Issues Paper

Inquiry into State Underground Power Program Cost Benefit Study

28 June 2010

Economic Regulation Authority
WESTERN AUSTRALIA

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Foreword

The Economic Regulation Authority (**Authority**), at the request of the Treasurer, will conduct an inquiry into the overall costs and benefits of the State Underground Power Program.

In accordance with the inquiry's Terms of Reference, the Authority is required to have regard to the costs of undergrounding the overhead electricity distribution network, compare the costs associated with maintaining the current distribution network with the costs of undergrounding, and determine the types of costs which are avoided as a result of undergrounding the overhead electricity distribution network.

The Authority is also required to identify and quantify (where possible) all costs and benefits of underground power and undertake 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, individual households and Western Power. The cost benefit study is limited to the undergrounding of power in the South West Interconnected System.

The purpose of this issues paper is to provide background information and outline the issues to be reviewed. It is intended to assist stakeholders to understand the nature of the issues under review and to facilitate public comment and debate. Throughout this issues paper questions that may be of particular interest to stakeholders are raised and are highlighted in boxes.

Submissions on any matters, including those raised in this issues paper, should be submitted by **4:00 pm (WST) on Friday 6 August 2010** to:

publicsubmissions@erawa.com.au

or addressed to:

Inquiry into State Underground Power Program Cost Benefit Study
Economic Regulation Authority
PO Box 8469
Perth Business Centre
PERTH WA 6849
Fax: (08) 9213 1999

Section 1.4 of this issues paper provides further information regarding the process for making a submission.

Interested parties and stakeholders will have further opportunity to make submissions following the release of the Authority's draft report. The final report for the inquiry is scheduled to be delivered to the Government by 23 April 2011, following which the Government will have 28 days to table the report in Parliament.

I encourage interested parties to consider the Terms of Reference and matters raised in this issues paper and prepare a submission to the inquiry.

LYNDON ROWE
CHAIRMAN

Contents

List of Tables

List of Figures

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 household (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.

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, 65 projects have been completed and just over half of the metropolitan area is now serviced by underground power. A fourth round of projects is currently underway and State Government funding for a fifth round of projects was announced by the Minister for Energy in October 2009.

The Minister for Energy also announced that the Office of Energy is going to carry out a major public review of the SUPP before the State Government commits to any further funding for the SUPP. 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.

The broader review by the Office of Energy, which is yet to commence, 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:

- This issues paper invites submissions from stakeholder groups, industry, government and the general community on the matters in the Terms of Reference. Submissions are due by 6 August 2010.
- Following consideration of submissions, the Authority will publish a draft report and invite further public comment.
- The final report for the inquiry is to be delivered to the Treasurer by 23 April 2011 and the Treasurer will, in accordance with the Act, have 28 days to table the report in parliament.

The Authority will also be consulting with its Consumer Consultative Committee during the course of the inquiry.

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 issues paper 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 6 August 2010.

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:

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2 State Underground Power Program

The State Underground Power Program (**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.[1] The service lines between poles in the street and people's houses were particularly affected, and around 80 per cent of the damage in the 1994 storms was caused by falling trees.

In summary, the SUPP involves the undergrounding of Western Power's existing overhead distribution lines in residential and commercial areas. Local governments submit proposals, or Expressions of Interest (**EOIs**), for areas that they want to be undergrounded to the Underground Power Steering Committee (**Committee**). This Committee evaluates the EOIs whilst, at the same time, local governments carry out a survey of affected ratepayers to gauge community support for undergrounding a specific area. It is worth noting that in the next round of the SUPP (round five), the Committee will undertake the ratepayer surveys instead of local governments.

During the evaluation process of the EOIs, the Committee identifies the proposals that will be subjected to a more detailed evaluation process, based on a set of criteria that are publicly available. Following on from this detailed consideration of proposals, the Committee provides a list of the recommended SUPP projects to the Minister for Energy for approval. The Ministerially approved projects are subsequently implemented by a group in Western Power and another community survey of affected ratepayers is carried out for each area to establish their level of satisfaction with the completed projects.

Since the program began in 1996, 65 projects where existing overhead distribution lines have been placed underground have been completed. Just over half of the metropolitan area is now serviced by underground power, largely as a result of the change in the Western Australian Planning Commission's (**WAPC**) planning policy in 1992, which requires underground power for all new developments in the South West Interconnected System (**SWIS**). The WAPC may require underground power as a condition of subdivision in areas outside the SWIS as well.[2] To a smaller extent, the SUPP and other initiatives, such as the 'pole to pillar' requirement[3], have also contributed to the amount of underground power that is servicing the metropolitan area.

The next section provides more information about how the SUPP works, including details about each of the steps in the evaluation and selection processes of SUPP projects, an outline of the SUPP project costs and the existing funding arrangements, and a discussion about what the SUPP has achieved so far.

2.1 How does the State Underground Power Program Work?

The Committee is responsible for the management of the SUPP, and is comprised of representatives from the Office of Energy (**OoE**), Western Power and the Western

[1] Distribution lines run from zone sub-stations to the customers.

[2] Western Australian Planning Commission, 2003, *Policy No. 2.2 Residential Subdivision*, pp9-10.

[3] All new homes in the Perth metropolitan area are required to have an underground power connection from the pole in the street. Western Power may subsidise the cost of replacing an overhead service line with an underground pole to pillar connection, if certain conditions are met. *Source: Western Power website.*

Australian Local Government Association. The Committee has appointed an independent probity auditor, who provides advice to the Committee and ensures all of its processes are transparent and equitable.

The Executive Officer to the Committee, from the OoE, provides secretariat support to the Committee and is the initial point of contact for local government inquiries. A group within Western Power, the Underground Power Program Team (**UPPT**), coordinates project implementation on behalf of the Committee.[4]

The program offers two types of projects:

- Major Residential Projects (**MRPs**) involve the conversion of overhead supply to underground distribution lines operating at 33,000 volts or less in suburban areas, with the aim to improve electricity reliability. The MRPs must cover between 500 and 800 lots in order to achieve economies of scale and to underground a sufficient part of the network to achieve reliability improvements. MRPs generally require a one year development process to finalise the scope of the project, boundaries and budget, and the implementation of large MRPs can take up to two years.
- Localised Enhancement Projects (**LEPs**) aim to beautify urban gateways, scenic routes and tourism/heritage centres, particularly in regional towns, through the undergrounding of distribution lines. These are smaller than MRPs in size and they are aimed at delivering improved amenity benefits to the local community.

