2005	63.26
Round 2 LEPs	June 2001 - December 2004	4.31
Round 3 MRPs	June 2004 - August 2009	98.03
Round 3 LEPs	February 2005 - August 2008	3.24
Round 4 MRPs	January 2008 – *July 2012*	40.09*
Round 4 LEPs	June 2008 – *October 2011*	2.48*
Estimated total	***April 1996 – July 2012***	***265.19***

Source: Information from Western Power.

* The figures for Round 4 are estimated actuals – projects are still being undertaken as part of this round of the SUPP.

Figure 4.1 below shows the average cost of underground power per allotment of land in nominal terms for each of the rounds of the SUPP.

Figure 4.1 Average Cost per Allotment of Land* of the SUPP (MRPs, $ nominal)



* The total expenditure for a project divided by the total number of lots within each project.

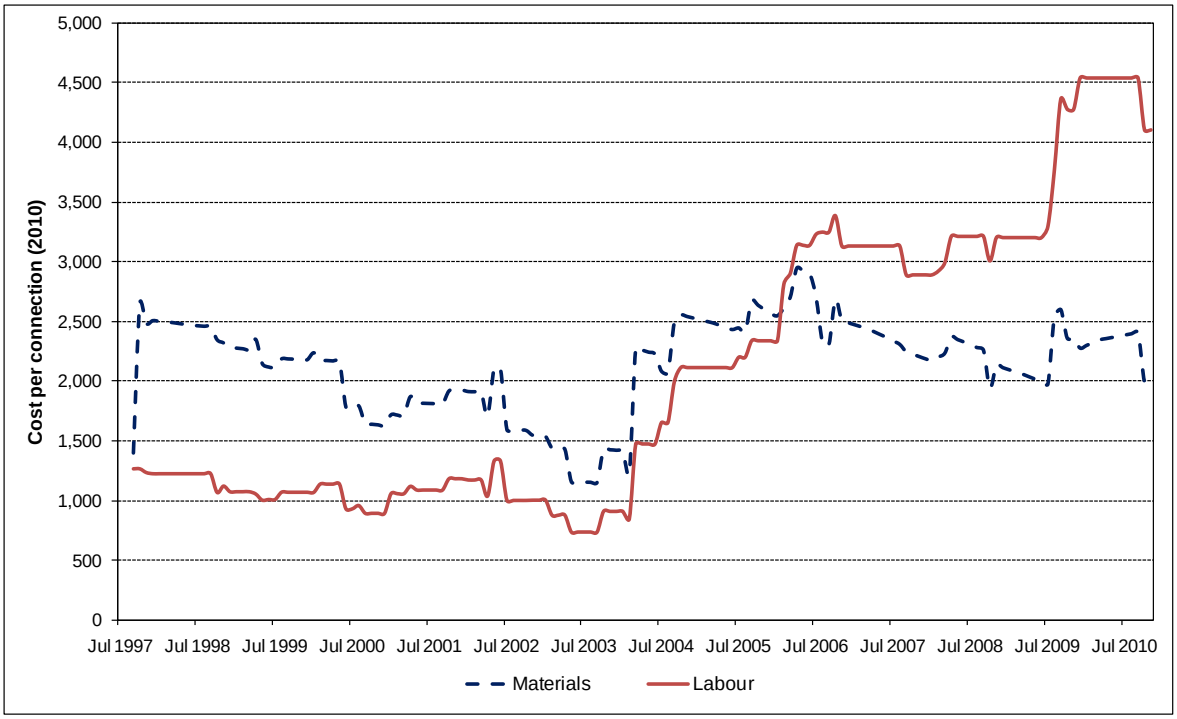
Source: Information from Western Power and Australian Bureau of Statistics – Non-residential construction price index – Quarterly index data.

The average cost to place power cables underground per allotment of land has increased by around 7.3 per cent in nominal terms per annum between the pilot round in 1996 and

the latest costs of the round four projects in 2011. Over the period 1996-97 to 2009-10, the consumer price index increased by 2.6 per cent on average per annum and the annual average increase in the house price index was 8.5 per cent.[30] The ABS non-residential construction price index increased by 3.9 per cent on average each year over the period 1997-98 (first year of the index) to 2009-10.

There are a number of reasons for the increases in the average SUPP project cost, such as significant increases in contract labour costs and commodity prices, as well as more technically challenging projects over time with difficult site conditions and additional project and site management costs associated with contractor delays.[31]

Figure 4.2 Labour and Material Costs of SUPP Projects over Time ($ per connection, Real)



As can be seen Figure 4.2, labour costs increased significantly in late 2003, and the costs of material also increased at that time, although not by as much as labour. Labour costs reflect the contract labour costs that the underground power program team in Western Power negotiate with contractors, whereas the material costs are driven by materials sourced from Western Power, as this is the lowest cost to purchase material for SUPP projects. The increase in material costs was in line with cost escalation indices for similar materials whereas the labour cost increases have been higher than cost escalation indices for related labour costs.

Western Power has advised that the higher contract labour costs between 2003 and 2006 were due to the unavailability of labour contractors during the mining sector expansion and the fact that the competitive tendering system at the time did not allow for the bundling of projects to enable Western Power to negotiate prices with contractors. This has since been mitigated by project bundling and fixed price contracting based on a

[30] Source: Australian Bureau of Statistics (ABS) Consumer Price Index – Quarterly index data for Capital Cities and ABS House Price Index – Quarterly index data for established houses only (excludes project house data = building not land) for Capital Cities.

[31] Western Power, November 2008, *Underground Power Program Review*, p11.

schedule of rates.[32] In regard to material costs, there has been a large escalation in the price of copper and nickel, which are major components of the cables and equipment. This price escalation has been mitigated by using aluminium cables as an alternative.

Consultant's Review

Halcrow undertook a detailed review of the Como East project budget as part of its review, which was provided to Halcrow by Western Power, along with other pieces of information. The Como East project was undertaken as part of round three of the SUPP, and it was carried out between February 2008 and August 2009. Halcrow noted in its report that the project management, material and labour cost components and cost estimates appeared to be comprehensive and complete, and provided a reasonable and appropriate level of detail, allowing for rigorous analysis and review.

The review by Halcrow also indicated that no obvious cost items were omitted from the Como East project budget. However, Halcrow noted that the project cost estimates did not provide an indication of the level of future operations and maintenance expenditure that would be saved through undergrounding the distribution network.[33]

4.2.2 Submissions on Upfront Costs

In regard to the increasing average cost per lot to underground power over time, Horizon Power submitted that the round three costs[34] were inflated by the much higher labour and accommodation costs of the Port Hedland project, as well as the costs associated with project installation disruptions due to the passage of four cyclones.[35]

The Eastern Metropolitan Regional Council[36] (**EMRC**) has submitted that the current method of calculating the costs of underground power is not appropriate, as they are generally based on unit costs (total costs divided by number of lots) and are not site specific. Further, under the existing arrangements there is no consideration of the costs that local governments incur to undertake the preliminary assessments and community consultation required to gain community support.

The EMRC recommended that a revised process to evaluate and select SUPP projects should seek to ensure that there is greater input from Western Power in relation to its estimated costs and that the estimates are based on NPV calculations to promote a more realistic up-front cost estimate. It was also recommended that a revised SUPP should contain a provision of funding to local governments to undertake the community consultation and the Expression of Interest processes.[37]

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[32] This involves contractors providing a fixed price tender based on a scope of work from Western Power and an agreed schedule of rates written into a Head Contract, where a number of major residential projects are allocated to contractors over each round of SUPP.

[33] Halcrow Pacific Pty Ltd, January 2011, *Economic Regulation Authority of Western Australia – Inquiry into State Underground Power Program Cost Benefit Study: Final Report*, pp46-47.

[34] The average cost per lot in round three was $7,897 – up from the average cost per lot in round two of $4,265.

[35] Horizon Power's submission on the Issues Paper, p1.

[36] Made up of six member councils: the Town of Bassendean, Cities of Bayswater, Belmont and Swan, and the Shires of Kalamunda and Mundaring.

[37] EMRC's submission on the Issues Paper, p6.

4.2.3 Authority's Assessment

The Authority has identified the upfront costs of removing overhead infrastructure and replacing it with underground infrastructure that can be quantified as part of the Cost-Benefit Analysis. These costs are based on Western Power's information on costs of the different rounds of the SUPP. Halcrow indicated in its report that the cost components and cost estimates appeared to be comprehensive and complete and that no obvious cost estimates were omitted from the project budget that was examined.

The SUPP project costs have been increasing since 2003, when there was an expansion in the mining sector, which pushed up the availability and cost of contract labour in particular. The Authority understands that there are only a few contractors in the Perth metropolitan area that provide the labour services required for SUPP projects (such as the demolition or removal of overhead infrastructure and the actual instalment of the underground infrastructure). This lack of competition seems to have placed upward pressure on the rates that labour contractors charge the UPPT in Western Power.

However, as mentioned in section 4.2.1 above, Western Power has mitigated the increases in labour contract costs to some extent through the bundling of projects and introduction of fixed price contracting. The availability and cost of labour contractors is likely to be a challenge in the future as well, as the mining sector in Western Australia is expected to continue to expand.

In regard to the project management costs, which account for around 10 per cent of SUPP costs each year, the Authority's view is that the funding for a separate full time Executive Officer in the Office of Energy needs to be reassessed. While the Executive Officer is likely to have a full workload during the evaluation and selection process, it is not clear that there is much work outside of this process that warrants the employment of a full time Executive Officer.

The EMRC has suggested that the current method of calculating costs based on unit costs is not appropriate and that the costs should instead be based on the specific costs of each site or property. While there might be some specific costs associated with certain properties, given that the key drivers of costs include residential density, ground conditions, traffic management requirements (and in some cases street or verge topography) as well as the block frontage, many of the costs would be similar for properties in a particular area. In addition, it would be time consuming and expensive to provide site specific cost estimates to property owners to gauge their support for a proposed SUPP project in the early stages of the selection process.

The Authority accepts that Western Power's method of costing SUPP projects is comprehensive and complete and that no costs appear to have been omitted from Western Power's cost calculations.

4.3 Additional Costs of Undergrounding Overhead Power Cables

In addition to the upfront costs, a number of additional costs are associated with undergrounding powerlines.[38] These are:

[38] InfraSource Technology (for Florida Utilities), February 2007, *Undergrounding Assessment Phase 1 Final Report: Literature Review and Analysis of Electric Distribution Overhead to Underground Conversion*, pp29-32.

- Environmental damage, since open trenching can destroy surface vegetation and can result in an increase in soil erosion and if placed in ecologically sensitive areas, underground cables have the potential to disrupt the local ecosystem, especially during construction.
- Electricity network operator employee work risks during vault and manhole inspections when underground systems are installed in conduit, manholes and vaults.
- Increased exposure to dig-ins (prompting campaigns such as "dial-before-you-dig"), which is a safety problem as well as a reliability problem since it generally results in interruption of electricity supply to customers.
- Longer duration interruptions, as it can be more difficult to find and repair faults on underground systems. Although interruptions may occur less frequently with underground power, when interruptions do occur, they last longer and more customers tend to be impacted per outage.
- Susceptibility to flooding, storm surges and damage during post-storm cleanup. During the recent floods in Queensland, some of the underground power infrastructure that was likely to be inundated by floodwater in Brisbane had to be switched off to prevent accidents, resulting in power blackouts for 100,000 homes and businesses.
- Reduced flexibility for both operations and system expansion, as it is much easier to modify, extend and add equipment to an overhead system than an underground system.
- Reduced life expectancy of underground cables when compared with overhead lines. Overhead distribution system components typically have a life expectancy of around fifty years, whereas underground distribution system components have a life expectancy of around thirty years.
- Higher maintenance and operating costs of underground power, due to the fact that it may be more difficult to find faults and more expensive to repair faults on underground power systems. However, a cost comparison study undertaken in North Carolina in the US showed that the overhead and direct buried underground systems (which is the approach used by Western Power) had about the same operating and maintenance costs.[39]

4.3.1 Submissions on Additional Costs

The Authority sought feedback from stakeholders on whether or not there are additional costs of the SUPP. Western Power submitted that underground power does have some negative impacts:[40]

- The costs of underground power may reduce the amount of funding available for other work (to facilitate growth and improve network performance) due to the State Government's budget constraints.
  - That is, the opportunity cost of the funds used for SUPP may be higher than the discount rate used in this analysis.

[39] North Carolina Utilities Commission, 2003, *Report of the Public Staff to the NC Natural Disaster Preparedness Task Force on the Feasibility of Placing Electric Distribution Facilities Underground*, Raleigh, North Carolina.

[40] Western Power's submission on the Issues Paper, p4.

- The current non-continuous approach of the SUPP may also have reduced the potential network reliability and power quality benefits of underground power.
- It may be more difficult to find faults and undertake repairs on underground cables, and affected customers are likely to face longer supply interruption times, although this is expected to be offset by lower maintenance requirements.
- Underground power also increases the hazards for installation of other utility services (such as gas and telecommunications) and excavations.

4.3.2 Authority's Assessment

In relation to the possible negative impacts of underground power:

- There may be some costs associated with soil erosion when overhead distribution infrastructure is removed and replaced with underground power, but the Authority does not have any estimates of these costs.
- Western Power has advised that its employees do not face additional risks of electrical contact when inspecting underground power components, as manholes or vaults are not used in Perth.
- There are costs associated with the increased exposure to dig-ins when cables are placed underground, but these costs are likely to be at least partially offset by the reduced electrical contact injuries associated with overhead power systems.
- Western Power suggested in its submission that although it may be more difficult to find faults and undertake repairs on underground cables and affected customers are likely to face longer supply interruption times, this is expected be offset by lower maintenance requirements.
- In regard to the susceptibility to flooding, storm surges and damage during post-storm cleanup, the Authority has not found any evidence of this being a problem in Perth. During the March 2010 storm, when there were localised flooding in areas, including areas with underground power, Western Power did not record any problems or outages as a result of underground power infrastructure being damaged by water.
- During the early rounds of the SUPP, when undergrounding was done on a like-for-like approach, there was reduced flexibility for both operations and system expansion by Western Power. However, since 2002 Western Power has allowed reasonable future proofing of the SUPP design to build additional network capacity, which goes some way towards mitigating the potential reduction for operations and system expansion resulting from underground power.
- In regard to the reduced life expectancy of underground cables when compared with overhead lines, Western Power has advised that current underground power systems have a life expectancy of forty to fifty years, which is similar to Western Power's life expectancy of overhead distribution systems.
- In regard to potentially higher maintenance costs of underground power in comparison to existing overhead system maintenance costs, Western Power has provided information which shows that the maintenance costs of underground power are actually lower than the maintenance costs of the existing overhead distribution system. This information is outlined and discussed in more detail in section 5.2.1.
- It is not clear that there are any opportunity costs associated with retrospective underground power. The Authority would require more evidence of any higher return non-SUPP projects that have not gone ahead due to funding constraints

before increasing the discount rate used to assess the costs and benefits of the SUPP.

4.4 Efficiency of the Current Approach to Undergrounding

In accordance with the terms of reference for the inquiry, part of the CBA undertaken by the Authority is a comparison of the costs associated with maintaining the current overhead distribution system and the costs of undergrounding. In the issues paper, the Authority recognised that there are some issues associated with comparing the two which need resolving, including the approach that is taken to undergrounding, as it has an impact on the costs that are compared to maintaining the existing overhead distribution system. The two approaches to undergrounding are:

- The optimised approach, where the overall network design is examined and replaced with a new, redesigned underground network with an aim to 'optimise' the network, by taking into account things such as:
  - the current and future load patterns;
  - the characteristics and cost structures of underground networks;
  - the undergrounding of the parts of the overhead distribution network that have reached the end of their asset lives first; and
  - the successive roll out of underground power (one area/suburb followed by an adjacent area/suburb).
- The like-for-like approach, where overhead distribution lines are replaced with underground cables using the same or similar route and using the existing or similar configuration of the network.

The approach to the undergrounding for the SUPP was initially a like-for-like approach, which replaced all the overhead distribution lines with underground lines with the same or possibly greater capacity, on similar or even the same routes, using the existing sub-transmission system. It did not really allow for any substantial changes to be made to the configuration of the network.

However, since 2002, this approach was modified to allow reasonable future proofing of the design to build additional network capacity. Major enhancements, such as additional high voltage reinforcement, are fully funded by Western Power.

4.4.1 Submissions on Approach to Undergrounding

The Authority sought feedback from stakeholders about the approach that should be adopted for undergrounding existing overhead distribution cables. In response, Western Power submitted that an optimised approach should be adopted for underground power, since it is not practical or economically efficient to adopt a like-for-like approach in retrospective undergrounding of modern power networks.[41]

The City of Belmont supported the optimised approach to underground power in its submission, since it provides a better long term outcome for the network.[42] The EMRC also submitted that the optimised approach should be adopted as it is more efficient.

[41] Western Power's submission on the Issues Paper, p4.

[42] City of Belmont's submission on the Issues Paper, p3.

However, this or any approach that is adopted should take into account equity and responsibility issues as well.[43]

4.4.2 Authority's Assessment

The Authority's view is that to the extent that it is possible, the optimised approach to retrospective undergrounding of power should be adopted by Western Power, as it is important to ensure that the new underground distribution network is operating as efficiently as possible. It is also vital to allow for future growth, as it is very expensive to replace or place additional electricity cables underground in the future.

The Authority understands that Western Power pays for any major enhancements to the network, which will benefit all or most of its existing and/or future customers, when underground power is installed retrospectively as part of the SUPP. As such, the other contributors to the SUPP (ratepayers and taxpayers) are not required to pay for something which benefits a different group in the community (electricity customers).

4.5 Current Evaluation and Selection Processes

The Underground Power Steering Committee's evaluation and selection processes for MRPs and LEPs are summarised below in Figure 4.3. The round five guidelines for MRPs, which set out the evaluation and selection processes for round five MRPs in detail, are provided in **Appendix C**. The round five guidelines for LEPs have not been published yet, so the summary of the process for LEPs is based on the round four guidelines.

[43] EMRC's submission on the Issues Paper, p10.

Figure 4.3 Evaluation and Selection Processes for MRPs and LEPs

Summary of Evaluation and Selection Process for Major Residential Projects

1) Preparation and submission of Expression of Interest (EOI) proposals (local governments).
2) EOI proposals evaluation stage, in terms of:
   - Network reliability and performance requirements (by the Committee and Western Power);
   - Project feasibility and development of pre-selected proposal list (by the Committee and Western Power); and
   - Public support (rate payer survey) and other evaluation criteria (by the Committee and pre-selected local governments).
3) Development of a short-list and a reserve list for the Minister for Energy's approval followed by an announcement of short listed EOI proposals (by the Committee).
4) Detailed proposal stage:
   - Design and tender process (by Western Power);
   - Confirmed community support may be required, but it is not compulsory (by local governments); and
   - Final agreement (between Office of Energy, Western Power and local governments).
5) Implementation of approved MRPs (by Western Power).

Summary of Evaluation and Selection Process for Localised Enhancement Projects

6) Preparation and submission of Expression of Interest (EOI) proposals (by local governments).
7) EOI proposal stage, where proposals are assessed and short-listed based on a range of selection criteria (including regional location and the level of heritage, tourism, scenic and geographical significance) – by the Committee.
8) Detailed proposal stage, where the short-listed proposals are examined in detail before they are approved for implementation (by the Committee).
9) Implementation of approved LEPs (by Western Power or Horizon Power).

4.5.1 Impact of Evaluation and Selection Process on Costs of SUPP Projects

The SUPP evaluation and selection processes may have an impact on the costs of the projects. For example, the current processes for selecting and assessing projects are largely driven by the need to improve the reliability of electricity supply in an area, and they do not require that underground power projects for suburbs are undertaken in a successive manner (that is, one suburb or part of a suburb followed by an adjacent suburb). This may not be the most efficient process for installing underground power.

Halcrow reviewed the selection process and suggested that there are a number of factors that adversely impact on the SUPP project costs. In particular, Halcrow found that:[44]

- Western Power cannot engage contractors on a continuous basis due to the periodic manner in which SUPP projects are approved and implemented. This affects mobilisation and standing time costs, which are ultimately borne by the SUPP projects.
- Increased labour and materials costs and a need to minimise commercial exposure from single projects has restricted the size of work packages offered by Western Power in each of the construction streams (street and streetlight services, house services and decommissioning and interface services). This reduces the commercial attractiveness of the work packages, particularly for larger contractors, which affects the competitiveness of the tendering process.
- Western Power's ability to take advantage of economies of scale is hindered by the requirement to spread the geographical coverage of SUPP projects, as well as the existing funding arrangements.

Western Power has indicated that if the existing funding constraints are removed and the selection process allowed for successive roll-out of the SUPP, the costs of delivering SUPP projects could potentially be reduced by around 15 to 20 per cent.

4.5.2 Submissions on Evaluation and Selection Process

Horizon Power noted in its submission that the current SUPP selection process has resulted in only one project being completed outside of the SWIS (in Port Hedland) and only two projects being completed outside of the Perth Metropolitan area. Horizon Power would like to see the development of a scheme similar to the SUPP for the remainder of Western Australia.[45]

WALGA submitted that the existing evaluation and selection process under the SUPP is driven by the identification of areas with poor reliability performance, but within the constraints of the property owners' willingness to pay. It was suggested that the design principles of the SUPP should be amended so that the project evaluation and selection is based on a system of reliability and asset management optimisation principles, rather than the willingness or capacity of property owners' to pay.[46]

WALGA also submitted that Western Power should develop a high level program to underground all electricity distribution infrastructure in the SWIS over 20 to 40 years utilising best practice asset management principles, which should be used as the basis to determine the sequence of work to be undertaken. As part of this proposed program, a group of beneficiaries should have the opportunity to bring forward underground power projects in specific locations and meet the incremental costs of doing so.

This proposal by WALGA would change the existing funding arrangements for the SUPP, where property owners provide a large proportion of the funding and determine whether or not projects are undertaken through ratepayer surveys. Western Power would be

[44] Halcrow Pacific Pty Ltd, January 2011, *Economic Regulation Authority of Western Australia – Inquiry into State Underground Power Program Cost Benefit Study: Final Report*, p35.

[45] Horizon Power's submission on the Issues Paper, p1.

[46] WALGA's submission on the Issues Paper, p6.

required to provide most of the funding for underground power under WALGA's proposal.[47]

The Member for Alfred Cove, Dr Janet Woollard MLA, submitted that the current SUPP selection process has resulted in suburbs divided into the "haves" and "have nots". For example, the suburbs of Ardross, Attadale and Bicton have sections with and without underground power. As the Member for Alfred Cove, Dr Woollard is contacted regularly by constituents who would like to be connected to underground power and want the SUPP to be escalated. Dr Woollard also submitted that more weight should be placed on community support and the willingness of property owners to pay for SUPP projects during the selection process, to minimise the risk of local governments dropping out after being shortlisted.[48]

The EMRC submitted that the current method of evaluation and selection of SUPP projects is not responsive to the needs of local governments or the community. The process takes too long (up to three years) and during that time, costs may have escalated by up to 60 per cent from the original cost estimate.[49] It was also submitted that the evaluation and selection process for SUPP projects needs to be streamlined to ensure appropriate funding responsibility, fast-tracked construction and avoid cost escalations.[50]

4.5.3 Authority's Assessment

The member for Alfred Cove submitted that more weight should be placed on community support and the willingness of ratepayers to pay for SUPP projects. The Authority's view is that the current evaluation and selection process has been improved by the recent change to survey ratepayers about their support to contribute to the costs of underground power in their area.

In previous rounds of the program, the ratepayers' surveys were undertaken later in the process, which in some cases led to that work being undertaken by the Steering Committee and Western Power in respect of projects which did not go ahead, due to the lack of support from ratepayers. The surveys for these earlier rounds of the SUPP were undertaken independently by the affected local governments, which meant that the questions asked and the quality of those questions were not consistent across all the SUPP projects.

One potential issue associated with surveying ratepayers early in the process is the possibility that Western Power's estimated costs for ratepayers are not reflective of the actual costs when the projects are implemented, which could be one or two years after the survey was undertaken. However, the underground power program team in Western Power has suggested that this is no longer an issue, due to the development of fixed price contracts.

In regard to Halcrow's finding that there are a number of factors that increase the SUPP project costs and the suggestion by WALGA that projects should be selected based on reliability performance and asset management optimisation principles, the Authority's view is that the current requirement to allocate the SUPP projects across different local governments should be reconsidered, as it would be more cost efficient to have successive roll-out of the SUPP. This may also result in an overall improvement in the reliability and quality of electricity supplied to electricity customers. However, this would

[47] Ibid, pp3-4.

[48] Member for Alfred Cove's (Dr Janet Woollard MLA) submission on the Issues Paper, pp2-3.

[49] EMRC's submission on the Issues Paper, p5.

