

Economic Research Associates

**An Economic Evaluation of the Proposed Derby
Tidal Power Station**

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Executive Summary

This report looks at the overall economic contribution to the region and the State of the proposed Derby Tidal Power Station. Aspects not covered in the financial analysis are the economic benefits of the 500km transmission line to the region and the financial implications of the environmental benefits, though these are explored in the text of the report.

In summary, the analysis demonstrated, apart from construction economic impacts, three major areas of growth. They are through tourism, aquaculture enterprises and electricity generation operation and maintenance. Regional multipliers have been used to generate employment numbers from base case employment for these three areas. A total of 280 permanent jobs will be created as a consequence of the operation of the tidal power station. Other scenarios are also quantified, a more conservative view of the base case numbers and a more optimistic view of the same numbers with the resultant flow on employment effects.

The project social rate of return is quantified at a net present value of \$23.4 million. This equates to \$2.2 million in the first year, growing in real terms. This social rate of return can only occur when the tidal power station is constructed. Without it, these benefits would not otherwise occur. Using the value of the net social benefits as a basis, the figure of around 1.4 cents per kWh is the value of the regional benefits.

Introduction and Project Overview

The project will have an initial 36 MW capacity. The scheme will replace the current electricity generation capacity in the Kimberley and would serve Broome, Derby, Fitzroy Crossing and Pillara. The project has the capacity to handle the projected growth in electricity demand.

The project is an integrated power supply system comprising the installation of diesel generation at each of the towns, a major new tidal power facility at Derby and a 500 kilometre transmission line linking the main centres.

This report looks at the benefits and costs that are associated with the project. Some of these are private benefits and costs, others are external benefits and costs. The overall social benefit cost position is an aggregate over both these types of benefits and costs.

The project will have a variety of direct and indirect employment impacts associated with it. Some of these relate to the actual generation of the electricity. Others relate to the new economic activities (e.g. aquaculture) that might arise because of the project.

In the analysis that follows, estimates have been made of the various costs and benefits that might flow from the project.

The primary focus is the Kimberley region and the benefits and costs that accrue to the region, although some of the benefits accrue primarily to the State and may or may not ultimately benefit the region.

The analysis attempts to be realistic about the nature and value of the benefits. The tidal power project creates the necessary preconditions for other economic activities to develop (most notably aquaculture and tourism) but the ultimate scale and success of these developments is beyond the control of the tidal power proponents. It depends on the ability of organizations in the region to successfully promote new developments and undertake the necessary investments.

The assumption is that the local community will be proactive in promoting new opportunities. In addition to the core evaluation, discussion is included of the consequences of varying key outcomes covering more conservative and more optimistic scenarios.

The various outcomes are entirely a reflection of the extent to which the wider community can successfully take advantage of the water body and the associated conditions that the tidal power station creates.

Benefits and Costs

Electricity Production and Sales

The project will produce around 217 GWh including supplementary generation, of electricity in 2003 rising to 333 GWh by 2027. This electricity will be sold at market prices to Western Power and contestable customers in the region. It is estimated that the capital cost of the project is in the vicinity of \$250 million excluding supplementary generation.

The electricity produced is a private good. The private benefits are captured through the market place as sales revenue by the proponents and are reflected in the private internal rate of return. However, the substantial capital investment to be made by the proponent relieves the State of the burden of the current loss making electricity supply to the region and establishes considerable long life infrastructure in the region.

Beyond this however, there are benefits that need to be accounted for relating to:

- Environmental energy benefits
- Aquaculture development benefits
- Tourism benefits related to visiting the tidal power facility but most important use of the basin for recreational fishing and access to King Sound.
- Transmission line benefits
- Broader social benefits based on the fact that most of the activity is in Derby and the fact that the jobs are likely to be local jobs suitable for younger members of the workforce.
- General social benefits based the contribution that the project itself, but even more so the spin off projects, can make to sustaining an economic base in Derby.

- Improvement in the quality of life in Derby as a town due to the creation of a permanent water basin close to the town itself, and
- Reduction in road damage and accident costs.

These are external benefits that occur because of the tidal power station but which accrue to others, not the proponent. They are possible because of the large capital outlays made by the proponent to establish the basins and transmission line. The effect of these external benefits is to distinguish between the return to the proponent and the return to the society. The return to society exceeds the return to the proponent where the external benefits are positive.