2.1.1 Selection Process for Major Residential Projects

The major goals of the MRPs are to improve:

- the energy security of Western Australia's electricity distribution system in extreme weather events; and
- the standard of electricity supply to consumers by addressing reliability issues in areas with existing overhead power lines.[5]

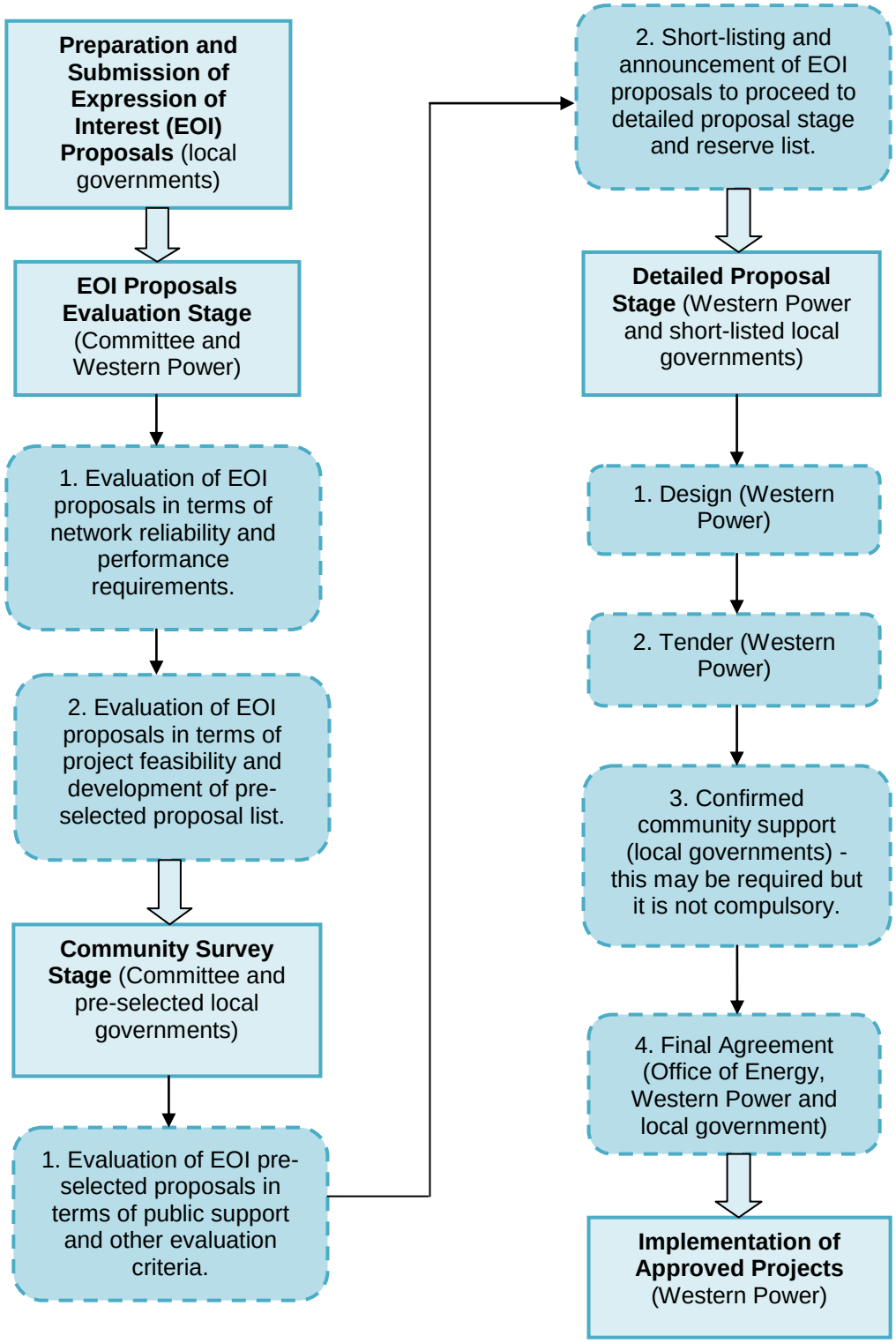
The process that will be used to identify, assess and implement underground power projects for round five of the program is detailed on the next page.[6]

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

[5] Ibid, p1.

[6] Ibid, p4.

Figure 2.1 State Underground Power Program Process for Major Residential Projects



Preparation and Submission of EOI Proposals

The first step in the process is to invite local governments to submit expressions of interest for consideration by the Committee, and there are guidelines and a template to assist local governments' preparation of the EOIs. The guidelines also set out the conditions and requirements of the program, including the funding arrangements that apply.

As part of the EOI, local governments have to clearly nominate an area in which they are proposing to replace existing overhead lines with underground cables.[7]

EOI Proposals Evaluation Stage

An evaluation team, consisting of people from the OoE and Western Power, evaluates the information provided in the proposals, together with an analysis by Western Power of the existing distribution system, against a set of pre-established selection criteria. The evaluation process will occur in two stages:

- Evaluation and ranking of EOI proposals in terms of energy security and network reliability and performance (technical criteria).
- Evaluation of the project feasibility of EOI proposals which demonstrate significant reliability benefits (non-technical criteria).

An independent probity auditor is present during the evaluation to ensure that the process is undertaken in an unbiased and transparent manner.

At the end of the initial evaluation of all the EOI proposals received, a list of pre-selected proposals is developed by the Committee.[8]

Community Survey Stage[9]

The Committee, with the cooperation of the relevant local governments, conducts public support surveys of all proposal areas on the pre-selected list. This survey is used to assess the level of community support and willingness of the community to contribute to the funding of a project. In 2006, as part of round three of MRPs, a survey was undertaken by affected property owners in the Town of Vincent 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 were prepared to contribute to the costs to have the power lines placed underground.[10]

During this stage, a number of other criteria or contributing factors are considered by the Committee:

- Whether or not the proposals are outside of the Perth metropolitan area.
- The relative vulnerability of the proposed area due to extreme weather events.

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7 Ibid, pp5-7.

8 Ibid, pp10-13.

9 Prior to round five, the Community Survey Stage was not part of the Committee's formal evaluation phase. Instead, surveys were undertaken after the detailed design stage of the proposal and prior to the local government formally committing to the project. This approach exposed the SUPP to significant development costs, with the risk that residents would not necessarily support the project or the local government would not commit to the project.

10 Information from the Office of Energy.

- Whether there are any local governments that have never received a project in previous rounds of the program.
- Whether there is an equitable allocation of projects between local governments so that there is not a majority of projects in a specific round that falls within one local government boundary.
- Whether proposals include areas of lower socio-economic status.
- The overall effectiveness of the program objectives and benefits for the broader community.

After getting the results of the public surveys, the Committee develops a formal short-list and a reserve list for the Minister for Energy's approval. The proposed areas that demonstrate community support and meet the additional criteria are ranked and placed on the short-list and reserve list of projects.[11]

Detailed Proposal Stage

Local governments with short-listed EOIs will need to develop detailed proposals in conjunction with the Committee. The detailed proposal stage will confirm that each MRP addresses the following issues:

- Demonstrated ability of the local government to meet its share of costs.
- Project boundaries have been finalised.
- Equivalent underground power system design and costs (i.e. equivalent service level to original power system).
- Street light design and cost – local governments can choose to install either Western Power street lighting or private street lighting.
- Non-equivalent direct costs to local government and Western Power, which are the costs of any agreed extra project requirements that are not standard equivalent design, such as painted street light columns or system reinforcement.
- An agreed payment schedule, which sets out when payments have to be made by the various parties.
- Boundary issues with other local governments.
- Has majority community support (50 per cent or more).

If the MRPs meet all of these requirements, the Committee will recommend their implementation to the Minister for Energy, subject to the funding limit set by the budget for round five, and formal agreements are developed and signed by the parties before the projects are implemented. The local governments that participate in the projects are represented on an Expanded Underground Power Steering Committee during the implementation of the projects.

Implementation of Approved Projects

A team within Western Power, the UPPT, is responsible for the implementation of underground power projects. This team is led by a Program Manager, who manages the schedule of projects and budgets on behalf of the Committee. Western Power project managers, who report to the Program Manager, manage the different projects with assistance from representatives from participating local governments.

[11] Ibid, p14.

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.

Contract prices may be impacted by the availability of skilled labour, especially jointers,[12] the hardness and geology of the ground,[13] and other complicating factors, such as traffic management (which can extend the duration of a contract).

