BEFORE THE ENVIRONMENT COURT
AT CHRISTCHURCH

ENV-2010-CHC-115, 123, 124 AND 135

IN THE MATTER	**of Appeals pursuant to Section 120 of the Resource Management Act 1991**
BETWEEN	**WEST COAST ENT INC** **Appellant**
AND	**ROYAL FOREST AND BIRD PROTECTION SOCIETY OF NEW ZEALAND INC** **Appellant**
AND	**WHITE WATER NEW ZEALAND INC** **Appellant**
AND	**DIRECTOR GENERAL OF CONSERVATION** **Appellant**
AND	**WEST COAST REGIONAL COUNCIL AND BULLER DISTRICT COUNCIL** **Respondents**

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STATEMENT OF EVIDENCE OF
PETER WILLIAM JOHN CLOUGH
FOR DIRECTOR-GENERAL OF CONSERVATION
Dated: 17 May 2012

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AND	**MERIDIAN ENERGY LIMITED** **Applicant**
AND	**FRIDA INTA** **Section 274 Party**
AND	**WHANAU PIHAWAI WEST – RICHARD WAYNE BARBER AND IRI MAY BARBER MILNER** **Section 274 Party**
AND	**J MacTAGGART** **Section 274 Party**
AND	**ORION ENERGY NZ LTD, ALPINE ENERGY LTD, MAIN POWER NZ LTD AND ELECTRICITY ASHBURTON LTD** **Section 274 Party**
AND	**NZ RAFTING INC** **Section 274 Party**
AND	**ANN SHERIDAN** **Section 274 Party**
AND	**BULLER ELECTRICITY** **Section 274 Party**

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1. QUALIFICATIONS AND EXPERIENCE

1.1. My full name is Peter William John Clough, and I am currently employed as Senior Economist at the NZ Institute of Economic Research (Inc.) in Wellington. In that capacity I have engaged in a wide range of consultancy work, but I specialise in applying economics to the natural environment, energy, transport, and public sector issues such as the provision of public goods and services, transport networks and safety, the regulation of external effects of activities (such as pollution) and the economic appraisal of projects and policies.

1.2. My qualifications include a Bachelor of Arts degree in Geography and Land Economy from Cambridge University, a Master of Science degree in Land Management from the University of Reading, and a post-graduate Diploma in Agricultural Economics from Massey University. I have over 25 years experience in applied economics research, obtained since joining NZIER in 1987, and previously as research officer for the Centre for Agricultural Policy Studies at Massey University in Palmerston North. In 1996-97 I completed a 15-month secondment as economic adviser to English Nature, a statutory agency of the UK government with responsibility for policy and matters relating to the natural environment. I have also had spells working inside the Ministry of Economic Development, in 2000-2001 working on design of an emissions trading scheme as part of climate change policy, and in 2004 helping to prepare a government publication on sustainable energy.

1.3. I am familiar with the institutional setting provided by legislation governing local government powers and funding, including the Resource Management Act 1991

("the Act"), and I have prepared or presented evidence under that Act on a range of issues including consent applications for new wind farms, reconsenting of existing hydro-electric plant, consent applications for the use of water, and consents for clearance of indigenous vegetation. I have practical experience of undertaking cost benefit analyses of hard-to-quantify matters impacting on the natural environment and human health and safety, including potential impacts and responses to biosecurity incursions, the adoption of national environmental standards on air quality, and the economic value of safety improvements in transport appraisals.

1.4. I am familiar with Meridian Energy Ltd's proposal to construct a hydro electric power plant on the Mokihinui River (Mokihinui Hydro Power Scheme or MHP) to which these proceedings relate.

1.5. I have read the Environment Court's Code of Conduct for Expert Witnesses, and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise.

1.6. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed. I have specified where my opinion is based on limited or partial information and identified any assumptions I have made in forming my opinions.

1.7. My opinions rely in part on the evidence presented by Mr William Heaps, Dr John Leathwick, Mr Ian Wightwick and Dr Astrid van Meeuwen-Dijkgraaf, and I have also considered the evidence prepared for the Applicant by the following witnesses:

- Mr Michael Copeland

- Mr Philip Barry
- Mr James Baines
- Dr David Norton
- Mr Robert Greenaway
- Mr James Truesdale
- Mr Nicholas Eldred
- Mr Brian Cox
- Mr Erik Westergaard
- Mr Stephen Godfrey

2. SCOPE OF EVIDENCE

2.1. My evidence will deal with the following:

(a) The relevance of an economic analysis to the circumstances of this case with due regard to the provisions of the Resource Management Act 1991 ("the Act");

(b) The type of economic analysis required to inform the Act's considerations;

(c) The scope and scale of benefits and costs to be considered in the case of; MHP

(d) The local expenditure impacts of MHP;

(e) The likely balance of economic benefit of the MHP to the nation at large.

3. SUMMARY OF KEY FACTS AND OPINIONS

3.1. In this evidence I explain:

(a) The total economic effects of the MHP and how to assess them, including the value of ecosystem services

(b) The workings of the electricity market and the influence of price, short run marginal cost (SRMC), long run marginal cost (LRMC), options and alternatives to the MHP and economic benefits for electricity supply to the West Coast

(c) The strengths and weaknesses of the applicant's evidence on economic value of MHP to the nation, and other evidence with economic implications

3.2. Key findings from my analysis are:

(a) In my opinion effects on well-being, resource use efficiency and effects external to the applicant's interests are the main issues of relevance to the Act where economic considerations can assist in deliberations under the Act

(b) The appropriate economic technique for examining these issues is cost benefit analysis, which needs to identify, quantify and value as far as possible all the consequences for all parties affected by a proposed new development such as the MHP, including effects on producers, consumers and third parties in the surrounding environment; the

commonly encountered alternative of economic impact analysis of new expenditures and jobs created cannot distinguish real productivity gains from redistribution effects and is uninformative of effects on overall well-being and efficiency

(c) The applicant's economic evidence is deficient in its coverage of effects on the environment and the services people derive from it, and it does not provide a sound basis for assessing the economic effects of MHP; its consideration of MHP with other alternatives for expanding generation relies on estimates of long run marginal cost that are demonstrably unsuited for comparisons between individual plant, and also deficient in not accounting for differences in environmental costs of the various plant

(d) There are other options for meeting national and regional electricity needs that do not require inundating a hitherto unmodified valley; if undertaking a comprehensive analysis, taking account of environmental costs, other options with less environmental impact than MHP would look more favourable in providing electricity at lower overall cost to the nation

(e) Meridian is a principal beneficiary of MHP but its benefit is not synonymous with benefit to the nation; some of the claims made for benefits such as lower prices being passed on to customers are exaggerated

(f) The economic value of the natural and cultural heritage of the Mokihinui valley is enhanced by its scarcity, lack of close substitutes and likelihood of its appreciation over time as unmodified environments become more scarce. These characteristics have not been properly accounted for in the applicant's evidence.

4. TOTAL ECONOMIC EFFECTS OF THE MHP

4.1. I have been asked to comment on the economics of the proposed Mokihinui Hydro-electric Power (MHP) development, with particular reference to matters contained in Part II and section 104 of the Act. I understand the proposed development would involve the construction of an 85 metre high dam and inundation of the gorge-like Mokihinui River upstream to just below the Mokihinui Forks. It would create a reservoir covering approximately 337 ha, 14 kilometres long and 200-300 metres wide on land currently occupied by unmodified indigenous vegetation and riverbed. The electricity it generates would be available to supply the local demands of the West Coast, or at times of surplus it could be fed into the national transmission grid and exported to other regions. The proposed MHP development is currently anticipated to have an installed capacity of 100 megawatts (MW), with expected annual output of 386 GigaWatt hours (GWh). The 100 MW defines its peak capacity, and Meridian's evidence states it would produce just 10 MW for 35% of the time.