[50] EMRC's submission on the Issues Paper, p5.

still need to be considered against the benefits of each area under consideration, as the aim of the program should be to maximise net benefits, not simply to minimise costs.

Western Power's existing funding constraints are set by the Government as part of its annual State budget deliberations, and are outside the scope of the evaluation and selection process. However, greater flexibility within the program, e.g. through a variation in the amounts contributed by ratepayers depending on their willingness to pay, could result in more underground power projects being undertaken with the same amount of funding from the Government and Western Power, or a reduction in the contributions from the Government and Western Power. There is a possibility that the administrative costs of a more flexible program would be higher, and it would be important that these costs do not exceed any benefits gained from greater flexibility.

4.6 Draft Findings

Costs of Underground Power

1) There are two types of costs associated with retrospective underground power:

   - the upfront costs of removing overhead distribution infrastructure and all of the direct costs to place the infrastructure underground; and
   - the indirect costs of any negative effects when the infrastructure is placed underground, such as soil erosion or accidents when people dig into underground cables.

2) To the extent that it is possible, the optimised approach to retrospective undergrounding of power (where the overall network design is examined and replaced with a new, redesigned underground network with an aim to 'optimise' the network) should be adopted by Western Power, which should continue to fund any major improvements to the network during the installation of underground power.

5 Benefits of Retrospective Undergrounding of Power

The Authority is required to have regard to the following issues included in the terms of reference:

- The types of costs which are avoided as a result of undergrounding the overhead electrical distribution system.
- Identification and quantification (where possible) of all costs and benefits of underground power including but not limited to:
  - network capital, operation and maintenance costs;
  - quality of supply and reliability of electricity;
  - energy security;
  - emergency response;
  - residential property values;
  - public safety;
  - street lighting;
  - public and private amenity;
  - environmental impacts; and
  - maintenance of street scapes and verges.

The undergrounding of existing overhead distribution lines is likely to result in number of avoided costs and benefits to different groups of the community. The Authority outlined some of the most commonly cited benefits of underground power in its issues paper and these have been reiterated, along with additional benefits, in submissions from stakeholders. These are considered below.

5.1 Background

The potential benefits of underground power can be grouped into the following four types:

- Economic benefits (or avoided costs) to Western Power;
- Avoided tree pruning costs to local governments;
- Benefits to property owners/ratepayers; and
- Benefits to the wider community.

These potential benefits, and any related feedback provided in submissions from stakeholders, are discussed separately below.

The Authority engaged Marsden Jacob Associates (**MJA**) to develop a model to estimate the extent to which SUPP has affected house prices[51] to establish if the benefits that accrue to ratepayers from placing distribution lines underground have an impact on property values. This is discussed in section 5.5.2.

[51] In the housing market, the price of a property is determined by the size, appearance, features and condition of the house (the internal characteristics) as well as the characteristics of the area where the house is located (such as accessibility to schools and shopping, ocean or river views, the value of other homes and underground power).

The Bureau of Transport and Communications Economics (**BTCE**) prepared a report for the Putting Cables Underground (**PCU**) Working Group in 1997, which identified and assessed the tangible benefits and the external benefits and costs of undergrounding cables.[52] In this report, the following costs and benefits were found to be potentially significant to the viability of undergrounding cables (electricity distribution and telecommunications cables):

- Improved visual amenity;
- Safety improvements (motor vehicle accidents with power poles, electrocutions);
- Reduced maintenance;
- Re-connections to customer properties; and
- Reduced potential for co-locating street lights on power poles.[53]

Other benefits and costs were considered to be moderate (such as the improved reliability of supply as a result of lower rates of storm and accidental damages and damage to trees)[54] or of little importance. The benefits and costs that were identified to be of little significance, which were recommended to be excluded from further consideration by the PCU Working Group, included:

- Reduced cost of outages to customers;
- Reduced leaching of chemical pole preservatives and other herbicides to control plant growth;
- Reduced health hazards from electro-magnetic field radiation;
- Reduced interference with radio and television reception;
- Reduced wind noise;
- Reduced fire hazards in urban areas; and
- Interference to public during underground construction.[55]

5.1.1 Submissions on Benefits of Underground Power

The Member for Alfred Cove, Dr Janet Woollard MLA, submitted that the following benefits were the ones most often cited by constituents:

- Enhanced power reliability and security, with less interruptions of power supply due to storms and pole top fires;
- Enhanced community safety through reduction in fallen power lines and car pole accidents when the number of electricity poles is reduced;
- Reduced the cost of pruning trees; and
- Improved visual amenity and aesthetics of suburbs, including the ability to beautify the area through the planting of more street trees.[56]

[52] Bureau of Transport and Communications Economics, 1997, *Measuring the Benefits of Putting Cables Underground*.

[53] Ibid. p4.

[54] Ibid, p4.

[55] Ibid, p5.

[56] Member for Alfred Cove's (Dr Janet Woollard MLA) submission on the Issues Paper, p3.

The Member for Alfred Cove also suggested that the benefits to local governments should be addressed more clearly by the Authority as this could impact how SUPP project costs are funded. In addition to savings on tree pruning costs, when local governments have sought or obtained funding to place power lines underground in areas of high significance (e.g. shopping districts and tourist destinations) they have cited that underground power has provided the ability to plan better streetscapes and reduced the cost of some future infrastructure works. Local governments are also likely to benefit from reliability improvements in the supply of electricity, as it would reduce the interruptions to their operations and services to ratepayers. It was also suggested in the submission that there may be others who benefit from underground power as well, such as insurance companies, other utilities and Main Roads.[57]

The EMRC has submitted that while there are benefits to local governments, such as reduced tree pruning costs and increased reliability, the State Government is the main benefactor of SUPP and it should accept a greater share of responsibility for funding the program.[58] The following benefits to the State Government were identified in the EMRC's submission:

- An increase in network stability during storm, bushfires and other environmental events.
- A reduction of costs in corrective emergency repairs as a result of storms, bushfires and other environmental events (i.e. 60.5% of maintenance expenditure for 2007/08 as per Western Power's Annual Report).
- An increase in network reliability through reduced power outages.
- A reduction in line pole and pole-top maintenance costs.
- A reduction in line pole inspections costs.[59]

5.2 Benefits to Western Power

In the issues paper, the Authority suggested that there may be some savings, or avoided costs, to Western Power if its existing overhead distributions lines are undergrounded. This included possible reductions in:

- Operating and maintenance costs, including storm repair costs and maintenance of street scapes and verges; and
- Costs associated with power interruptions.

All or some of the avoided costs that may accrue to Western Power flow through to its customers, some of which are likely to benefit more than others. For example, customers who live in or directly adjacent to suburbs with underground power are likely to benefit more than Western Power's other customers. Ideally, those who benefit from underground power should pay for the cost of having it installed. However, since Western Power's network tariffs are the same for all customers in the SWIS and all residential customers pay the same electricity retail tariffs regardless of where they live in Western Australia, it is not possible to directly charge those who benefit from underground power through the electricity retail tariffs.

[57] Ibid, p4.

[58] EMRC's submission on the Issues Paper, pp8-9.

[59] Ibid, p8.

5.2.1 Operating and Maintenance Costs

There may be potential savings from reduced operating and maintenance costs, although this depends on the type of specification and design of the underground power lines. Consequently, these costs could also be similar, or even higher, than for equivalent overhead distribution lines.

A study in the United States (North Carolina) found that on average, the operating and maintenance costs per mile were similar for direct buried underground cables (the method used by Western Power) and overhead lines.[60]

The 1998 report by the PCU Working Group estimated the total maintenance costs (the sum of preventive maintenance, vegetation management and reactive maintenance) of overhead and underground distribution systems. The estimates suggested that existing overhead infrastructure was approximately twice as expensive to maintain as existing underground infrastructure. It noted that the avoided maintenance cost of putting cables underground is not the difference between overhead and underground maintenance costs, but rather the difference between the maintenance costs of existing overhead systems and the installation costs of new underground cables.[61]

Some of the repair and maintenance benefits of operating underground electricity cables, compared to overhead electricity systems, include:

- various types of specialist mechanical plant and equipment to work on overhead lines and poles, such as cherry-pickers, mobile cranes and borers and pole transportation;
- specialist labour requirements for overhead line workers to ensure that they can work at heights and in severe weather conditions; and
- ongoing requirements for pole inspections and treatments, network reinforcements and vegetation management programs associated with the overhead electricity system.

However, as discussed in section 4.2.3, there are costs associated with operating and maintaining underground electricity systems as well, such as increased exposure to people digging into the cables.

In regard to Halcrow's consideration of Western Power's maintenance costs of overhead powerlines and underground cables, Western Power only provided budgeted estimates for 2010-11, relating to operating maintenance expenditure budgets for planned and unplanned maintenance of the overhead and underground distribution networks in the SWIS (outlined in Table 5.1). Western Power did not provide information on capital maintenance expenditure, such as asset replacements and any associated capital expenditure, to Halcrow.

[60] InfraSource Technology (for Florida Electric Utilities), February 2007, *Undergrounding Assessment Phase 1 Final Report: Literature Review and Analysis of Electric Distribution Overhead to Underground Conversion*, p25.

[61] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group*, pp64-65.

Table 5.1 Western Power's 2010-11 Operating Expenditure Budgets (Per Kilometre)

Maintenance Activity	Metro ($/km)	Country ($/km)	SWIS ($/km)
Overhead - planned	2,674	816	1,181
Overhead - unplanned	3,389	673	1,173
Underground - planned	261	364	280
Underground - unplanned	871	429	869

Source: Halcrow Pacific Pty Ltd, January 2011, Economic Regulation Authority of Western Australia – Inquiry into State Underground Power Program Cost Benefit Study: Final Report, p43.

As can be seen in Table 5.1, Western Power's planned and unplanned operating expenditure on the underground distribution network in 2010-11 are lower than on the overhead distribution network in all regions (metro, country and SWIS). However, given that the underground distribution network assets are generally newer than the overhead distribution network assets, this would be expected.[62]

Western Power has since provided information to the Authority about the actual cost per kilometre per year for distribution overhead and underground maintenance costs (operating and capital) from 2006-07 to 2009-10. This information is presented in Table 5.2 below.[63]

Table 5.2 Overhead and Underground Maintenance Costs from 2006-07 to 2009-10 (2010-11 Dollars)

Region	Overhead - $/km per year			Underground - $/km per year		
	Operating	Capital	***Total***	Operating	Capital	***Total***
Metro	5,150	3,500	***8,650***	1,400	620	***2,020***
Country	1,250	580	***1,830***	950	480	***1,430***

Source: Western Power

Table 5.2 shows that Western Power's operating and capital expenditure on maintenance of overhead distribution systems has been four times higher than the same expenditure on underground distribution systems in the Perth metropolitan area. However, as mentioned above, the overhead distribution assets are older than the underground distribution assets, so the comparison of costs in Table 5.2 is not on a like-for like basis.

Storm repair costs are included in Western Power's unplanned operating and maintenance costs. One example of this is Western Power's overall repair costs following the severe hail and thunderstorm that moved through the Perth metropolitan area in March 2010, which amounted to $3.3 million.[64]

Western Power has developed a methodology to calculate its avoided operating costs when existing overhead distribution cables are placed underground. The model calculates the value on a per-bay basis (distance between two poles) and takes into account all the factors relevant to Western Power's planned and unplanned maintenance, as well as when the overhead assets are due to be replaced.

[62] Halcrow Pacific Pty Ltd, January 2011, *Economic Regulation Authority of Western Australia – Inquiry into State Underground Power Program Cost Benefit Study: Final Report*, pp43-44.

[63] Information provided by Western Power.

[64] Information provided by Western Power.

In regard to SUPP projects, Western Power has used the model to estimate its avoided maintenance costs based on four representative SUPP projects.[65] The results showed that the NPV of the avoided cost component was between 7.12 and 13.66 per cent of the total SUPP project costs. The mean NPV of avoided costs was equal to 10 per cent of total project costs.[66]

Western Power Benefits from Reduced Maintenance of Street Scapes and Verges

Underground power lines may require less maintenance of street scapes and verges, such as tree pruning, which is likely to reduce Western Power's vegetation management costs. Western Power is responsible for vegetation management on verges and under overhead powerlines for the vegetation that occurs naturally (i.e. vegetation that has not been planted or cultivated). Western Power has not provided any separate estimates of its avoided vegetation management costs, but these costs are included in the actual maintenance costs provided by Western Power.

In 1998, Sinclair Knight Merz (**SKM**) undertook analysis for the PCU Working Group that considered putting cables underground (led by the then Department of Communications, Information Technology and the Arts).[67] This included the estimation of vegetation management costs incurred by electricity utilities (it did not include the vegetation management costs incurred by local governments). Vegetation management covered all the activities performed by company labour or contractors associated with the initial clearing of verges and the maintenance of existing vegetation of the verges.

Based on surveys of electricity utilities, SKM estimated that the median cost per kilometre for vegetation management was $194 per circuit kilometre. For utilities with high cost operations (high tree density and fast growing trees) the cost increased to $285 per kilometre. On the other hand, in areas with low tree densities, low growth trees and easily accessible overhead lines the cost was $107 per kilometre.

5.2.2 Costs Associated with Power Interruptions

Undergrounding of distribution lines may also benefit Western Power in terms of improved reliability if it results in a reduction in the number of power outages and the associated costs to its customers. These benefits would be achieved through reduced compensation claims and payouts to affected customers, and the costs associated with processing and verifying claims.

However, underground power may not necessarily improve the reliability performance of the distribution network through a reduction in the number of outages that customers experience, as any outages on underground systems can last longer and impact a larger number of customers. On the other hand, underground power almost eliminates all of the very short outages and disturbances that are not recorded for reliability purposes, which are often caused by pole top fires, tree branches, birds or vandals. An assessment of reliability benefits is undertaken in section 5.4.1.

Western Power produced a report following the severe storm that moved through Perth on 22 March 2010, which examined the performance of the overhead and underground

[65] This was calculated using the following formula: Net benefit to Western Power = maintenance saved (net present value of actual savings to Western Power) + overhead replacement cost (net present value) – written down value of assets replaced.

[66] Information provided by Western Power.

[67] Sinclair Knight Merz, 1998, *Consultancy to Investigate Potential Benefits from Putting Cables Underground*.

distribution systems during the storm event.[68] This report showed that only five per cent of customers in SUPP areas (areas fully undergrounded through the SUPP) experienced outages, compared to 26 per cent of customers in non-SUPP areas (all other areas, which includes areas with underground power installed as part of subdivisions). However, the report also showed that the average duration of outages in SUPP areas was 563 minutes, which was slightly longer than the average outage duration in non-SUPP areas of 504 minutes. As the non-SUPP areas include areas that were developed after 1992, which have underground power, these results are not necessarily showing that underground power results in longer outages.

Caution is also needed in drawing conclusions from the report since a SUPP area may still be supplied by an upstream overhead network, so that outages counted in SUPP areas may have been caused by overhead faults further up the distribution network.

Western Power customers who have experienced loss or damage because of a power interruption or surge can make a claim for compensation. Every claim is investigated by Western Power to determine the cause of the interruption or surge. However, Western Power will only compensate customers for loss or damage if it is the result of its negligence. If the damage was the result of factors outside Western Power's control, it is not required to pay any compensation.

Western Power customers who are affected by power interruptions that last 12 continuous hours or longer may be eligible for an $80 payment under the State Government's Power Outage Payment Scheme. This payment is available to electricity account holders who are on the SWIS and use less than 50MWh of electricity a year. This includes nearly all households and most small businesses.[69]

The number of claims paid under this scheme so far in 2010-11 is 22,910 and Western Power has paid $1,832,800 in compensation to customers. Storms in January and February of 2011 meant that 15,000 claims alone were paid from February to April 2011. In 2009-10, the number of claims was 34,067 and Western Power paid $2,725,360 in compensation to customers. The number of claims in 2009-10 was very high due to the severe storms that hit Perth on 22 March 2010. Before this date, 7,500 claims had been made during the year.[70] These compensation payments are actual costs incurred by Western Power, some of which might be avoided if there were fewer outages lasting for more than 12 hours when underground power is installed retrospectively.

However, it is worth noting that in a CBA, any avoided costs to Western Power from making compensation payments are just a transfer of benefits (or costs), rather than a net benefit. Money is just a way of quantifying consumers' valuation of a service (or the absence of a service for a period of time).

5.2.3 Submissions on Benefits to Western Power

Western Power submitted that the most important benefits to its network are:

- Network safety enhancement, through reduced programs of works to improve system safety, such as:
  - Reduction of the distribution network pole reinforcement and replacement program in the metropolitan area and regional centres; and

[68] Western Power, 2010, *State Underground Power Program Distribution Network Performance, March 2010 Storm*.

[69] Western Power's website.

[70] Information provided by Western Power.

  - Reduction of the overhead customer services replacement program.
- Network reliability, including:
  - Reduction in costs associated with power interruptions and storms.
- Reduction in maintenance costs, pole and conductor capital costs.
- Reduction in power line vegetation pruning costs and risks.[71]

Horizon Power submitted that it has undertaken many internal reports which compare the maintenance costs of overhead and underground systems, with all of them suggesting that underground network assets are more cost effective. Further, Horizon Power's view is that the whole of life costs for an underground network are superior to the equivalent overhead network.[72]

5.2.4 Authority's Assessment

Based on information provided by Western Power, the Authority has found that there are benefits to Western Power associated with the retrospective undergrounding of power through avoided operating and maintenance costs. These costs include lower vegetation management and storm repair costs for Western Power.

The value of the avoided maintenance costs can be quantified based on the information provided by Western Power, which estimated that the mean NPV of avoided costs to Western Power was equal to 10 per cent of total SUPP project costs. This estimate is the basis for the Authority's quantification of the benefits that accrue to Western Power as a result of the SUPP that are included in the CBA in section 6.2.4. However, this does not include any benefits (through additional avoided maintenance and network upgrade costs) that may accrue to Western Power from the improvements in the power quality performance (discussed below in section 5.4.1).

The Authority's view is that costs are avoided by Western Power when the reliability of the distribution network improves as a result of the retrospective undergrounding of power. These avoided costs (or benefits) to Western Power would be achieved through reduced compensation claims and payouts to affected customers, and the costs associated with processing and verifying claims. However, these avoided compensation payments are a transfer from one party to another, and have not been included as part of the benefits to Western Power in the Authority's CBA.

5.3 Benefits from Reduced Maintenance of Street Scapes and Verges to Local Governments

Underground power lines may require less maintenance of street scapes and verges, such as tree pruning, which would benefit local governments, who are responsible for the management of vegetation that has been planted or cultivated and is within a street verge, or Main Roads, where it is recognised as the relevant landowner or occupier.

[71] Western Power's submission on the Issues Paper, p4.

[72] Horizon Power's submission on the Issues Paper, p1-2.

However, the undergrounding of distribution lines may well result in additional costs to the community. In IPART's 2002 final report for its review into electricity undergrounding in NSW,[73] it was noted by the Local Government and Shires Association of NSW that:

> ...landscaping, tree planting schemes, replacement of public amenities such as drinking bubblers, bus shelters, and conveniences require design, capital expenditure and long term maintenance - costs which are indirectly part of the undergrounding program.

The Underground Power Program Team in Western Power has developed a model to estimate the reduced tree pruning costs associated with the retrospective installation of underground power.[74] Western Power noted that it is difficult to quantify the benefits from reduced tree pruning resulting from the installation of underground power, since the avoided costs are dependent on a number of factors specific to a particular area. For example, the types of trees and the number of trees under the power lines vary, as do the pruning requirements and contracted rates for street tree pruning by local governments.

Western Power also indicated that any reductions in street tree pruning costs may not be realised immediately after underground power has been installed. This is because alternative pruning techniques are often required for three to five years after underground power has been installed, to reshape the trees that were pruned under the overhead power lines for many years.

Nevertheless, Western Power has developed a model for a 1,000 lot project area to estimate the average reduction in tree pruning costs if underground power was installed retrospectively, using cost information collected from local governments. The model suggested that an average cost saving of around $13,350 per annum for local government was possible over a nine year period, and that by the end of approximately 49 years, the annual costs would equalise. This is because the trees that were previously below overhead power lines would be likely to require increased monitoring for health and safety reasons and require regular pruning, for example for property line and road clearances.

5.3.1 Submissions on Benefits to Local Governments

WALGA submitted that a preliminary investigation into the savings to local governments from reduced tree pruning shows that any savings are quite short-lived. While less tree pruning is required for several years after placing power underground, tree pruning will be required again to ensure that any trees on the verges remain healthy and safe.[75]

5.3.2 Authority's Assessment

The Authority's view is that there is a short term benefit to local governments as a result of a reduction in tree pruning costs when overhead power lines are replaced with underground power. This benefit is quantifiable and the estimated cost saving to local governments of around $13,350 per annum over nine years for a 1,000 lot project area, which has been estimated by Western Power, will be included in the CBA in the next section.

[73] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy*, p17.

[74] Western Power, November 2008, *Underground Power Program Review*, pp88-89.

[75] WALGA's submission on the Issues Paper, p5.

5.4 Benefits to Property Owners (Ratepayers)

There are a number of benefits associated with the SUPP that accrue to property owners, which are discussed in the following sections. They are:

- Improved reliability of the electricity network;
- Improved quality of the electricity supply;
- Improved amenity values; and
- Other benefits, such as reduced vegetation management costs and more efficient street lighting.

5.4.1 Quality of Electricity Supply and Reliability Benefits

The undergrounding of existing overhead power lines has the potential to improve the reliability of the electricity network, the quality of the electricity supply and energy security (the reliability of electricity during severe weather events, such as the storm that hit Perth in March 2010, and the wider impact it may have on the community).

Improved Reliability of the Electricity Network

Improvements in the reliability of electricity supply as a result of undergrounding electricity lines (through a reduction in outages during normal weather) may reduce the costs related to the unreliability of supply, such as the direct financial costs and inconvenience borne by customers when power outages occur. Submissions to IPART's review into electricity undergrounding in NSW highlighted the increasing importance of reliability as more people choose to work or study from home and require access to the internet and other computer services.[76]

As part of the work for the PCU Working Group, SKM[77] undertook a survey of electricity utilities to establish the number of interruptions per 100 kilometres of line each year for overhead and underground systems. The survey suggested that the ratio of interruptions between an overhead network and an underground network is about 3 to 1. However, the survey also indicated that customers are likely to be off-supply longer with an underground fault:

> The survey of utilities found that restoration for an overhead line fault averaged four hours, while the repair time for an underground cable fault could be up to 24 hours. If the underground system had an average outage duration of 24 hours, it would impose a higher cost on consumers than an overhead system with a four hour average outage (measured in terms of average annual costs). These results suggest that from a residential consumer's view the benefits of the improved reliability of underground systems may be outweighed by the costs associated with the extended duration of a typical underground outage.[78]

In the United States, the Edison Electric Institute (**EEI**) has examined six years of data on storm events to determine the trends and impact these events have had on the electricity industry. EEI found that the available reliability data demonstrated that major storm events can have a significant negative impact on the reliability of the electricity system.

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[76] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy*, p26.

[77] Sinclair Knight Merz, 1998, *Consultancy to Investigate Potential Benefits from Putting Cables Underground*.

[78] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group,* p62.

However, the reliability data indicated that underground power infrastructure only had a slightly better reliability performance than overhead infrastructure.[79]

In regard to comparisons of reliability data of overhead and underground infrastructure, the EEI noted that overhead and underground elements of a utility electrical system are not always independent of each other, since a large portion of underground systems are supplied by an overhead feeder.[80]

In Western Australia, the key reliability indicators that are used by Western Power are:

- SAIDI – the System Average Interruption Duration Index or the total of all customer interruptions (in minutes) divided by the total number of customers averaged over the year. This measures the total number of minutes on average that a customer is without electricity in a year.
- SAIFI – the System Average Interruption Frequency Index or the total number of interruptions divided by the total number of customers averaged over the year. This calculates the average number of times customers' supply is interrupted each year.
- CAIDI – the Customer Average Interruption Duration Index or SAIDI divided by SAIFI, which gives the average outage duration any customers' experience.

These are internationally accepted reliability indicators, which are calculated over a 12 month period to reduce any seasonal impacts.

The UPPT in Western Power has considered the reliability performance of distribution electricity systems before and after the installation of underground power, using the recent MRP in City Beach as a case study.[81] This project was completed in August 2006 and it is one of the largest projects that have been undertaken by the SUPP. The project installed underground power to 1,650 lots, or 89 per cent of the suburb, at a cost of $12.3 million.

The key findings of the case study were that for the suburb of City Beach:

- a 79 per cent improvement in the SAIDI reliability trend was observed after the installation of underground power;
- the underground power system has performed better than the old overhead system during severe weather events – data shows a 99.7 per cent reduction to storm related SAIDI contributions for similar storm events in the City Beach area prior to the undergrounding of most of the suburb's power lines;[82]
- an 83 per cent improvement in the SAIFI reliability trend was observed after underground power was installed;
- the average interruption time experienced by a customer increased by 60 per cent after the installation of underground power, but the number of customers experiencing an outage has fallen;
- conversion of entire high voltage feeders to underground has resulted in a 98 per cent improvement to SAIDI;

[79] Edison Electric Institute, December 2009, *Out of Sight, Out of Mind Revisited: An Updated Study on the Undergrounding of Overhead Power Lines*, pv.