Environmental Energy Impacts

The tidal power station itself harnesses renewable energy. As such it can help satisfy the growing demand to use renewable energy sources. Primarily the benefit arises from the reduction in greenhouse gases that the use of tidal power allows. Greenhouse gas abatement arises because of the displacement of diesel fuel currently used to generate the power for the areas. The use of renewable energy will allow around 150,000 –200,000 tonnes of CO₂ to be avoided per annum.

The estimation of these energy benefits and their treatment is connected to the potential for markets to allow them to be traded. This will contribute to meeting various targets that have been set for greenhouse gas reduction and use of renewable power.

The Australian government has a commitment internationally to reduce greenhouse gases through the Kyoto Protocol. Presently three mechanisms are the focus to achieve reductions. One mechanism is the setting of a target for renewable energy production. This target is for electricity producers in Australia to have 2% of their electricity generated from new renewable sources by 2010. Another is through subsidy schemes where in Australia, most states have 'Greenpower Schemes' in place which promote electricity generation from renewable sources through consumers paying up to 3% extra on their normal power bill. The third is through emissions trading, both nationally and internationally.

Some emission trading has commenced in the US prior to mandatory legislation being enacted in the U.S. The United Nations has in place the Greenhouse Gas Emissions

Trading Project which has as its target the year 2000 for the mechanisms to be in place to allow international trading. It is highly likely therefore that trading will be fully developed and that greenhouse emissions trading will be relevant for this project, with the expectation when mechanisms are in place that the values will be \$10 – 20/tonne of CO₂. However, if the target is mandatory but no trading develops, then the contribution to gas reductions and to the renewable energy target is still an external benefit and would need to be valued as such. In this case rather than being treated as a private benefit to the proponent, it would be viewed as an external benefit accruing to society but which is not captured by the proponent. In this case, the individual producers would be forced to construct renewable generating capacity to meet the target.

In addition to the above, there are potential opportunities to sell or trade emission credits internationally where a market in greenhouse gas reductions is already operating (e.g. the GERT pilot program in Canada) though the mechanisms for this and the full implication of trading for the project need further investigation.

Where credits are fully tradable and tradable internationally, the environmental benefits are valued by the market and can be internalised into the project. In this case they can be collected as revenue by the operator.

As noted, the expectation is that the greenhouse gas benefits associated with the tidal power station will be tradable. The 2% renewable energy target may result in a renewable energy credits market being established. The full extent of this market is not yet known. However, from an economic perspective, it allows the energy credits to be produced in one location but be transferred to another via the market. In this case a NSW producer could purchase renewable energy credits from a firm such as Derby Hydro and transfer then to the NSW operation thereby avoiding the need to invest in renewable energy production capacity. This will allow efficiency gains for the Australian energy industry. The willingness to pay for these credits will depend on the net costs avoided by the fossil fuel generator not having to build and operate the renewable capacity.

Preliminary estimates indicate that the various possible options may collectively be valued in excess of 4c per kWh. At a production rate of around 200 GWh per annum, this equates to an sum of at least \$8 million per annum. These benefits accrue over the whole 120 year life of the project.

The environmental energy benefits are substantial. If trading is not feasible, then they are an external benefit to the community and can be accounted for as such. If full tradability is possible, the benefit still exists but can now be valued by the market as a potential revenue benefit to the company.

Other External Impacts

The other external benefits are in one sense more clear cut than the energy benefits. This is because they are genuinely external to the project, are not tradable and are therefore not open to capture by the proponent

New Aquaculture Developments

The creation of the permanent water body at Derby offers the potential for the development of an aquaculture industry. In the absence of this water body, such a development would not be possible in the area. While many variables will interact to ultimately determine the viability of aquaculture at the tidal power station site, the incremental benefits that flow from any future developments are attributable to the construction of the suitable water area. Kimberley Prawn Farms are proposing a new development in the Sound that will be complimentary to the tidal power station.

The prawn farm would be a large user of electricity and would use the same water resource as the power station. The prawn farm does not depend on the basin but may not be viable without the long term reliable supply of electricity that the tidal station can provide. A barramundi farm cannot proceed without the basin.

Estimated scale of potential developments

Initial enquiries show interest in farming barramundi in the basin.