4.2. Building and to a lesser extent operating the MHP will inject funding into the local economy of the West Coast

and provide a stimulus for further spending and economic activity, like any other major development, but in my opinion this is not the main economic consequence from the perspective of resource management. The purpose of the MHP proposal is to harness a natural resource, water flow, to create a valuable commodity, electricity. This is of value to the MHP's operators, Meridian Energy, and it also benefits the wider community to the extent that it contributes to generation capacity available to meet demands across the electricity system, and avoids the resource costs and consequences of alternative generation. However, its construction and operation will also have effects on the surrounding environment, some of which have economic consequences but may not be readily measured in economic terms. The consenting process exists to identify, assess and put in place conditions if needed to avoid, mitigate or remedy those effects.

4.3. That Meridian Energy is seeking consent for MHP indicates the company believes it is a worthwhile prospect for its investment funds, and it will only proceed if it stacks up as a commercially viable investment. Matters critical for the Court's attention are those effects that fall outside of the commercial decision that affect the surrounding environment and the wider community. The applicant's evidence goes to great length to enumerate positive effects in economic terms, but makes little effort in assessing negative effects in like manner and it provides an unbalanced view of the economic consequences of the MHP. In my evidence I will redress that balance and illustrate the full economic effects in ways which, although they may not give precise numerical estimates or determine the outcome, nevertheless aim to inform the Court and assist its weighing up of effects.

Economics and resource management

4.4. It is my general understanding that there are several distinct threads in the Act which allow the Court to have regard to "economic" considerations relevant to its consideration of what constitutes sustainable management in any given situation. This is particularly apparent in section 5's enabling provisions for community well-being and section 7(b)'s regard to the efficient use and development of natural and physical resources. It is my opinion that economic considerations are particularly relevant to the assessment of effects on well-being and efficiency under the Act, as I discuss further in this evidence.

4.5. Despite the idea persisting in the public at large that "economic" means "commercial" or "financial", economic gains are not confined to matters covered by financial transactions. To economists the defining characteristic of economics is its insights into choices made under conditions of scarcity: how limited resources are used in the satisfaction of relatively unlimited human wants. A central issue is that of economic efficiency, defined as maximising output value obtainable from a given set of inputs, or minimising inputs required to obtain a given value of outputs. Economics distinguishes between three types of efficiency: productive efficiency within activities, allocative efficiency across activities and dynamic efficiency across time.

4.6. A large literature now exists to show that, although not necessarily evident in conventional economic measures of income and production, improved health, environmental surroundings and quality of life contribute to human well-being and are economic benefits that people are willing to pay for, but commonly do not because they are not amenable to market provision. This is particularly the case

with shared environmental resources, such as air, water and biodiversity, which often have no single owner and no-one directly responsible for maintaining their quality, the degradation of which may affect everybody. In the absence of reliable private markets for environmental resources, government intervenes with public provision or regulation so the community pays collectively.

4.7. This government role in environmental management has parallels in the economic theory of "externalities". Externalities occur when individuals' actions unwittingly affect third parties directly without invitation or compensation, as in the example of air and water pollution. There can also be positive or beneficial externalities, a particular class of which are the so-called "public goods" which private suppliers under-supply because they cannot recover their full costs. Public goods and services (such as local street lighting and national defence) are practically indivisible amongst their beneficiaries and can only be provided on a collective basis with tax-payer support. Environmental management, such as the activities of the Department of Conservation, is often provided as a public good, because of the collective nature of the environmental resources and difficulty of extracting contributions from beneficiaries in proportion to their use.

4.8. I suggest that the relevance of this to the Act is in section 5's reference to enabling communities to provide for their "social, economic and cultural well-being". Economists use the term "economic … well-being" as synonymous with the technical term "economic welfare", which is the notional sum of all individuals' well-being, encompassing both the quantity of goods and services they consume and less tangible aspects of the quality of life they enjoy. Put another way, well-being is the sum of the community’s consumption of tangible goods and services and its

consumption of intangibles, such as quality of the environment.

4.9. Tangible goods can often (though not always) be measured by observing the quantities and values of goods and services traded in markets. Intangible goods generally cannot, except through rather indirect means. This results in missing markets, in which externalities affect consumption and well-being and still have economic consequences. The processes enacted under the Resource Management Act perform the function of countering those missing markets by identifying and weighing up the various effects of resource use and development and setting conditions to remedy the externalities on the surrounding environment.

4.10. Where goods are delivered by markets, the level provided is determined at the point where the marginal cost of additional supply is equal to the marginal benefit of additional consumption. These marginal cost and benefit schedules are depicted in economics textbooks by intersecting supply and demand curves which map out the quantity supplied and demanded at different levels of price, with the point of intersection determining the market price and quantity supplied and consumed. The supply curve usually slopes upwards with increasing quantity supplied as price rises; the demand curve slopes downwards with increasing quantity demanded as price falls. In markets where supply curves do slope upwards, all suppliers other than the marginal supplier have a supply cost less than the market price they receive, and hence earn a “producer surplus”, or profit. Similarly, at any market price there will be some consumers who would be willing to pay more for the goods or services than the market price they face, and they earn a consumers’ surplus. These surpluses are the measure of economic welfare gained or lost through a

change in the market. For public goods for which there is no market price, the change in the consumers' surplus is the only measure of output value and techniques have been developed to estimate it.

4.11. This outline of economics and the Act provides the grounding for the rest of my evidence, which deals with the nature of the externalities that would be created by the MHP. These externalities need to be taken into account in any consideration of the positive effects and net national benefits of the proposed project.

5. ECONOMICS AND THE NATURAL ENVIRONMENT

5.1. Much of the land the MHP is proposed to occupy is currently held for conservation purposes. Although it may not support much tangible economic production, it is not without economic value. All decisions on using or retaining resources place an *implicit* value on conservation, which efficiency requires should be reasonably consistent across similar cases. Since New Zealand has committed to the 1992 Convention on Biological Diversity a major aim of conservation has been formalised as the conservation of biodiversity, which can be viewed as maintaining the diversity of ecosystems, their component species and their genetic variety. It is economically rational to conserve biodiversity to avoid the risk of losing its contributions to human well-being, including:

(a) The contribution of functioning natural ecosystems to water and nutrient cycling, and to resilience and recovery after extreme events like storms, flooding or drought;

(b) The potential for future development of medicines, crops and animal varieties from as yet unexplored genetic material; and

(c) The contribution of natural landscapes to public enjoyment and inspiration, including recreation, tourism and extractive pastimes like whitebaiting.

5.2. Given these potential sources of value, the economics of conservation focuses on survival probability of key contributors to biodiversity, contrary to the common perception that conservation is about reverting landscape to some former state. Biodiversity in New Zealand has characteristics that distinguish it from conservation efforts elsewhere. A high proportion of New Zealand species are endemic, having evolved to a form found nowhere else, implying particular importance in conserving indigenous species as contributions to both local and global biodiversity. Conserving a representative cross-section of New Zealand ecosystems requires looking beyond the areas currently reserved under protected status, which are mostly upland and mountain territory of little value in alternative uses, to secure more lowland habitats.

5.3. Section 6 of the Act is specific in identifying matters of national importance such as outstanding natural landscapes, significant indigenous vegetation and wetlands. Having regard to economic efficiency in the development and use of physical resources, if it is demonstrated that a natural resource (including biodiversity) is significant and faces a real threat to its integrity or perhaps even survival from possible resource use change, then restraining development to reduce that threat can be an economically rational response.