[80] Ibid, p11.

[81] Western Power, November 2008, *Underground Power Program Review*, pp58-67.

[82] In 2005, a major storm contributed 187 SAIDI minutes from lightning induced outages, affecting 1,030 customers in City Beach. In 2007, a major storm contributed 0.4 SAIDI minutes from wind and debris induced outages, affecting 12 customers in City Beach. Ibid, p59.

- partial conversion of high voltage feeders to underground has had a limited impact on reliability performance and has actually led to a worsening in reliability performance due to faults on the overhead portion of the feeder;
- the average interruption time for an overhead protective device[83] is 60 per cent less than for an underground protective device; and
- the reliability improvement at the suburb level of 78 per cent has led to a reliability improvement of 27 per cent at the zone substation level (areas serviced by the same zone substation as City Beach) and a 0.24 per cent reliability improvement to Western Power's entire network system.

The UPPT's review of reliability performance in other suburbs where underground power has been installed also indicated a general improvement in SAIDI reliability trends.[84] Some of the other key findings from this review were that:

- a significant increase in underground power installed in a suburb is likely to lead to a relatively high reduction to SAIDI within that area;
- areas with high levels of underground power already will only have a marginal improvement in reliability when more underground power is installed, as defined by SAIDI;
- areas where only a small proportion of underground power is installed in an area which is largely supplied by overhead lines will only have a marginal improvement in reliability; and
- underground power installation in regional networks has a significant impact on system SAIDI reliability as the customer base is relatively small.

Halcrow considered the reliability characteristics of overhead and underground systems and analysed reliability information provided by Western Power on behalf of the Authority.[85] In its report, Halcrow concluded that undergrounding generally results in improved reliability, expressed as lower SAIDI and SAIFI. Maintainability is normally reduced due to underground cables being harder to access for repair, which results in a higher value of CAIDI.

The reliability data presented by Western Power[86] to Halcrow follows this pattern but gives superior results for reductions in SAIDI and SAIFI to those typically obtained. The probable reason for this over and above the inherent reliability advantage of underground power is that the Western Power's SUPP projects involve selecting older overhead areas with high SAIDI and replacing them with new underground systems. It is expected that the reliability of the underground system will deteriorate to some extent as it ages. However, Halcrow expects that the improvement in reliability will be sustained over the average projected life of the underground systems.

Other positive factors according to Halcrow are that improvements in the reliability of cables have occurred in recent years, and Western Power has developed particular expertise in cable selection and installation. In addition, improved reliability and safety in

[83] Protective devices, such as fuse disconnectors and drop out fuses, are applied to electricity systems to detect abnormal and intolerable conditions and to initiate appropriate corrective actions.

[84] Western Power, November 2008, *Underground Power Program Review*, pp67-72.

[85] Halcrow Pacific Pty Ltd, January 2011, *Inquiry into State Underground Power Program Cost Benefit Study - Technical Assessment: Final Report*, pp13-23.

[86] Detailed data on SAIDI, SAIFI and CAIDI for six areas that were undergrounded in Round 3 of the SUPP Program.

regard to storms, bushfires, danger from fallen wires and pole-top fires are significant factors favouring undergrounding.

In respect of the accuracy of reliability data, Halcrow did not undertake a detailed audit down to individual event level of the information provided by Western Power. An analysis of a sample of monthly level data has, however, confirmed that Western Power has correctly analysed the data to determine the reliability performance characteristics (SAIDI, SAIFI and CAIDI).

The Authority requested additional reliability performance information from Western Power to analyse the reliability performance of distribution electricity systems before and after the retrospective installation of underground power.

In response, Western Power provided information on the reliability performances for a selected number of suburbs that are predominantly or partially undergrounded due to SUPP projects as well as for adjacent or nearby suburbs that are predominantly supplied by overhead power (as at December 2010). The summary of this analysis, which is based on 48 months of annualised performance to December 2010, is provided in Table 5.3 below. The performance ratio is the ratio of the performance of suburbs with underground power versus the performance of suburbs with overhead power. Where the ratio is below 100 per cent, the underground power suburb performance was better than in the nearby suburb with mostly overhead power.

Table 5.3 Selected Suburb Reliability Performance Summary

Suburb (showing percentage of underground conductors)	Distribution Unplanned Outages*			Normalised Unplanned Outages		
	SAIDI	SAIFI	CAIDI	SAIDI	SAIFI	CAIDI
Trigg (23%)	426	3.18	134	265	2.86	93
City Beach (98%)	39	0.28	139	34	0.28	122
Performance Ratio	*9%*	*9%*	*104%*	*13%*	*10%*	*132%*
Maylands (38%)	141	1.31	108	127	1.19	107
Highgate (81%)	77	0.58	132	64	0.53	121
Performance Ratio	*55%*	*45%*	*123%*	*50%*	*44%*	*113%*
Mount Hawthorn (32%)	162	1.50	107	159	1.50	106
West Leederville (89%)	53	0.21	252	53	0.21	252
Performance Ratio	*33%*	*14%*	*234%*	*34%*	*14%*	*238%*
Kelmscott (19%)	689	6.94	99	481	6.35	76
Gosnells (55%)	240	2.65	91	176	2.46	72
Performance Ratio	*35%*	*38%*	*91%*	*37%*	*39%*	*94%*
Kensington (38%)	132	0.67	197	60	0.64	94
Como (84%)	82	0.77	106	67	0.73	92
Performance Ratio	*62%*	*115%*	*54%*	*113%*	*115%*	*98%*
All sample OH power suburbs (29%)	**323**	**3.05**	**106**	**238**	**2.81**	**85**
All sample UG power suburbs (77%)	**136**	**1.39**	**98**	**104**	**1.29**	**80**
Performance Ratio	***42%***	***45%***	***92%***	***44%***	***46%***	***95%***

*The distribution unplanned figures include outages from 14 major event days, which are usually excluded from reliability performance measures, which are normalised.

Source: Western Power

This analysis indicates that the customers in most of the underground power suburbs experienced a lower number of minutes on average without electricity in a year than the customers in the overhead power suburbs (SAIDI measure). The results are similar for the number of outages that customers experience each year (SAIFI measure).

However, in three of the five sample suburbs, the average duration of outages increased in the underground power suburbs, although the overall results showed that the length of outages in the underground power suburbs and overhead power suburbs were almost the same (CAIDI measure).

As part of the response to the Authority's request for additional information, Western Power provided additional reliability data[87] for the last two suburbs that had projects completed in Round 3 of the SUPP: Victoria Park South and Wembley Downs.

The effect of undergrounding the distribution network on reliability measure for these two suburbs is shown in Table 5.4 below.

[87] Western Power (2010), Supplementary information regarding performance of the SUPP program for the ERA, section 4

Table 5.4 Reliability measures for Victoria Park South and Wembley Downs, pre and post undergrounding of the distribution network

Reliability measure	Victoria Park South	Wembley Downs
SAIDI (duration of interruption in minutes per connection per year)		
Prior to undergrounding	231	63
After undergrounding	5	20
SAIFI (frequency of interruption per connection per year)		
Prior to undergrounding	2.85	0.62
After undergrounding	0.03	0.09
CAIDI (duration in minutes per interruption)		
Prior to undergrounding	81	102
After undergrounding	146	217

Source: Western Power

This reliability data follows the same trends as have been observed in earlier analysis of Western Power's SUPP program. Typically, post undergrounding, suburbs demonstrate improved reliability through the lowering of SAIDI and SAIFI measures. For example, in Wembley Downs, SAIDI (the average duration of an interruption per connection) reduced by 68 per cent after the distribution network was undergrounded. Similarly, the SAIFI measure indicates that the frequency of interruptions per connection for Victoria Park South reduced by just under 100 per cent following undergrounding. However, the CAIDI measure, which is the average duration in minutes per interruption, tends to increase. This results from interruptions on the underground network, when they do occur, taking longer to locate and to access for repair. Both Victoria Park South and Wembley Downs showed increases in CAIDI, from 81 minutes to 146 minutes and 102 minutes to 217 minutes respectively.

Including results from these two suburbs into the average of selected suburbs for Round 3 of the SUPP project lowers the averages for each reliability measure further as shown in Table 5.5 below.

Table 5.5 Updated reliability measure averages including Victoria Park South and Wembley Downs

Reliability measure averages	Prior to undergrounding*	After undergrounding**	After undergrounding – updated***
SAIDI (minutes per year)	202	60	52
SAIFI (interruptions per year)	1.82	0.67	0.57
CAIDI (minutes)	111	91	92

* Data for 24 months prior to undergrounding
** Data for 24 months to September 2011
*** Data for 24 months to December 2010

Source: Western Power and Halcrow Final Report, p20

Reliability measure averages also demonstrate reductions in SAIDI and SAIFI pre and post undergrounding. The average CAIDI figure, contrary to the trend in most suburbs, also shows a reduction after undergrounding.

In conclusion, Western Power's reliability indicators (SAIDI, SAIFI and CAIDI) show that there have been improvements in the reliability of the suburbs that have participated in the SUPP and have a large proportion of underground power. The improvements have been greater than has been observed elsewhere according to Halcrow, which is most likely due to the fact that the SUPP has resulted in the replacement of some of the oldest and least reliable overhead infrastructure in the Perth metropolitan area with new underground power infrastructure.

Quality of Electricity Supply

Quality problems occur when there are variations or fluctuations in the energy supply. Power doesn't go out altogether, but lights may dim and appliances may work intermittently or burn out. Energy losses[88] may be reduced if electricity lines are placed underground, but this is likely to depend on the load densities in specific network segments, particularly the design and spare capacity of the networks.[89]

In the report prepared by the PCU Working Group,[90] it was estimated that the savings of electrical energy through a reduction in losses as a result of putting the cables underground would be approximately 0.3 kilowatt hours per day for a typical domestic electricity customer. However, this figure only provided an indication that there would be reduced electrical loss when overhead cables are replaced underground, and was not included in the CBA of placing cables underground.[91]

Western Power has suggested that conversion of high and low voltage overhead distribution networks to underground systems can have a significant beneficial impact on power quality performance indicators such as voltage regulation and line losses. The key findings from Western Power's studies were that:[92]

- Power system modelling of a high voltage distribution network in the City Beach area before and after the installation of underground power has confirmed an improvement in network performance when demand on the network is the greatest.
  - Voltage levels across the new underground system have improved to a point where no locations within the project area violate the permissible voltage drop limit of minus 5 per cent from the nominal.[93] The voltage varies on a power system depending on the size and location of loading, and the route the power has to travel from generation to load. Normally, if the voltage at any point on a network rises above 110 per cent or drops below 90 per cent, the quality of power delivered is unacceptable as it may cause damage to

[88] As current passes through the conductors in electricity cables, they heat up due to the resistance of the conductor. This heating effect consumes energy, which cannot be delivered elsewhere and therefore represents a loss.

[89] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy*, p28.

[90] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group,* p74.

[91] This figure was not to be used to calculate losses for any particular undergrounding scheme, since the load and loss factors will vary for different localities as will the cross sectional area of the cables, the load and the configuration of the load.

[92] Western Power, November 2008, *Underground Power Program Review*, p81 and p86.

[93] The voltage the electricity grid is designed to operate at is referred to as nominal voltage. Nominal voltage can also be referred to as 1 per unit (pu) or 100 per cent (of nominal voltage). When a point at the grid is operating at 1.05pu or 105 per cent, this means that the voltage measured at that point is 5 per cent higher than the nominal voltage. Source: Western Power, May 2008, *Generator Grid Connection Guide: An Introduction to Power Systems and the Connection Process*, p7.

connected equipment. Closer to the power consumer, the range of acceptable voltage variation during normal operation decreases to plus or minus 6 per cent.[94]

  - Underground replacement of distribution systems in areas of existing poor voltage regulation may offset the requirement for network voltage improvement devices such as voltage regulators or capacitor banks.
  - Further system simulations have also confirmed that the new underground distribution system is more efficient and that there has been a 27 per cent reduction in line losses in the case study area examined. Cost savings to Western Power due to these line loss reductions is estimated at approximately $20,000 per annum. One of the benefits to Western Power is the avoided costs associated with the maintenance and upgrade of networks that are inefficient in delivery of power.

- Power system modelling of a low voltage distribution network in the Palm Beach area before and after the installation of underground power has confirmed an improvement in network performance when demand on the network is the greatest.
  - Voltage levels across the new underground system have improved to a point where no locations within the project area violate the permissible voltage drop limit of minus 6 per cent from the nominal voltage.
  - Further power system modelling has also confirmed that the new underground distribution system is more efficient and that there has been a 61 per cent reduction in line losses in the case study area examined. Cost savings to Western Power due to these line loss reductions is estimated at approximately $54,200 per annum, reflecting the avoided maintenance and network upgrade costs.

Western Power's case studies show that underground power has improved the quality of the electricity supplied to customers in areas that have participated in the SUPP, as there are fewer instances of lights dimming and appliances burning out. There are also benefits to electricity customers in the SWIS resulting from lower electricity bills when line losses are reduced, since generators are likely to generate and send out less electricity than before. Western Power benefits as well, through avoided maintenance and network upgrade costs to meet its electricity supply quality requirements.

Submissions on Quality of Electricity Supply and Reliability Benefits

Horizon Power submitted that the exceptional reliability improvement in Port Hedland following undergrounding of the distribution network (during round three of the SUPP) should be noted. There have been virtually no power outages since undergrounding was completed, even though a number of cyclones have passed through Port Hedland since then.[95]

Authority's Assessment

The key objectives of the SUPP included improved system reliability and reduced distribution losses. The Authority has reviewed information provided by Western Power and Halcrow to assess how the SUPP has affected the quality of electricity supply and reliability performance.

[94] Ibid, p7.

[95] Horizon Power's submission on the Issues Paper, p1.

It is the Authority's view that the SUPP has resulted in reliability improvements, due to the lower number of outages that affect electricity customers living in suburbs with underground power. However, it is noted that these benefits to customers are likely to be reduced over time, as the underground power assets age and become less reliable.

The information provided by Western Power seems to indicate that although the average duration of outages has been longer for customers with underground power in many of the areas that have been part of the SUPP, overall the duration of outages seems to be similar for areas with underground and overhead distribution systems. It is also difficult to establish whether the outages in areas with underground power are due to faults on the underground network or the upstream overhead network that supplies electricity to the SUPP areas. The Authority is therefore of the view that underground power does result in improved reliability to ratepayers who live in the suburbs that have participated in the SUPP and have a large proportion of underground power. It is not possible to conclude at this stage that the benefits associated with a reduction in the number of outages are offset by the longer duration of outages when they do occur. The benefits from improved reliability to ratepayers are assumed to be capitalised into higher house prices, which is discussed further in section 5.5.2 below.

The Authority's view is that retrospective undergrounding of power is also likely to result in improvements in the quality of electricity supply. This benefits the individual ratepayers in a SUPP area, Western Power and the wider community through lower electricity bills (as generators need to generate and send out less electricity when line losses are reduced). However, the Authority notes that any quality improvements vary significantly between areas and they are difficult to measure.

5.5.1 Other Benefits

The other benefits that may accrue to property owners are outlined in the following sections.

Reduced Vegetation Management Costs

If there are power lines in a street verge, it is the responsibility of the owner or occupier of property adjacent to the verge to ensure that the vegetation within the property is kept well clear of power lines in the street verge.[96] Property owners or occupiers may also benefit from a reduction in vegetation management costs when underground power is installed.

Improved Street Lighting

When an area is converted to underground power by the SUPP, new street lights are designed and installed to meet Australian Standard AS1158. These new street lights have more efficient fixtures and optimised spacing, which delivers brighter and more evenly lit streets, providing up to 15 per cent more efficient street lighting.

Lights are more closely spaced than on overhead electricity poles, with alternating positioning on both sides of the road closer to curbs. As mentioned above, the new street light poles are collapsible, which is much safer in the event of a motor vehicle collision.

Improved street lighting might also enhance the local security of an area, which could benefit the property owners or occupiers living in an area that has underground power.[97]

[96] Information from Western Power.

[97] Information from Western Power.

Submissions on Other Benefits

WALGA submitted that anecdotal evidence suggests that improved street lighting has been linked to higher rates of exercise, leading to improved health outcomes and reduced use of cars, leading to broader environmental benefits. It was recommended that the Authority should investigate the potential benefits to community health from higher exercise rates arising from improved street lighting.[98]

Authority's Assessment

The Authority's view is that there is likely to be a short term benefit to residents of properties through a reduction in costs to maintain vegetation adjacent to verges when overhead power lines are placed underground.

The Authority accepts that there are some benefits to the residents from the installation of more efficient street lights when underground power is installed. These benefits are assumed to be captured in any increases in residential property values, which are discussed next.

5.5.2 Residential Property Values

One of the key benefits of undergrounding existing overhead power lines is the improved aesthetics, through the removal of poles and wires and the planting of more trees which improves the visual amenity and streetscapes of suburbs. However, aesthetic benefits tend to be difficult to quantify, although they may contribute to higher property values in areas where overhead distribution lines have been replaced with underground cables.

In this section, the Authority considers if all or some of benefits of the SUPP to ratepayers have capitalised into higher house prices. Since residential property values increase due to a number of factors other than the presence of underground power, the Authority has attempted to establish what amount is due to the undergrounding of existing overhead power lines.

The Authority has assumed that most of the benefits that accrue to ratepayers, which are discussed in the previous sections, are captured in higher house prices. However, it is likely that there are some benefits that are not captured, or only partially captured, in house prices. As a result, the benefits to ratepayers are likely to be higher than any value that can be estimated from increases in house prices in areas that have participated in the SUPP.

A study which examined house prices and underground electricity distribution lines in three selected suburbs in Canberra in 2009 found that the presence of underground power increased house prices by 2.9 per cent. At the median house price used in the study of $404,000, the value of underground power was estimated to be around $11,700.[99]

In the 1998 report by the PCU Working Group, specific reference was made to the effect of underground power on the Western Australian property market. The Western Australian Valuer-General concluded that underground power would, on average, increase property values between 1.25 per cent and 2.5 per cent, up to a maximum of

[98] WALGA's submission on the Issues Paper, p5.

[99] McNair, B, (2009), *House Prices and underground electricity distribution lines: the case of three selected suburbs in Canberra.* Occasional Paper No. 13, Crawford School of Economics and Government, the Australian National University.

5 per cent. However, the Valuer-General warned against using averages as opposed to examining property value impacts for each different location as a means of identifying the likely level of benefits.[100]

A report on undergrounding both electrical transmission and distribution lines in Hawaii, prepared for the Hawaiian State Senate by the State's Legislative Reference Bureau of the State of Hawaii, found that the data on changes in property value due to undergrounded utilities were inconclusive regarding whether or not there is actually a measurable impact. One local study found no impact while another assumed there would be improved property values.[101]

The Authority engaged MJA to establish whether or not property values in areas with underground power are higher, or rose relative to the rest of the market when underground power was installed, than in similar areas with no underground power (e.g. by looking at a suburb where underground power has been installed in some areas but not in others). MJA's report on how underground power has affected house prices and the method that was used to estimate the value of underground power to ratepayers is available on the ERA's website.

The results of MJA's study of Perth property prices, to establish the value of underground power, are summarised in Table 5.6 and Table 5.7.

Table 5.6 Variability in the Value of Underground Power (2000 to 2010)

Variable	Value ($, Real)
Minimum	6,214
Mean	9,962
Standard deviation	2,613
Maximum	14,069
Mean sale price	389,620

As can be seen in Table 5.6, the mean value of underground power to ratepayers as measured by increased house prices is $9,962. However, Table 5.7 below shows that there is a difference in the value of underground power between properties depending on the value of the property. This could be due to the fact that people who own high value properties may value underground power more than people in low value properties.

[100] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group*, p72.

[101] Martin, Pamela, 1999, *Undergrounding Public Utility Lines*, Honolulu, HI: Legislative Reference Bureau.

Table 5.7 Variability in the Value of Underground Power by House Price

House Value ($, Real)	Mean Value of Underground Power ($, Real)	Percentage of Mean Sale Price	Percentage of Properties in the Price Range
0 - 299,999*	na	na	35.2%
300,000 - 499,999	4,840	1.2%	43.5%
500,000 - 699,999	14,210	2.4%	15.2%
700,000+	29,590	3.5%	6.1%
389,620 (mean sale price)	9,962	-	-

* As the majority of the suburbs that have been involved in SUPP to date are in the top 10th percentile for median house prices in 2010, the mean value of underground power for properties valued at less than $300,000 is statistically insignificant.

The potential increases in property values might also vary between different areas, depending to some extent on the supply and demand of properties in a particular area.

Willingness to Pay

Where there are no established prices in the market, surveys of willingness to pay can provide an indication of how much a good or service is worth. In this analysis, the ratepayer surveys as part of the SUPP process can provide a useful check of the Authority's calculation of the benefit that is capitalised into house prices. Additionally, they also examine the willingness to pay of existing residents, rather than only the new residents who have purchased a property. The surveys also have consequences in terms of the respondent having to pay for underground power if enough people want it, which reduces the incentive for people to free ride.

In regard to underground power, the surveys can provide information about how much each beneficiary values the unquantifiable benefits of underground power. For example, it may not be possible to value all of the aesthetic benefits to the local community and the wider community, which is often one of the key reasons for undergrounding, but in many cases people are willing to pay the additional costs of placing distribution lines underground.

The results of the ratepayer surveys provide some information about how much households value underground power, even though they do not show how much each household is willing to pay, which would have been a more useful approach to determine the value of underground power. Instead they show the percentage of residents who are willing to pay the ratepayer contribution for the particular SUPP project (50 per cent of the total project cost).

For example, a survey was undertaken by affected property owners in the Town of Vincent in 2006 regarding the undergrounding of power in Highgate East. The majority of the property owners (82.9 per cent) supported the installation of underground power, and 77.6 per cent of the respondents indicated that they would pay to have the power lines placed underground. This survey also showed that a higher proportion of non-pensioners (79.6 per cent) would be willing to pay for underground power when compared to pensioners (54.8 percent).[102]

In addition, this survey showed that just over half of the respondents (50.4 per cent) would prefer to make an upfront payment for the underground power, with no interest fee. A

[102] Information from the Office of Energy.

three year payment option was the second most popular payment preference (18.2 per cent), while a five year payment option was the third most popular payment. The least popular payment option was a seven year payment option.

Survey Results from Round Five of the SUPP

Western Power engaged Data Analysis Australia during the round five selection process, to conduct a survey of rate payers in 18 proposed project areas (only ten of these proposed projects have been short listed) to assess their support for contributing towards the costs of underground power in their area. The survey was conducted through a mail out, and the response rate was 53 per cent from all of the proposed project areas.

The following questions were asked in the survey, which was sent out by the local governments of the proposed project areas:

- **Question 1**: Are you generally in favour of underground power in the proposed project area?
- **Question 2**: Installing underground power would cost property owners on average $x,xxx for a typical single residential property. [Optional Sentence: The $xxx,xxx being contributed by the <<CouncilName>> will reduce the amount payable for a typical single property to around $x,xxx.] The amount would generally be less for units in multi-unit developments. Costs for commercial properties would generally be greater than for a single residential property. If the project goes ahead, underground power would be installed for all properties in the area.
  - Given the choice, which of the following options do you prefer?
    - Option 1. To pay this amount to get underground power in my area.
    - Option 2. To NOT pay this amount, and keep the existing overhead power supply.

The results of the main question in the survey (question 2) to ascertain the rate payers' willingness to contribute financially to the proposed underground power projects showed that out of the ten short listed projects, Salter Point in the City of South Perth had the most support (86 per cent willing to pay a contribution to get underground power installed in their area). Coolbellup East had the least support from rate payers for the project out of the short listed areas in round five, with 62 per cent willing to pay to get underground power installed in their area.

Table 5.8 shows the proportion of rate payers who are generally in favour of underground power in the short listed project areas, as well as the proportion of ratepayers who are willing to contribute to the cost of installing underground power in their areas (each council provided the average cost to rate payers to have underground power installed for a single residential property in the surveys that were sent out).