Mr Bill Rucks, an aquaculture developer, has made an initial assessment and is interested in developing in this location.

This assessment indicates that an investment of \$850,000 would produce annual production of around 70 tonnes. This is for a single operation only. The size of the water body to be created offers the prospect of additional producers, although at this stage the exact number is uncertain. On the basis of the initial interest and the known capacity and

expected suitability of the basin construction and operation of two 70 tonne operations has been assumed.

Value of production

The estimated annual turnover for such developments is around \$2 million.

Estimated value added per annum

The exact cost structure of the aquaculture development is difficult to assess in advance. However based on surveys undertaken of aquaculture and aquaculture cost structures elsewhere in Western Australia, a reasonable estimate of the value added from such a production level is \$500,000 per annum.

Potential employment impact

It is estimated that a development at this level would employ 48 people (8 technicians and 40 labourers).

New Tourism Activity

The Kimberley area currently relies on a relatively small number of attractions. It also has a very seasonal visitation pattern. Tourism has been identified in many studies as a potential growth industry for the Kimberley. It has been recognised in these studies that growth depends on ensuring a range of quality accommodation, improving access to some sites and developing a wider range of attractions. Most importantly, the current distribution of attractions and accommodation is centred on Broome and Kununurra. Derby has not experienced significant tourism growth.

The construction of the tidal power station creates a significant water body. This has several tourism implications as follows:

Fishing opportunities that currently do not exist.

The attraction of a unique infrastructure facility.

Easier access for boats to King Sound for touring and fishing.

These are the sorts of activities that have successfully developed elsewhere where similar water bodies have been created as part of major power developments. Tourists have been attracted to these facilities to visit the facility and to participate in the related water based activities. The following are two examples.

The Electricity de France Tidal Power station at La Rance (France)

The 240 MW tidal power station was commissioned in 1967. This is a single basin design that allows electricity generation on the ebb tide. Over and above the energy production role, the tidal power station contributes to the economic, social and tourist development of the region. 58 permanent staff are involved in the operation and maintenance of the facility. The erection of the dam favoured the rapid development of recreational activities. The estuary has become a sheltered reservoir covering 22 sq kms, (The lake to be created in Doctors Creek will be 12 sq kms).

Every year the tidal power station receives between 300,000 and 400,000 visitors attracted to the facility which is the largest of its kind in the world.

The Gordon River Hydro Facility in Tasmania

The Gordon River scheme involves the creation of two large lakes. Lake Pedder and Lake Gordon. Combined they are the largest water storage in Australia. Water is used in the underground Gordon Power Station which is located some 160 kms from Hobart. The power station is the largest in Tasmania. Roads leading into the area have a number of Viewing points and tourist facilities. The lake levels vary little and therefore it is popular as a site for fishing and touring.

Visitor statistics for the Visitor Information Centre at Gordon Dam are:

1993 - 15,862

1996 - 18,917

1997 - 17,707

1998 - 18,589

The Gordon facility highlights the range of facilities that could be offered in the Derby facility. It is 160 kms from Hobart. Derby is 220 kms from Broome which is the main tourist centre in the Kimberley.

Based on the most recent tourism surveys, across all accommodation types, around 254,000 visitor trips occur in to the Kimberley. These generate around 1.87 million visitor nights and this is associated with \$113 million in expenditure by visitors. The overwhelming reason for this activity is holidays. This accounts for 72% of the total visitor nights. The average length of stay is 7.2 nights. Average expenditure is \$61 per night. Holiday makers spend on average \$58 per night while business visitors spend on average \$89 per night.

For commercial accommodation only, visitor trips are 213,676, visitor nights are 1.25 million. The average length of stay is 5.6 nights. Holiday makers in commercial accommodation spend on average \$66 per night while business visitors in commercial accommodation spend on average \$151 per night.

Across all accommodation types, Derby accounts for 41,977 visitors and 103, 569 visitor nights with the average stay being 2.5 nights. Based on Kimberley wide expenditure data, this would generate expenditure of \$6.3 million. For those staying in commercial accommodation, Derby had 29,481 visitors and 61,000 visitor nights. Based on Kimberley expenditure data, this would generate around \$4.56 million. Around 60% of the activity in Derby is associated with commercial accommodation. For those staying in commercial accommodation, the average length of stay is just 2.1 nights. Forty eight percent of visitors stay only one night.