2.1.2 Selection Process for Localised Enhancement Projects

The key objectives of LEPs are to achieve:

- efficient retrospective installation of underground power, contributing to improved system reliability and cost savings in terms of maintenance and reduced distribution losses; and
- significant contributions to local communities, including enhanced streetscapes and visual amenity of public places, improved property values and improved safety.[14]

As the LEPs have different objectives to the MRPs, the selection criteria and evaluation methodology for LEPs are not as focussed on achieving improvements in reliability. However, the first and last steps of the MRP process applies to LEPs as well (i.e. the preparation and submission of EOI proposals and the implementation of approved projects are the same for MRPs and LEPs). The selection process for LEPs consists of the following two stages:

- The Expression of Interest proposal stage, where proposals are assessed and short listed based on a range of selection criteria.
- The Detailed Proposal stage, where the short listed proposals are examined in detail before they are approved for implementation.[15]

Expression of Interest Proposal Stage

At this stage, the Committee will assess each EOI proposal against the following criteria that are set out in the round four guidelines (local governments may submit more than one proposal for projects within their area):

- The regional location.
- The level of heritage, tourism, scenic and geographical significance.
- The estimated project budget.

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

[13] Drilling in rocky ground requires specialised, expensive equipment and techniques.

[14] Underground Power Steering Committee, *Underground Power Program: Localised Enhancement Projects: Round Four Guidelines*, p4.

[15] Ibid, p11.

- The demonstrated level of commitment by the local government to fund at least half of the cost of the project and the development of a funding strategy.
- The community's willingness to participate in and contribute (if required) to the project and any plans for follow up consultation with affected ratepayers.
- The power system criteria assessed by Western Power (or Horizon Power if it is outside of the SWIS).

The selection of projects is based on information provided by the local governments in their EOIs, combined with an analysis by Western Power (or Horizon Power) of the existing distribution system status and the estimated cost and complexity associated with replacing the overhead lines with underground cables.

The Committee recommends the selected proposals to the Minister for Energy, up to the limit of funding that is available for LEPs in each round.[16] The projects that are approved by the Minister then go through to the detailed proposal stage before they are implemented.[17]

Detailed Proposal Stage

During the Detailed Proposal stage, the selected local governments will need to satisfy a number of conditions in consultation with the Committee. In the round four guidelines, the conditions that had to be considered and addressed before a project was selected and approved for funding were:

- detailed community support;
- proposals to raise local government's share of finance;
- final project boundaries and project design and costs, including:
  - equivalent underground power system design and cost;
  - equivalent street light design and cost; and
  - exclusion of any non-equivalent direct costs to the local government and Western Power (or Horizon Power);
- the "cash process" – an agreed process with respect to payment schedules and other issues relating to accounting management;
- in principle Agreement approved by all the parties; and
- commitment to proceed.[18]

[16] Ibid, p11.

[17] Round five Guidelines for LEPs (including the funding limit) are yet to be reviewed and approved.

[18] Underground Power Steering Committee, *Underground Power Program: Localised Enhancement Projects: Round Four Guidelines*, p12.

2.1.3 State Underground Power Program Project Costs

The two largest costs associated with undergrounding distribution lines (excluding project management costs,[19] which represent approximately 10 per cent of the $20 million annual project costs) are:

- contract labour costs, which make up approximately 55 per cent of all underground power project costs (discussed in section 2.1.1, under the heading Implementation of Approved Projects); and
- cost of materials, making 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,[20] transformers, switchgear and standard street lights. In doing so, economies of scale are achieved, which is one of the advantages of Western Power undertaking the projects instead of local governments.

Other costs to Western Power are not currently included in the costs of underground power, including the costs associated with the early retirement of overhead network assets, prior to their effective expiry lives. However the SUPP selection process does allow focus on areas near retirement with the greatest power reliability and quality problems.

The current processes for selecting and assessing projects is largely driven by the need to improve the reliability of electricity supply in an area,[21] 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). The Authority will examine if these current processes have an impact on the costs of undergrounding in the draft report.

It is generally more expensive to place cables underground than it is to place power lines overhead. If overhead power lines are maintained correctly, the overhead distribution system is not likely to need replacement in its entirety. The ongoing replacement of poles and various electrical components are part of the maintenance costs for Western Power, and the operating and maintenance costs of overhead lines and underground cables are discussed in section 4.4.1.

2.1.4 Existing Funding Arrangements and Allocations of Costs

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). However, as it is difficult to quantify all of the benefits of underground power, it is complicated to decide who benefits and should pay as a result, as well as how much the different parties should pay.

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[19] The UPPT allocates planning, project development and project delivery costs to each project.

[20] Due to the composition of the cables, the price of cables is linked to aluminium and copper, and to a smaller extent oil prices (as the insulation is oil based).

[21] The key objectives of the MRPs, which account for 96 per cent of the cost of the SUPP, are to improve the energy security of Western Australia's electricity distribution system in extreme weather events and the standard of electricity supply to consumers by addressing reliability issues in areas with existing overhead power lines. *Source: Underground Power Steering Committee, October 2009, Underground Power Program: Major Residential Projects Round Five Guidelines, p1.*

Since 1999-2000, the MRPs have been funded 50 per cent by local governments (generally through ratepayers),[22] 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.

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, which reduces the amount they 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 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 2010-11 State Budget that was released on 20 May 2010, the funding for the SUPP from the State Government and Western Power will double 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 early 2011).

2.1.5 What has the State Underground Power Program Achieved?

Since the SUPP began in 1996, 65 projects have been completed, providing underground distribution systems to over 70,000 properties. Round four is currently underway, and as mentioned above, it is expected to be completed in 2011-12. **Appendix B** provides a list of the projects that have been completed or are underway in the first four rounds, and the initial pilot projects.

To date, 37 MRPs and 28 LEPs have been completed at a cost of approximately $246.9 million in nominal terms.

On 26 October 2009, the Minister for Energy announced that it would fund round five of the SUPP from 2010-11. Short listed projects for round five of the SUPP will be announced in September 2010. The first successful round five projects are expected to commence in early 2011 and all projects in this round are scheduled to be completed by late 2014.[23]

[22] The program does not specify to councils how they fund their share of the costs, but councils often pass on the costs to ratepayers in each project area. *Source: Office of Energy website.*

[23] Media Statement by Minister for Energy, *Submissions open for underground power projects*, 26 October 2009.

Indicators of Electricity System Reliability

System reliability is claimed as a key benefit of the SUPP. 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 would 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.[24] This project was completed in August 2006 and it is one of the largest projects that has 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;[25]
- 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;
- 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[26] is 60 per cent less than for an underground protective device; and

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

[25] 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.

[26] 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.

- 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.[27] 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.

Issues for this Inquiry

1) Do the current methods used to evaluate and select underground power projects have an impact on the costs of undergrounding?

2) Is the current method of calculating the costs of underground power appropriate?

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

3 Underground Power Programs in Other Jurisdictions

Retrospective undergrounding of power occurs in some of the other Australian jurisdictions as well, and the details of other programs are provided below. The Northern Territory is the only other jurisdiction that has a government program to underground power in residential areas of Darwin. None of the other Australian jurisdictions have large scale government programs for undergrounding existing overhead lines in residential areas.

3.1.1 New South Wales

There is no large scale, formal government undergrounding program of existing overhead distribution lines in New South Wales (**NSW**). However, a large part of the distribution network has been undergrounded by distribution network service providers (**DNSPs**). These programs are often initiated by the DNSPs themselves, or by third parties (such as local governments and developers).