5.4. In recent years there has been some convergence of economics and ecological science in viewing the natural environment as a source of various "ecosystem services" which have economic value to people and communities in leaving them better off than they would be without them. The Millennium Ecosystem Assessment (2005)[1] summarised these services of the natural environment as:

(a) Provisioning services, e.g. a source of food, fibre and fuel and water

(b) Supporting services, e.g. soil formation and insect pollination that supports primary production

(c) Regulating services, e.g. moderating water quality and flows, climate, and disease spread

(d) Cultural services, e.g. a source of aesthetic, educational, recreational and spiritual inspiration.

5.5. Each of these services has economic value in the sense that if they were diminished there would be some loss of well-being, either because people have to make do without them and face restricted choices or because they would incur other costs to make good the loss. Reduction of such natural services may be offset by a greater benefit obtained from converting a natural resource to a modified one, but that can only be determined by conscious decisions after taking account of the potential effects on all the services at stake. As many of those sources of value occur in diffuse form away from the resource in question, they are

[1] http://www.maweb.org/en/index.aspx

externalities that are unlikely to be fully accounted for in the private decisions of resource owners and users.

5.6. The significance of this for the MHP application is that, although it has a lot of supporting evidence on environmental effects, very little of that is framed in terms of the services obtained from the environment from which people derive economic value. It is understandable that such matters should not be assigned precise dollar values because it is not simple to infer values for these effects to compare with the more readily available market values, but it is an omission for evidence to ignore or dismiss the existence of such effects having economic value.

5.7. There is now a well-established view that the total economic value of a natural resource contains a number of components.[2] These can be summarised as:

(a) Direct current use values, such as the realisable value of extractable timber, fish or other products from a natural resource, and the resource's value to non-extractive service activities such as tourism or recreation

(b) Indirect current values derived from supporting other sorts of production, such as the resource's contribution to water or nutrient cycling, river-flow management or habitat for insects that assist plant propagation

[2] Kerr & Sharp (2005) Option and Existence Values for the Waitaki Catchment; Report to Ministry for the Environment, Wellington
http://www.mfe.govt.nz/publications/water/waitaki-option-existence-values-jan05/waitaki-option-existence-values-jan05.pdf

(c) Future use values, which refers to the value of retaining the option of obtaining direct and indirect values in the future

(d) Existence values, reflecting the current community's willingness to pay to retain natural resources for a number of non-utilitarian reasons, such as their aesthetic, cultural or spiritual associations, or the desire to bequeath some of the natural environment to future generations.

5.8. Only some of the direct current and future use values can be inferred from the market values of goods and services from these resources. The others fall into the area of non-market valuation for which a number of techniques have been devised, but with varying degrees of practical application. These include:

(a) Cost-based methods that infer the costs that might otherwise be incurred as a measure of welfare loss, such as:

(i) The avoided damages that would otherwise be incurred without an intervention, such as estimates of likely reduction in flood damage as an indicator of the value of flood protection works

(ii) Replacement cost of providing a service in other ways, such as the cost of restoring alternatives to habitats damaged by a project

(b) Revealed preference methods based on observed economic behaviour, including:

(i) Market valuations of goods and services associated with the resource that are bought and sold (e.g. outdoor equipment sales as indicator of value of outdoor recreation areas)

(ii) Non-market valuation techniques, such as analysis of visitors' travel costs to infer the value of recreational sites, or analysis of house prices to infer the price premium of proximity to parks or other sources of environmental amenity

(c) Stated preference methods based on responses to survey questions, which may apply to both market and non-market goods and include:

(i) Contingent valuation that surveys people's stated willingness to pay to secure a defined scenario or environmental outcome

(ii) Choice modelling in which people rank alternative scenarios with different environmental attributes.

5.9. In these methods economic value is inferred from expressions of individual and collective willingness to pay for particular outcomes, of sacrificing other consumption in favour of securing the preferred outcome. The exception is the cost-based methods which, as the name implies, concentrate on the costs to be avoided by a course of action rather than people's willingness to pay to secure a favourable outcome. As for some people that willingness to pay may be higher than the costs avoided – for instance reflecting a value in the security of reducing the probability

of losses, over and above the actual value of the losses – cost base methods are often regarded as providing lower bound estimates of value, sufficient in some circumstances but not ideal.

5.10. The non-market valuation techniques are data-intensive, costly to implement and sometimes produce results that seem improbable in light of other indications of public willingness to pay for environmental protection.[3] While the use of such techniques has sometimes received official endorsement in other countries, for instance in assessing the costs of environmental damage from the Exxon Valdez oil spill in Alaska, in New Zealand they are not routinely used and in my opinion these techniques have not yet reached a stage where their results can be regarded as consistently reliable indicators of the public value of what they purport to measure. However, this does not mean the environmental impacts they refer to have no value, or that the community's well-being would be unchanged by natural resources being modified or degraded.

5.11. Even without precise monetary valuation, economic principles still apply to natural resources. Scarcity will increase the value of a natural resource such as an unmodified river system. Conversely, abundance or availability of substitutes tends to reduce value. A naturally created resource is more valuable than an artificial one which, by definition, is more readily reproduced. The defining characteristic of natural environmental resources is that they are created by natural processes, so they cannot be readily recreated in a short period of time. Successive development of natural areas therefore tends to deplete the

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[3] http://nzier.org.nz/publications/realistic-valuations-of-our-clean-green-assets

NZIER Insight 19 Realistic valuation of our clean green assets, October 2010

stock of natural resources and the value of those remaining is likely to increase over time. This is both because as they become rarer retaining what remains becomes worth more, but also because as people become better off, their tastes change and appreciation of natural areas tends to increase, raising the demand for these areas as places to visit or contemplate from afar.

5.12. As the output of readily reproducible material goods such as mobile phones or electricity increases but the availability of environmental goods and services such as biodiversity or natural landscapes declines, the value of the environmental amenities relative to other goods should grow over time. The non-market impacts of a development such as MHP are important precisely because it is these non-market effects that can be expected to rise in value over time. Some non-market attributes of the natural environment may grow in value sufficiently to counter-balance and outweigh the effects of discounting future value streams.[4] It is these non-market attributes of the natural environment in the Mokihinui valley that the applicant's economic evidence fails to come to grips with in its assessments of the economic effects of MHP. The fundamental economic choice presented by the MHP proposal is between transforming the Mokihinui valley to generate electricity, a commodity which is easily transportable and for which many alternative generation opportunities exist, or retaining it as unmodified river valley, one of a dwindling stock of such natural areas.

[4] See for instance Sterner T & Persson UM (2007) "An even Sterner Review: Introducing relative prices into the discounting debate"; Discussion paper 07-37, Resources for the Future, Washington DC, *www.rff.org*

Economic approaches to the assessment of MHP

5.13. In assessments of new developments it is common to see an economic impact analysis, which summarises the development's effects on output, incomes and employment after taking account of the indirect flow-on effects of new business in the economy stimulated by the initial direct effect of the project works. Such analysis has a familiar feel, as the framework and indicators presented are drawn from the system of national accounting that is used to calculated gross domestic product (GDP). GDP is the sum of a country's value added production over a year and is calculated in three ways:

(a) The production method, in which GDP = Gross Outputs less Inputs

(b) The income method, in which GDP = sum of incomes to main production factors, namely compensation of employees, fixed capital consumption (depreciation of capital stock), and operating surplus (the profit from which owner's return and new investment is funded)

(c) The expenditure method, in which GDP = sum of all final consumption expenditure and all capital consumption expenditure.

5.14. The flow-on effects are summarised in economic multiplier coefficients which vary with the extent to which industries' expenditure leaks out of the local economy on imported products. Ideally multipliers are specific to the area and the sectors most affected by the particular development. Calculating multiplier coefficients requires building an input-output model of the local economy that can capture the inter-industry transactions stimulated by the project's injection of funds into the local economy. Such an analysis

of MHP is provided in the evidence of Mr Michael Copeland.