The tourism potential for the region comes from the impact that the project might have in attracting visitors and in inducing existing visitors to extend their stay. The first arises because the tidal basin creates opportunities that previously did not exist in Derby or the Kimberley. Recreational fishing for prized species is the key element in this. The second arises because existing visitors have very little reason to include Derby on their itinerary. The tidal power station will encourage them to do so, both to visit the site (as they currently do for the Ord) and to take advantage of the additional opportunities that the tidal basin allows (eg recreational fishing and water cruises).

Assessing the attractiveness of these opportunities is difficult at this stage. However, visitors to the Kimberley already exhibit a willingness to undertake these activities. Around 22% participate in fishing, around 27% take a river cruise around 20% visit estuaries. Many do all three.

The full exploitation of these opportunities will ultimately depend on the willingness of businesses to invest in the support infrastructure (e.g. accommodation) and associated businesses (e.g. fishing cruises).

Although the actual impacts are difficult to assess, an indication of the potential has been made based on current visitor numbers.

Estimated potential from existing visitors

The creation of a permanent water body near Derby offers opportunities that have previously not existed in Derby. Initial inquiries indicate that the tidal facility itself will be an attraction. Fishing is expected to be good, reliable and accessible in the basin. The creation of the water body offers the possibility of developing a range of commercial accommodation that can take advantage of the water access and views. This may include a backpacker's lodge, an extension of existing commercial accommodation or new hotel facilities.

Visitor numbers to Derby

At this early stage it is impossible to say with certainty what additional tourism will be generated. However some idea can be gained by considering the economic consequences of an estimated increase in tourism visitor numbers.

It has been suggested that the attraction of the facility and the water recreational opportunities created may induce visitors to stay longer. Currently there are around 41,977 visitors and 103,569 visitor nights for Derby, with the average stay being 2.5 nights. If the existence of the facility and the basin increased the average length of stay by one night, total visitor nights would be increased by around 43,000. This equates to around 170 additional commercial rooms.

Expenditure by visitors to Derby

The 170 room facility would increase annual visitor expenditure by around \$2.64 million.

Potential employment impact

For each \$1million dollars of visitor expenditure it is estimated that around 12 Jobs are generated. At the level of activity indicated this would represent around 32 jobs.

Estimated potential from new private vehicle travellers entering Derby

The main method of transport in and around the Kimberley is private vehicle. This is highest for interstate travellers. The major access to the region from and to Perth bypasses Derby. However, the number of road based travelers indicates a significant market opportunity if Derby can create attractions such that a side trip to Derby is justified.

As already noted, 254,000 visitors to the region account for 1.87 million visitor nights. The most recent surveys indicate that between 50% and 60% of visitors are in private vehicles and buses. This equates to around 140,000 visitors and just over 1 million visitor nights.

Clearly the requirement to fill a new facility as documented in the previous section is a modest one. If Derby, on the basis of the tidal power station and related developments such as fishing, could divert a further 25% of these visitors into Derby for one night, this would equate to a 137 room facility and around \$2,135,000 in expenditure based on average Kimberley holiday maker expenditure. Such a level of expenditure would generate around 26 jobs.

Such a diversion is consistent with the demonstrated behaviour of Kimberley visitors because, as already noted, around 22% participate in fishing, around 27% take a river cruise around 20% visit estuaries and many do all three.

Potential from recreational fishing

Recreational fishing in the region includes some highly valued species such as mud crabs and barramundi. There are also sea perch, red emperor and threadfin salmon. Doctors Creek is primarily a recreational fishing area. Commercial fishermen have not utilised it.

Recreational fishing is a major activity in Western Australia. The overall economic impact has been assessed in a number of reports.

Most recent surveys indicate that 36% of the population have fished in the previous 12 months. Fishers spent on average 7 days a year fishing and travelled in excess of 800 kms in doing so. Aggregate direct expenditure is estimated to be \$299 million with a total impact inclusive of flow-on effects of \$569 million.

Recreational fishing opportunities in Derby have two impacts. First, they may be the catalyst for attracting visitors as documented in the previous section. Individual and club fishers have a demonstrated willingness to travel to sites where good fishing opportunities are available. This appears to be especially so if the site can offer a prized species different from that which is routinely available to them in their home location (usually Perth).