Table 5.8 Rate payers in Favour of Underground Power and Willingness to Contribute to Projects

Area Name	Estimated contribution from ratepayers ($ August 2010)	Ratepayers in favour of underground power (per cent)	Ratepayers willing to pay to get underground power (per cent)	Median house prices (year to March 2011) ($)
Salter Point	4,300	90.2	86.0	915,000
Coolbinia	5,100	85.8	78.7	1,025,000
Ardross West	4,000	85.1	80.4	885,000
Shoalwater	4,600	81.4	76.8	425,000
Ashfield	3,900	80.0	72.9	435,000
Lathlain North	4,200	79.0	72.8	625,000
Wilson East	4,200	77.8	68.6	515,000
Lathlain South	4,200	77.3	68.2	625,000
Hamilton Hill	4,200	76.2	72.6	474,000
Coolbellup East	3,900	69.6	62.4	400,000

Source: Data Analysis Australia & REIWA Median House Prices, 1 April 2010 to 31 March 2011

The survey also asked what the preferred payment option was for ratepayers in each area if the underground power project proceeded. Most of the respondents preferred to spread the cost of underground power over a number of years (seven years received the highest proportion of support in the short listed project areas).

A key issue for this inquiry is that property owners in higher income suburbs may have a higher willingness to pay for underground power than in areas where property owners have lower incomes. This was found in MJA's hedonic analysis of house prices and is confirmed by the survey data. If the provision of underground power was not delivered through a subsidised government program, this would not be an issue. However, the current funding arrangement of the SUPP does raise the issues of why a Government contribution should go to some of the (on average) wealthiest households in Perth. This is discussed further in section 6.4.

IPART concluded that an estimation of consumers' willingness to pay for underground power is the only appropriate method for assessing the community's value of the unquantifiable benefits of underground power.[103]

A paper on households' willingness to pay to underground existing distribution lines in Canberra was released in May 2010.[104] Using a stated choice survey to estimate the willingness to pay for undergrounding in established residential areas in Canberra, it was concluded that the average willingness to pay is at least $6,838 per household. There is however a significant variation in preferences over the population and the results suggested that benefits would be highest in areas with higher household income and older residents, where the visual amenity, safety, tree trimming or restrictions on the use of yard space are of concern.

[103] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy,* ppiv.

[104] McNair B.J., Bennett J. and Hensher D.A. (2010), *Households' willingness to pay for undergrounding electricity and telecommunication wires*. Occasional Paper No. 15, Crawford School of Economics and Government, The Australian National University.

Interestingly, in the US state of Virginia, analysis showed that undergrounding of distribution lines would require an additional payment of $US3,000 per year from each customer, but the willingness to pay of the customers was only estimated at around $US180 per year.[105]

While the information on consumers' willingness to pay for underground power is not conclusive, it supports the conclusion of MJA's analysis of house prices.

Submissions on Residential Property Values

The EMRC submitted that if the property value benefit can be quantified and realised, it would provide a much greater incentive for property owners to want to invest in underground power. This additional value could be incorporated into funding options for property owners who wish to defer the cost of undergrounding power until the property is sold. The EMRC therefore recommended that further research should be undertaken by the Authority to quantify if underground power does provide a tangible benefit in increased property values, and if this value will be sustained.[106]

Authority's Assessment

The Authority's view is that all of the benefits that accrue to property owners, such as improved amenity, greater reliability, improved quality supply and lower vegetation management costs, are capitalised into higher property values when existing overhead distribution lines are placed underground. The estimated mean value of underground power to ratepayers, as measured by increased house prices, is $9,962. This estimate will be used to establish the total value of the benefits that have accrued to property owners as a result of the SUPP.

However, the Authority notes that there is a difference in the value of underground power between properties depending on the value of the property, and that owners of high value properties have benefited more from the SUPP than owners of lower value properties. This result is relevant to the discussion in section 6.3, where the Authority considers the extent to which different groups benefit from the SUPP and what the appropriate funding arrangements for SUPP projects should therefore be.

5.6 Benefits to the Wider Community

One of the key objectives of the SUPP included improved energy security of the electricity distribution system, which would benefit the wider Western Australian community. This benefit, as well as the other benefits that are likely to accrue to the wider community, are discussed in the sections below.

5.6.1 Widespread Electricity Outages and Secondary Community Impacts (Energy Security)

Energy security is concerned with the reliability of electricity during severe weather events, such as the recent storm that hit Perth in March 2010, and the wider impact it may have on the community. During severe weather events, underground cables are less likely to be damaged than overhead lines and may therefore provide greater security against widespread power supply failures and secondary community impacts. For example,

[105] Commonwealth of Virginia State Corporation Commission, 2005, *Placement of Utility Distribution Lines Underground, Report to the Governor and the General Assembly of Virginia*, Richmond, Virginia.

[106] EMRC's submission on the Issues Paper, pp8-9.

cyclone Clare caused so much damage to the electricity distribution system in Pannawonica in 2006 that the town had to be evacuated, due to the impact this had on the supply of water, fresh food, fuel, telecommunications and waste water treatment.[107]

Authority's Assessment

The improvements in energy security that may benefit the wider community are difficult to measure, and it is not clear to what extent the SUPP has improved the energy security for people that live in the area supplied through the SWIS. In areas that are affected regularly by cyclones, such as Port Hedland, an improvement in energy security through the undergrounding of power is likely to result in benefits to the wider community. As the cost benefit is restricted to the SWIS, where severe weather events are not as common as in the areas outside of the SWIS, the Authority's view is that there may be a small, non-quantifiable benefit associated with improved energy security to the wider public.

It is also likely that energy security in the Perth metropolitan area would be improved, especially if the entire distribution network was undergrounded. However, as indicated by the reliability data in section 5.4.1, the SUPP seems to have benefited the residents of the SUPP areas during severe weather events. There are also likely to have been some benefits to the wider community, as there are now fewer areas that have overhead power cables with faults that Western Power crews need to focus on after such an event.

5.6.2 Health and Safety Benefits

There are potential health and safety benefits from the undergrounding of electricity lines as well, such as a reduction in electrical contact injuries, reduction in motor vehicle accidents involving electricity poles, and from a health and environment perspective, there may be a reduction in both vegetation-management and pole-protection herbicide and pesticide use. These potential benefits are discussed separately below.

Reduction in Electrical Contact Injuries

There is likely to be a reduction in accidental live-wire contact, which can occur when electricity workers or members of the general public come into contact with overhead cables. It is believed that there is less chance of live-wire contact when cables are placed underground, although there is a potential for people to dig into the underground cables. There is a program in place called "dial-before-you-dig", which informs people where the underground cables are buried, as well as water, sewerage and gas pipes, to prevent this from happening.

The PCU Working Group found that data available to the working group on the incidence of electrocutions for overhead and underground electricity networks was inconclusive. The relative safety of networks depends on a number of factors and the working group did not consider that any potential changes in the number of electrocutions from putting cables underground was quantifiable on the available evidence. [108]

Reduction in Car to Pole Accidents

From a safety perspective, underground power may result in avoided costs to the community, as the removal of electricity poles for overhead lines is likely to reduce the severity of motor vehicle accidents. However, street light poles will still be located on

[107] Information from the Office of Energy.

[108] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group*, p74.

verges, but these are designed to be collapsible in the event that a motor vehicle hits them.

The Office of Road Safety (**ORS**) in Western Australia reports that poles and other roadside objects are a significant hazard. In 2004, 21 per cent of metropolitan serious crashes and 41 per cent of rural serious crashes involved a single vehicle hitting a roadside object. According to the ORS:

> Poles concentrate collision energy, causing great damage and more intrusion into the body of the cars. The introduction of underground powerlines will reduce the number of roadside poles. Main Roads is tackling the issue of roadside poles with new technology where possible, such as the use of slip base poles which sheer away at the base when they are hit, and safety barriers. Improvements to the roads are being targeted towards roads with high traffic rates and high crash rates.[109]

The total value of reduced motor accidents resulting from putting cables underground was considered as part of the quantifiable benefits by the PCU Working Group. A consultant (BTCE) was contracted to examine the total net benefits to be gained from removing poles without street lights on them across urban Australia.[110]

Based on available data, the report by the BTCE estimated that the net benefits arising from the reduction in motor vehicle accidents caused by collisions with poles would be about $105 million each year. In addition, if the current rigid poles carrying street lights were replaced with 'collapsible' poles, it was estimated that there would be a further saving of about $57 million a year (in 1997 dollars). The additional expenditure for replacing the light poles was estimated to be about $1 billion.

The BTCE estimated savings associated with undergrounding cables by determining:

1. the cost (medical and property costs for all stakeholders) of each type of accident (fatality, serious injury, non-serious injury etc.) using data from jurisdictions;
2. the prevalence of each type of accident in major urban areas of Australia based on data from jurisdictions (no reliable rural data was available); and
3. the total cost of pole related vehicle accidents by multiplying the cost of each accident by it prevalence.

The PCU Working Group noted that it was widely acknowledged that the number of street trees planted would increase when overhead cables are removed. The BTCE's study assumes that such trees would not contribute at all to collisions because of the relatively small size of their trunks. However, to the extent that additional large trunk trees were planted, they would in time contribute to the number and cost of collisions. As a result, the PCU Working Group recognised that the maximum saving estimated by the BTCE at $162 million per annum, based on the assumption that additional trees planted would not contribute to collisions, was on the high side.[111]

Environmental Impacts

Underground power also has the potential to reduce negative impacts on the environment as well. When the electricity poles are removed, there may be a reduction in the amount

[109] http://www.ors.wa.gov.au/Documents/FinalThemes.pdf (Road Safety Council Response to Community Comment, p10.)

[110] Bureau of Transport and Communications Economics, *The Extent of Reductions in the Number and Severity of Motor Vehicle Collisions with Power Poles Following an Undergrounding of Cables*, 1998.

[111] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group*, pp59-60.

of pesticide and herbicide used to protect the poles and maintain the verges. For example, the wooden electricity poles used for overhead cables are treated with pesticide to prevent termite activity. The ability to plant more trees on the verges may also have environmental benefits, as it might provide additional wildlife habitats.

Another potential environmental outcome of replacing overhead distribution cables with underground power is a reduction in greenhouse gas emissions, due to the savings in transmission losses (discussed in section 5.4.1), which would require less consumption of fossil fuels to generate electricity. However, any reductions in greenhouse gas emissions may be offset by the increased greenhouse gas emissions produced during the manufacturing and installation of the underground distribution system components that replace an asset that may still have a considerable working life remaining. Consequently, it is unclear whether or not there are any reductions in greenhouse gas emissions from placing electricity cables underground.[112]

Submissions on Health and Safety Benefits

WALGA submitted that the provision of underground power can be catalytic in enabling achievement of other benefits such as enhanced and more energy efficient street lighting. This would contribute to the achievement of other State and Federal Government objectives, including reduction in greenhouse gas emissions (from improved energy efficiency), improved feelings of community safety and health benefits from encouraging more physically active lifestyles. In addition, the opportunity for increased tree plantings in the road reserve would provide important habitat for wildlife and contribute to broad environmental and biodiversity objectives.[113]

Authority's Assessment

The Authority's view is that any reductions in electrical contact injuries resulting from retrospective undergrounding of power may be partly offset by injuries from people digging into the underground cables. However, there is no data available to establish if there have been reductions in electrical contact injuries as a result of the SUPP.

The Authority has examined overhead power connection data and road crash statistics to determine whether the undergrounding of overhead power distribution assets is a significant contributor to improved road safety. Improved road safety may refer to either a reduction in the total number of incidents or a reduction in the severity of accidents. The Authority utilised panel data on the frequency of vehicle crashes involving a power pole to test whether a reduction in the number of overhead connections resulted in a statistically significant reduction to the number of accidents.

A sample of 38 suburbs was considered on an annual basis over the period 2006 to 2010. Western Power provided data on the number of overhead assets in the relevant suburbs over the sample period. Data on the frequency, location and type of accident in the Perth metropolitan area was provided by the ORS. The ORS also provided information on the type of vehicle crashes, being disaggregated into four categories based on severity. The categories included:

[112] Ibid, p74.

[113] WALGA's submission on the Issues Paper, Executive Summary.

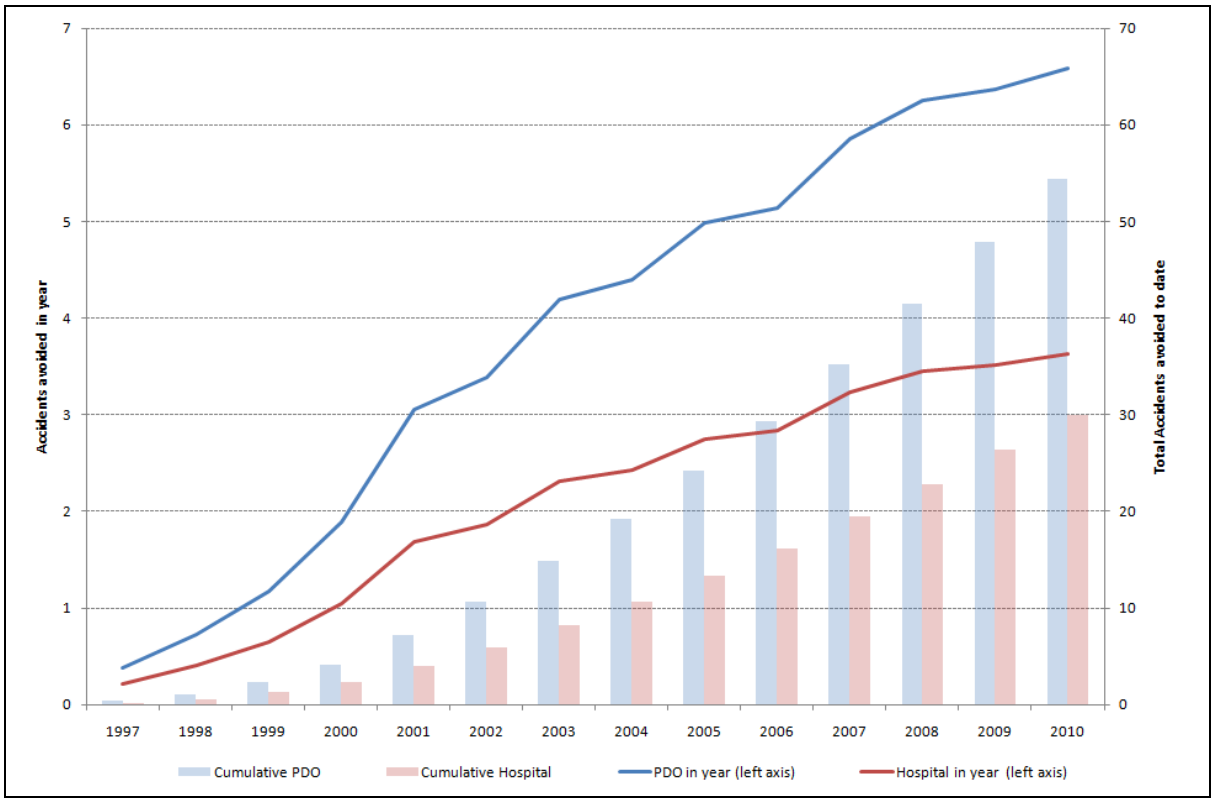
- Type 1: Property damage only (**PDO**);
- Type 2: On-site medical attention required;
- Type 3: Hospitalisation required; and
- Type 4: Fatality

A model was created from the vehicle crash and overhead connection data, which was structured to assess the impact of a change in the number of connections within a suburb on the frequency of vehicle crashes. The results of the modelling exercise indicated that there was a statistically significant relationship between the number of overhead power connections and the frequency of type 1 and type 3 crashes. More information about this model is provided in **Appendix D**.

The model showed that in order to reduce the number of type 3 accidents (where hospitalisation is required) by one in a single year, 20,446 overhead connections would need to be converted to underground connections for a single year. At the moment, approximately 2,000 residences are converted to underground power as part of the SUPP each year.

Based on an extrapolation of the results from the model, Figure 5.1 below provides an estimate of the avoided number of accidents on a per-annum and cumulative basis for type 1 and 3 crashes as a result of the SUPP.

Figure 5.1 Estimated Number of Motor Vehicle Accidents Avoided as a Result of the SUPP (Annual and Cumulative Impacts)



Note: The Authority recommends that these values be treated with caution, as they reflect a probabilistic interpretation of accident frequency.

Source: ERA analysis, based on information provided by Western Power and the Office of Road Safety.

The Authority estimates that approximately 30 accidents in the Perth metropolitan area that would have required hospitalisation have been avoided as a result of the SUPP over the period 1997 to 2010. In regard to accidents resulting in property damage only over the same period, it is estimated that around 55 of these crashes with power poles have been avoided.

While there is no information about the severity of property damage or injuries requiring hospitalisation that have been avoided, the Authority has estimated the financial cost that has been avoided as a result of fewer accidents requiring hospitalisation, assuming that one person involved in each accident would be seriously injured.

Based on the ORS estimate that each serious injury has a financial cost of around $445,000,[114] the avoided cost to the wider community has been estimated at $13.4 million in present value terms since the SUPP was introduced in 1996.

In regard to the potential reduction in environmental impacts when power is undergrounded, although there is no data available for analysis, the Authority's view is that there is likely to be a qualitative benefit to the wider community from the SUPP.

5.7 Draft Findings

Benefits of Retrospective Undergrounding of Power

Benefits to Western Power

3) There are quantifiable benefits to Western Power associated with the retrospective undergrounding of power through avoided operating and planned and unplanned maintenance costs. These avoided costs include lower vegetation management and storm repair costs for Western Power.

4) The avoided maintenance and network upgrade costs to Western Power that are associated with supply quality improvements when distribution infrastructure is placed underground have not been quantified.

Benefits to Local Governments

5) There is a short term, quantifiable benefit to local governments as a result of a reduction in tree pruning costs when overhead power lines are replaced with underground power.

Benefits to Property Owners (Ratepayers)

6) The SUPP has resulted in reliability improvements, due to the lower number of outages that affect electricity customers living in suburbs with underground power.

7) The benefits associated with the lower number of outages affecting electricity customers do not appear to be offset by the costs imposed by a longer duration of outages.

[114] Office of Road Safety, 2010, *Serious Injury Fact Sheet*.

8) Retrospective undergrounding of power is likely to improve the quality of the electricity supply to customers, although quality improvements vary significantly between areas.

9) Property owners benefit from an improved amenity value when existing overhead distribution lines are placed underground.

10) There is a short term benefit to property owners as a result of a reduction in their own tree pruning costs when overhead power lines are replaced with underground power.

11) Residents will benefit from safer local communities due to the installation of new street lights when power poles are removed.

12) Most of the benefits that accrue to property owners are assumed to be capitalised into higher property values.

13) There is a difference in the value of underground power between properties depending on the value of the property. The Authority's analysis indicates that owners of high value properties benefit more from the SUPP program than owners of properties of lesser value.

Benefits to the Wider Community

14) There is a benefit to the wider community when overhead power lines are placed underground, through:

- improved energy security during severe weather events, including a reduction in secondary impacts on the provision of essential services;
- improved amenity values to non-residents of SUPP areas;
- avoided costs to the community as a result of fewer vehicle accidents when underground power is installed; and
- reduced environmental impacts.

6 Cost-Benefit Analysis of the State Underground Power Program and Distribution of Benefits

In undertaking a CBA of the SUPP, the terms of reference for the inquiry require the Authority to have regard to:

- An analysis of the distribution and timing of benefits including an appraisal of who benefits and the overall public benefit to the wider community.
- In particular, the Authority is to report on what is the appropriate share of funding between the Government (representing broad community benefits), the individual householder (representing private and local community benefits) and the Network Operator (representing network benefits).
- The cost benefit analysis should be limited to the South West Interconnected System.

In this analysis, the distributional impacts involve discrete, well-defined parties, rather than individuals within groups. Consequently, costs and benefits can be calculated for each party specified in the terms of reference. However, the Authority's analysis indicates a wide variation in benefits to ratepayers depending on the suburb in which they live, so this issue is further examined.

6.1 Background

The next section sets out the Authority's CBA of the SUPP, which is the basis for determining who the beneficiaries of the SUPP are and how much each of these beneficiaries should contribute to the funding of SUPP projects.

This is followed by a discussion about the distribution of the benefits in section 6.3 and consideration of equity issues associated with the distribution of costs and benefits between parties in section 6.4.

6.2 Cost-Benefit Analysis

The Authority has undertaken a CBA of the SUPP to the society as a whole, which in this case refers to Western Australia. However, it should be noted that the costs and benefits of each SUPP project are likely to vary. For example, it is more expensive to place cables underground in areas with limestone rocks than areas with sandy soils and the value of amenity benefits is greater in areas where residents have ocean or river views.

The Authority's approach for the CBA is summarised in Figure 6.1 and each step of this approach is discussed separately below.

Figure 6.1 Authority's Approach for Cost-Benefit Analysis of the SUPP

1) What are the objectives of the SUPP?
2) Where is the market failure and why should the Government be involved?
3) What are the alternative options to achieve the objectives (including the base case, or do nothing option)?
4) Identify and value the quantitative costs and benefits and consider the qualitative costs and benefits
5) Undertake a sensitivity analysis
6) Discuss overall results of the CBA

6.2.1 Objectives of the SUPP

As mentioned earlier in section 2.1, the four key objectives of government intervention to provide underground power retrospectively to residential properties are to:

- Improve energy security of the electricity distribution system;
- Improve system reliability and cost savings in terms of maintenance and reduced distribution losses;
- Enhance streetscapes and visual amenity of public places to improve property values; and
- Improve safety.

This is the context within which the CBA is undertaken.

6.2.2 Existence of Market Failures

The second step of the CBA is to consider if there are any market failures that require the State Government to be involved in delivering or funding the SUPP. If there are no market failures and no benefits accruing to the wider community (represented by the State Government) as a result of the SUPP, there may not be a need for any State Government involvement.

Before the SUPP was introduced in Western Australia, there were few instances where existing overhead power lines were placed underground. Similarly, in other jurisdictions where there are no formal government programs to retrospectively underground power, the provision of this service has been limited (see section 2.4). This could be due to some form of market failure, or may simply mean that the benefits of underground power do not exceed the costs.

Governments provide a range of goods and services to the community, ranging from social and environmental services to more commercial services, such as the provision of electricity and water. The need for government involvement in the market should generally only occur as a result of a market failure, such as the need to provide goods or services with public good characteristics, or when the consumption of goods and services has an impact on a third party (an externality) which could be solved by government intervention through the delivery of projects or regulation.

Underground power has certain public good characteristics (although it is not a pure public good) in that some of the benefits of underground power are non-excludable (it is not possible to exclude others from benefiting, for example, from improved visual amenity, although most of the benefits accrue to the local community), non-rivalrous (one person's benefit from underground power does not limit the ability of another person to benefit from it) and non-divisible (as it is not possible to individually supply underground power).

The key public good characteristic that prevents the market from supplying retrospective undergrounding of power is that it is not possible to supply underground power to just one or a few individuals who may be willing to pay for it. In order for individual property owners to buy underground power, they would need to take collective action and form a group to purchase it for a particular area. However, the incentives for the different individuals in a group may vary, which could affect the success of the collective action.

Further, when collective action is taken to purchase public goods, it may result in a situation where individuals with a greater willingness to pay will contribute a greater amount to the provision of the public good than those who are willing to pay less. In some cases, individuals with a low willingness to pay may even attempt to benefit from the public good without contributing to its provision at all (free riders). This could lead to the under-provision of the public good and may explain why underground power has not been installed retrospectively to any great extent around Australia in the absence of Government programs.

However, underground power is not a true public good. Many of the benefits of underground power accrue to a specific group (the residents in the area being undergrounded) and exclude everyone else. In this regard, underground power shares more similarities with goods that benefit specific groups, such as a common garden in a unit complex, which is shared by the residents who live in those units.

As such, Western Power may be able to provide retrospective underground power to areas as a commercial service, with local governments acting on behalf of a group (ratepayers) that is willing to pay for such a service provided by Western Power (less any avoided costs to Western Power). However, to the extent that there are benefits to the wider community, the provision of underground power may be less than optimal. For example, there could be some true public benefits from improved safety as a result of underground power.

In conclusion, even though there are some public good characteristics associated with retrospective undergrounding of power and some form of collective action is required which could be coordinated by local governments, it is not clear that State Government intervention is required to deliver this service.

6.2.3 Alternative Options to Meet the Objectives

It is important to consider if there are any alternative options that can meet the objectives of the program or project for which a CBA is being undertaken. If there are, consideration needs to be given to whether the alternative options are more efficient. This should include consideration of the base case, or the 'do nothing' option. The base case, or do nothing option, in this CBA is the continued level of reinforcement and maintenance of the overhead distribution system, which is currently the approach that is adopted by Western Power outside of the SUPP. However, this option does not meet all of the objectives of the SUPP.