5.15. Clearly local communities will be interested in how much money a project brings into their local economy. However, such impact analyses are not particularly informative about a project's effects on well-being under section 5 of the Act, or on economic efficiency under section 7(b). They are based on the measurement of expenditure transactions and have nothing to say about non-market values, except to the extent they pick up changes in expenditures on services ancillary to non-market activities (e.g. goods and services associated with unpriced recreation). They are usually structured as local economic studies, so they record as "gains" activity which is simply relocated into the area of study from places outside, and which from a wider regional or national perspective is a simple redistributional transfer with no net gain. Such studies also generally make no attempt to consider effects over time, or reconcile the impact on the economy of the large boost in activity caused by construction of a project and the following wind down of activity and relatively low impact of the project's operational phase.

5.16. There are also practical and theoretical limitations to such multiplier analyses, due to the inter-industry input-output tables on which they are based not being regularly updated by Statistics New Zealand, and because such multipliers do not account for constraints on input resources: all sectors in such models can expand their output in response to the initial stimulus of the new direct expenditure. In contrast in the real world, the larger the development the more likely it is to exhaust the local supply pool and encounter resource constraints that can only be alleviated by importing new resources or by bidding up their price in competition with other local businesses. The additional demand for inputs

like labour and land increases price and costs for all other sectors in the local economy. These price effects are known as "pecuniary externalities" which redistribute wealth between buyers and sellers and in themselves do not affect overall economic welfare, but they also cause reallocation of resources across sectors, which can be disruptive and result in real productivity losses in the economy.

5.17. Although GDP is commonly used as a measure of economic progress, there is also a long literature that recognises its limitations as a measure of well-being. A recent example was a review penned by two Nobel prize-winning economists for the French Government, which concluded that economic indicators drawn from the national accounts needed to give more emphasis to the level and distribution of income and consumption across the economy than the current focus on production, and also take into account non-market activities, including voluntary work, production in the home, and the state of nature and its depletion.[5] Another weakness of the GDP is the limited indication it gives of borrowing against the future, as became all too apparent in the debt-fuelled global financial crisis in recent years. For these reasons GDP and its associated indicators do not give reliable measures of the full economic effects of developments that use and deplete natural resources.

5.18. The technique that economists use for assessing the net effect of proposed policies or projects is cost benefit analysis (CBA), which allows consideration of both positive and negative impacts of the proposal. This is an

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[5] Report of the Commission on the Measurement of Economic Performance and Social Progress, By Amartya Sen, Joseph Stiglitz and Jean-Paul Fitoussi, 2009. http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf

adaptation of financial analysis from a community-wide perspective to identify whether a project's benefits exceed its costs, regardless of to whom they accrue. Such analysis looks beyond the perspective of the project proponent, and beyond the expenditures generated by such a project to examine the net return from the costs incurred across the whole community, encompassing the separable impacts on consumers, producers and on third parties ("externalities"). In my opinion it is particularly appropriate to the Act, as it is commonly described as "applied welfare analysis": it calculates net benefits as economic surpluses (value gained less cost of achieving it) that give rise to economic welfare or well-being, pertinent to the concerns of the Act's section 5; it can also enable conclusions to be drawn about economic efficiency from the relationship between benefits and costs, which in my view is relevant to the concepts to be considered in section 7(b) of the Act.

5.19. Assessing economic efficiency of a proposed course of action requires taking account of all its effects on resource use, not just those that are readily measurable through financial transactions. In the case of MHP, it requires weighing up the tangible net benefits of electricity generation and the intangible effects of the wider environmental impacts, and coming to a conclusion about their relative "worth". This cannot be avoided, for whatever decision is made about consenting the MHP implies an economic value for all the intangible or non-market effects that elude quantified analysis: if the consent is granted these effects are implicitly valued less than the quantified net benefit; if the consent is declined they are implicitly worth more. The difficulty for decision-makers is in how to assess such economic worth in the absence of ready value indicators such as those provided by market prices.

5.20. In assessing effects of a project CBA draws distinction between real resource effects which count in a welfare analysis, and what are known as pecuniary transfer effects which do not. Similarly economic literature on national accounting and the estimation of Gross Domestic Product (GDP) distinguishes between genuine growth-enhancing activity and so-called "defensive expenditures" which only serve to counter an adverse effect and maintain welfare at its pre-existing level. In the MHP, transfer effects occur in some of the price effects claimed as benefits, and defensive expenditures appear in the sea defence works proposed at Mokihinui township, which are largely to counteract effects on coastal erosion of sediment interruption caused by the MHP. The proposed "biodiversity offset" could also be viewed as defensive expenditure in the sense that it is designed to mitigate adverse effects of the MHP on biodiversity. But unlike the sea-wall the connection between cause and effect is more tenuous as the offset targets different habitats from those transformed by the dam, and defensive expenditure could be more clearly argued where the effects and the offset have clearly equivalent impact on well-being.

5.21. CBA also ignores taxes and other distributional transfers within the community. This includes local government rates, which Michael Copeland's evidence (paragraph 6.22) claims as a benefit of the MHP, because in occupying conservation land the project would bring that land from non-rateable Crown-owned status to rateable private status. However, this is not a real resource benefit. The same electricity would be generated regardless of the rating status of the land, and all that rateable status does is ensure a portion of the producer's surplus from generation is transferred to the local council. As rates are intended to collect funding for planned expenditures in a district,

bringing a valuable property into rateable status increases the district's rating base, allowing redistribution of funding liability across the district and easing the burden on other ratepayers, but this is purely a redistributional transfer with no overall effect on net national welfare. The same can be said of Meridian Energy's offer to contribute to a Buller Community Development Fund (Copeland, paragraph 6.24), which is another claim on the productive output of the MHP and a redistribution or transfer from other New Zealanders, not an additional real benefit in economic terms.

5.22. CBA proceeds by comparing the consequences of a proposed project or change against the "counter-factual" situation that would arise if it did not proceed. The framework for cost benefit analysis applicable to MHP consists of:

(a) Benefit of gains in electricity generation – valued at prices with tax and transfers removed or at the resource costs avoided by displacing higher cost electricity from the market

(b) Benefit of gains in transmission services – both the avoided electricity losses of long distance transmission and the variable component of transmission charges (but not the fixed cost component, which is simply transferred to other customers of the transmission grid)

(c) Benefit of energy security and reliability improvement – valued at the expected costs avoided from reduced incidence of outages

(d) Benefit of new services from the altered environment – principally recreation and tourism, but may also include pest control

(e) Cost of construction of the MHP – valued at current costs

(f) Cost of on-going operation and maintenance of MHP

(g) Cost of mitigation of environmental damage

(h) Cost of reduced services from the natural environment, including loss of settings for recreation, ecological communities and habitats for biodiversity, effects on water flows and sediment movements etc.

5.23. This last category (h) contains a variety of non-market effects which are both difficult to place a value on and uncertain in their scale and significance. Such analysis cannot give precise answers, and some economists do not attempt to include such effects because they weaken the apparent precision of the analysis. But all CBA depends on assumptions that are uncertain to some degree, and uncertainty is not a reason to exclude items from the analysis. The value of a CBA is not so much in the precision of its result but in its systematic ordering of relevant items for consideration. It is a decision-aiding tool rather than decision-making rule. And it is informative to include the value of all items as far as possible, even in the environmental area, as this gives some indication of the relative magnitude of effects and reduces the uncertainty around items that must be weighed against each other in other ways.

5.24. Some of these categories offset each other. For instance, gains in recreation opportunities created by MHP are set against losses of recreation opportunities arising from the inundation of the gorge. The critical point is that MHP, like any reservoir-based hydro scheme, only generates electricity by transforming a part of the natural environment and changing the characteristics of what that provides to community well-being. In my opinion that change in characteristics needs to be recognised and accounted for in an economic assessment of the hydro scheme that is as comprehensive as possible.