In addition to the simple attraction of visitors, fishing is an expenditure activity in its own right. Individual fishers value the fishing experience highly. In a recent survey of metropolitan fishers, it was estimated that the fishing experience was valued at some \$40 per trip over and above actual expenditure incurred. This varies systematically with the fishing conditions, species and related conditions. Quality and abundance of the stock have been identified as a crucial variable.

The development of the tidal basin does several things for recreational fishing.

It opens up an alternative fishing location. It offers easier access to more prized fish species, such as barramundi. It opens up a fishing opportunity in an area of the state where fishing (Exmouth, barramundi in rivers etc) is already established. A 1990 survey estimated that up to \$62 million was spent on recreational fishing in the areas of the state north of Kalbarri. Finally, the plans for the tidal power station involve the creation of easy access to King sound which further opens up recreation fishing opportunities.

It is not possible to predict at this stage visitor numbers attracted to Derby because of the fishing opportunity. However, it reinforces the argument for the increase in visitor numbers given previously.

The significance of fishing can be drawn from available data on what visitors do in the Kimberley. The most recent data suggest that, for visitors in commercial accommodation, around 22% undertake fishing activities. This equates to around 47,000 visitor trips.

Clearly, given the already significant propensity to fish on trips to the Kimberley, the development of a new fishing opportunity is significant. Assuming 25% of the fishers could be enticed to spend at least one additional night because of the tidal basin fishing, an additional value (consumer surplus) of \$470,000 would occur.

Tourism benefits for the region

The increase in visitation to Derby discussed above is based on (a) extending the stay of visitors already travelling to the Derby and (b) diverting existing Kimberley travellers into Derby and thereby enticing them to stay longer in the Kimberley. The effect of both is to increase activity due to existing visitors.

There is also the question of the overall effect of the development (tidal power station, basin, fishing, access to King Sound etc) on attracting visitors to the Kimberley who would not otherwise go there.

Around 254,000 visitor trips occur in to the Kimberley. These generate around 1.87 million visitor nights and this is associated with \$113 million in expenditure by visitors.

The basin and associated developments create an attraction that can be promoted as a reason for visiting the area. To the extent that additional visitors come it can be expected that they will also visit other sites such as Broome creating wider benefits within the region.

Availability of Transmission Capacity

In order to transport power from the tidal power facility in Derby to the other major consumption points at Broome and Pillara, a 500km long transmission line is to be built. This may have spin off effects for the regional economy if it allows projects to proceed that would otherwise not occur. The extent to which this happens depends on the location of potential projects relative to the transmission line and on the power price.

Reduced marginal cost of power at certain locations

The way that the line will influence project operators to increase production or commence production is by reducing their power costs. For those proximate to the line

this is a real possibility because they will be able to substitute power taken from the transmission line for power they would otherwise have to generate themselves.

At this stage the magnitude of any production increases and the scale of any new projects cannot readily be assessed.

Stability of electricity prices,

In addition to the access to the transmission line there is also the potential benefit from price stability. There is a reduced dependence on diesel fuel as a result of the tidal power proposal, as it is used as a supplement. This means that there is a greater certainty of long term reduced power costs. For mining and associated projects, this may well be the necessary condition that will enable a project to go ahead.

Competition/deregulation

The process of developing competition in the electricity market is enhanced by the construction of the transmission line. In the future, additional generators may exist in the area. These could be associated with large scale mining developments.

The existence of the transmission line offers the scope for such generators to wheel power around the region.

This means that contestable customers can source supply from alternative generators.

Likely projects to benefit from this include:

- Kimberley Prawn Farm
- Kimberley Resources (Ellendale diamond field)

The Kimberley Prawn Farm is expected to become the largest user of electricity in the Derby area. The proponent indicates growth in power demand up to 5MW (the present townsite load) within five years. This is based on a 200 pond facility within the five years. The current Western Power system cannot supply electricity for the project even in the startup phase.

It is possible that with a transmission line to the Ellendale field, Blina oil can be used to generate power for transmission to customers through the transmission line.

Summary of transmission line impact

The extent to which the above beneficial effects arise clearly depend on factors well beyond the mere existence of the transmission line. However the important point is that these potential benefits cannot be realised in the absence of the transmission line and it is only the tidal power proposal which results in an extensive transmission line. Moreover, because the transmission line costs are paid for by the primary project, any of the possibilities that do arise in future are a genuine external benefit of the project. There is no down-side risk in this. Commitments to these spin off projects are not needed to justify the project.