The Authority sought technical advice on a range of issues from Halcrow, which included identification of any possible electricity delivery alternatives that would meet at least some

of the objectives of the SUPP. In addition, Western Power submitted that the following four options are alternatives to underground power:[115]

1. Undergrounding main feeders (mostly 22 kV feeders), which would deliver the biggest reliability improvement of the four options. However, some of the other benefits (such as amenity value, improved street lighting and reduced tree pruning costs) associated with this option are lower than what is achieved with underground power.
2. Pole to pillar, which involves running an underground cable from the pole in the street to the property. A pillar is then installed just inside the property, close to the side and front boundary. This would result in a limited improvement in safety and reliability and improve local amenity values and tree pruning costs for the property owner.
3. Aerial bundled cable (also known as ABC), where overhead lines are insulated, would also improve reliability. This option is cheaper than underground power, but it does not result in any safety improvements and any increases in the amenity value and lower tree pruning costs are likely to be limited.
4. Increased expenditure on maintenance of the existing overhead lines is the cheapest alternative to underground power, which is likely to result in some improvement in reliability, power quality, and street lighting. However, Western Power submitted that the operating expenditure for this alternative is likely to be higher than for underground power.

Halcrow considered the alternative options suggested by Western Power, as well as the Hendrix spacer cable distribution system, which is similar to the aerial bundled cable option. The Hendrix system involves an overhead distribution system using insulated conductors in close triangular configuration, providing additional mechanical strength over conventional overhead distribution systems. The triangular configuration offers further protection against storm event damage and contact with falling trees and tree branches.

In relation to the objectives of the SUPP, the Hendrix spacer cable system would improve energy security and reliability and would be cheaper to install retrospectively than underground power cables. However, any improvements in local amenity benefits would be less than that achieved by the SUPP.[116]

In regard to the alternative options, including the Hendrix system, Halcrow found that all of the above options would provide an improvement in energy security and reliability, thus meeting some of the objectives of the SUPP. In many instances, the alternative options identified would also be cheaper to install retrospectively. However, none of these alternative options would provide the level of local amenity value as that achieved by the SUPP.

Halcrow also concluded that whilst the first two objectives of the SUPP are improved energy security and reliability of the electricity distribution system, under the current arrangements the program is heavily dependent on significant financial support from the community (50 per cent). This support is predicated on the perceived amenity benefits, and other benefits associated with this, such as potential property value increases. A more detailed assessment would be necessary to determine if any of the identified

[115] Western Power's submission on the Issues Paper, p3.

[116] Halcrow Pacific Pty Ltd, January 2011, *Economic Regulation Authority - Inquiry into State Underground Power Program Cost Benefit Study Technical Assessment: Final Report*, pp50-51.

alternative options would be financially viable in the absence of financial support from the community.[117]

If any of these alternative options are financially viable, Western Power may already be using them when upgrading its network.

6.2.4 Identification and Valuation of Costs and Benefits

The Authority has identified the costs and benefits that can be quantified and have an impact on the viability of underground power. They are:

- Upfront costs to remove existing overhead lines and the installation of equivalent underground power cables;
- Reduced operating and maintenance costs for Western Power (including storm repair costs and vegetation management costs);
- Higher residential property values, capturing the benefits that accrue to ratepayers;
- Reduced vegetation management costs to local governments; and
- Avoided costs to the wider community resulting from fewer vehicle collisions with distribution power poles.

Valuation of costs

The upfront costs to remove existing overhead lines and the installation of equivalent underground power cables in the CBA are based on the actual cost of all the SUPP projects that have been completed to date. The estimated total cost in 2010 in present value terms of the SUPP is $312.5 million.

The actual amounts of the total SUPP costs that have been recovered from each beneficiary to date are:

- Local governments (ratepayers) - $142.5 million (or 45.6 per cent of total costs);
- Western Power - $89.4 million (or 28.6 per cent of total costs); and
- State Government (wider community) - $80.6 million (or 25.8 per cent of total costs).

Valuation of benefits

The costs that are avoided by Western Power when power cables are placed underground have been estimated based on analysis of four SUPP projects that have been undertaken by Western Power. This analysis, which is discussed in section 5.2.1, suggests that the NPV of the avoided cost component to Western Power is between 7.12 per cent and 13.66 per cent of the SUPP project costs.[118] The mean NPV of the avoided costs was equal to 10 per cent of SUPP project costs. When the range of avoided cost savings is applied to all of the SUPP project costs to date, the benefit to Western Power in present value terms is estimated to have been between $22.3 million and $42.7 million.

[117] Ibid, p51.

[118] These costs were estimated by bringing forward the full cost of Western Power's capital expenditure to underground an area and subtracting any avoided capital and operating costs of doing so.

As identified earlier in this draft report, Western Power benefits from an improvement in the reliability of the network when power is placed underground, as it results in lower compensation payments to customers. However, in the Authority's CBA, the reliability benefits are included in the benefits to ratepayers (capitalised in the higher property prices) and the avoided costs to Western Power as a result of lower compensation payments to customers are considered as a money transfer between groups.

As discussed in section 5.5.2, MJA's study of the effect that underground power has on house prices showed that the mean value of underground power between 2000 and 2010, based on the entire sample of the Perth metropolitan area, was $9,962 per property. Based on this figure, the increase in the value for all of the properties that have been part of completed SUPP projects to date is $739.4 million in present value terms. However, there is a difference in the value of underground power between properties depending on the value of the property, ranging from $4,840 (for house prices between $300,000 and $499,999) to $29,590 (for house prices greater than $700,000).

The reduced tree pruning costs that would benefit local governments in the short term (for 9 years), based on a tree pruning cost of $13.35 per lot each year, is estimated to be $9.5 million in present value terms. For the purposes of this analysis, ratepayers and local governments are treated as the same party as any benefits to local governments also benefit ratepayers through lower rates or improved services.

In regard to the avoided costs to the wider community as a result of fewer vehicle collisions with distribution power poles, the Authority estimates that the benefit associated with fewer people requiring hospitalisation for severe injuries in present value terms is $13.4 million. This is based on the Authority's finding that approximately 30 accidents in the Perth metropolitan area which would have required hospitalisation have been avoided as a result of the SUPP over the period 1997 to 2010.

Qualitative Costs and Benefits

The qualitative costs and benefits have been identified as these must also be considered as part of the CBA. To enable these costs and benefits to be considered alongside the quantitative costs and benefits, descriptive information for each of the costs and benefits has been provided. In some cases (where possible), the Authority has valued some of the qualitative costs and benefits in physical units.

The qualitative costs and benefits that have been identified for inclusion in the Authority's CBA are described below.

Indirect costs associated with negative impacts

The indirect costs that may be incurred when underground power is installed include soil erosion during construction, greater exposure to dig-ins (people digging into the underground cables) and the opportunity cost of funding for the program (reduction in the amount of funding available to undertake other work).

Improved quality of electricity supply

The undergrounding of existing overhead power lines under the SUPP improves the quality of electricity supply to customers through reduced variations or fluctuations in the energy supply. When this happens, power does not go out altogether, but lights may dim and appliances may work intermittently or burn out. As discussed in section 5.4.1, energy losses are likely to be reduced if electricity lines are placed underground, although this depends on the load densities in specific network segments, particularly the design and spare capacity of the networks.

Reduced energy losses also benefit electricity customers through lower electricity bills, since less electricity will need to be generated and sent out by the generators (such as Verve Energy).

Improvements in the quality the electricity supply also results in benefits to Western Power, due to avoided costs associated with maintenance/upgrade of the network to meet power quality performance requirements.

Reduced vegetation management costs to property owners

Property owners or occupiers also benefit from a reduction in vegetation management costs when underground power is installed to replace existing overhead cables. As mentioned in section 5.5.1, if there are power cables in a street verge, it is the responsibility of the owner or occupier of property adjacent to the verge to ensure that the vegetation within the property is kept well clear of power lines in the street verge.

Improved street lighting

When an area is converted to underground power by the SUPP, new street lights are designed and installed. These new street lights have more efficient fixtures and optimised spacing which delivers brighter and more evenly lit streets, providing up to 15 per cent more efficient street lighting.

The new street lights are more closely spaced than on overhead electricity poles, with alternating positioning on both sides of the road closer to curbs. Improved street lighting enhances the local security of an area, which is of benefit to the property owners or occupiers living in an area that has underground power.

Greater energy security

Energy security is concerned with the reliability of electricity during severe weather events, and the wider impact it may have on the community. During severe weather events, underground cables are less likely to be damaged than overhead lines and may therefore provide greater security against extended power supply failures with consequential community impacts, such as loss of fresh water supply and fresh food.

The fact that these types of severe weather events are infrequent makes it difficult to quantify these consequential impacts on the wider community.

Improved amenity value

One of the key benefits of undergrounding existing overhead power lines is the improved aesthetics, through the removal of poles and wires and the planting of more trees which improves the visual amenity and streetscapes of suburbs. These improvements in the amenity of an area result in higher property values where overhead distribution lines have been replaced with underground cables, which have been quantified in this CBA.

However, not all of the improvements in amenity may be captured by higher property values when underground power is installed. There is a small component of this benefit which is of value to the wider community when visiting the areas that have underground power, in particular in areas that have ocean or river views.

Environmental impacts

Undergrounding existing overhead power cables also has a positive effect on the environment. When the electricity poles are removed, there is a reduction in the amount of

pesticide and herbicide used to protect the poles and maintain the verges. For example, the wooden electricity poles used for overhead cables are treated with pesticide to prevent termite activity. The ability to plant more trees on the verges also has some environmental benefits, as it might provide additional wildlife habitats.

As discussed in section 5.6.2, there is also likely to be a reduction in greenhouse gas emissions if overhead electricity cables are placed underground due to the expected reduction in energy losses. However, any reductions in greenhouse gas emissions may be at least partially offset by the increased greenhouse gas emissions produced during the manufacturing and installation of the underground distribution system components.[119]

Calculation of the Net Present Value

The costs and benefits, which have been quantified and valued in present value terms[120] for each beneficiary and in total where possible, result in a positive total quantifiable NPV of the SUPP between $472.0 million and $492.4 million, and a benefit-cost ratio of 2.5 to 2.6. The quantifiable and qualitative costs and benefits are all listed in Table 6.1.

[119] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group*, p74.

[120] This ensures that all flows of benefits and costs over time are expressed in the same manner in terms of their present value, as they occur at different points in time.

Table 6.1 Net Present Value of SUPP

Costs and Benefits	Ratepayers/local governments ($ million)	Western Power ($ million)	State Government (wider community) ($ million)	Total ($ million)
Quantifiable Costs				
Cost of SUPP projects	142.49	89.37	80.62	312.48
Total Quantifiable Costs	***142.49***	***89.37***	***80.62***	***312.48***
Benefits				
Avoided maintenance costs	-	22.25 to 42.68	-	22.25 to 42.68
Benefits to ratepayers captured in higher property values: • Improved amenity value • Improved street lighting	739.37	-	-	739.37
Reduced vegetation management costs	9.45*	**	**-**	9.45
Avoided vehicle collisions with distribution poles	-	**	***13.36***	13.36
Total Quantifiable Benefits	***748.82***	***22.25 to 42.68***	***13.36***	***784.43 to 804.86***
Net Present Value (Cost) - quantifiable benefits less quantifiable costs	**606.33**	**–67.12 to –46.69**	**–67.26**	**471.95 to 492.38**
Benefit-Cost Ratio	**5.26**	**0.25 to 0.48**	**0.17**	**2.51 to 2.58**
Qualitative Costs				
Indirect costs	*nq*	*nq*	*nq*	nq
Qualitative Benefits				
Improved reliability	*	**	***	-
Improved quality of electricity supply	*	*nq*	*nq*	-
Positive environmental effects	-	-	*nq*	-
Reduced electrical contact injuries	-	-	*nq*	-
Improved amenity value to wider community (non-residents of SUPP areas)	-	-	*nq*	-

Source: Authority's analysis and MJA analysis.

nq = not quantified

** To the extent that this is a benefit to ratepayers, it is assumed to be largely captured in higher property values.*

*** These benefits are reflected in Western Power's avoided maintenance costs.*

**** The benefit to the wider community includes a reduction in secondary impacts from long outages caused by severe weather events (such as loss of fresh water supply and fresh food).*

The NPV that has been calculated is based on the following timing assumptions:

- The present values of avoided costs to Western Power and benefits to ratepayers through higher property values are calculated from the year that the underground power is installed.
- Tree pruning benefits to local governments are realised for the nine years following the installation of underground power.
- Safety benefits are incurred in perpetuity from the year underground power is installed.

As can be seen, while there has been an overall positive NPV of the SUPP, taxpayers and Western Power (and Western Power's customers) have contributed to a greater extent than they have benefited (in terms of benefits that can be quantified) from the SUPP.

The Authority notes that the results in Table 6.1 do not accurately predict any future net benefits, as the areas that have been part of the SUPP are not representative of all suburbs in the Perth metropolitan area. This is due to the fact that the areas that have been included to date have been predominantly in suburbs with high property values, where ratepayers benefit more from the SUPP than they do in areas with lower value properties.

6.2.5 Sensitivity Analysis

As there is uncertainty associated with the estimation of NPVs, sensitivity analysis has been undertaken to understand how sensitive the results are to changes in the costs and benefits by looking at different scenarios.

Given that the largest variable in the cost benefit study is the benefit to ratepayers, the sensitivity testing was focused on any changes to the value of underground power as measured through house prices. The results showed that the mean value per property would need to be reduced from $9,962 to $3,662 for the costs to exceed the benefits. Given that the estimated minimum value that would accrue to property owners is $4,840 for median house prices below $500,000 based on MJA's analysis, the Authority considers it unlikely that the mean value be reduced to $3,662.

6.2.6 Overall Results of the Cost-Benefit Analysis

The CBA of the SUPP estimates that there has been an overall positive NPV of the SUPP to date between $472.0 and $492.4 million. Approximately 93 per cent to 95 per cent of the quantifiable benefits from the SUPP have accrued to ratepayers and local government. Ratepayers and local governments have been treated as the same party in the CBA since any benefits to local governments benefit ratepayers through lower rates or improved services.

The taxpayers (State Government) and Western Power (and its customers) have not benefited to the same extent as ratepayers from the SUPP. The quantifiable benefits to Western Power resulting from its avoided costs represent around 3 per cent to 6 per cent of the total benefits. In addition, Western Power is expected to benefit from the avoided costs associated with improvements in the quality supply as well, which have not been quantified.

The quantifiable benefits to the State Government, or the taxpayers, account for around 2 per cent of the total benefits from the SUPP. As there are a number of qualitative

benefits to the wider community as well, the share of benefits to taxpayers is likely to be greater than what has been estimated in dollar terms in the CBA.

The results of the CBA indicate that the current funding arrangement has resulted in inequities between the different groups that have funded and benefited from SUPP projects. As ratepayers have on average benefited more from SUPP projects (as indicated by the increase in property prices in areas with underground power) than they have paid to install underground power retrospectively, ratepayers have been subsidised by taxpayers and Western Power's customers, who have paid more than they have benefited from SUPP projects.

Even though there are some public good characteristics associated with retrospective undergrounding of power and a need for the State Government to continue its contribution to fund a proportion of underground power, it is not clear that a State Government program is required to deliver this service.

6.2.7 Authority's Assessment

The CBA has estimated that the SUPP to date has resulted in a quantifiable NPV between $472.0 million to $492.4 million to Western Australia. Based on the CBA of the SUPP (including the qualitative benefits), which indicated that a large proportion of the benefits from retrospective undergrounding of power are capitalised into higher property values (between 93 and 95 per cent of quantifiable benefits), the Authority's view is that the retrospective undergrounding of power provides a net benefit to the community (at least for the projects that have been undertaken to date).

However, the Authority's view is that there does not appear to be any significant market failures which require the State Government to continue its involvement in the delivery of retrospective undergrounding of power. The retrospective undergrounding of power lines could be achieved by commercial arrangements between Western Power and local governments, with the State Government contributing funding as appropriate.

6.2.8 Draft Findings

Cost Benefit Analysis of the State Underground Power Program

15) The provision of retrospective underground power services has public good characteristics in that it is not possible to supply this service to an individual. Collective action by a group is required to purchase retrospective underground power in the absence of Government intervention.

16) There are no alternatives that would result in the same benefits as the retrospective undergrounding of power.

17) In cost-benefit terms, the total quantifiable net present value of the SUPP to Western Australia has been between $472 and $492 million to date, with a benefit-cost ratio of around 2.5.

18) Most of the benefits associated with the SUPP have accrued to ratepayers as measured through higher property values.

6.3 Distribution of Benefits

The Authority has also been asked to determine who should pay for the retrospective undergrounding of power and how much each party should pay based on the proportion of benefits accrued to individual ratepayers, local governments, Western Power and the broader Western Australian community.

The Authority's CBA indicates that ratepayers have been the greatest beneficiaries of the SUPP (in terms of benefits that can be quantified), whereas Western Power and the State Government have not benefited to the same extent. However, the benefits to ratepayers vary depending on the value of the property that they own.

When underground power is installed retrospectively, the analysis of house prices undertaken by MJA indicated that those who own higher value properties benefit more than others (a range of $29,590 to $4,840). Further, the costs to install underground power in high value suburbs and medium value suburbs may be similar. As a result, while the benefits are likely to exceed the costs of SUPP in high value areas, the costs could actually exceed the benefits received in areas where property values are lower. An appropriate funding arrangement should take this into consideration.

The affordability of underground power appears to have worsened over time for property owners, as the cost per lot to underground power has increased in every round of the program, particularly in rounds three and four. As mentioned earlier, the average cost per lot has increased by around 7.3 per cent per annum since the program was introduced in 1996.

The average cost of round four projects is currently $9,685 per lot in nominal dollar value terms, although this cost per lot varies for each project area. This is just below the mean value of underground power to ratepayers of $9,962 in 2010, as measured by increased house prices in real dollar value terms. However, as indicated in Table 5.7, the value of underground power varies depending on the value of the property, with lower value properties benefiting less from underground power than higher valued properties. In

areas with lower mean property values (below $500,000), the average cost of $9,685 per lot is higher than the mean value of underground power to ratepayers of $4,840.

6.3.1 Submissions on the Distribution of Benefits

In regard to the appropriateness of the existing funding arrangement being based on a 'beneficiary pays' approach, Western Power submitted that the shared funding arrangement that is in place for the SUPP has been the key to Western Australia having the largest ongoing retrospective residential underground power program in Australia.

Western Power suggested that property owners gain at least an equivalent financial benefit to their contribution to underground power through increased property values. In the Perth metropolitan area, around 393,000 property owners have paid for underground power (either through sub divisional purchase prices or the SUPP). This current funding arrangement establishes a precedent for a beneficiary pays approach for the remaining 380,000 property owners with overhead power lines.[121]

Western Power submitted that the existing share of funding is a reasonable approach that recognises the benefits that accrue to each party:

- Local governments, who pay 50 per cent of the costs to underground power which is generally passed on to property owners, benefit through reduced tree pruning requirements and local area amenity, safety and security improvement. Property owners benefit from underground power as well, through:
  - A more reliable power supply;
  - Improved local area amenity;
  - Improved property values; and
  - Improved local area safety through reduced motor vehicle collisions with power poles and reduced risk of human contact with exposed live power lines.
- The State Government, who funds 25 per cent of the SUPP, benefits in terms of a more efficient electricity network with improved community amenity and safety.
- Western Power, who funds the remaining 25 per cent, receives the following key benefits from underground power:
  - Improved reliability performance at all levels of the distribution network;
  - Reduced asset based maintenance costs; and
  - Reduced emergency network repair costs in the event of storms.[122]

There was consistent support for the SUPP in submissions and many stakeholders wanted the program to be expanded to install underground power at a faster rate. However, it was a common view in many of the submissions that the State Government and/or Western Power should pay for most of the costs to underground power rather than the property owners.

For example, the City of Belmont submitted that the State should be paying a greater proportion of the cost of upgrading Western Power's network infrastructure and that there should be no cost shifting of this to local governments or individual property owners affected by undergrounding of power in their immediate area. This is because the City of

[121] Western Power's submission on the Issues Paper, pp4-5.

[122] Ibid, p5.

Belmont believes that the benefits of underground power are of much greater value to the State (the State Government and Western Power) than local government or individual property owners. Examples of benefits to the State included improved network stability, reduced emergency repair costs and lower maintenance costs. It was suggested that the benefits to the local governments and the community, which include reduced tree pruning costs of approximately $50 per tree per annum and some improvement in power reliability, are quite small.[123]

WALGA submitted that the Authority should consider whether the benefits received by stakeholders are similar across all projects and if not, identify the principles for a project specific basis for cost sharing between the beneficiaries. The Authority was also asked to assess if the benefits of higher property prices have changed over time (as underground power becomes more common) and if those benefits are sustainable if the vast majority or the entire network in the SWIS is placed underground.[124]

WALGA also submitted that the Authority should estimate the benefits from improved reliability of the electricity network to electricity generators, such as Verve Energy, and retailers, such as Synergy. The generators and retailers should be included in any consideration to share the costs of underground power between the beneficiaries.[125]

In regard to the affordability of the SUPP and property owners' capacity to pay for underground power, WALGA submitted that local governments have noted that the costs to property owners for the SUPP have increased significantly since the program was established. As a result, the willingness and ability for property owners to pay for the SUPP is increasingly more difficult to achieve. WALGA also noted that nearly 27 per cent of Perth households are renters, and in these cases the property owner, who pays for the underground power, will not receive the benefits of underground power. A property investor will only receive the benefit of any higher market value for the property that may arise when power is placed underground.

WALGA therefore recommended that the Authority should consider the different perspectives of owner-occupiers, private investors, government owned homes and other investors when assessing the benefits received by property owners. Another recommendation was that the cost estimates that are used to gauge community support for projects be adjusted for cost inflation during the expected time between the consultation period and the construction of the project.

WALGA also questioned whether the Index of Relative Socio-economic Disadvantage, which is prepared by the Australian Bureau of Statistics, or other similar measures provide a sufficient measure of the capacity to pay of a property owner to contribute to the cost of an underground power project.[126]

The EMRC submitted that the State Government and Western Power should undertake a study to evaluate the costs of upgrading its existing overhead distribution network and maintaining it to the mandatory requirements, as well as include the estimated costs of potential litigation and risks associated with the existing overhead infrastructure in comparison to the costs of undergrounding the existing overhead distribution network. This study should also provide for a range of funding options planned over the long term and it should be made available for a community wide discussion.[127]

[123] City of Belmont's submission on the Issues Paper, p1.

[124] WALGA's submission on the Issues Paper, p4.

[125] WALGA's submission on the Issues Paper, p5.

[126] Ibid, pp6-8.

[127] EMRC's submission on the Issues Paper, p10.

In regard to who benefits from underground power, the EMRC has submitted that the State Government should recognise that the provision of SUPP is an essential service and a strategic infrastructure asset that needs to be funded through a more equitable funding arrangement that recognises the responsibility of the asset owner.[128]

The EMRC submitted that the existing funding arrangement, which is based on a "beneficiary pays" approach, is not appropriate since it is not supportive of ratepayers in areas of lower socio-economic means. The projects that have been undertaken as part of the SUPP so far are generally in affluent areas, where local governments have obtained agreement from the majority of their rate payers who are generally well off financially.[129] Further, the EMRC recommended that the State Government should investigate and develop a funding model that is largely funded by the State as the asset owner and service provider, which is accessible to all rate payers.[130]

The EMRC also submitted that the State could accelerate its underground power program in partnership with the NBNCo, who is rolling out high speed fibre across Australia. In relation to the Perth Hills, where undergrounding is often impractical due to the rocks, it was suggested that aerial bundled cables could replace the existing overhead lines, particularly in areas that experience a lot of blackouts or where there are high fire risks.[131]

In regard to who should pay for underground power, the Member for Alfred Cove, Dr Janet Woollard MLA, submitted that Western Power should include placing power lines underground for parts of overhead power lines which need upgrading or replacement, as part of its asset management plan. It was also suggested that the State Government's proportion of funding for LEPs could be reduced and savings redirected towards the MRPs, to enable more residential projects within a round of funding.

The submission from the Member for Alfred Cove suggested another proposal that could be considered to speed up the progress of placing power lines underground, by encouraging direct partnerships for fully funded undergrounding projects between local governments and Western Power, where residents are willing to pay for the full cost of underground power. However, if a fully funded project coincides with Western Power's upgrade or maintenance work of the lines, Western Power should contribute to the costs. Local governments could make such an investment as part of infrastructure works, or recoup the costs through ongoing levies on ratepayers (e.g. the City of Subiaco applied a special levy on all ratepayers for many years to fund the undergrounding of power before the SUPP was introduced).[132]

6.3.2 Authority's Assessment

The Authority considers that the beneficiary pays approach, which is the basis for the current funding arrangements for the SUPP, should continue to be used to fund the retrospective undergrounding of power. The beneficiary pays approach is suitable as it is possible to identify those who benefit.

Based on the beneficiary pays approach and the results of the CBA which provide an indication of the proportion of benefits that has accrued to each party, the Authority has considered who should pay for the continued retrospective undergrounding of power and how much each party should pay.

[128] Ibid, p13.

[129] EMRC's submission on the Issues Paper, p11.

[130] Ibid, p14.

[131] Ibid, p7.

[132] Member for Alfred Cove's (Dr Janet Woollard MLA) submission on the Issues Paper, pp5-6.