6. WORKINGS OF THE ELECTRICITY MARKET

6.1. The primary purpose of a hydro-electric power scheme is to supply generation to meet demand for electricity, and much of the evidence in support of the MHP application is oriented to extolling the benefits for this purpose. I agree with much of the evidence of Mr James Truesdale in providing a description of the operation of the electricity system and I do not wish to take up more time by repeating that description here, but I will highlight some key points for the analysis of the economic consequences of the MHP.

The significance of short run marginal costs and price

6.2. The first concerns the operation of the wholesale electricity market, the offering of generator bids to supply for half-hourly periods and the selection for despatch by the system operator, Transpower, of the bids that can meet demand in each location at the lowest cost in terms of both generation and the transmission costs. The system is designed to encourage generators to offer at their short run marginal cost (SRMC), an efficient price, so as to maximise their

chances of selection for despatch, but it pays all those selected the offer price required by the highest cost marginal generation plant. [6]

6.3. This means all plant despatched with a lower SRMC than the marginal plant earn a producer surplus – a payment greater than the amount necessary to cover their costs of supply. As economic welfare or well-being comprises both producer and consumer surpluses this is a relevant component of benefit, but it is one that accrues to the generators and owners – shareholders and taxpayers in the case of state owned enterprises – rather than to consumers served by that generation plant. Competition between all the West Coast generators will exert downward pressure on their offer bids to serve the West Coast loads, but as long as marginal supply is from higher cost generation transmitted in from outside the region, all local suppliers will earn a surplus from the higher price of that supply. If built, MHP would be the largest individual generation plant on the Coast and could at times swamp local demand, but as it will only be generating 10 MW for 35% of the time and has limited capacity to withhold water for storage, it will not be exerting downward pressure on prices all of the time.

6.4. It follows that it is easy to overstate or misrepresent the benefit of price changes from addition of new generation on the West Coast. Adding a low cost generator, such as a hydro plant, to the despatch stack should displace high cost generation at the margin, but in some circumstances this will have no effect on the marginal price. If, for instance, it simply reduces the volume dispatched by the marginal

[6] SRMC is the short run marginal cost, the variable cost of an additional unit of generation that would be saved if that generation did not occur. Existing generation plant can be profitably despatched whenever SRMC is less than the price they receive.

generator at the same high offer price the market price will not change, yet from a national perspective there is still a saving in resource costs from reducing that marginal generation, even though it is captured by generators, not consumers. (Appendix 2 of my evidence has further explanation).

6.5. Conversely, to the extent that new generation does drag the despatch stack down the supply curve to lower cost generation, the price reduction seen by consumers is also a price reduction for suppliers, and hence largely a transfer effect in which the gain in consumers' surplus is matched by the loss in producers' surplus with no net effect on overall welfare. The only exception to this is where the lowering of price to consumers encourages an increase in electricity consumption by moving it down the demand curve. There is a welfare gain on any additional volume of consumption in response to the change in price although as demand for electricity is generally not price responsive, the welfare gain will be very small relative to the transfer effect of price changes on existing consumption. This characteristic of the supply and demand for electricity is described graphically in the Appendix 2 to Mr Barry's evidence (to which I will return later).

6.6. If MHP were to be built, the choice for supplying West Coast demand would be between several local hydro plant, or between a local hydro plant and one at some distance away, the principal difference being the costs of transmission and associated losses. In that case local demand can be met at lower resource cost by the local generator, but claiming benefits from reduced prices and transmission savings would be double counting, as the price reduction is caused by the transmission saving. In practice the market is not so simple. Meridian Energy has commercial objectives and if MHP is built it will become a

prominent, if not a dominant, generator on the West Coast, with enough capacity to serve much of the region's demand at times for years to come. Knowing that its main rival volume suppliers are 500 kilometres or more away, it has incentive to lower its prices no more than necessary to price out this competition, or alternatively to withhold its volume offering to admit some higher cost generation at the margin to receive the higher marginal price. The wholesale electricity market is a repeated game that generators become adept at playing.

6.7. These characteristics mean that all claims of benefit from lower prices or resulting revenue gains from MHP are tainted by a mix of transfer effects and double counting with transmission savings. Prices and revenues can be unreliable indicators of welfare effects. An alternative measure of national welfare benefits that avoids these drawbacks would be to estimate the real resource costs savings from displacing higher cost generation at the margin, making due allowance for the loss of producer surplus on displaced generation that would be just inside the margin in the without-MHP case.

The significance of long run marginal costs

6.8. Whereas SRMC determines the competitiveness of existing plant to supply the market, it is not economic for new plant to be built until the expected price they receive will cover their long run marginal cost (LRMC), which comprises their SRMC plus the cost of capital. In general it is efficient for new generation to proceed by selecting plant with the lowest LRMC, but this is not always the case. At times of relatively low demand growth, as has prevailed in New Zealand in recent years, there is more risk in committing to new large plant than smaller plant, so smaller less expensive plant with higher LRMC may be preferred over

larger plant with lower LRMC. The roll-out of new plant is guided by more than simplified LRMC criteria, for instance risk and affordability considerations for individual generators or developers.

6.9. In his evidence for Meridian Energy, Mr Cox claims that MHP's development will defer the construction of other higher priced schemes and help lower the national cost of new generation, as MHP has a LRMC at the lower end of the national range of potential new generation (paragraph 3.4). LRMC for MHP is variously estimated to be $89-93/MWh by Meridian Energy, $88/MWh in Mr Barry's evidence, and $91/MWh from the 2010 LRMC model of the Ministry of Economic Development (MED) that specifies a slightly smaller MHP of 85 MW and 372 GWh output per year.[7] With reference to the MED model he then compares MHP's LRMC against those of other plant in the West Coast/top of the South Island region to conclude that the MHP is the only scheme in the region that has an LRMC with a compelling case for immediate construction (paragraph 3.5). Moreover, he claims that on the basis of his analysis of these schemes, other already consented schemes would not be economic to build in the near future: in particular, the Wairau scheme would not be economic until 2034, and the Arnold enhancement and Stockton schemes would not be economic until 2040.

6.10. While the general proposition that MHP should defer the date of building other higher cost new generation is sound, little reliance can be placed on Mr Cox's conclusions drawn from analysis of the MED's LRMC model. This

[7] Estimates of LRMC will vary with changes in the assumptions about total capital costs, the length of time over which capital is to be recovered, the discount rate applied to that capital, and the GWh generated by the plant.

model is intended to assist the Ministry in forecasting the likely timing and future mix of generation types for new construction, but it is not designed to be used to make comparisons between individual plant. It is inappropriate to use it in the way Mr Cox does to pick winners on the basis of LRMC. Put simply, the model is an abstraction from reality with a number of simplifying assumptions and standard inputs and it is not up to the job of comparing individual plant. The MED model lists a number of prospective new plant with their costs, outputs and LRMC, but some of these are described as "generic wind" or "generic hydro", and while others are named after particular real projects, their details do not necessarily correspond to those given out by the actual schemes' developers. This is clear with respect to the MHP itself: the MED model has it achieving 50% of utilisation (the expected annual generation divided by potential annual generation) whereas Meridian's own expected output achieves only 44% utilisation, a reflection of the rather "flashy" hydrology of the Mokihinui with its wide variation between low flows and floods. The model cannot be relied upon to give predictions of which new plant will be economic to build and when, given these characteristics and the fact that decisions to proceed are made by commercial companies according to their own strategic and financial considerations.[8]

[8] Reliance on the MED's LRMC model is further complicated by the fact that the model was revised in 2011 and now shows MHP of 100 MW having LRMC of $77/MWh which, if correct, would be one of the lowest LRMC's in the new generation list. On close inspection the drop in LRMC is caused by forcing 50% utilisation on MHP (giving it annual output of over 430 GWh), and using slightly different construction costs and lower operating costs than given in Meridian's evidence.