Western Australia has emerging evidence on the consequences of extending infrastructure. New gas pipelines are being developed. Most notably, the second pipeline from the Pilbara to Kalgoorlie has had the effect of placing many more projects within reach of competitively priced gas. As a consequence projects have become more secure and others have become viable.

There is also the example of the transmission line to Kalgoorlie. It was commissioned in September 1984 and at the time had a maximum demand of 56 MW. Ten years later the max demand had risen to 160 MW.

The transmission line is a major part of a potential Pilbara/Kimberley regional grid. The prospect of a regional transmission system offers potential for increased competition in power production and a further stimulation to economic activity. This will be re-inforced by the long run stability of power prices that the tidal power station can offer.

Other Environmental and Social Impacts

The benefits flowing from the development of the basins have been discussed above in terms of the impact it will have on tourism generally and on eco-tourism and recreational fishing tourism in particular.

In addition, there will be an improvement in the quality of the township of Derby because of the access to the permanent water of the basin. Doctors Creek West, the high basin, extends right back to the town. Derby residents will therefore have easy access to permanent water. Although it is not possible to place a value on this aspect of the access to permanent water, studies around the world have shown that communities place a

significant value on nearness to water (lakes, rivers etc) over and above the value they derive from any consumptive use they make of the resource (such as fishing).

Currently the power system uses diesel fuel with generators in each location. An important consequence of the tidal proposal is that the transport of diesel fuel by road train will be diminished. The tidal power station will offset the transportation of 39,000,000 litres (32,800 tonnes) of fuel per annum. Road trains have negative effects on road infrastructure which is not charged for in road user charges. At the margin they also increase accident risks which is similarly not charged for. These are genuine externalities that can be avoided by the switch to tidal power. As such they are a genuine benefit of the tidal power station development.

Economic Impacts

Estimated direct and indirect employment

Insofar as direct employment effects associated with the project are concerned we can identify the following;

91 jobs over 2 years in constructing the tidal facility and transmission line

20 jobs in the power generation activity

48 jobs in the spin off aquaculture industry

58 jobs in the spin off tourism industry

Each of these industries has an associated employment multiplier. Using available State input/output data, the statewide employment multipliers are estimated to be 2.67 for aquaculture/fishing, 2.94 for electricity and 1.61 for tourism (based on the hotel sector).

On this basis, the estimated indirect or flow on jobs are;

38 jobs associated with electricity production

80 jobs associated with aquaculture

35 jobs associated with spin off tourism.

This gives a total (direct plus indirect) jobs generation of 279, excluding the construction jobs.

Regional employment impacts □ share captured in Derby

The regional multipliers will be less than the state multipliers because there will be significant leakage of expenditure away from the region. Based on available regional input-output data, our estimate is that, the regional multipliers are in the order of 1.2 for fishing/aquaculture, 2.16 for electricity and 1.45 for tourism. On this basis, the total jobs generated in the region are as follows:

43 jobs associated with electricity production

57 jobs associated with aquaculture

84 jobs associated with spin off tourism.

This gives a combined (direct and indirect) jobs generation in the region of 184, again excluding the construction jobs.

These regional estimates need to be interpreted with caution. The multipliers may be different because the aquaculture and tidal electricity proposal are unique and have not yet been in operation in the area.. However, they are not expected to have lower multipliers than those estimated. This is because, in the case of aquaculture there is scope to make many inputs locally as a project of this nature does rely on complex imports e.g. fish food. For the tidal power station itself, it largely eliminates the major on-going import associated with electricity – diesel fuel.

Other benefits

The above estimate is that up to 280 permanent jobs will be generated as a consequence of the operation of the tidal power project and likely spin off projects. The other identified potential benefits (e.g. new projects along the transmission line), mean that this could be a very conservative estimate. However, in addition to the simple number of jobs there are further effects that should be noted. These fall into the category of social and distributional impacts.

Of most significance is the nature of the employment generated in aquaculture and tourism. Both have a heavy reliance on local labour. This is in direct contrast to mining where the trend over many years has been to rely on fly in-fly-out arrangements. Therefore while mining generates significant benefits, the local employment consequences are not always proportionate to them. Both aquaculture and tourism offer job opportunities the young less educated members of the labour force. Potentially this is very important in an area like Derby where job creation for young people has been a long running issue, as it has been generally in the Kimberley.