- The funding contribution from local governments (through ratepayers) should reflect the quantifiable benefits that they receive from underground power through increased property values and reduced vegetation management costs. Based on the quantifiable benefits to local governments and ratepayers of approximately $749 million as a proportion of the total benefits of the SUPP (which ranged from $784 million to $805 million), the contribution from local governments (through ratepayers) should be between 90 and 95 per cent. However, after taking into consideration the qualitative benefits to Western Power and the wider community, the Authority's view is that the contribution from ratepayers should be adjusted by reducing the contribution from local governments/ratepayers to between 75 and 90 per cent.
- Western Power should contribute funding equal to the value of its avoided costs as a proportion of the total benefits of the SUPP. On the basis of the range of Western Power's avoided costs in the CBA ($22 million to $43 million) as a proportion of the total benefits, which ranged from $784 million to $805 million, and after taking into account the qualitative benefits that accrue to Western Power as a result of an improvement in the quality of electricity supplied, Western Power should contribute between 5 and 15 per cent. Western Power should ideally determine the costs that are avoided when underground power is installed in a particular area, to determine how much it should contribute to the total costs of each project on a project by project basis.
- The State Government's funding contribution should be based on the benefits to the wider community as a proportion of the total benefits of the SUPP. Based on the quantifiable benefits of approximately $13 million as a proportion of the total benefits of the SUPP, which ranged from $784 million to $805 million, and the qualitative benefits to the wider community, the State Government contribution should be somewhere between 5 and 10 per cent.

The existing funding shares of the SUPP and the Authority's proposed contribution shares are summarised in Table 6.2.

Table 6.2 Existing and Proposed Funding Shares for Retrospective Underground Power

	Local Governments/Ratepayers %	Western Power %	State Government (Wider Community) %
Existing funding shares	50	25	25
Authority's proposed funding shares	75-90	5-15	5-10

The effect on property values depends on the mean value of a property, even though the costs of undergrounding may be the same. Consequently, for future projects the proportion that ratepayers should contribute to recover the costs of SUPP projects should ideally be recovered based on an examination of the costs and benefits to retrospectively install underground power in each specific area under consideration. As part of this examination, the relevant avoided costs for Western Power for that area would need to be estimated, as would any wider community benefits to be funded from the State Government.

In regard to ratepayers' willingness to pay, discussed in section 5.5.2., the results of the surveys which have been undertaken to gauge the level of support for SUPP projects from affected ratepayers show that people in higher income areas are more willing to pay their share of the SUPP project costs than the people in lower income areas.

This is consistent with IPART's finding that available quantitative evidence suggested that on a strict beneficiary pays basis, the role for direct State Government funding is likely to be modest. However, a range of unquantifiable benefits would also need to be taken into account to determine how much the State Government should fund. Unless the community wide benefits substantially outweigh the local community benefits associated with undergrounding, there could be a risk of significant cross subsidisation of some local communities by others if the State Government funding share is too large.[133]

The PCU Working Group recommended that the appropriate funding arrangement would be one where the total cost less any avoided costs to local governments and electricity distribution companies (estimated at 10 per cent) should be recovered from rate payers. State Governments could contribute a small amount to the total costs if there are wider community benefits when overhead cables were placed underground in certain areas.[134]

Greater funding of SUPP projects by residents is likely to mean that future SUPP projects will occur mainly in areas with high-value properties. In this regard, the Authority's view is that the undergrounding of existing overhead cables is not an essential service, or a strategic infrastructure asset, that needs to be funded through a more equitable funding arrangement that recognises the responsibility of the asset owner. The existing overhead network and the continued maintenance of this network provide an adequate essential service to Western Power's customers. The key benefit of undergrounding existing overhead cables through the SUPP is the improved amenity value, which is not an essential service that should be funded by the Government.

Further, given that there are no significant market failures that require government involvement and that the wider public benefit appears to be small based on the Authority's CBA, the question is whether the Government should be involved at all in the retrospective undergrounding of power. The need for Government involvement should also be considered in light of the fact that the UPPT in Western Power does undertake some residential underground power projects outside of the SUPP, which are fully funded by local governments. This includes residential projects in the suburbs of Quinns Rock, South Perth and Nedlands.

The Authority's view is that there may no longer be a need for the State Government to deliver retrospective underground power projects. Local governments should ideally be able to purchase underground power from Western Power on behalf of the ratepayers who are willing to pay for their share of the costs to have underground power installed in their area. The only constraint on Western Power's ability to deliver this service to local governments is the budget that is allocated to the UPPT by Western Power to undertake customer funded underground power projects.

As indicated in section 4.5, a successive roll-out of underground power may reduce the overall costs of underground power. However, there is no guarantee that the benefits in each project area would outweigh the costs of a successive roll-out program. If the results of an aggregated CBA to underground the remainder of the overhead distribution system in the Perth metropolitan area showed that there were substantial benefits to Western Power, then Western Power could present a case to the local governments to obtain support from ratepayers, who would share any cost savings with Western Power (especially if the costs outweighed the benefits in some areas). Alternatively, if Western Power co-ordinated the project, it could prioritise projects based on the NPV of work

[133] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy*, p44.

[134] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group*.

undertaken over a certain time period, rather than as a sum of the individual NPVs of each area.

Local governments also need to consider their cost recovery methods from ratepayers to address affordability issues in any future underground power projects. Some of the ways in which local governments can address affordability issues, which are already used in some instances, include:

- Recovering the costs from ratepayers over time;
- Allowing ratepayers to pay for their share of the project costs when their property is sold and the gain from retrospective underground power is realised; and
- Subsidising the costs of the program for all or some of the ratepayers, such as pensioners.

6.3.3 Draft Findings

Distribution of Benefits

19) There may no longer be a need for the State Government to be involved in the delivery of retrospective underground power, as local governments should ideally be able to purchase this service directly from Western Power.

20) The amount that each of the beneficiaries are asked to contribute to recover the costs of retrospective underground power should ideally be based on the cost for each project, as the costs and benefits are likely to vary for each project area.

21) The costs of retrospective underground power should be recovered from the following beneficiaries, based on the proportion of quantifiable and qualitative benefits that they each receive:

- Local governments (through ratepayers) could contribute between 75 and 90 per cent;
- Western Power could contribute between 5 and 15 per cent, depending on its avoided costs when a particular project area is undergrounded; and
- The State Government could contribute between 5 and 10 per cent.

6.4 Equity Issues

There are likely to be equity issues associated with the distribution of costs and benefits between individuals within the three groups considered in the CBA.

In regard to the Authority's view that ratepayers should fund a greater proportion of the costs to have underground power installed, an inequity is created between those who have already received a substantial financial contribution from the State Government to retrospectively underground power in their area and those that are yet to do so. This

inequity is amplified since the State Government has subsidised the installation of underground power in some of Perth's wealthiest suburbs (on average)[135]. Consequently, there are some equity grounds for the State Government to continue its funding contribution at a higher level than the proposed 5 to 10 per cent, in particular for project areas in low-value suburbs.

However, as the average cost of the SUPP per lot ($9,685) seems to be approaching the mean value of benefits as measured by the average increase in property prices for properties that have participated in SUPP projects ($9,962), ratepayers in suburbs with low property values may not be willing or able to pay for their share of costs to install underground power retrospectively, even if the State Government contributes funding.

Another inequity arises from the likelihood that some Perth suburbs (such as those in the Darling Range) are not likely to be provided with retrospective underground power, due to the prohibitive costs of placing cables underground in areas with difficult ground conditions and lower population density. In some of these areas, the reliability and quality of the power supply can be very poor. As a result, the benefits associated with underground power may be greater in these areas, in particular if it also improved safety through a reduction in the number of electricity-caused bushfires. If the costs and benefits of each project are considered separately, the benefits of installing underground power may exceed the costs in some of these areas where there are significant benefits to the ratepayers and the wider community. However, there is no case for State Government funding just because it is more expensive to provide underground power in some areas than others.

6.4.1 Submissions on Equity Issues

The City of Belmont submitted that if a CBA shows that an underground power project should be undertaken and the project is to be funded largely by affected property owners, other matters need to be considered to address equity issues. The equity issues raised by the City of Belmont were that low income households may not benefit as much from underground power as higher income households from increased property values (they may not even benefit at all) and low income households are less likely to be able to afford the payment to place the power underground.[136] WALGA submitted that the Authority should consider the equity issue that arises between those who have already received a public contribution to provision of underground power and those yet to do so.[137]

6.4.2 Authority's Assessment

The Authority acknowledges that there may be some equity issues associated with any changes to the existing SUPP arrangements, in particular since the Authority's view is that the individual ratepayers should pay for a greater proportion of the costs than they currently do to get underground power installed in a particular area.

As discussed earlier in section 6.2.6, the current funding arrangement has resulted in inequities between the different groups that have funded and benefited from SUPP

[135] Based on 2006 Census data from the Australian Bureau of Statistics, 31 per cent of households in suburbs that have participated in the SUPP were classified as high income households (with weekly wages above $2,500). In comparison, only 15 per cent of households in all of the Perth metro area were classified as high income households. Of the 33 suburbs that have been participants of the SUPP and included in the Census income data, 27 suburbs had a larger proportion of high income households compared to the Perth metro average (of 15 per cent), with many of these suburbs consisting of between 30 per cent to 65 per cent of high income households.

[136] City of Belmont's submission on the Issues Paper, p2.

[137] WALGA submission on the Issues Paper, p8.

projects. As ratepayers have on average benefited more from SUPP projects (as indicated by the increase in property prices in areas with underground power) than they have paid to install underground power retrospectively, ratepayers have been subsidised by taxpayers and Western Power's customers, who have paid more than they have benefited from SUPP projects.

Further, as the benefits of the SUPP to ratepayers depend on property values (with owners of high value properties benefiting more than owners of lower value properties) and given that many of the remaining Perth metropolitan areas with overhead power lines are in suburbs with lower property values, the Authority considers that it may be equitable for any future State Government contributions to continue at a higher level than the Authority's proposed 5 to 10 per cent, if they are directed towards areas with lower property values. This is supported by the finding that under the current program, the State Government has largely subsidised the installation of underground power in areas where property values are high. However, it is important that projects should only proceed if ratepayers are willing to pay their share (including any Government contribution).

These equity issues will need to be considered by the State Government as part of its broader review into the future of the SUPP. The Authority was not specifically asked to consider or make recommendations on equity issues in the terms of reference.

6.4.3 Draft Findings

Equity Issues

22) The current funding arrangement of SUPP projects has resulted in some inequities. As ratepayers have on average benefited more from SUPP projects than they have paid to install underground power retrospectively, ratepayers have been subsidised by taxpayers and Western Power customers, who have paid more than they have benefited from SUPP projects.

23) Any future funding arrangements should minimise the extent to which one group of beneficiaries subsidises another.

24) It may be equitable for any future State Government contributions to continue at a higher level than the proposed 5 to 10 per cent if the subsidy is directed towards areas with lower property values. However, projects should only proceed if ratepayers are willing to pay their share (after taking into account any Government contributions).

APPENDICES

7 Appendix A. Terms of Reference

STATE UNDERGROUND POWER PROGRAM COST BENEFIT STUDY

FINAL TERMS OF REFERENCE

I, TROY BUSWELL, Treasurer, pursuant to section 32(1) of the *Economic Regulation Authority Act 2003,* request that the Economic Regulation Authority (ERA) undertake an inquiry into the overall costs and benefits of the State Underground Power Program.

The ERA is to have regard to the following:

- The costs of undergrounding the overhead electricity distribution network, including the impact on costs of the current process for selecting and assessing projects.
- A comparison of the costs associated with maintaining the current distribution network compared to undergrounding.
- The types of costs which are avoided as a result of undergrounding the overhead electrical distribution system.
- Identification and quantification (where possible) of all costs and benefits of underground power including but not limited to:
  - network capital, operation and maintenance costs;
  - quality of supply and reliability of electricity;
  - energy security;
  - emergency response;
  - residential property values;
  - public safety;
  - street lighting;
  - public and private amenity;
  - environmental impacts; and
  - maintenance of street scapes and verges.
- An analysis of the distribution and timing of benefits including an appraisal of who benefits and the overall public benefit to the wider community.
- In particular, the Authority is to report on what is the appropriate share of funding between the Government (representing broad community benefits), the individual householder (representing private and local community benefits) and the Network Operator (representing network benefits).
- The cost benefit analysis should be limited to the South West Interconnected System.
- The ERA will complete a final report no later than 12 months after receiving the Terms of Reference.

TROY BUSWELL MLA
TREASURER; MINISTER FOR COMMERCE;
SCIENCE AND INNOVATION; HOUSING AND WORKS

The Treasurer has amended the reference twice to extend the due date for the delivery of the final report from 23 April 2011 to 30 September 2011.

8 Appendix B. State Underground Power Program Projects Completed or Underway

Local Government	Project Areas
Pilot Projects	
City of Albany	Albany
City of Melville	Applecross
Town of Cottesloe/Claremont	Claremont and West Cottesloe
Town of Cambridge	Wembley
Round 1 Major Residential Projects	
Town of Cottesloe	East Cottesloe
Shire of Peppermint Grove	Peppermint Grove
City of Nedlands	Dalkeith and Swanbourne
City of Stirling	Woodlands
City of South Perth	Como
City of Canning	Rossmoyne
Town of East Fremantle	East Fremantle
Round 1 Localised Enhancement Projects	
Shire of Nannup	Nannup
Shire of Dowerin	Dowerin
Shire of Donnybrook-Balingup	Donnybrook
Shire of Collie	Collie
Shire of Augusta-Margaret River	Margaret River
Shire of Irwin	Dongara
Round 2 Major Residential Projects	
City of Melville	West Bicton
Town of East Fremantle	Plympton
City of Belmont	Rivervale
City of South Perth	Mill Point
Town of Claremont	South Claremont
City of Melville	Mount Pleasant
City of Stirling	Mount Lawley
Town of Cambridge	West Leederville
Town of Victoria Park	East Victoria Park
City of Subiaco	Subiaco
City of Nedlands	West Nedlands
Town of Mosman Park	Mosman Park
Round 2 Localised Enhancement Projects	
Shire of Serpentine-Jarrahdale	Jarrahdale
City of Gosnells	Gosnells
Shire of Shark Bay	Denham
Town of Vincent	Highgate
Shire of Harvey	Harvey
Shire of Mundaring	Mundaring

City of Rockingham	Rockingham
Shire of Murray	Pinjarra
City of Fremantle	Fremantle
Shire of Bridgetown-Greenbushes	Bridgetown
City of Stirling	Scarborough
Round 3 Major Residential Projects	
Town of Victoria Park	Victoria Park South
City of Subiaco	Shenton Park
Town of Cambridge	City Beach
City of Gosnells	Gosnells North
City of Fremantle	Fremantle
City of Nedlands	Nedlands East
City of Stirling	Churchlands/Wembley Downs
Town of Port Hedland	Port Hedland
Town of Vincent	Highgate East
City of South Perth	Como East
Round 3 Localised Enhancement Projects	
Plantagenet	Mount Barker
Collie	Collie
Donnybrook-Balingup	Balingup
Nannup	Nannup
Bunbury	Bunbury
Geraldton	CBD/foreshore
Lake Grace	Lake Grace
Gingin	Guilderton
Carnamah	Town site precinct
Round 4 Major Residential Projects	
City of Melville	Mount Pleasant North - Completed
City of Rockingham	Palm Beach – Completed
City of Canning	Wilson West – Completed
City of Gosnells	Maddington – Completed
City of Canning	Bentley East – Commenced
City of Melville	Attadale South – Commenced
City of Melville	Attadale North* – Being developed
Round 4 Localised Enhancement Projects	
Shire of Toodyay	Toodyay – Completed
Shire of Harvey	Brunswick Junction – Completed
Shire of Augusta-Margaret River	Cowaramup – Completed
Shire of Bunbury	Bunbury – Completed
Shire of Dandaragan	Jurien Bay – Completed
Town of Victoria Park	Victoria Park – Completed
City of Bayswater	Bayswater – Commenced
City of Belmont	Belmont – Commenced

* Replacing a project withdrawn in the City of Stirling (Balcatta).

Source: Office of Energy Website.

9 Appendix C. Underground Power Program Round 5 Guidelines

Underground Power Program

MAJOR RESIDENTIAL PROJECTS

Round Five Guidelines

Government of **Western Australia**
Office of **Energy**

WESTERN AUSTRALIAN
LOCAL GOVERNMENT ASSOCIATION

TABLE OF CONTENTS

UNDERGROUND POWER PROGRAM – ROUND FIVE

Goals

1. To improve the energy security of Western Australia's electricity distribution system.
2. To improve the standard of electricity supply to consumers by addressing reliability issues in areas with existing overhead power lines.

Program Objectives

In implementing the Program, the Underground Power Steering Committee will seek to achieve:

1. Efficient retrospective installation of underground power, contributing to improved energy security of the electricity distribution system, system reliability and cost savings in terms of maintenance and reduced distribution losses.
2. Significant contributions to local communities, including enhanced streetscapes and visual amenity of public places, improved property values and improved safety.

In managing the Program, the Steering Committee is committed to:

1. Maximising the effectiveness of the Program by working in partnership with local governments, contractors and relevant areas of government.
2. Equitable, transparent and efficient selection processes.
3. Best practice project management, providing shared benefits to all project partners, such as risk-sharing, cost savings and efficiencies.
4. Continuous improvement of the Underground Power Program process, including all aspects of the application, selection and implementation phases.

These objectives form the basis of the Committee's decision-making and management processes for the Program. The selection criteria and evaluation methodology contained within these Guidelines reflect these objectives and the priorities of the State Government.

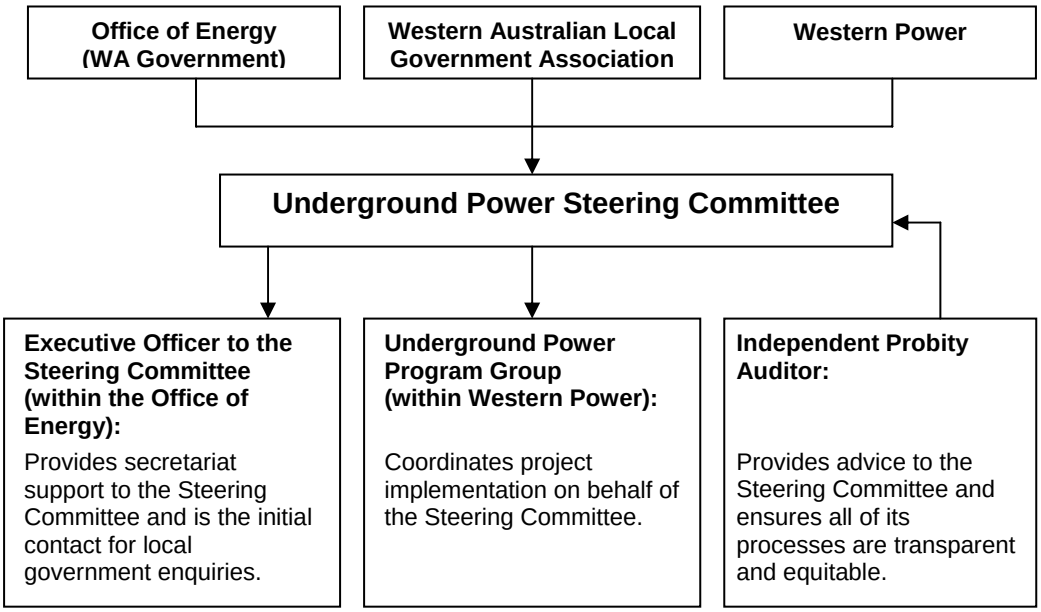
Background

In 1996, the Underground Power Program was established to contribute to the Government of Western Australia's long-term goal of improving the energy security of the State's electricity distribution network. In doing so, the Program has contributed to the State Government's objective of ensuring underground power services are provided to 50 per cent of residential properties in Perth, with a corresponding improvement in non-metropolitan areas of the State. The Government is confident that this target will be met by the conclusion of the current Round Four. However, the Program has been achieving its energy security goals and has been well received. Therefore the Government has committed to the funding of Round Five.

The May 1994 storms, resulting in widespread blackouts across Perth, were a significant catalyst for this multi-million dollar initiative. The State Government recognised that placing power cables underground gave improved security of supply in severe weather conditions. Planning rules were changed to require underground power for all new developments and the Underground Power Program was established to replace existing overhead supply with underground power. Western Australia is one of only a few places in the world to have such an initiative.

The Program is undertaken and funded jointly by the State Government (including its wholly owned business, Western Power) and participating local governments. The Underground Power Steering Committee is responsible for the management of the Program, and is comprised of representatives from the Office of Energy, Western Power and the Western Australian Local Government Association.

The relationships between these parties and the Steering Committee, Underground Power Program group and other contributors to the Program are illustrated by the following diagram:



To date, four rounds (and five pilot projects) have been implemented under the Program, as indicated by the table and map provided in Appendix I.

Major Residential Projects

The Program comprises two streams: Major Residential Projects and Localised Enhancement Projects. These Guidelines only apply to the process for Round Five Major Residential Projects.

Major Residential Projects involve the delivery of underground distribution lines in suburban areas, typically of between 800 and 1,300 residential properties.

However, for Round Five local governments are encouraged to submit proposals for undergrounding power to areas between 500 and 800 lots. This is to assist in minimising commercial exposure to single projects and spread the geographical coverage without losing economies of scale.

Replacing overhead power lines with underground systems is an expensive exercise. While there are benefits to Western Power, in terms of reduced maintenance and reduced losses of electricity, they fall well short of commercially justifying the capital investment. However, there are many other benefits of underground power, including fewer blackouts, enhanced visual appearance, improved property values, reduced tree pruning and improved safety, which flow through to residents, local governments and the broader community.

The Steering Committee recognises that the selection criteria for Major Residential Projects mostly suit the undergrounding of overhead distribution networks in metropolitan and major regional centres. There are physical limitations on the implementation of Major Residential Projects, such as the minimum project size and terrain difficulties, that make them impractical for some local governments. These local governments are encouraged to consider the potential for a Localised Enhancement Project within their areas (Round Five Localised Enhancement Project guidelines will be released at a later date).

PURPOSE OF THESE GUIDELINES

Invitation

The Steering Committee, on behalf of the State Government, invites proposals from local governments to participate in Round Five of the Program. Local governments are invited to submit proposals that outline the area(s) nominated for retrospective undergrounding of power in accordance with the requirements specified in these Guidelines.

These Guidelines outline:

- the process to be followed by local governments that wish to participate in the Program;
- the levels of funding available through the Program;
- the selection criteria for short-listing projects; and
- the process for prioritising and selecting projects.

These Guidelines reflect the priorities of the State Government and experience gained in previous rounds of the Program. Proposals submitted under previous rounds must be updated by the respective local government to satisfy the new criteria contained within these Guidelines, prior to being re-submitted.

Equitable, Transparent and Efficient Selection Process

The selection criteria for Round Five Major Residential Projects have been developed to ensure that all proposals are evaluated on an equitable basis. The Steering Committee and its representative bodies are committed to ensuring that the selection of proposals to participate in the Program is fair and impartial to all parties.

The Office of Energy, on behalf of the Steering Committee, has engaged an independent probity auditor to oversee the selection process for Round Five of the Program. All documentation relating to the selection of proposals will be controlled by the Office of Energy and held in a secure and restricted access environment.

Communication of Outcomes

Local governments should note that the Steering Committee may release to the Minister for Energy and to the general public details relating to short-listed and reserve listed proposals submitted by local governments for Round Five of the Program.

Representation made by the Steering Committee

Local governments should note that the Steering Committee does not make any representation or provide any undertaking to local governments in relation to proposals submitted for Round Five of the Program. Proposals that are submitted are not guaranteed funding. While the Steering Committee will endeavour to fully inform all interested local governments, it does not take responsibility for ensuring that the information is received by local governments.

Fees and Charges

Local governments must prepare and provide their proposals at their own cost. The Office of Energy, Western Power and the Western Australian Local Government Association will not be liable for any charges or costs incurred by participating local governments in preparing and submitting their proposals.