6.11. The principle of new plant not being built until expected prices rise high enough to cover their LRMC is nevertheless still valid, and companies' own assessments of the LRMC of their prospective plant are important considerations in their choice of timing and location for new generation plant. However, from a national perspective those timing and location decisions will be inefficient if they are driven by LRMC calculations that omit components of societal cost, such as environmental externalities. In the cost inputs into LRMC calculations, for instance, it is rarely possible to isolate a component value for land occupied by the plant, or draw distinction between sites with conservation or other public values from those that have none. From a national perspective, in choosing between two identical plant, one located on a site with particular conservation value and another on a site without it, the economic choice would be to choose the option with the lower social cost for the same level of output which, other things being equal, would not be the site with conservation value. Such considerations do not enter into LRMC or other market indicators of plant prioritisation, and reliance on those indicators needs to be qualified as a result. Developers will not make effective location decisions from society's viewpoint if relying on LRMC calculations that only consider some values and systematically exclude others.

Options and alternatives to the MHP

6.12. If built, the MHP would add about 1% to the current stock of national installed generation capacity, and about 0.9% to the current annual generation of GWh.[9] At 100 MW

[9] Compared to figures in Ministry of Economic Development (2011) *Energy Data File*, Table G.2.d.

capacity it is a moderately sized plant, and there are a number of wind farms seeking consent around the country of two to three times that capacity with a similar level of utilisation (e.g. three such large wind farms are proposed for the northern Wairarapa at Castle Hill, Waitahora and Puketoi). These characteristics suggest that, although MHP will be a significant addition to the electricity system on the West Coast, and is likely to export power from that region at times, it is not particularly significant at a national level. There are many other potential plant that could be built, better located close to major load centres or the main transmission lines, to deal with national electricity demand.

6.13. This is clear from the MED's LRMC model, which lists an extensive array of potential generation prospects that could be alternatives to MHP. It is not exhaustive, as not all plant that are currently seeking consent are included in the list. It is also evident in the Generation Expansion Model (GEM) used by the Electricity Authority and the former Electricity Commission to prepare forecast scenarios for its *Statement of Opportunities* publication. My modelling colleagues at NZIER obtained an electronic version of this model to look at the mix and cost of new generation build with and without MHP included in the list of potential plant. Looking at plant expansion over a 30 year period to 2040, the model showed very little change between the with and without MHP model runs: the "with MHP" run was actually slightly more expensive than the without MHP run which had more build of cheaper gas peaker plant, but not by a significant amount over the 30 year period. As with the MED's LRMC model, there is a risk in reading too much into the results for individual plant in this model, but

it does suggest the presumed benefit of MHP deferring higher cost generation is no more than minor.[10]

6.14. There are other options for meeting future electricity demands on the West Coast that do not require building MHP in an unmodified river valley. As explained in the evidence of Mr Heaps, these include several other proposals for new generation plant on the Coast and building additional transmission infrastructure to increase robustness of links to other regions. The government's 2011 *Energy Strategy* also makes reference to supporting "distributed generation", which means enabling more localised generation, co-generation or even household generation units selling their surplus generation into the market. None of the applicant's witnesses take an overarching view of electricity demand needs and the various ways they could be met, and the evidence tends to be skewed as a result.

Economic benefits for the West Coast

6.15. The claimed economic benefits for the West Coast include the impacts of expenditures on construction and operation as described in Mr Copeland's evidence, and claims of lower power prices and greater energy security from reduced risk of disruption of transmission from outside the region (Mr Truesdale's evidence, paragraph 3.5). If security is measured in having local generation capacity to

[10] Another caveat on these results is that the model run at NZIER gave results close but not exactly the same as in the Statement of Opportunities forecasts; and when we sent our model and its input specifications to the EA they got a different set of results as well. This divergence in results cannot be explained by differences in model and data, but may be attributable to differences in computer processing speeds which in such optimisation models create small variations that compound to a noticeable difference in final results when running the same model on different machines.

meet regional demands in the event of a disruption in the transmission links, one large generation plant that can be taken out by a single event is less secure than two smaller ones which are less likely to be taken off-line simultaneously. Transpower's prioritisation of its grid upgrades, which emphasises maintaining supply security, will be little changed by provision of one plant, however large, in meeting its requirement to maintain the integrity and security of transmission into the West Coast. This is explained at greater length in Mr Heaps' evidence.

6.16. The characteristics of generation on the West Coast at the extremity of the national transmission grid also cast doubt on the claims of Mr Copeland, Mr Baines and Mr Truesdale that the MHP's benefits would be "additive" to those of other West Coast generation schemes. While it may add some benefits to those provided by existing generation plant in the region, it is also likely to preclude some new prospective plant and in some respects detract from the benefits that these others would provide (such as the resilience and security and reduction of risk of single-plant failure). If MHP is run in a way that lowers wholesale power prices on the coast, it reduces the profitability and likelihood of other new generation being built on the Coast, with the possibility of curtailing competition and forgoing building new plant that may be better placed to meet localised demands. This is because it would relieve the constraint created by transmission distance that local generators can currently exploit to gain higher prices, so any new generation will face much more risk in earning a return with such a large competitor next door.

6.17. So, far from encouraging more competition in generation, MHP would create conditions that will deter further investment in new generation. This is not just a "trade competition" effect to be disregarded under the Act's

section 104(3)(a): competition would be enhanced by a large number of electricity retailers with access to a wide number of different generators and wholesale suppliers, which include not just plant operated by the large vertically integrated generator-retailers but also those run by smaller retailers embedded in local lines networks. The building of such smaller, embedded plant will also be deterred by the effect on the market in the West Coast of such a large single plant. The barriers to increasing competition in the West Coast erected by such a large addition to the local generation mix call into question the presumption by the Applicant's witnesses that MHP would significantly lower wholesale electricity prices in the region and that these would be translated into lower retail prices. The attraction of investing in new generation in the West Coast is largely driven by the opportunity for earning larger producer surplus than in other parts of the country, and it is in Meridian's producer surplus that I would expect most benefits to accrue.

7. THE ECONOMIC VALUE OF MHP TO THE NATION

7.1. Two of the Applicant's witnesses explicitly address the economic value of the MHP beyond the workings of the electricity market. Mr Michael Copeland explicitly states that the appropriate community viewpoints to consider are those of the Buller District and West Coast region (paragraph 4.7) and he presents an outline of economic impacts in terms of additional expenditures and jobs brought into the region by the MHP, plus the indirect impacts on other sectors in the economy as estimated through economic multipliers. He assumes that economies of scale, increased competition and increased capacity

utilisation will occur and be associated with improvements in economic efficiency (paragraph 4.5) and he further claims that increased economic activity will help retain the local population base in the district and contribute to reduced unemployment and under-employment of resources, and improvements to, or retention of, central government services in the region (paragraph 3.5). That would be an impressive achievement if it were true, but as explained in my paragraphs 5.14-5.18 above, the technique he uses is not the right one to demonstrate if that is the case. Using the economic impact approach provides no way of assessing efficiency of the MHP at either the regional or national level and the expenditure gains in the region are primarily a redistribution of resources that could have been deployed in other locations, quite possibly to better effect than at MHP. Clearly the region will benefit from the added expenditure there, but that is not an indication of whether using the resources there is an efficient and valuable use for the nation.

7.2. Societal cost benefit analysis is the appropriate analytical technique for assessing the national value of the proposed MHP. This is because:

(a) It allows conclusions to be drawn about the efficiency of resource use

(b) It is usually undertaken from a national perspective and avoids mutually offsetting redistribution and transfer effects that obscure local analyses

(c) It is explicitly focused on economic welfare or well-being, and the economic surpluses generated by different types of activity.