For example, local governments often require DNSPs to underground distribution lines in new urban developments. Where this is the case, the developers are required to install the underground cables before handing over the ownership of the assets to the relevant DNSP.

In areas with existing overhead distribution lines, the DNSP or other parties may initiate an underground power project. DNSPs may initiate an underground power project in an area where 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.[28]

In 2002, the Independent Pricing and Regulatory Tribunal (**IPART**) of NSW reviewed the costs, benefits and funding of underground power to assist the NSW Government, who at the time was exploring the possibility of implementing an underground power program. At the end of the review, IPART concluded that:

> [G]eneral widespread undergrounding is only justified by cost-benefit analysis if the value of hard to quantify benefits such as improved amenity and environmental management is very high. If the program goes ahead, the Tribunal recommends that it be funded through a beneficiary pays approach, in which the majority of the costs [around 60 per cent] are recovered from property owners through local government charges, and the remainder from the state government and DNSPs. The Tribunal also recommends that local communities that place a relatively low value on amenity benefits such as views and other local benefits be able to opt out of the program.[29]

3.1.2 Victoria

Victoria does not have a formal government program for undergrounding power in residential areas. However, local governments tend to initiate projects for undergrounding

[28] 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.

[29] Ibid, p1.

of distribution lines for main roads or public spaces, based on social benefits. 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 Government funds up to 50 per cent of the cost of undergrounding powerlines in places of high vehicular or pedestrian activity for visual amenity reasons. [30] The Victorian Government currently provides $2.7 million to local government undergrounding projects each year as part of this scheme.[31]

Customers of a distribution company may also request that a distribution service be placed underground, in which case the customers would have to pay most of the costs of undergrounding, including a large upfront contribution. Distribution licences require distributors to participate in proposals for undergrounding projects and make an offer to undertake such projects in order to:

- avoid or minimise any threat or possible threat to the health or safety of any person or any property or the environment or an element of the environment; or
- improve the amenity or appearance of the environment.[32]

During its price review in 2004, the Essential Services Commission (**the Commission**) considered options for the future funding of undergrounding projects, concluding that underground power benefits are mostly private in nature, benefitting local residents or businesses, and that the total costs of undergrounding should not be charged to all the customers of a distribution system as a result. However, the Commission concluded that all the customers should contribute to the cost of undergrounding to the extent that they would otherwise have received a windfall as a result of such projects (for example, through lower prices in the future as some costs are avoided by the distribution company).[33]

As a result of the 2009 Victorian Bushfires Royal Commission, some work is currently being undertaken on the costs of alternatives to current overhead Single Wire Earth Return (**SWER**) lines[34] in Victoria. SWER lines tend to be used in rural areas, as they are often an inexpensive option to provide electricity to remote areas. However, this work relates mostly to prevention of bushfires rather than any broader consideration of benefits that arise from alternatives to SWER lines. The Royal Commission's findings in regard to the alternatives to deliver power to rural Victoria are not yet available.

3.1.3 Queensland

There is no large scale, formal government undergrounding program in Queensland. However, 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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[30] Department of Primary Industries (Victoria), *Powerline Relocation: An Assistance Scheme for Local Areas*, p3.

[31] Information provided by the Victorian Department of Primary Industries.

[32] Essential Services Commission (Victoria), April 2004, *Review of Augmentation and Customer Connection Guideline - Final Decision*, pp5-6.

[33] Ibid, p5.

[34] 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.

Energex, who operates and maintains the electricity distribution network in South East Queensland, seeks to develop the most cost effective solution when investing in new or upgraded distribution infrastructure. While the most cost effective solution is often overhead power lines, there are instances where undergrounding of power is the best solution. As this is a commercial investment decision, Energex pays for the additional costs of undergrounding in these situations.[35]

3.1.4 South Australia

South Australia does not have a formal government program for undergrounding power in residential areas. However, a Power Line Environment Committee (**PLEC**) was established in 1990 to assess submissions from local governments for funding projects to underground power lines. The PLEC recommends undergrounding projects to the Minister for Energy, who then directs ETSA Utilities, which is the electricity distribution network operator in South Australia, to undertake the work (in accordance with the South Australian *Electricity Act 1996*). 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.[36]

3.1.5 Tasmania

There is no large scale, formal government undergrounding program in Tasmania.

3.1.6 Northern Territory

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 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.

The Northern Territory Government believes that there are many advantages of underground power in a tropical environment such as Darwin, which is subject to cyclones and severe thunderstorms. It also suggests that underground power provides substantially improved reliability and security of supply in tropical areas.[37]

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[35] Energex, *Overhead and Underground Powerlines Fact Sheet*, http://www.energex.com.au/pdf/network/8121_overhead_underground_powerlines.pdf

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

[37] Power and Water's website (www.nt.gov.au/powerwater).

3.1.7 Australian Capital Territory

The Australian Capital Territory does not appear have a formal government program for undergrounding power. 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.

4 Cost Benefit Analysis

4.1 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,[38] 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 benefits distribution 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 always the first 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 generally of benefit to the local community.
- An externality exists whenever the decision of one party impacts 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 as well, through greater public amenity value and a reduction in motor vehicle accidents involving power poles. 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.

[38] The time value of money is the value of money figuring in our preference for consuming today rather than tomorrow.

- Sometimes externalities can be "internalised", by requiring the decision maker to take into account the impacts on third parties when they make their decision.[39] For example, in the case of congestion, it may be appropriate to introduce a congestion charge as has occurred in London. In this case, drivers who travel to the city during peak times are charged a congestion tax.

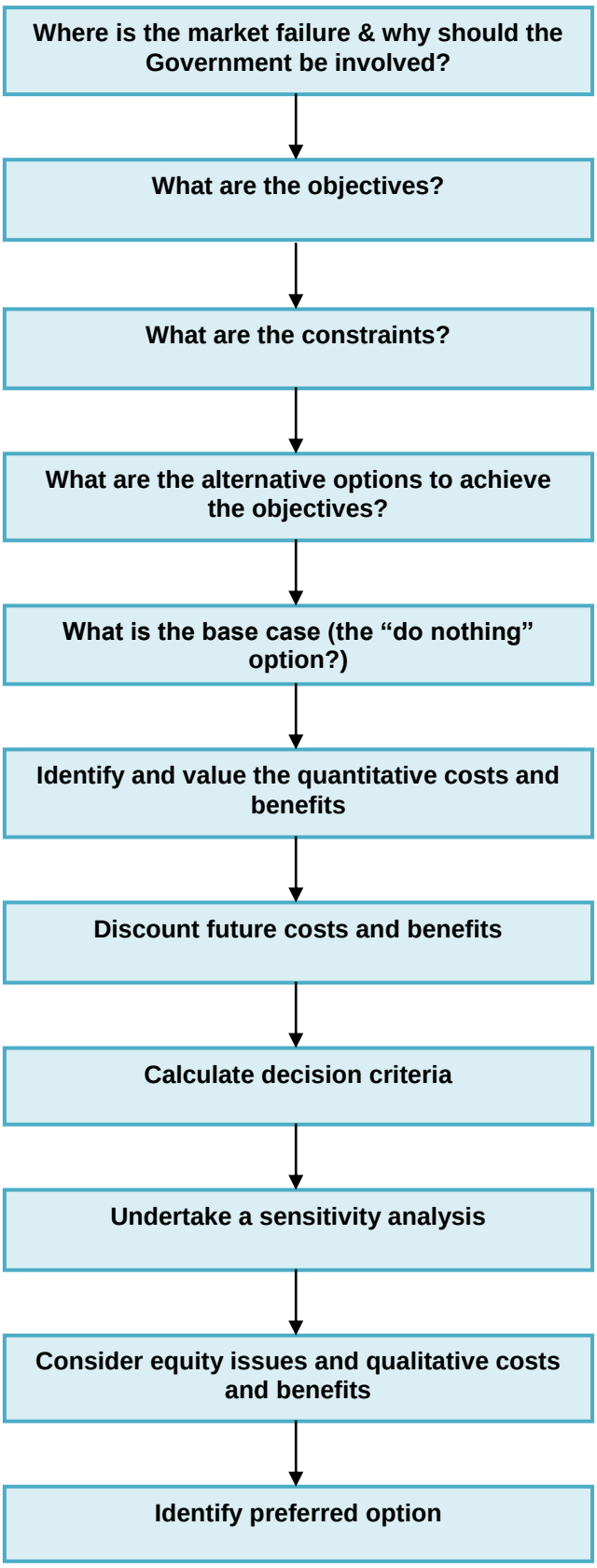
4.2 Proposed Approach to Cost Benefit Analysis of the State Underground Power Program