An important aspect of the flow on developments in Derby is that the infrastructure is already in place. Over recent years Derby has lost economic activity. Hence it is likely to have excess capacity in much of its infrastructure. This will allow easy development of new accommodation etc.

The excess capacity may also mean the possibility of competitive pricing to encourage such developments, but this would depend on the exact infrastructure position and pricing policy.

Other Scenarios

The analysis of the previous sections was based on a pro-active approach by the local community in promoting tourism and encouraging the necessary developments in tourism and aquaculture. Consultations with bodies like the Kimberley Development Commission indicate a very positive approach to making these potential developments a reality.

However, even on very conservative assumptions, there are significant external benefits. For example, only the one farm may be developed. Current tourists may stay only an extra half a day and diverting tourists might be 15%. If these very conservative performance levels eventuated then the economic outcome would still yield significant benefits. In summary, one aquaculture farm of 7 tonnes would have turnover of \$1 million with around \$250,000 in value added. Employment would be around 24.

If current visitors to Derby stayed an extra half day, and 15% of road based visitors in the Kimberley diverted into the Derby area, tourism expenditure would be \$2.6 million, with value added of \$475,000. This would generate around 31 jobs.

If 22% of the visitors went fishing and valued it at \$40 per experience this would add \$280,000 to the benefits.

Under this pessimistic scenario, total jobs would be the following;

91 jobs over 2 years in constructing the tidal facility and transmission line

20 jobs in the power generation activity

24 jobs in the spin off aquaculture industry

31 jobs in the spin off tourism industry

Our estimate is that, the regional multipliers are in the order of 1.2 for fishing/aquaculture, 2.16 for electricity and 1.45 for tourism. On this basis, the total jobs generated in the region are as follows:

43 jobs associated with electricity production

29 jobs associated with aquaculture

45 jobs associated with spin off tourism

In contrast to the conservative scenario, there is the real possibility that the local community can exceed the estimates in the previously stated realistic scenario. This is because the extent to which the basin and associated developments are exploited is, as already noted, largely in the hands of those organisations promoting and developing tourism, aquaculture and recreational fishing opportunities. The same is true of the exploitation of the opportunities that the transmission line creates.

An indication of the potential can be gained by considering the impacts of higher levels of activity in these areas. If current tourists stay an extra two days, diverting tourists captured are 50% and three aquaculture farms were developed the consequences would be significant. Three aquaculture farms would have around 21 tonnes of harvest, turnover around \$3 million with around \$750,000 in value added. Employment would be around 72.

If current visitors to Derby stayed an extra two days, and 50% of road based visitors in the Kimberley diverted into the Derby area, tourism expenditure would be \$9.4 million, with value added of \$1.7 million. This would generate around 114 jobs.

If 22% of the visitors went fishing and valued it at \$40 per experience this would add \$940,000 to the benefits.

Under this optimistic scenario, total jobs would be the following;

91 jobs over 2 years in constructing the tidal facility and transmission line

20 jobs in the power generation activity

72 jobs in the spin off aquaculture industry

114 jobs in the spin off tourism industry

Our estimate is that, the regional multipliers are in the order of 1.2 for fishing/aquaculture, 2.16 for electricity and 1.45 for tourism. On this basis, the total jobs generated in the region are as follows:

43 jobs associated with electricity production

86 jobs associated with aquaculture

165 jobs associated with spin off tourism

Project Social Rate of Return

As has been noted in the report some of these benefits are difficult to quantify. Others, most notably the aquaculture and tourism potential are amenable to quantification.

The project has been modeled using cost benefit analysis starting with the actual private electricity project and making adjustments to reflect the opportunity cost of the resources devoted to it. The adjustment to prices is based on 20% of the labour and other inputs being incremental production and the shadow wages rate being 75% of the wage rate paid.

The environmental energy benefits have been treated as private benefits captured by the proponent by sale into a relevant market place. As noted this depends on the actual market conditions. If no such market with international trading develops then the

environmental energy benefits – use of renewable energy – would be an external benefit and would be valued accordingly.