7.3. In his evidence prepared for the applicant Mr Philip Barry describes a national CBA of the benefits and costs of MHP over a 70 year project life-span, on the assumption the project would be commissioned in 2019. Discounted to present values at a real rate of 8.5% per year, this results in a net present value of $64 million. He tests the sensitivity of results to changes in some of his key assumptions and concludes that none of these tests changes the result sufficiently to overturn his central estimate of a net benefit to a net cost. A number of these tests result in enlargement of his estimated net benefit.

7.4. The benefits in Mr Barry's analysis are identified as:

(a) The electricity generated by the MHP, valued as a revenue stream worth $289 million in present value terms

(b) Savings in transmission losses in serving West Coast electricity demands, with a present value of $21 million

(c) Benefits to consumers from lower prices with present value of $70 million.

7.5. The costs in Mr Barry's analysis are identified as:

(a) Construction costs with a present value of $203 million[11]

(b) Operating and maintenance costs with a present value of $24 million

[11] Although in his paragraphs 6.5 and 7.6 construction costs are cited as $309 million, his evidence calculates costs and benefits in present value terms from the viewpoint of 2011, so construction costs phased over 2016-2019 are discounted back to a present value that is substantially smaller than the commonly quoted figure of construction cost.

(c) Costs of environmental mitigation with a present value of $19 million

(d) Revenue forgone by suppliers with a present value of $70 million.

7.6. Compared to the framework I outlined in paragraph 43 above, this is a somewhat truncated analysis, with only two categories of benefit and three of cost once the mutually offsetting transfer effects of reductions in consumer prices and producer revenues are removed (items 7.4(c) and 7.4(d) above). Even though the benefit stream is only possible with the appropriation for use of an area of public conservation land and other publicly owned land, there is no place in this analysis for non-market effects associated with ecosystem services from current and future uses of the land. Mr Barry acknowledges the limitations of his approach when he states in his paragraph 3.4 that he cannot determine conclusively through his national cost benefit analysis whether MHP is net beneficial. However, he qualifies that limitation by expecting significant non-monetary benefit from the proposed Biodiversity Enhancement Area and protection to Mokihinui township from the sea wall (paragraph 3.4). Both those measures are defensive expenditures intended to counter the adverse effects that would be caused by MHP, and in the case of the Biodiversity Enhancement Area in particular, which deviates substantially from a like-for-like offset arrangement, the enhancement is unlikely to fully offset the economic cost of ecological services lost under MHP, in view of the evidence of Dr van Meeuwen-Dijgraaf.

7.7. In his paragraph 9.3 Mr Barry explains that in the absence of reliable estimates of monetary values of non-market effects, the practical alternative is to rely on relevant experts to advise the Court on the nature and significance

of these effects, and for the Court to determine the weight to apply to these effects. He does state, however, that on the basis of his central analysis, the non-market values of the Mokihinui valley would need to be at least $64 million in present value terms (or more under some alternative assumptions) for retention of the unmodified valley to outweigh the net benefit of the MHP. That may be a pragmatic approach but it does not assist the Court in assessing the economic choice before it, of conserving a hitherto unmodified valley or consenting to its development and transformation.

7.8. I will return to the likely value of non-market effects later in my evidence. First, however, I would point out a number of peculiarities of Mr Barry's analysis.

(a) In this analysis the $70 million benefit of lower electricity prices to consumers is exactly offset by the revenue forgone by electricity suppliers, which means it is a transfer effect with no consequence for total economic well-being or assessing resource use efficiency

(b) In his evidence paragraph 7.19 Mr Barry states the principal reason why MHP is expected to lower prices on the West Coast is reduced transmission losses, so there is an element of double counting in enumerating both prices and transmission loss avoidance as benefits

(c) The comparison of MHP's revenue with its costs may be appropriate for a private company analysis of the project's net present value, but it is problematic for a national cost benefit analysis because revenue streams

include some redistribution between suppliers and are not wholly attributable to productivity gains, hence their use overstates the national value of benefits

(d) The use of an 8.5% discount rate, which Mr Barry suggests is an appropriate rate for a company investing in MHP, also implies he is taking a private sector perspective rather than a public sector perspective that is more appropriate for dealing with the externalities in a resource management setting. The public sector discount rate recommended by the Treasury for use on infrastructure projects is currently 8% which, Mr Barry states, would raise the NPV over 70 years from $64 million to $86 million.

7.9. Mr Barry's evidence, therefore, does not seem to be wholly aligned with the public perspective of externalities and the consequence of converting a public resource to hydro-electricity generation. This is particularly troubling over the treatment of price changes, which Mr Barry and other witnesses for Meridian claim to be a significant part of the benefit of MHP. Another problematic aspect of his analysis is the relative estimate of benefit to producers and consumers, given that MHP will only proceed and be an efficient use of Meridian's private resources if it captures sufficient producer surplus to cover its capital and fixed costs. Without a substantial increase in producer surplus, Meridian Energy could not justify proceeding with MHP because it could not recover the fixed capital costs that form part of its long run marginal cost.

7.10. The size of Mr Barry's estimated consumer surplus gain relative to the producer surplus changes is also problematic,

because on his own evidence (Appendix 2) consumer demand for electricity is not particularly price responsive – the measure of price response, the price elasticity of demand is -0.15, meaning that it would take a 10% reduction in price to obtain a 1.5% increase in quantity consumed. Although some other witnesses have suggested West Coast prices are 10% above those elsewhere [Mr Westergaard] and Mr Truesdale estimates wholesale prices in 2019 could be 7% lower on the West Coast and 2% lower in the upper South Island on average after the building of MHP, it is unlikely that a single plant installed on the West Coast without substantial local competition would result in such large price reductions.

7.11. I would expect the predominant benefit of inserting any low cost generator to be a gain in producer surplus for the new generator, for reasons explained earlier in my description of the wholesale electricity market and further elaborated in Appendix 2 of my evidence. This is the opposite of the result in Mr Barry's Appendix 2, in which consumers gain a present value of $70 and a net producer surplus loss of $6 million to arrive at his net present value of $64 million. This result needs more explanation and a reconciliation with the summary results in Mr Barry's evidence at Table 3, as MHP has the capacity to supply over 80% of West Coast average consumption at present and it should be able to gain substantial producer surplus from its position in the regional electricity market.

The role of biodiversity offsets in considering the economic effects of MHP

7.12. The MHP is proposed to have an offset scheme to provide enhanced predator and pest control, as described in the evidence of Dr David Norton. This would cover 35,500 hectares of the South Branch of the Mokihinui River above

the Forks, with specific guarantees for implementing the control over the entire duration of the consent. Much of this Biodiversity Enhancement Area (BEA) coincides with an area identified by DOC as a priority site for integrated biodiversity management, but currently it is only able to apply possum control over 1900 hectares. Dr Norton claims this will enable the BEA to provide a conservation enhancement.

7.13. Biodiversity offsets have potential in overcoming the impasse that can arise between development of a site and its preservation in its current uses. The concept is beguilingly simple: find another site that can be restored or enhanced to equivalent biodiversity value elsewhere and the development can proceed with no net loss to biodiversity. In principle it may even be possible to "trade up" with an offset that is worth much more than the site being developed, which in economic terms means you get more conservation gain per dollar invested in it. This would require offsetting damage to a relatively abundant habitat-type by restoring or enhancing a much rarer site of higher conservation distinction, thus reducing the probability of components of biodiversity disappearing. The international Business Biodiversity Offsets Programme (which is guiding development of similar measures in New Zealand) is developing processes to facilitate such offsets, and a number of offsets have been put in place, apparently with some success.[12] In practice, however, the critical issue is in determining the "equivalent value" for conservation between the offset and the area being developed, which becomes increasingly difficult in moving away from an offset that closely resembles the site being developed.