A CBA to consider the net benefit or cost of the SUPP to the society as a whole will be undertaken by the Authority, and the proposed approach to the CBA is outlined on the next page.

It should be noted that individual SUPP projects might have different costs (e.g. construction costs) and benefits (e.g. valuation of amenity benefits). While the inquiry will aggregate these projects, if the program does continue, each future project's costs and benefits should be evaluated before proceeding.

[39] 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.

Figure 4.1 Proposed Approach for Cost Benefit Analysis of the SUPP



4.2.1 Summary of Each of the Steps in the Analysis

Where is the Market Failure and Why Should the Government be Involved?

The first step is to consider if there are any market failures that require the State Government to be involved in delivering the SUPP. For example, some of the benefits of underground power, such as the avoided costs that accrue to the wider community associated with overhead distribution lines, could be considered to be positive externalities, as the Government's uniform tariff policy prevents Western Power (through Synergy) from recovering the benefits directly from the affected area.

Some of these benefits may also have public good characteristics, which means that the wider community receives benefits. As a result, Government involvement may be warranted and a proportion of the SUPP costs would be funded by taxpayers (via the State Government).

What are the Objectives?

The objectives of the MRPs, which account for approximately 96 per cent of the costs of the SUPP, are to improve the energy security of Western Australia's electricity distribution system in extreme weather events, as well as the standard of electricity supply to consumers during normal weather, by addressing reliability issues in areas with existing overhead power lines.[40]

The objectives of the LEPs, which account for around 4 per cent of the SUPP costs, are to achieve efficient retrospective installation of underground power and significant contributions to local communities, including enhanced streetscapes and visual amenity of public places, improved property values and improved safety.[41]

What are the Constraints?

The CBA will need to identify the constraints, or any potential constraints, on meeting the above objectives. Some common constraints include financial/budget limits, labour availability and environmental protection standards.

What are the Alternative Options to Achieve the Objectives?

The Authority will consider alternative options to underground power which would achieve the same objectives set out above. Technical advice will be sought to identify these alternative options, which may include things such as the undergrounding of the first feeder section of distribution lines from zone substations.

What is the Base Case?

This is another alternative that will be considered, which is the do nothing option. The base case in this study is where existing overhead distribution lines are not placed underground.

[40] Underground Power Steering Committee, October 2009, *Underground Power Program: Major Residential Projects Round Five Guidelines*, p1.

[41] Underground Power Steering Committee, *Underground Power Program: Localised Enhancement Projects: Round Four Guidelines*, p4.

Identify and Value the Quantitative Costs and Benefits

At this stage, the costs and benefits that can be quantified will be identified and valued in money terms where possible. This is likely to include, for example, the costs of removing the overhead lines and replacing them with underground cables, the avoided costs to Western Power, and the benefits associated with the potential reduction in motor vehicles colliding with electricity poles.

Discount Future Costs and Benefits

The net benefits of a project or program in each year are determined by subtracting the total costs in each year of the project's or program's life from the total benefits in that year. This stream of net benefits will then need to be discounted to take account of the fact that the further into the future that a dollar's worth of net benefit occurs, the less should be its influence in determining a project's or program's outcome. Finally, the stream of the discounted net benefits will be summarised to yield the estimated Net Present Value (**NPV**) and Benefit-Cost Ratio (**BCR**) of the project or program.

As mentioned earlier, 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 tend to occur at different points in time (costs are often incurred upfront while the benefits tend to accrue over time).

Calculate Decision Criteria

Subject to budget and other constraints, as well as consideration of qualitative costs and benefits and distributional issues, a project is acceptable if the NPV is equal to or greater than zero (which implies a BCR greater than 1.0).

Sensitivity Analysis

As there is uncertainty associated with the estimation of net present values, sensitivity analysis will be undertaken to get an understanding of how sensitive the results are to changes in the costs and benefits by looking at different scenarios. Sensitivity analysis can also identify which costs or benefits have the greatest impact on the outcome of the project or program.

Consider Equity Issues and Qualitative Costs and Benefits

The qualitative costs and benefits will be identified as these must be considered as part of the analysis as well. To enable these costs and benefits to be considered alongside the quantitative costs and benefits, descriptive information for each of the costs and benefits is required. In some cases, it may also be possible to value some of the costs and benefits in physical units.

At this stage, consideration will also be given to the equity issues associated with the distribution or transfer of costs and benefits between individuals or certain groups. This will not change the NPV or BCR of the overall project, but can also be information for the Government to consider in evaluating the project.

Identify Preferred Option

The last step in the CBA will be to, if possible, provide a conclusion based on the results of the analysis, and recommend whether or not the quantitative and qualitative benefits of the SUPP is equal to or greater than the quantitative and qualitative costs.

4.3 Costs of Underground Power

The approach to the undergrounding for the SUPP was initially a like-for-like approach, which replaced all the overhead distribution lines with underground cables 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 has been 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.

4.3.1 Upfront Costs

The largest initial cost of undergrounding is the removal of existing overhead lines and the installation of equivalent underground power cables. Western Power uses a system of direct burial of its electricity lines for the SUPP. However, there are also costs associated with the connection or modification of existing equipment to provide underground power to each customer, which can be substantial in some cases. Western Power's transmission network telecommunication cables are included in the project cost when present on the overhead distribution system. No other utility cables, such as Telstra cables, are present or included in the SUPP project costs.

However, the rollout of the Commonwealth Government's National Broadband Network (**NBN**), which is likely to begin in Western Australia in 2011, might have implications for the SUPP in the future. When the NBN is rolled out in Western Australia, it is currently expected that the NBNCo (the Commonwealth company responsible for the roll out of the NBN) will use both overhead and underground deployment of the fibre.

Western Power is currently developing its position with regard to the NBN roll out in Western Australia, and it is working closely with NBNCo to ensure an optimum arrangement for the fibre deployment program. Consideration is being given to the implications of deploying fibre overhead in areas which might become targets for the SUPP in the future, and how any associated costs of undergrounding the fibre in the future could best be avoided.[42]

As mentioned in section 2.1.3, relocating power lines underground is more expensive than reinforcing overhead power lines. In the US, cost data for electricity utilities indicates that the cost of putting overhead power lines underground is five to 10 times the cost of new overhead power lines.[43]

[42] Information provided by Western Power.