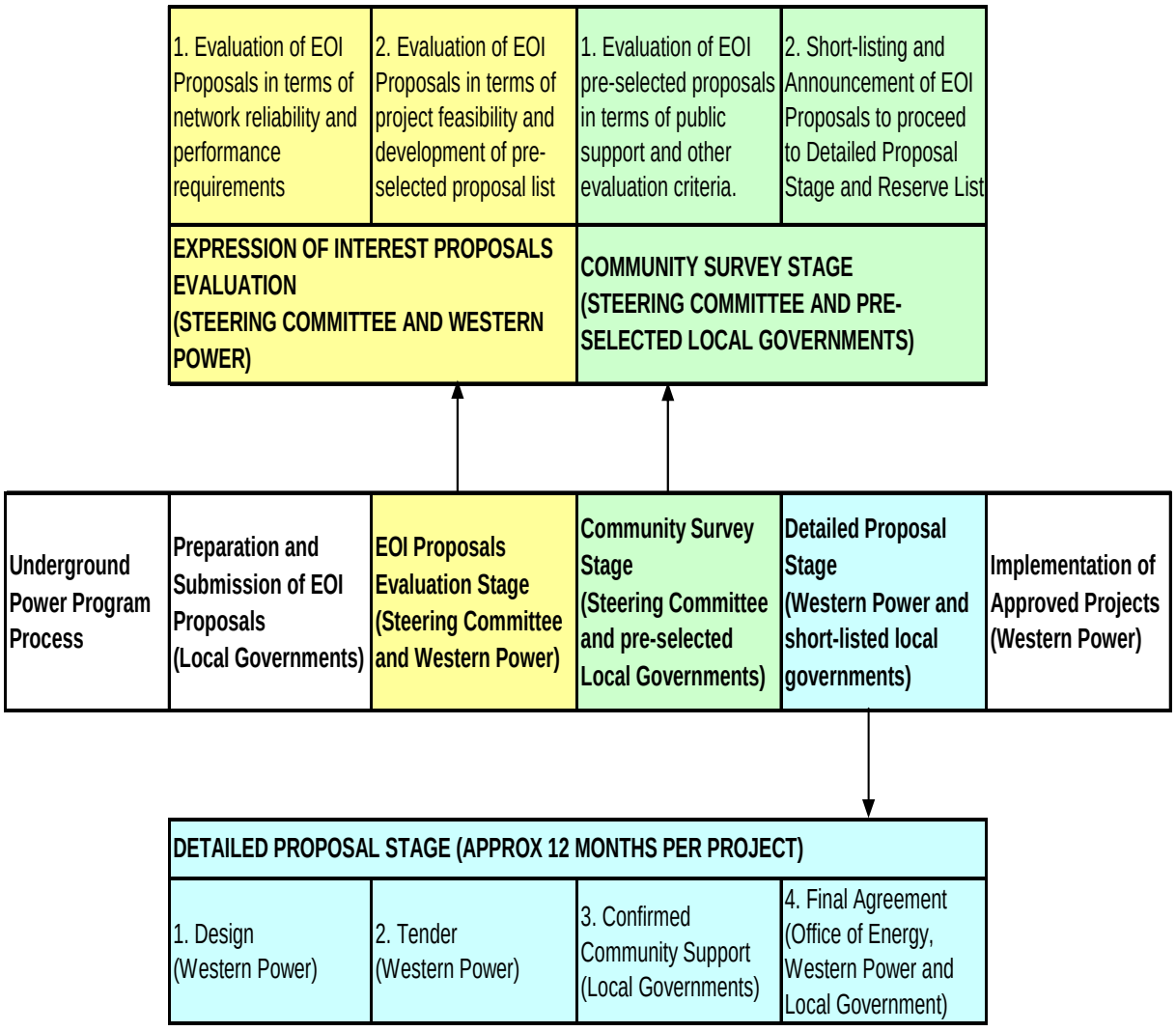
Local governments should note that an in-kind contribution will be considered in accordance with '*Guidelines - In-kind costs incurred by Parties participating on selected projects*', as specified in Appendix F.

Timetable

The steps in the Round Five Major Residential Project processes are:

• Deadline for lodgement of Expressions of Interest proposals	**19 February 2010**
• Evaluation of Expressions of Interest proposals completed	**June 2010**
• Announcement of short-listed projects	**July 2010**
• *Detailed Proposal Stage* for first short-listed Major Residential Projects commences	**July 2010**
• Implementation of first approved Major Residential Project	**July 2011**
• Expected completion of all Round Five Major Residential Projects	**Mid to Late 2014**

The diagram below illustrates the Underground Power Program Process, including the Expression of Interest Proposal, Community Survey and Detailed Proposal Stages:



Please note that the Detailed Proposal Stage is conducted separately for each short-listed Major Residential Project according to the project schedule (i.e. these projects are staggered). Hence, the Detailed Proposal Stage for the last short-listed Major Residential Project may not start until late 2011.

Please refer to:

- Appendix B for more information on the Expression of Interest Stage;
- Appendix C for more information on the Community Support and Other Evaluation Criteria Stage; and
- Appendix D for more information on the Detailed Proposal Stage.

PREPARATION OF PROPOSALS

Format and Submission of Expressions of Interest Proposals

In preparing and submitting Expression of Interest proposals for Round Five, local governments should note the following requirements and information:

- Local governments should use the template available from the Office of Energy website (www.energy.wa.gov.au) to assist in the preparation of proposals.
- The template provides a basic format for proposals and further explanation of the types of information required.
- Three hardcopies of each individual proposal may be submitted by post or courier. These documents must be clearly marked as 'Original', 'Copy 1' and 'Copy 2'. Where there are discrepancies between copies, the document marked as 'Original' will be treated as correct and accurate. An electronic copy of each individual submission must also be provided (in a single file PDF format) on CD/DVD.

Or

- An electronic copy of each individual submission may be provided (in a single file PDF format) on CD/DVD. Multiple submissions can be provided on a single CD/DVD.
- No facsimile or email submissions are permitted.
- Submissions must be addressed to the Executive Officer of the Steering Committee (see back cover) and arrive no later than 5pm (WST), Friday 19 February 2010.
- Late submissions will be rejected and returned to the local government unopened and unevaluated.
- Any proposal that does not contain all the information requested may be classified as incomplete. While incomplete proposals may not be automatically disqualified, they may be assessed wholly on the information contained in them at the time of submission. Therefore, proposals that are incomplete are likely to have a reduced chance of being successful.

Enquiries and Clarification

- ALL enquiries regarding any part of these Guidelines MUST be directed to:

  Glenn Sebestin, Executive Officer, Underground Power Program.
  Phone: 9420 5679
  Email: glenn.sebestin@energy.wa.gov.au

- Enquiries relating to the application of the technical criteria to a specific nominated area will be referred to the Western Power Underground Power Program Group. Responses to enquiries will be kept confidential and not disclosed to parties outside of the local government making the enquiry, the Program Group or the Steering Committee.
- In all instances, every attempt will be made to respond to enquiries at least five business days prior to the closure date for submissions. Local governments should endeavour to seek further clarification as early as possible prior to the submission date. Late requests for clarification (i.e. less than five days prior to the submission date) may not be addressed.

- Responses addressing any general point of clarification related to these Guidelines or the Program may be circulated to all local governments in order to assist them in making submissions. However, the identity of the originator of the request for clarification will be confidential and not disclosed to parties outside of the Evaluation Team or the Steering Committee.

STRUCTURAL AND FINANCIAL ARRANGEMENTS

General Program Arrangements

It is important that all local governments understand and agree to the conditions and requirements below, prior to submitting their proposals:

- The Program is a partnership between State Government, Western Power and local governments. Local governments are permanently represented on the Steering Committee by the Western Australia Local Government Association, while participating local governments are directly represented on the Expanded Underground Power Steering Committee, which meets on an as needs basis.
- Successful local governments are required to enter into an Agreement with the State Government and Western Power to jointly participate in Round Five of the Program and carry out the retrospective undergrounding of overhead distribution lines and replacement or relocation of related infrastructure.
- Ordinarily, where additional funding of 15 per cent for low income areas does not apply, the State Government and Western Power each contribute 25 per cent of a project's total costs. The remaining 50 per cent is to be matched by the participating local government. Additional funding for low income areas is discussed in Appendix E of these Guidelines.
- Each Party to the Agreement may invoice the project for its costs as specified according to the Guidelines for in-kind costs incurred by Parties participating on selected projects (see Appendix F).
- Please note that State funding will only apply to the retrospective conversion of overhead distribution lines to underground power supply, i.e. transmission lines are not included (see Appendix G).
- Local governments may propose project areas outside the preferred range of 500 to 800 lots. The project must be based on exceptional circumstances and be supported by evidence that the program's goals, objectives, effectiveness and efficiency would be maintained.
- Local governments may also wish to incorporate improvements outside the basic scope of the undergrounding projects, such as enhanced street lighting, for which they would bear the full additional cost.

Approval Process

- Following the initial evaluation of all Expressions of Interest proposals submitted for Round Five, a list of approximately twenty pre-selected proposals will be developed by the Steering Committee.
- The Steering Committee, with the cooperation of the appropriate local governments, will conduct public support surveys of all proposal areas on the pre-selected list. After obtaining the results of the public surveys, the Steering Committee will develop a formal short-list and reserve list for the Minister for Energy to approve.
- Proposals on the approved short-list will progress to the Detailed Proposal Stage. Projects are deemed to be successful only when they have met all of the requirements of the Detailed Proposal Stage (see Appendix D).

Project Management Arrangements

- Major Residential Projects selected for implementation are centrally managed under the Program, in order to deliver the best possible outcomes to all parties involved.
- In consultation with local governments, the Western Power Underground Power Program Group schedules and manages the implementation of successful projects on behalf of the Steering Committee. It is a requirement of the Program that participating local governments comply with all of the Committee's project planning, scheduling and management requirements. Those authorities that fail to do so will have their projects removed from the Program unless otherwise determined by the Steering Committee.
- The coordinated management of projects is crucial to delivering the best possible outcomes to all participants. Local governments that are unable or unwilling to cooperate with this process are advised to not submit proposals for Round Five.

EVALUATION, SELECTION AND FINALISATION OF MAJOR RESIDENTIAL PROJECT PROPOSALS

Overview of the Process

Recognising the cost to local governments in developing submissions for earlier Rounds, the Steering Committee has sought to provide further clarification on its requirements for Round Five. There is a template available on the Office of Energy's website (www.energy.wa.gov.au) that indicates the type and level of information required for the evaluation process. Projects will be selected on this basis, with finer details and formal Agreements being left until just prior to the project commencing.

In Round Five the selection of projects will be driven by:

- an initial assessment of Expression of Interest proposals based on the selection criteria set out in Appendix A;
- a community survey of those proposals that make the pre-selected list; and
- a detailed examination of short-listed Expressions of Interest proposals (i.e. Detailed Proposal Stage), prior to the approval of Major Residential Projects for implementation.

Expressions of Interest Proposal Stage (Pre-selection of Proposals)

The Steering Committee is seeking Expression of Interest proposals from local governments to participate in the Round Five Major Residential Projects. As part of each Expression of Interest proposal, local governments must clearly nominate an area in which they are interested in undergrounding power.

The Expression of Interest proposal template available on the Office of Energy website is intended to show the format and level of the information required, in order to minimise the cost and effort to local governments of preparing proposals.

The Underground Power Program Group will also be available to provide further guidance to local governments on network reliability issues within proposed project areas during the development of Expression of Interest proposals. However, please note that all enquiries, technical or otherwise, should be directed in the first instance to the Underground Power Program Executive Officer (see contact details on page 28).

To assist local governments further, the Steering Committee will provide a "council area specific map" that indicates relative network reliability within a council's area for stage one of the evaluation process. Western Power will provide reliability data to assist the Steering Committee and this map will be available upon request. The provision of this information is for the purpose of assisting local governments, however it does not guarantee the proposal area will be successful in the competitive selection process of Round Five.

The Steering Committee will evaluate the information provided in the proposals, together with Western Power's analysis of the existing distribution system, against a set of pre-established selection criteria (see Appendix A).

This process will occur in two stages:

- Evaluating and ranking of Expression of Interest proposals in terms of energy security (risk of extreme weather events) and network reliability and performance (i.e. the relative need for replacement of the existing overhead distribution lines to improve reliability). Proposals that cannot demonstrate that there is a significant reliability benefit to be obtained by replacing the overhead infrastructure within the nominated project areas are unlikely to proceed further (see Appendix B for more details).
- Evaluating the project feasibility of Expression of Interest proposals that demonstrate significant reliability benefits. This will drive the selection of proposals for the list of pre-selected projects.

This evaluation process will be carried out in accordance with the predetermined selection process and evaluation methodology. In addition, an independent probity auditor will be present to ensure that this process is undertaken in an equitable, transparent and efficient manner.

Community Support Stage (Short-listing of Projects)

The Steering Committee will be carrying out a community survey of all proposal areas that were successful in the Expression of Interest Stage and made the pre-selected list.

The Steering Committee will use the survey to evaluate the level of community support and willingness of the community to financially contribute to the project. Additional project criteria will be considered during this stage of the evaluation. These criteria are outlined in detail in Appendix C of the Guidelines. This stage of the evaluation will drive the final short-listing and reserve listing of proposals.

Only the local governments with Expression of Interest proposals that are short-listed following the above process will be invited to participate in the Detailed Proposal Stage. Proposals on the reserve list may be selected for further consideration if any of the short-listed proposals do not meet the requirements of the Detailed Proposal Stage.

Detailed Proposal Stage (Finalisation and Approval of Projects)

Local governments with short-listed Expression of Interest proposals will be invited to develop detailed proposals in consultation with the Steering Committee.

Prior to being finalised for implementation, the information provided by the short-listed proposals is examined in detail and these proposals are further developed. As in Round Four, the Detailed Proposal Stage seeks to confirm that each Round Five Major Residential Project will meet the following basic requirements:

- The project must demonstrate that it will improve the energy security and reliability of power supply to consumers living in the nominated areas.
- The project design and boundaries must be finalised, and the project budget must be achievable with the available funding. This includes equivalent underground power network design and cost, liaison with property owners regarding position of equipment, equivalent streetlight design and cost, and agreed treatment of any non-equivalent direct costs to the local government or Western Power.

- The participating local government must confirm that it has strategies to secure its share of the project budget over the life of the project and that the project has a sufficient level of public support within the nominated area.
- The participating local government must provide evidence that it has strategies in place to maintain community support for the life of the project.
- All boundary issues with other local governments must be resolved and the boundaries must be accurately mapped to enable ratepayers and residents to determine whether their properties are included in the Major Residential Projects.
- There must be an in-principle agreement between all parties on all of these issues, including the 'cash process' that set outs the process for cash calls and other issues relating to account management.
- Local governments are to provide all storm water drain plans to Western Power to ensure they are accounted for during the detailed design phase.
- At or near the completion of the detailed design stage, the participating local government may be required to conduct a survey of non-government landowning ratepayers, to provide evidence that it has continued community support and the extent at which the community is prepared to pay. The survey needs to be conducted under arrangements approved by the Steering Committee unless the Steering Committee waives the need or otherwise decides on different arrangements. Evidence of continuing support will be if a clear majority of non-government landowning ratepayers, who respond to the survey, are in support of the project.

Once Major Residential Projects have met all of the requirements of the Detailed Proposal Stage, the Steering Committee will recommend their implementation as part of Round Five to the Minister for Energy. Formal Agreements that define the respective roles, responsibilities and obligations of all parties are developed and signed prior to implementation of all Major Residential Projects.

Under these Agreements, the participating local governments are represented on the Expanded Underground Power Steering Committee during the implementation of their projects, which provides an opportunity for discussion of high-level project management issues.

Appendix A - SELECTION CRITERIA FOR ASSESSING EXPRESSIONS OF INTEREST PROPOSALS

Selection Criteria

Proposals for Major Residential Projects will be assessed for short-listing on the basis of information provided by local governments and Western Power.

The purpose of this section of these Guidelines is to outline to local governments the criteria that will be used, in order to assist them to understand the information necessary for the Steering Committee to assess and recommend to the Minister for Energy suitable projects to be short-listed for participation in Round Five of the Program.

Local governments should use the template provided on the Office of Energy's website: (www.energy.wa.gov.au) when preparing their expression of interest proposals.

Energy Security and Power System Reliability (Technical) Criteria

Local governments are encouraged to seek assistance from the Underground Power Program Group (within Western Power) in order to identify areas within their municipalities in which the network is poorly performing or is at greatest risk of damage and are therefore likely to benefit most from the replacement of the overhead powerlines with underground power. This process can be initiated by contacting the Executive Officer, Underground Power Program (whose details can be found at the end of these Guidelines).

The Evaluation Team will use the following criteria to assess and rank each proposal against its current and future requirements for the power system, and identify the relative risk of power system failure within nominated areas:

a) System Reliability including annual customer interruption minutes due to:
   - Pole top fires;
   - Pole-related traffic accidents;
   - Equipment failures;
   - Overloaded equipment;
   - Conductor clashing;
   - Extreme weather and storm-related damage; and
   - Pollution, wildlife and vegetation related faults.

b) Power Quality, including:
   - Number of power quality complaints; and
   - System reinforcement priority for project area.

c) Network Growth Requirements, including:
   - Fault rating of conductors.

d) Network Characteristics, including:
   - Proximity to zone substation;
   - Voltage conversion requirements;
   - Proximity to the coast;
   - Zoning changes that may lead to system overloading; and
   - Age of existing network infrastructure.

Information used for the above criteria is sourced from Western Power and the Local Government.

Project Feasibility (Non-Technical) Criteria

The following criteria will be used to assess the feasibility of Major Residential Projects, which will drive selection for those Expression of Interest proposals that are competitive in terms of the power system reliability criteria:

a) Nominated Area issues, including:

- Number and size of residential lots;
- Stated zoning of lots, the actual residential density within the nominated area and any approved plans to amend density in the near future;
- Proportion of commercial properties;
- Suitability of ground conditions for underground drilling;
- Amenity improvements such as reducing tree lopping requirements, contiguity with underground power in adjacent areas and extent of transmission line clusters; and
- The extent of vacant land within the nominated area owned by the State or the local government and any future plans for the use of this land.

b) Project Budget - Western Power will utilise a model it has developed that uses project variables (technical and non-technical cost escalators) to provide preliminary estimates of projects' budgets.

c) Local Government and Community Commitment and Support:

- Demonstrated ability of the local government to meet its share of a project's likely costs (on average, Major Residential Projects are expected to cost about $5-8 million in total, of which local governments fund 50 per cent); and
- Indicative level of Council and Community Support and a commitment to maintain community support.

Appendix B - EVALUATION METHODOLOGY FOR ASSESSING EXPRESSIONS OF INTEREST PROPOSALS

Evaluation Team

The evaluation of Expression of Interest proposals will be conducted by an Evaluation Team consisting of personnel from the Office of Energy and Western Power, supported by other specialists and advisers where required.

The Evaluation Team will evaluate proposals in a structured process to identify proposals that best satisfy the criteria identified above. Once the rankings of proposals have been established, the Evaluation Team will present its recommendations to the Steering Committee for endorsement.

Compliance Check

The Evaluation Team will conduct a preliminary evaluation of Expression of Interest proposals for completeness and determine whether the proposals meet the stated minimum requirements.

The Steering Committee has sole discretion in determining whether proposals fully conform or are incomplete.

Further Information

The Steering Committee or the Evaluation Team reserves the right to seek further clarification to verify claims made in Expression of Interest proposals, or to base its evaluation only on the information provided in the proposals. This may be undertaken at any time during the evaluation through:

- presentation; and/or
- structured interviews; and/or
- written questions.

If there is a major deficiency in any claim against the evaluation criteria during the Expression of Interest Proposal Stage, or issues being considered as part of the Detailed Proposal Stage, the proposal may be declined by the Steering Committee.

Evaluation Process

In Round Five, the Government has reaffirmed its goal of improving the security and reliability of power supply to consumers by installing underground power. In Round Five, power system reliability criteria must be met first, with the project feasibility criteria forming a second stage of evaluation. The evaluation and selection of Expression of Interest proposals for Round Five Major Residential Projects will involve a two-stage process.

Stage One - Evaluation and Ranking of Expressions of Interest Proposals in terms of Network Reliability and Performance Requirements

In stage one of the evaluation process, the Expression of Interest proposals will be evaluated against the power system reliability criteria outlined in Appendix A of these Guidelines, which will identify the areas in which the network is poorly performing or is at greatest risk of damage. Proposals that do not demonstrate that significant reliability benefits will be obtained from undergrounding the network in a proposed area will not progress to stage two and therefore will not be considered further in Round Five.

The Steering Committee acknowledges that selection of nominated areas by local governments must take these criteria into consideration for Expression of Interest proposals to have a reasonable chance of success. Western Power will be available to assist in identifying the areas within municipalities that provide the greatest reliability benefit from underground power. In the first instance, all such enquiries should be directed to the Executive Officer, Underground Power Program.

Please note that Western Power maintains and will provide the information required to the Evaluation Team to assess proposals against these criteria. This information will not be made publicly available but feedback on the power system criteria will be available through debriefing sessions with local governments after the announcement of the short-listed and reserve projects.

In the Expression of Interest proposals, local governments may provide a brief statement that summarises the concerns of the authorities, residents and businesses within the nominated areas, in regard to power system reliability issues.

Stage Two - Evaluation of Expressions of Interest Proposals that Demonstrate a Need for Replacing Overhead Infrastructure in Terms of Project Feasibility

Following the completion of stage one, those proposals still under consideration will be evaluated in stage two against the project feasibility (non-technical) criteria as outlined in Appendix A of these Guidelines. Each of the project feasibility criteria will have equal weighting, but local governments should note that some nominated area issues are linked to the estimation of project budgets by Western Power.

Rather than using an arbitrary cost per lot as the basis for the project budget criterion, Western Power will use project variables (technical and non-technical cost escalators) to provide preliminary estimates of projects' budgets. This will provide a more accurate estimate of total project costs and requires no additional effort on the part of local governments.

Local governments will need to provide a brief summary confirming their commitment to their Major Residential Projects and outline the funding strategies to be used. Given the links between funding strategies and ratepayer contributions, local governments should also provide some evidence of the likely level of community support for underground power, preferably from the ratepayers within the nominated areas. All Expression of Interest proposals must be certified by the Chief Executive Officer of the local government. Additionally, evidence of council meeting discussions regarding the nominated proposal area must be provided.

Those proposals that the Steering Committee considers as demonstrating a significant reliability benefit in replacing the existing overhead infrastructure and are also highly competitive against the project feasibility criteria (Appendix A) will be ranked accordingly and placed on a pre-selected list. Proposals on this list will then be considered for eligibility for an additional subsidy of 15 per cent, as described in Appendix E.

Appendix C - COMMUNITY SUPPORT AND OTHER EVALUATION CRITERIA

Those Expressions of Interest proposals that the Steering Committee have pre-selected based on success in the expressions of interest evaluation stage will be evaluated further.

Public Support

The Steering Committee will conduct a survey of each proposal area to determine if there are sufficient levels of community support in the proposal area. The local government responsible for the proposal area must cooperate with the Steering Committee in conducting the survey.

For a proposal to be considered for short-listing or reserve listing, the community survey must show that a clear majority of ratepayers who respond, support undergrounding of power. For the purposes of informing the local government's and the Steering Committee's assessment of the capacity of the local government to financially commit to the project, the survey will also include questions relating to the ratepayers preparedness to financially support the project. Land owned by the Government and participating local government will be excluded from the survey to ensure the results accurately show non-government landowning ratepayer's opinions on underground power and willingness to pay. It will be assumed that the applicant local government supports the proposal and the State Government agencies who own land in the proposal area support the State Government's underground power policy.

Additional Evaluation Criteria

The Steering Committee may evaluate the relative order of proposal ranking using other contributing factors. The Steering Committee may give preference and consideration to the following:

- proposals outside the Perth metropolitan area;
- relative vulnerability of the proposed area due to extreme weather events;
- local governments that have never received a project in previous rounds of the Program;
- equitable allocation of projects between local governments to ensure there isn't a majority of projects in a specific round that falls within one local government boundary;
- areas of lower socio-economic status; and
- the overall effectiveness of the Program objectives and benefits for the broader community.

Timing of Projects

The schedule and sequence of successful projects in Round Five will be at the discretion of the Steering Committee which will be assisted by the Western Power Underground Power Group. Strategic capacity will be instrumental in deciding the order of project implementation and timing of each project.

Final Short-list

Proposed areas that have clear majority community support and meet the additional criteria, will be ranked and placed on a short-list and reserve list of projects.

Once the evaluation process is finalised, unsuccessful local governments will be given the opportunity to be debriefed on their proposals. Please note that comparison will not be made with other proposals and specific power system reliability information and statistics will not be made available.

Appendix D - DETAILED PROPOSAL STAGE REQUIREMENTS

Prior to receiving final approval for implementation, detailed proposals are developed for short-listed projects in order to finalise Major Residential Project designs, boundaries and budgets. Local governments should note that short-listed Expression of Interest proposals are not approved for implementation. Local Governments must satisfy all of the requirements of the Detailed Proposal Stage to proceed.

The Detailed Proposal Stage seeks to confirm that each Round Five Major Residential Project will address the following issues.

Demonstrated Ability of the Local Government to meet its Share of a Project's likely Costs

It will be necessary to include practical proposals for raising the local government share of the project budget. Underground power projects differ in cost but local governments should expect their proposed projects to cost approximately $5-8 million in total (of which their share would be 50 per cent).

Local governments should note that it is their responsibility to determine their own financial arrangements. However, the local government must adequately demonstrate to the Steering Committee that it has community support for the proposed financial arrangements.