The aquaculture and tourism benefits have been treated as external benefits. The estimates are based on the aquaculture and tourism production and expenditure estimates given above. However, as it costs society real resources to produce these outputs, only the net income (value added) has been taken into account. The history of the Kimberley is that tourism and recreation have been major growth areas. To reflect this trend the tourism and recreational fishing benefits have been assigned growth of three percent per annum.

These are standard adjustments in cost benefit analysis. Their effect is to increase the social rate of return relative to the private rate of return. The overall estimates are summarised in the attached table which relates to the main scenario discussed above.

In the case of the current project, under the main scenario, the estimated present value of the aquaculture, tourism and recreational fishing external benefits is \$23.4 million, using a 6% real discount rate and a time period of 25 years. When combined with the other adjustments for taxes and employment, in real terms these benefits are valued at around \$2.2 million per annum in the first year.

Over the period, total production is 6,939 GWh. Some 4,576 GWh will be from the tidal station, which equates to around 156 GWh per annum initially. The value of the benefits in current values is around 1.4 cents per kWh for the project. The social rate of return is around 1.2% higher than the private rate.

This analysis would change substantially if the environmental energy benefits could not be internalised through market sales and were captured only as external benefits.

This analysis excludes any benefits arising from new projects flowing from the existence of the transmission line, additional aquaculture developments beyond the assumed two farms and any net expenditures that recreational fishers might make over and above normal tourist expenditure outcomes.

Conclusion

The above analysis shows that the development of a tidal power station has the potential to produce benefits that extent well beyond the project itself. These fall into the following main categories:

- Environmental energy benefits
- Aquaculture development benefits
- Tourism benefits related to visiting the tidal power facility but most important use of the basin for recreational fishing and access to King Sound.
- Transmission line benefits related to the potential for new electricity using projects such as mining and prawn farming
- Broader social benefits based on the fact that most of the activity is in Derby and the fact that the jobs are likely to be local jobs suitable for younger members of the work force.
- General social benefits based the contribution that the project itself, but even more so the spin off projects, can make to sustaining an economic base in Derby and,
- Improvement in the quality of life of Derby as a town due to the creation of a permanent water basin close to the town itself.

It is important to note that without the project these benefits would not eventuate. Certainly they would not eventuate in Derby and given the uniqueness of the project and the opportunities it creates, they would not be created elsewhere in the Kimberley.

These benefits are in some cases direct market benefits as is the case with the new aquaculture and tourism developments and for any new developments arising from the availability of the transmission line. For other benefits, such as the social benefits of creating jobs in Derby and improving the overall attractiveness of Derby, market valuation is difficult.

For those things that are amenable to valuation, the estimate is that they have a present value of around \$23.4 million. It is estimated that the net social benefits equate to a value of around 1.4 cents per kWh. The value to the region is predicated on the tidal power station being constructed. Presently the project is being evaluated against fossil fuelled

alternatives for electricity supply to the region. If the project was not to proceed because alternative fuelled generation systems were selected and installed at the towns, then it is likely the opportunity to construct the tidal power station will be lost. The significant economic and social benefits will therefore not occur.

Derby Hydro Power Evaluation

Net Social Benefits

al Report Active Local Response Case

analysis.dss

	NPV	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2027
sh Flow		-104,340	-145,620	24,491	25,294	26,087	26,867	27,642	28,406	29,226	30,080	30,930	27,962
	84,315.31												
	9.26												
es	2,004.97	154.62	154.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	348.3
ployment	6,882.82	1,485.00	1,485.00	331.42	331.42	331.42	331.42	331.42	331.42	331.42	331.42	331.42	331.42
ments													
entive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sts (benefits)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
osts (benefits)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ulture, rec fishing	-23,430.20	0.00	0.00	0.00	0.00	-1,850	-1,891	-1,933	-1,975	-2,020	-2,065	-2,112	-3,087
i Rents		-102,700	-143,980	24,859	25,662	28,305	29,126	29,943	30,750	31,614	32,513	33,410	31,729
	116,633.30												
	10.38												
axes/Charges													
		108.00	108.00	24.10	24.10	24.10	24.10	24.10	24.10	24.10	24.10	24.10	24.10
dj		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	311.67
		48.60	48.60	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.85
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		-1.98	-1.98	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
es	2,004.97	154.62	154.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	348.30
ovt subsidies													
te		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
entive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00