[43] Edison Electric Institute, January 2004, *Out of Sight, Out of Mind? A Study on the Costs and Benefits of Undergrounding Overhead Power Lines*, p14.

Overhead power lines, if maintained well, have infinite asset lives and do not need to be replaced, whereas underground power cables do have finite asset lives of 50 years or less and do need replacement from time to time.[44]

Project costs vary depending on residential density, block frontage, ground conditions, power needs, traffic management requirements (and in some cases street or verge topography).

Table 4.1 below shows the average cost per allotment of land to underground power for the pilot round and the four rounds of the SUPP, which is calculated by dividing the total expenditure for a project by the total number of lots within each project area.

Since the program was introduced, the average cost per lot has increased by 7.4 per cent per annum. Over the same period, the average annual increase in the consumer price index was 2.9 per cent and the average annual increase in the house price index was 10.9 per cent.[45]

Table 4.1 Average Cost per Allotment of Land of the SUPP (MRPs)

Rounds	Pilot Round	Round 1	Round 2	Round 3	Round 4
Average cost per lot	$3,379	$4,435	$4,265	$7,897	$9,181

The average costs have increased for a number of reasons, including significant increases in contract labour costs and commodity prices, as well as more technically challenging projects with difficult site conditions and additional project and site management costs associated with contractor delays.[46] This highlights that it is difficult to do a CBA for the entire SUPP program, and that different projects should be evaluated separately.

Between 1999-2000 and 2008-09, the average cost per property owner as determined by local governments increased by 12.5 per cent per annum.[47]

The costs of the LEPs, which are reported on a per street frontage metre basis to allow for comparison of LEPs that are different in length, have increased at an annual rate of 7.7 per cent per annum. The average costs per round has increased from $340 per metre in round one to $768 per metre in round four.[48]

[44] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy*, p18.

[45] 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.

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

[47] Ibid, p11.

[48] Ibid, p22.

4.3.2 Negative Impacts of Underground Power

Undergrounding of distribution power lines may have some potential negative effects, with some commonly cited ones including:[49]

- stranded asset costs for existing overhead facilities;
- environmental damage, including soil erosion and disruptions of ecologically-sensitive habitat;
- electricity network operator employee work risks during vault and manhole inspections;
- increased exposure to dig-ins (prompting campaigns such as “dial-before-you-dig”);
- although interruptions may occur less frequently with underground power, when interruptions do occur, they last longer and more customers are impacted per outage;
- susceptibility to flooding, storm surges, and damage during post-storm cleanup;
- reduced flexibility for both operations and system expansion;
- reduced life expectancy of underground cables when compared with overhead lines; and
- higher maintenance and operating costs.

These will be considered as part of the CBA, and the Authority is seeking comments from stakeholders on whether or not any of these negative impacts are affecting the costs of the SUPP.

4.4 Benefits of Underground Power

There are a number of potential benefits that may accrue to the wider community when overhead distribution lines are placed underground, which can be grouped into the following:

- economic benefits (or the avoided costs) for the service provider (Western Power);
- quality of supply and reliability benefits to customers;
- aesthetic benefits;
- health and safety benefits; and
- other benefits.

The potential benefits for each of these groups are discussed separately below.

In its 2002 final report, IPART suggested that the benefits of underground power that may accrue to the wider community are the avoidance of the negative externalities associated with overhead electricity lines. These negative externalities include impacts on the visual amenity of a local area, motor vehicle collisions with electricity poles and the costs to consumers of power outages that result from storm damage to overhead electricity lines.

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

IPART also noted that these external costs are generally much more difficult to quantify than the avoided costs that accrue to service providers such as Western Power.[50]

4.4.1 Potential Economic Benefits for Western Power

There may be some savings, or avoided costs, to Western Power as a result of undergrounding existing overhead distribution lines, such as reductions in:

- operating and maintenance costs;
- storm repair costs;
- maintenance of street scapes and verges; and
- costs associated with power interruptions.

These avoided costs that may accrue to Western Power are discussed briefly below. All or some of these benefits flow on to Western Power's customers, although some customers may benefit more than the rest (for example, people living in, or adjacent to, suburbs with underground power). However, since Western Power's network tariffs are the same for all areas in the SWIS and all residential customers pay the same electricity retail tariffs regardless of where they are in Western Australia, it is not possible to charge a higher electricity tariff to those who benefit from underground power.

In 2004, the Essential Services Commission in Victoria concluded that:

> The rationale for calculating avoided costs is that this reflects the portion of the cost of a project that would provide a benefit to the community as a whole, and which is reasonable to be reflected in general tariffs.
>
> The Commission considered relevant avoided costs to be:
>
> - the deferral of asset replacement; and
> - avoided maintenance and vegetation management costs.[51]

Operating and Maintenance Costs

There may be potential savings from reduced operating and maintenance costs, including repair 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.

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

- overhead electricity systems require various types of specialist mechanical plant and equipment to work on the 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

[50] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy*, p23.

[51] Essential Services Commission (Victoria), *Review of Augmentation and Customer Connection Guideline - Final Decision*, April 2004, p6.

- ongoing requirements for pole inspections and treatments and vegetation management programs associated with the overhead electricity system.

However, as discussed in section 4.3.2, there are costs associated with operating and maintaining underground electricity systems as well, such as the work risks for employees during vault and manhole inspections and the increased exposure to people digging into the cables.

The Network Performance Branch of Western Power has undertaken analysis of the operating expenditure for underground cables and overhead lines in the SWIS between 2007 and 2009. It determined that:

- the average cost for overhead operating expenditure per kilometre was $2,091; and
- the average cost for underground operating expenditure per kilometre was $1,475.[52]

Western Power's overall repair costs following the severe thunderstorm that moved through the Perth metropolitan area in March 2010 amounted to $3.3 million.[53]

A study in the US (North Carolina) found that on average, the operating and maintenance costs per mile were similar for direct buried underground cables and overhead lines. However, operating and maintenance costs for underground duct bank systems (a set of electrical conduits) were between two to five times more expensive than for overhead lines. Duct bank systems are often required in urban areas in the US, or where subsurface conditions could damage direct buried lines.[54]

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).

Costs Associated with 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 reliability, as any outages on underground systems often 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.

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[52] Information from Western Power.

[53] Information from Western Power.

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

It is worth noting that in a CBA, any lost revenue to Western Power is 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 lack of it).

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 cannot 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 houses and most small businesses.[55]

The number of claims made so far under this scheme in 2009-10 is 24,995 and Western Power has paid close to $2 million in compensation to customers. The number of claims is 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. Western Power is still expecting more claims to be lodged in 2009-10 as a result of the storms.[56]

4.4.2 Quality of Electricity Supply and Reliability Benefits

The undergrounding of existing overhead electricity lines has the potential to improve the reliability of the electricity network as well as the quality of the supply of electricity that is provided to customers. These potential benefits in reliability were the key drivers for the Government's introduction of the SUPP back in 1996. As mentioned in section 2.1.1, the key objectives of the MRPs are to improve:

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

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 and more people choose to work or study from home, using essential access to the internet and other computer services.[57]

[55] Western Power's website.

[56] Information from Western Power.

[57] 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.

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[58] 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.[59]

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 extended power supply failures and consequential community impacts.[60] The performance of Western Power's distribution network during the March 2010 storm is discussed in the box on top of the next page.

[58] As current passes through the conductors in electricity lines, 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.

[59] 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.