Based on Program experience, local governments are offered the following suggestions for consideration:

- raising at least one-fifth of the local government contribution from the general rate base in recognition of reduced pruning costs and generally improved value of the area to the local government;
- where funding is raised from the directly affected ratepayers:
  - funding to be in accordance with the *Local Government Act 1995*;
  - giving discounts to owners of properties adjacent to transmission lines (66,000 volts or more) which will not be placed underground (note that State Government and Western Power funding will only apply in relation to local distribution lines);
  - giving discounts to owners of properties where the connection is already underground (see Appendix H);
  - giving discounts to owners of properties where transformer or switchgear substations are located on the front verge;
  - giving special consideration to multiple connections on one lot;
  - giving special consideration for affordability by offering extended payment plans to property owners; and
  - providing rebates to pensioners in accordance with the State Government Rate Rebate Scheme.

Final Project Boundaries

Should the proposal be short-listed for participation in the Detailed Proposal Stage, project boundaries will be finalised and a detailed design and cost estimate prepared. This will include streetlight design.

Participating local governments will be required to provide, to the best of their knowledge, details of all underground services infrastructure, including water and storm water drains, gas and telecommunications services to the Underground Power Program Group.

Equivalent Underground Power System Design and Cost (i.e. Equivalent Service Level to Original Power System)

Equivalent replacement of the overhead distribution system shall result in reasonable enhancements considering the condition and adequacy of the existing system, difference in technical requirements and reasonably anticipated growth. This shall not include transmission system reinforcement or redesign (see Appendix G).

Streetlight Design and Cost

Local governments may elect to have Western Power street lighting or private street lighting installed.

Western Power Streetlights

Western Power streetlights funded as part of the project will use Western Power standard galvanised poles and luminaires that will provide lighting levels to Australian Standards.

Additional street lighting requirements such as the use of decorative poles/luminaires or increasing the light levels to a higher Australian Standard category may be installed at an additional cost to the local government. Please note that increasing light levels will incur greater tariff charges for street lighting and that decorative lighting will require a separate contract prior to the project agreement being signed.

A list of standard street lighting and decorative street lighting equipment is available on the Western Power website: www.westernpower.com.au.

Private Streetlights

If a local government elects to install private lighting, a contribution to the cost of this lighting may be made from the project budget if there is existing Western Power lighting.

The amount of this contribution is 50 per cent of the costs incurred if Western Power standard galvanised poles and luminaires were used to match the existing lighting levels. Typically, the local government will be responsible for funding the installation of private street lighting.

Non-Equivalent Direct Costs to Local Government and Western Power

Each Party shall be responsible for the costs of any agreed extra project requirements, which are not standard equivalent design such as painted streetlight columns or system reinforcement.

The “Cash Process”

The Parties will contribute their respective shares of costs in cash in accordance with an agreed cash call schedule. The local government is to invoice monthly its progressive project ‘in-kind’ costs determined using these Guidelines – In-kind costs incurred by Parties participating on selected projects specified in Appendix F. These invoices are to be verified by the Project Accountant and approved by the Program Manager.

Local governments should note that the Program Manager shall (based on approved budgets and anticipated expenditure) make cash calls in respect of each project on the relevant Parties every two months or as agreed by the Parties to the Agreement. Each Party shall contribute its share of a cash call within 14 days and all such monies received shall be held by Western Power for and on behalf of the Parties to the project.

“Boundary” Issues with other Local Governments

The Steering Committee may agree to expand the scope of the project to include a street contiguous to the project boundary and where it crosses a local government district boundary.

This is subject to the Steering Committee being satisfied that suitable arrangements are in place between the local government (and/or Parties) that is a Party to the underground power project Agreement and the adjacent local government.

The adjacent local government will not be a Party to the underground power project Agreement. Evidence of consultation with the adjacent local government is expected and confirmation in writing from the adjacent local government attesting to the funding arrangement is required prior to project implementation.

Community Support

Confirmation of community support may be required through a detailed survey. Depending on the results of the survey of projects on the pre-selected list, the Steering Committee may request that another detailed survey is carried out during the detailed design stage. The local government may need to implement a consultation and education program, including the provision of public information. This needs to be handled with care and sensitivity, particularly when the local government plans to raise the bulk of its funds from directly affected property owners through rate notices.

State funding is conditional on the availability of clear evidence of continuing community support. The State will not proceed with proposals that do not demonstrate adequate support from the local community.

Participating local governments will have primary responsibility in consulting with property owners and residents throughout the Detailed Proposal Stage. However, all communications need to be aligned with the practices and policies of the Program and be formally approved by the Steering Committee (or its nominated representative). Participating local governments may approach the Steering Committee for assistance in designing and implementing the community consultation program. It is important to note that continuing community education might be required, for the public to gain a better understanding of the benefits of underground power.

Local governments will need to consult with property owners and residents regarding transformers/switchgear on their verges and sign-off that the final location of transformer/equipment is acceptable to all parties. The Underground Power Program Group will provide advice to local governments on how to conduct this process in order to meet the requirements of the Steering Committee.

A Draft Agreement

A draft legal joint Agreement between the State Government, Western Power and the local government(s) will be provided for formal signing by all Parties. This formalises the commitment to funds, scope of works, responsibilities for the Parties and general terms and conditions of the Agreement.

Appendix E - ADDITIONAL FUNDING ASSISTANCE FOR PARTICIPATING LOCAL GOVERNMENTS

The Steering Committee is keen to maintain equitable access to the Program by local governments.

In support of this, there is a subsidy of 15 per cent of the total cost to local governments to encourage areas of low socio-economic status to take part in the Program. Eligibility of any nominated area will be determined by the Socio Economic Index for Areas (SEIFA) developed by the Australian Bureau of Statistics. The subsidy would require respective local governments to raise only 35 per cent of the total cost of the project.

Due to the constantly varying data of the Australian Bureau of Statistics' SEIFA, the index will be applicable if the proposal area qualifies anytime between application date to the conclusion of the detailed proposal stage. The Steering Committee will ensure that the data used for each proposal area is equitable.

For the purposes of submitting an Expression of Interest proposal, local governments should identify areas which they consider may satisfy this requirement. This will be subject to further discussion with the Steering Committee.

In addition, it is also proposed to maintain the current initiative of facilitating low interest loans for those local governments that would find participation difficult unless assisted with cash flows. Interest subsidies of up to five per cent may be paid by the State for up to five years on borrowings by approved local governments from approved financial institutions (including the WA Treasury Corporation).

Local governments should advise in the proposal if they intend to seek an interest subsidy. The local government should also advise of the justification for seeking the interest subsidy. Acceptance of this advice is at the discretion of the Steering Committee.

The arrangement of the loan itself, payment of the balance of the interest and repayment of the principal, will be the responsibility of the local government.

Local governments that receive an additional subsidy of 15 per cent of the total cost are not eligible for the loan interest subsidy.

Appendix F - IN-KIND COSTS INCURRED BY PARTIES PARTICIPATING ON SELECTED PROJECTS

Introduction

The information contained within this Appendix has been prepared to assist all Parties participating on selected projects identify eligible ‘in-kind’ costs which may be claimed. This Appendix also defines and explains approved overheads, the process to submit claims, periodic audits, commencement and termination dates for eligible costs and the relationship between the ‘in-kind’ costs and the project budget.

Eligible In-Kind Costs

Eligible costs are reasonable direct project costs incurred by any Party to the Agreement. Subsequent to the Agreement, these costs are categorised into direct labour, direct materials and other general costs.

Direct Labour

Direct labour includes project specific hours worked by employees of a party. This can be estimated as a proportion of their total hours and will need certification from a senior officer/manager of that party.

Direct Materials

Direct materials are any material reasonably used on the project. Overheads cannot be applied to non-inventory direct purchase materials used on the project.

General Costs

These include:

- project newsletters to residents;
- costs of power levy notice preparation (excluding software);
- relevant consultant fees during the project implementation;
- reinstatement costs; and
- streetlight inspections.

Project Management Costs

These include labour and overhead material costs for:

- design of the new underground network;
- contract establishment;
- material management;
- engineering;
- project management, contract administration and site supervision;
- quality management; and
- accounting services and public consultation.

Ineligible ‘In-Kind’ Costs

Computer Hardware, Software or Software Development

Costs to Prior Agreement

Administration or consultancy costs prior to signing the Agreement, such as preparing the Expression of Interest proposal and community survey (unless project management is specific to the Program).

Non-Equivalent Extra Costs

Non-equivalent extra costs include extra project requirements, which are not standard equivalent design, such as painted streetlight columns, system enhancements or reinforcement.

Value for Money

Parties are required to justify that the best value for money, for the project, has been achieved in incurring the expenses being claimed as ‘in-kind’ costs where other alternatives are available to carry out the activity.

Any dispute on this matter is to be resolved by the Steering Committee. As part of the audit process, efficiencies of carrying out certain activities may be compared against similar activities carried out elsewhere. The intent is to strive for best practice.

Approved Overheads

The Agreement provides for 93 per cent overhead on base direct labour (includes annual leave, long service leave, public holidays, payroll tax, retrospective pay, sick leave, superannuation, workers’ compensation, insurance, fringe benefits tax, operational expenses and corporate support costs) and 10 per cent on direct materials. There are no overheads applicable to general in-kind costs, non-inventory items and consultancies.

Process to Submit Local Government Claims

A template is available to the local government from the Project Accountant to enable reporting of direct labour, direct materials, general costs and overheads. This is to be submitted with an invoice to the Project Accountant by the third working day of each month for approval and inclusion in the monthly project business report.

Periodic Local Government In-Kind Cost Audits

During the project the Project Accountant carries out periodic audits with an officer nominated by the local government. All queries are to be resolved prior to the next audit. At the end of the project the Program Manager and the senior representative of the local government will be required to sign-off on the total approved in-kind costs.

Commencement and Termination Dates

Local government in-kind costs are incurred from the date of Agreement signing with eligibility ceasing after the practical completion date. If justified by the Program Manager beforehand, reasonable in-kind costs incurred after practical completion may be claimed against the special 12-month warranty fund.

Relationship of In-Kind Costs to Project Budget

The Parties will contribute their respective shares of costs in cash in accordance with an agreed cash call schedule. As required in Clause 6 of this Appendix, the local government is to invoice monthly its progressive project in-kind costs which are determined using these guidelines. Invoices must be verified by the Project Accountant and approved by the Program Manager.

The ‘in-kind’ cost provision is included in the project budget based on local government reasonable estimates.

Further Information

If any further information is required, please contact the Project Accountant on phone (08) 9219 2006 or fax (08) 9335 5078.

Appendix G - REPLACING OVERHEAD INFRASTRUCTURE

Introduction

This Appendix identifies stakeholder and funding issues associated with interfaces between Program distribution and transmission systems and establishes Western Power's position in respect to responsibility and funding.

Background

The Program Agreement has an 'equivalence' requirement to underground the distribution system only. Extra transmission system work outside this distribution system equivalence policy is not funded by the Program.

The three key transmission system areas affected are:

- transmission overhead lines;
- overhead transmission pilot cables; and
- transmission line stayed on distribution poles.

Transmission Overhead Lines

Transmission overhead lines are above 66kV and form the interconnections between zone substations and terminal stations. In some cases, parts of the transmission and distribution systems share structural features.

Undergrounding of Transmission Lines

Although it would be preferable to underground transmission lines in a project area, prohibitive costs exclude this from the Program scope of work. The local government concerned may provide at its discretion partial Program rebates for affected ratepayers for the loss in amenity.

Re-Spacing Transmission Poles

Transmission overhead lines have in some instances had the bay distance reduced to facilitate the distribution network on a common pole. This has resulted in a significant number of additional poles being installed. With the distribution network now being removed, local governments are requesting that intermediate poles be removed and/or pole bays be re-spaced to improve the aesthetic appearance of the areas concerned.

Similar to undergrounding of transmission lines, the re-spacing of transmission pole bays is outside of the underground project scope.

In both cases, the local government is directed to Western Power's Environment & Land Management Manager for direct negotiations to establish costs and timing. The local government concerned will need to take the additional costs into account in determining their rating models.

Transmission Line Pole Staying

Once the underground system is operational, all of the redundant overhead distribution system is removed. Where this removal creates a structural problem with the transmission system (for example pole staying), the Program funds all remedial work, which may include:

- retaining existing distribution poles for support; or
- establishing alternate staying arrangements.

Key stakeholder representatives must agree on staying of transmission poles, before the removal of the distribution systems.

Overhead Transmission Pilot Cables

Transmission pilot cables are part of the transmission control system. Pilot cables are often reticulated overhead and share overhead distribution assets.

Replacement of overhead transmission pilot cables with equivalent underground pilot cables is included in the Agreement and is fully funded by the Program.

Summary

Program funding will include transmission interfacing needs such as retaining existing distribution poles for support or establishing alternate staying arrangements and re-establishment of pilot cable networks.

Non-Program associated transmission system work should be arranged separately and be fully funded by local governments.

Appendix H - CONSUMER MAINS ISSUES

It is acknowledged that at some premises in the project area a connection pillar (typically covered with a green plastic dome) and a consumer's mains (typically an underground cable connecting the premises to the connection pillar) may already be installed.

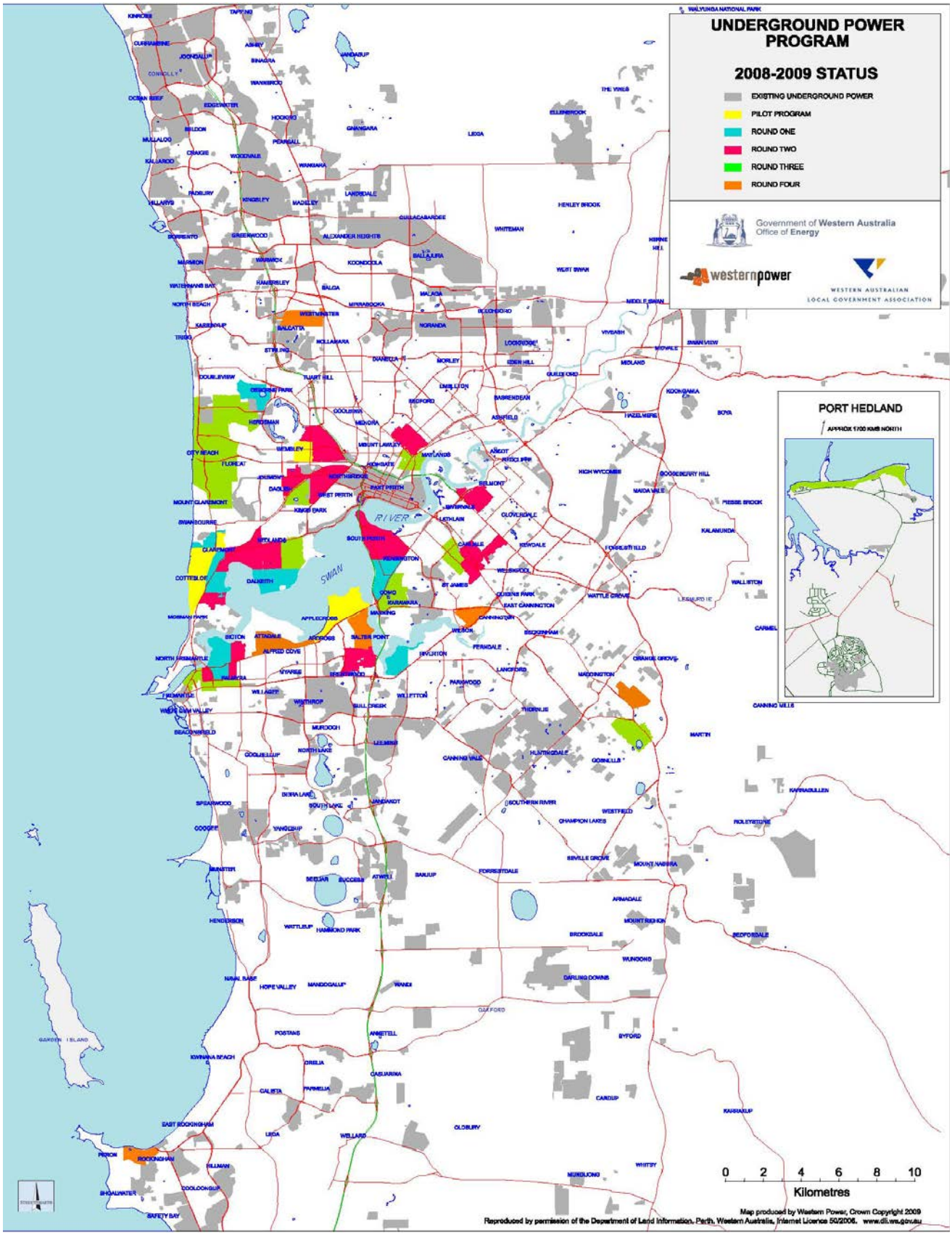
The Program Manager will take into account a pre-existing underground connection pillar and consumer's mains for any premises in the project area in the design of the project and the project budget, if those pre-existing works meet all the Western Australian Electrical Requirements for the project.

The local government will recognise any savings to the project and costs incurred by the owner of an applicable premise, achieved by the use of pre-existing works, by giving the owner an appropriate discount on the owner's levy payable to the local government. In each case, the amount of the discount will be determined by the local government in consultation with the Steering Committee, and in accordance with the local government’s proposal.

Appendix I - TABLE AND MAP OF PREVIOUS ROUNDS OF UNDERGROUND POWER PROJECTS

Local Government	Project Area(s)
Pilot Projects	
City of Albany	Albany
City of Melville	Applecross
Town of Cottesloe/Claremont	Claremont & West Cottesloe
Town of Cambridge	Wembley
Round 1 Major Residential Projects	
Town of Cottesloe	East Cottesloe
Shire of Peppermint Grove	Peppermint Grove
City of Nedlands	Dalkeith & Swanbourne
City of Stirling	Woodlands
City of South Perth	Como
City of Canning	Rossmoyne
Town of East Fremantle	East Fremantle
Round 1 Localised Enhancement Projects	
Shire of Nannup	Nannup
Shire of Dowerin	Dowerin
Shire of Donnybrook-Balingup	Donnybrook
Shire of Collie	Collie
Shire of Augusta-Margaret River	Margaret River
Shire of Irwin	Dongara
Round 2 Major Residential Projects	
City of Melville	West Bicton
Town of East Fremantle	Plympton
City of Belmont	Rivervale
City of South Perth	Mill Point
Town of Claremont	South Claremont
City of Melville	Mount Pleasant
City of Stirling	Mount Lawley
Town of Cambridge	West Leederville
Town of Victoria Park	East Victoria Park
City of Subiaco	Subiaco
City of Nedlands	West Nedlands
Town of Mosman Park	Mosman Park
Round 2 Localised Enhancement Projects	
Shire of Serpentine-Jarrahdale	Jarrahdale
City of Gosnells	Gosnells
Shire of Shark Bay	Denham
Town of Vincent	Highgate
Shire of Harvey	Harvey
Shire of Mundaring	Mundaring
City of Rockingham	Rockingham
Shire of Murray	Pinjarra
City of Fremantle	Fremantle
Shire of Bridgetown-Greenbushes	Bridgetown
City of Stirling	Scarborough

Local Government	Project Area(s)
Round 3 Major Residential Projects	
Town of Victoria Park	Victoria Park South
City of Subiaco	Shenton Park
Town of Cambridge	City Beach
City of Gosnells	Gosnells North
City of Fremantle	Fremantle
City of Nedlands	Nedlands East
City of Stirling	Churchlands/Wembley Downs
Town of Port Hedland	Port Hedland
Town of Vincent	Highgate East
City of South Perth	Como East
Round 3 Localised Enhancement Projects	
Plantagenet	Mount Barker
Collie	Collie
Donnybrook-Balingup	Balingup
Nannup	Nannup
Bunbury	Bunbury
Geraldton	CBD/foreshore
Lake Grace	Lake Grace
Gingin	Guilderton
Carnamah	Townsite precinct
Round 4 Major Residential Projects	
City of Melville	Mount Pleasant North – Completed
City of Rockingham	Palm Beach – Being developed
City of Canning	Wilson West – Commenced
City of Gosnells	Maddington – Commenced
City of Stirling	Balcatta – Being developed
City of Melville	Attadale South – Being developed
Round 4 Localised Enhancement Projects	
Shire of Toodyay	Toodyay – Completed
Shire of Harvey	Brunswick Junction - Commenced
Shire of Augusta/Margaret River	Cowaramup – Being developed
Shire of Bunbury	Bunbury – Being developed
Shire of Dandaragan	Jurien Bay – Being developed
Town of Victoria Park	Victoria Park – Being developed
City of Bayswater	Bayswater – Being developed
City of Belmont	Belmont – Being developed


UNDERGROUND POWER PROGRAM
2008-2009 STATUS
EXISTING UNDERGROUND POWER
PILOT PROGRAM
ROUND ONE
ROUND TWO
ROUND THREE
ROUND FOUR
Government of Western Australia
Office of Energy
westernpower
WESTERN AUSTRALIAN LOCAL GOVERNMENT ASSOCIATION
PORT HEDLAND
APPROX 1700 KMS NORTH
RIVER
SWAN
0 2 4 6 8 10
Kilometres
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10 Appendix D. Crash Statistics

The Authority engaged Marsden Jacob Associates (MJA) to undertake a statistical study of overhead power lines and road crash statistics to determine whether the undergrounding of overhead power distribution assets is a significant contributor to improved road safety. Improved road safety may refer to either a reduction in the total number of incidents or a reduction in the severity of accidents. The Authority utilised panel data on the frequency of vehicle crashes involving a power pole to test whether a reduction in the number of overhead connections resulted in a statistically significant reduction to the number of accidents.

A sample of 38 suburbs was considered on an annual basis over the period 2006 to 2010. Western Power provided data on the number of overhead assets in the relevant suburbs over the sample period. The number of overhead connections per suburb remaining ranged from approximately 3,000 connections to zero connections. Data on the frequency, location and type of accident in the Perth metropolitan area was provided by the Office of Road Safety (ORS). The ORS provided information on the type of vehicle crashes, being disaggregated into four categories based on severity. The categories included:

- Type 1: Property damage only;
- Type 2: On-site medical attention required;
- Type 3: Hospitalisation required; and
- Type 4: Fatality.

From this information the Authority constructed panel data (where n=5, T=38 and N=190) on which a linear regression could take place.

A balanced, fixed-effects panel data regression model was constructed from the vehicle crash and overhead connection data. The model was structured to assess the impact of a change in the number of connections within a suburb on the frequency of vehicle crashes. Additional parameters were included so that the impacts of changing driver behaviour, road condition and population density were not attributed to the number of overhead power connections. The model was run independently for each accident type.

The results of the modelling exercise indicated that there was a statistically significant relationship between the number of overhead power connections and the frequency of Type 1 and Type 3 crashes. These results are illustrated in Table 10.1 below.

Table 10.1 Statistically Significant Relationships

Variable	Coefficient	Significance
Type 1: Property Damage Only	8.868 x 10-5	0.083
Type 3: Hospitalisation	4.891 x 10-5	0.013

The coefficients in the table above indicate the mean number of crashes avoided due to a unit increase in the number of overhead connections (per annum). Therefore, in order to reduce the number of Type 3 accidents by one in a single year, 20,446 overhead connections would need to be converted to underground connections for a single year.

It is possible to extrapolate these results to the SUPP deliverables. Such a process assumes that the density of power poles in SUPP suburbs is equivalent to that of the

38 sample suburbs. Figure 5.1 on page 54 illustrates the impact on a per-annum and cumulative basis for the two statistically significant sample groups. The Authority recommends that these values be treated with caution, as they reflect a probabilistic interpretation of accident frequency.

11 Appendix E. Glossary

BCR	Benefit-Cost Ratio
BTCE	Bureau of Transport and Communications Economics
CAIDI	Customer Average Interruption Duration Index or SAIDI divided by SAIFI, which gives the average outage duration any customers would experience.
CBA	Cost-Benefit Analysis
DCITA	Department of Communications, Information Technology and the Arts (former Commonwealth Government agency)
EMRC	Eastern Metropolitan Regional Council
EOI	Expression of Interest
IPART	Independent Pricing and Regulatory Tribunal (NSW)
LEPs	Localised Enhancement Projects
MJA	Marsden Jacob Associates
MRPs	Major Residential Projects
NBN	National Broadband Network
NPC	Net Present Cost
NPV	Net Present Value
OoE	Office of Energy
ORS	Office of Road Safety
PCU	Putting Cables Underground
SAIDI	System Average Interruption Duration Index or the total of all customer interruptions (in minutes) divided by the total number of customers averaged over the year.
SAIFI	System Average Interruption Frequency Index or the total number of interruptions divided by the total number of customers averaged over the year.
SKM	Sinclair Knight Merz
SUPP	State Underground Power Program
SWIS	South West Interconnected System
UPPT	Underground Power Program Team
WALGA	Western Australian Local Government Association