[60] For example, 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. *(Source: Office of Energy)*

Distribution Network Performance during the March 2010 Storm

On Monday 22 March 2010, a severe thunderstorm moved through the Perth metropolitan area causing large hail, heavy rain and severe winds that resulted in a peak of around 155,000 premises without power. Following this, Western Power produced a report examining the performance of the overhead and underground distribution network during the storm event.[61]

The report shows that, of the 361 suburbs in the metropolitan area, 52 have a SUPP component.[62] Just over 71 per cent of the suburbs with no SUPP component were directly affected by the storm, compared to 81 per cent of suburbs with a SUPP component. Although the percentage of affected suburbs is higher for those suburbs with a SUPP component, this actually translates to fewer overall affected customers, 13 per cent compared to 27 per cent of customers affected in suburbs with no SUPP component. This could be as a result of there being fewer overall faults in those suburbs with a SUPP component (112, compared to 349 in suburbs with no SUPP component), and a smaller number of customers affected per fault (164 customers per fault in a suburb with a SUPP component compared to 391 customers per fault in a suburb with no SUPP component). Further analysis would be required to confirm this.

The report also compares network performance in areas fully undergrounded by SUPP, defined as SUPP areas, to other areas, defined as non SUPP areas.[63] Only five per cent of customers in SUPP areas experienced supply outages, compared to 26 per cent of customers in non SUPP areas. However, the average duration of outages in a SUPP area (563 minutes) is slightly longer than the average outage duration in a non SUPP area (504 minutes).

Caution should be exercised in drawing conclusions from the report as a suburb with a SUPP component or a SUPP area may still be supplied by an upstream overhead network, such that outages counted in SUPP related areas may have been caused by overhead faults further up the distribution network. It should also be noted that, as mentioned in Section 2.1, the majority of underground power across the metropolitan area has occurred as a result of undergrounding power supplies to new subdivisions and other initiatives, not just because of the SUPP.

4.4.3 Aesthetic Benefits

The improvement in aesthetics is one of the most commonly cited benefits of underground power. However, these are also the most difficult benefits to quantify.

Improved Amenity Value

The removal of unattractive electricity poles and wires is believed to be one of the key benefits of underground power as it improves the views and streetscapes for a community. In addition, the often ugly pruning of trees near the overhead lines which

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

[62] A suburb with a SUPP component is any suburb where some undergrounding occurs and this component can vary in size depending upon the extent of the SUPP completed in any given area.

[63] SUPP areas are typically discrete areas unrelated to existing suburb boundaries.

restricts the natural growth of the trees is no longer required when the lines are placed underground. The removal of electricity poles may also allow additional trees to be planted on the verges, improving the streetscape.

These improvements in the amenity value of an area may result in higher property values where overhead distribution lines have been replaced with underground cables. The Authority will consider if the amenity benefits of the SUPP has capitalised into higher house prices as part of its inquiry. Since residential property values increase due to a number of factors anyway, the Authority will need to establish what amount might be due to the undergrounding of power lines.

As indicated in Section 2.1.1, local governments carry out surveys of affected ratepayers to gauge community support for undergrounding a specific area. A second survey of affected ratepayers is also carried out following the completion of a SUPP, to establish their level of satisfaction with the completed project.

The ratings for the overall success of projects by ratepayers are often much higher than the initial surveys carried out to gauge community support for underground power. For example, the level of ratepayer support to install underground power in Palm Beach in Rockingham was just over 50 per cent when a second survey was carried out by the City of Rockingham in February 2008. However, when affected ratepayers in Palm Beach were asked to rate the overall success of the SUPP project, which was undertaken as part of round four of MRPs, 82 per cent were satisfied with the completed project.[64]

In rounds two, three and four of the MRPs, the overall success of the project ratings have ranged from 82 per cent (Palm Beach) to 97 per cent (North Subiaco).

Residential Property Values

In a 1998 report prepared by the Department of Communications, Information Technology and the Arts (**DCITA**), specific reference was made to the effect of underground power on the Western Australian property market. The Western Australian Valuer-General believed that underground power would, on average, increase property values between 1.25 per cent and 2.5 per cent, up to a maximum of 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.[65]

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.[66]

As part of the CBA of the SUPP, the Authority will attempt 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

[64] A survey of affected ratepayers in Palm Beach was first carried out in 2007, where 53 per cent supported the installation of underground power. The City of Rockingham decided not to proceed with underground power at that stage due to the closeness of the vote and the large number of submissions received. *(Source: Office of Energy)*

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

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

installed in some areas but not in others). In undertaking this analysis, it is important not to double count any other benefits that might be capitalised into house prices (e.g. reliability improvements), but are valued separately elsewhere.

The Authority will also consider if there is a difference in valuation of underground power between higher and lower priced areas, and if so, why this might be the case. People with higher income may value underground power more than people in lower income areas. To the extent that it is possible, the Authority will examine ratepayer survey results for lower income areas and higher income areas. The link between house prices and income in each area will also be examined.

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. In its 1998 report, the DCITA suggested that there may be no net benefit in terms of increased property values on a national level, as an increase in property values in one location are likely to detract from the value of properties somewhere else in the country.[67]

It may also be the case that the early underground power projects in the western suburbs resulted in higher property values where underground power had been installed due to the scarcity of properties with underground power at the time. As the SUPP has expanded and more properties have underground power, it is possible that this scarcity value has decreased.

Maintenance of Street Scapes and Verges

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. 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.[68] Property owners or occupiers may also benefit from a reduction in vegetation management costs when underground power is installed as a result.

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,[69] 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.

4.4.4 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

[67] Department of Communications, Information Technology and the Arts, November 1998, *Report by the Putting Cables Underground Working Group*, p70.

[68] Information from Western Power.

[69] 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.

may be a reduction in both vegetation-management and pole-protection herbicide and pesticide use.

Emergency Response

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.

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 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.[70]

Environmental Impacts

Underground power 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 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.

4.4.5 Other Benefits

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.

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

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.[71]

Issues for this Inquiry

3) Is the proposed approach to the cost benefit study appropriate?

4) What are the alternatives to underground power?

5) Have all the costs and benefits of underground power been identified?

6) What are the most important benefits of underground power?

7) Are there any negative impacts resulting from underground power in the SWIS?

[71] Information from Western Power.

5 Other Issues for this Inquiry

In addition to undertaking the CBA of the SUPP, the terms of reference required the Authority to also have regard to:

- a comparison of the costs associated with maintaining the current overhead distribution network and undergrounding; and
- 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 has 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).

These issues are discussed separately below.

5.1 Efficiency of the Current Approach to Undergrounding

A comparison of the costs associated with maintaining the current overhead distribution network and the costs of undergrounding will be part of the CBA undertaken by the Authority. There are some issues associated with comparing the two that need to be examined, including the approach that is taken to undergrounding, as it has an impact on the costs that are compared to maintaining the existing overhead network. These two approaches 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 like the current and future load patterns, the characteristics and cost structures of underground networks, and undertake a program of undergrounding the parts of the overhead distribution network that have reached the end of their asset lives first; and
- 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.

IPART appointed a consultant as part of its review of underground power in NSW, Meritec Limited (**Meritec**), who concluded that the optimised approach would offer significant cost and efficiency benefits for a large scale project like the one proposed for NSW and assessed by IPART. The like-for-like approach would be likely to achieve a less efficient result for a higher cost. However, Meritec did accept that it would be unlikely that an optimally planned network could be fully implemented in reality. IPART noted at the time that this approach was untested, and could prove to be impractical in the planning stages, in particular when environmental considerations were taken into account.[72]

[72] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy*, pp8-10.

5.2 An Analysis of the Distribution and Timing of Benefits

The existing funding arrangements of the SUPP are based on the view that the costs of underground power should be recovered from the individuals or groups who benefit from it (the beneficiaries). The costs to be recovered from each beneficiary should also be proportional to the level of benefits they receive. A beneficiary pays approach to fund underground power was recommended by IPART in its report on Electricity Undergrounding in NSW[73] as well as by the DCITA in its underground power report.[74]

The alternative to the beneficiary pays approach is the impactor pays approach, where those who incur a cost should pay for it, which in this case would be Western Power and/or existing electricity users in the SWIS. IPART believes that an impactor pays approach to fund underground power is not appropriate for the following reasons:[75]

- the external costs of the overhead distribution network (such as improved public amenity and reduction in motor vehicle accidents with power poles) are largely a legacy of historical decisions by electricity network operators, rather than current decisions. Those who are disadvantaged by this legacy are not likely to be compensated – instead, undergrounding is a direct means of reducing the externalities themselves; and
- electricity network operators have long-standing property rights to use overhead distribution networks (which means that as the owners, the electricity network operators have the authority to determine how the networks are managed), and an impactor pays approach to fund the retrospective undergrounding would reverse these implicit property rights.

In regard to the timing of benefits, these should flow straight from the CBA, and will be discussed in the draft report.

5.2.1 Who benefits?

Some of the benefits of underground power have public good characteristics, which mean 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. These include at least some benefits that accrue from improved public amenity, improved street lighting and the reduction in motor vehicle accidents involving electricity poles. As these benefits accrue to the wider community, it can be argued that the Government should fund part of the costs to underground distribution lines.

For other benefits, it is possible to identify those that benefit and who should therefore fund part of the underground power costs. This includes the avoided costs (benefits) to Western Power, and to the extent that it benefits all the electricity customers in the SWIS, a proportion of Western Power's costs to fund underground power should be recovered through network tariffs. Local ratepayers also receive individual benefits from underground power, such as improved reliability and quality of the electricity that is supplied, improved amenity values and potential increases in property values.

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[73] Ibid, p35.

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

[75] Independent Pricing and Regulatory Tribunal of New South Wales, 2002, *Electricity Undergrounding in New South Wales: A Final Report to the Minister for Energy,* pp35-36.

IPART concluded in its report that since a large proportion of the benefits of underground power accrue to local communities and the wider public, it is not possible to recover the full costs through a beneficiary pays approach without government involvement. As mentioned earlier, IPART recommended that a mixed funding approach should be adopted if the NSW Government introduces an underground power program, with most of the funding coming from local government rates or levies (60 per cent) and some from the State Government (15 per cent), electricity customers (5 per cent) and the Distribution Network Service Providers (20 per cent).[76]

The existing funding arrangement of the SUPP recognises the need for a mixed funding approach and government involvement. The Authority will consider whether or not these existing shares of funding are appropriate based on the CBA that will be undertaken.

5.2.2 Appropriate Share of Funding

The Authority is required to determine who should pay for underground power and how much each party should pay based on the proportion of benefits accrued to individual households (representing private and local community benefits), the State Government (representing the wider community benefits), Western Power (representing network benefits), and Western Power's customers (representing network benefits accruing to all customers in the SWIS).

As it may not be possible to quantify all the benefits of underground power, it could be complicated to determine who should pay and how much each beneficiary or group of beneficiaries should pay. For example, Western Power currently charges its proportion of costs of underground power to all the customers in the SWIS, but there may be some part of the costs that benefits Western Power alone and not its customers.

Also, the share of the underground power costs that Western Power funds needs to be examined. While faults tend to be less frequent for underground power when compared to overhead lines, once there is a fault on underground cables it may take much longer to repair and it may be more costly as well.[77]

In addition, from a reliability perspective, there may only be a small improvement to the overall network system, which was the case in the City Beach case study summarised in section 2.1.5. This study showed that while there were significant improvements in reliability for City Beach as a result of underground power (78 per cent improvement), the improvement at an overall system level was only 0.24 per cent. However, Western Power cannot charge the direct beneficiaries for any improvements in local areas since the same network tariffs are charged to all customers in the SWIS.

The potential difficulty to quantify the benefits that accrue to the wider community in particular might make it difficult to determine how much the State Government should contribute to the SUPP. IPART found 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

[76] Ibid, p.44.

[77] InfraSource Technology (for Florida Electric Utilities), *Undergrounding Assessment Phase 1 Final Report: Literature Review and Analysis of Electric Distribution Overhead to Underground Conversion*, February 2007, pp30-31.

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.[78]

Willingness to Pay and Equity

Where there are no established prices in the market, willingness to pay can provide an indication of how much a good or service is worth. In regard to underground power, willingness to pay 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 that are undertaken as part of the SUPP provide some information about how much households value underground power, even if it doesn't establish how much each household is willing to pay.

As mentioned in Section 2.1.1, 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).[79]

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 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.

A key issue for this inquiry is that higher income suburbs may have a higher willingness to pay for underground power than low-income areas. This is not particularly relevant in a purely private market, but does raise the issue of why a Government contribution should go to some of the (on average) wealthiest households in Perth.

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.[80]

A paper on households' willingness to pay to underground existing distribution lines in Canberra was released in May 2010.[81] 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.

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[78] 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.

[79] Information from the Office of Energy.

[80] 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.

[81] 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.[82]

Affordability

The affordability of underground power appears to have worsened over time for ratepayers, 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 6.4 per cent per annum since the program was introduced in 1996.

Although the Committee and the UPPT are responsible for delivering the projects in the most cost effective and efficient way to ensure that the costs of undergrounding remain affordable, local governments may also need to consider their cost recovery methods from ratepayers to address affordability issues. For example, local governments may be able to recover its share of the costs of undergrounding over time rather than through a one off payment from ratepayers.

Affordability issues will be considered further by the Authority in the draft report, and it is understood that this is an issue which will be considered by the OoE in its major review of the SUPP as well.

Issues for this Inquiry

8) What approach should be taken to undergrounding – the optimised or the like-for-like approach?

9) Is the existing funding arrangement, which is based on a 'beneficiary pays' approach, appropriate?

10) Who benefits from underground power?

11) What is the appropriate share of funding for underground power projects?

[82] 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.

APPENDICES

6 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

7 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 – Being developed
City of Canning	Wilson West – Commenced
City of Gosnells	Maddington – Commenced
City of Canning	Bentley East – Being Developed
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 – Completed
Shire of Augusta-Margaret River	Cowaramup – Being developed
Shire of Bunbury	Bunbury – Being developed
Shire of Dandaragan	Jurien Bay – Commenced
Town of Victoria Park	Victoria Park – Completed
City of Bayswater	Bayswater – Being developed
City of Belmont	Belmont – Being developed

Source: Office of Energy Website.

8 Appendix C. Glossary

BCR	Benefit-Cost Ratio
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)
EOI	Expression of Interest
IPART	Independent Pricing and Regulatory Tribunal (NSW)
LEPs	Localised Enhancement Projects
MRPs	Major Residential Projects
NBN	National Broadband Network
NPV	Net Present Value
OoE	Office of Energy
ORS	Office of Road Safety
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.
SUPP	State Underground Power Program
SWIS	South West Interconnected System
UPPT	Underground Power Program Team