[12] http://bbop.forest-trends.org/

7.14. I understand from the evidence of Dr John Leathwick that the Mokihinui River has a conservation ranking within the top 20% of New Zealand's large river systems. The MHP would profoundly alter the flow regime below the dam, create significant long term ecological damage by disrupting movement of native migratory fish, as well as inundate an area of diverse lowland forests and their established habitats. Dr Leathwick regards the offset proposal as inadequate compensation for the impact of the MHP, as it largely ignores the negative impacts on freshwater systems in the valley, makes inappropriate comparison of ecological qualities between forests in the impacted and offset areas, and provides for a relatively simplistic management regime of increased pest control to maximise the likelihood of a successful outcome for the offset area.

7.15. I also understand from the evidence of Dr Astrid van Meeuwen-Dijkgraaf that the Mokihinui valley has some ecological components that only occur within the project area and nowhere else in the country, which would confer scarcity value and a high priority for protection to reduce the probability of these components' loss. She finds the proposed BEA fails several of the criteria for best practice offset selection and design and questions Meridian's reliance on legal conservation protection status as a surrogate for conservation value, concluding that the ecological characteristics of the Mokihinui valley require that such developments as MHP should avoid it altogether.

7.16. Aside from the ecological question of whether an offset can be successful, in economic terms the aim of an offset is to leave the community at least welfare-neutral, if not better off, between the development and offset proceeding or not. In other words, the ecological services from the offset area which are additional to what the area would otherwise

provide, should provide at least as much welfare for the community as the net loss of welfare from the area being transformed by development. Viewed this way, offsets are welfare-maintaining defensive expenditures rather than welfare enhancing expenditures and they should not be viewed as additional benefits of MHP without explicit recognition of their shadow caused by the damage they are intended to redress.

The economics of restoring the Mokihinui River

7.17. In his evidence Mr Westergaard states that construction of MHP need not mean the Mokihinui River will be subject to permanent control [paragraphs 22 and 114]. Without citing specific examples or sources he claims that evidence from the United States highlights the opportunity for successful restoration of river systems following the removal of hydro dams at the end of their economic lives. I have seen no provision made for restoration in Meridian's evidence, its national CBA or its LRMC comparisons, and even if it were there it would make little difference to the economic assessment.

7.18. There certainly is a growing trend in dam removal in USA and other countries, as old dams reach the end of their economic lives, silt up and become less efficient, weaken and become a safety hazard. Faced with costly refurbishing of dams, their owners may choose decommissioning as a more cost effective option. Some environmental organizations have taken the opportunity to actively promote reinstating rivers, but restoration of what was there before the dam was built requires more than just removing dam structures.

7.19. Without claiming any particular expertise, I have observed that when a dam inundates a valley, all terrestrial

communities in the flooded area are destroyed, water entering the reservoir loses velocity and drops its load of sediment on the floor of the reservoir, obliterating the existing surface features in the valley. As illustrated near my home in Wellington, where an old water supply reservoir in a formerly forest filled valley in what is now the Zealandia Wildlife Sanctuary was decommissioned about 20 years ago, the lake-bed that was exposed was deep mud, and has only slowly been colonised by terrestrial vegetation.

7.20. From an economic perspective, although rivers may be reinstated, it takes far longer for ecological conditions to be restored to what they were, if they can be fully restored at all. That is a question for ecologists to address. In the case of the future decommissioning of the MHP this would occur beyond the dam's 70 year expected economic life. In an economic analysis of present values for aiding decisions now, any future benefit of such restoration of the MHP would be negligible due to discounting for time and the risk that restoration is not 100% successful. Until such time as the river was restored, people would be deprived of the ecosystem services of the natural river, although receiving some different services from the modified reservoir environment.

7.21. In practical terms and meaningful human time-frames, damming the Mokihinui would be a once-only irreversible event. That irreversibility means that the Mokihinui River, as an unmodified river reflecting natural processes, is a finite natural resource. While the river may continue to flow as long as rain falls on the West Coast, many of the river's attributes are lost forever with the transformation of the dammed section from river to reservoir. A long established principle in natural resource economics is that utilisation of a finite resource creates an opportunity cost

from the loss of its future availability, and resource rental and royalty schemes have been proposed to recover part of that opportunity cost from the users of such resources and slow down the rate at which they are depleted.

7.22. This does not mean that it is never economically worthwhile to utilise natural resources or transform natural environments, without which human development would be very much constrained. But it does mean consideration needs to be given to the opportunity cost of transformation, and in particular to the availability of ready substitutes for what is to be gained or lost from such transformation, as this affects the relative value of the resource in its natural or developed state. Notwithstanding the provision for proposed offsets, community funding and other offers by Meridian to sweeten the adverse impacts on a local natural resource, nothing in the evidence points to a serious assessment of this user cost for once only transformation of this non-renewable resource of an unmodified river valley.

8. REBUTTAL OF MERIDIAN'S EXPERT WITNESSES

8.1. Several other witnesses for the applicant present evidence with economic implications, without necessarily explicitly linking to the economic evidence. I will briefly review these in the paragraphs below.

8.2. The evidence of Mr Eldred describes how Meridian selected Mokihinui from a range of 128 prospective hydro-sites, screening out those that were too small, rendered non-viable by transmission constraints or those with a National Water Conservation Order or other high conservation classification. Having pre-determined they were only interested in large scale hydro-development (greater than 25MW), Mokihinui was the only remaining prospect that looked viable. That selection was also predicated on the assumption that the Mokihinui valley, being on DOC stewardship land, had low conservation interest, but that view is refuted in Dr Leathwick's (and others') evidence of current ecological conditions in the valley. The company's economic assessment and choice were, in other words, constrained by its preference for large schemes and a misjudgement of the conservation value attached to the valley.

8.3. Mr Cox's evidence states that the only generation options for the West Coast are wind and hydro-generation, that wind is intermittent and that MHP is the only substantial hydro option available. He paints a picture of local deficit in ability to generate locally to meet total consumption and to meet peak demands, and notes that the LRMC of hydro-generation will not change materially while that of thermal generation is likely to increase in face of fuel constraints and emissions costs under the emissions trading scheme.

That may be true for now, although it depends on water continuing to be available as a "free fuel" for hydro plant, a proposition that is being challenged in some catchments where extractive water uses (such as irrigation or industrial uses) may obtain much higher value from water than hydro-generation, and where competition for water could lead to more explicitly valuing and trading entitlements. Despite its economies of scale and favourable LRMC, MHP is expected to achieve a lower utilisation factor than any other hydro plant identified in Mr Cox's evidence, reflecting the Mokihinui's variable flow that results in the MHP's output using only 10% of its capacity for over a third of the time.[13] In that sense it is not the most technically efficient generation option compared to other smaller prospects on the West Coast.

8.4. Mr Westergaard (paragraph 34) claims that the positive relationship between infrastructure investment and economic activity is compelling justification for continued infrastructure development, while Mr Godfrey (paragraph 10.2) claims that any new power station in the Upper South Island will have a positive effect on reducing grid dependency and electricity prices in the South Island. The rider that both omit is that those general prescriptions do not mean generation at any cost, and to be efficient generation plant must be shown to have expected benefits greater than costs. Basing conclusion on a frame of analysis focused on electricity that defines out of consideration alternative uses of a project's fundamental land and natural

[13] If MHP averages 386 GWh from 100 MW its utilisation factor is 44%; the Arnold scheme's 201 GWh from 46 MW has utilisation of 50%; the new Wairau scheme's 320 GWh from 65 MW has utilisation of 55%; and the existing Cobb scheme's 192 GWh from 32 MW has utilisation of 68%.

resource inputs is not, in my opinion, a sound approach to ensuring the project is consistent with the Act.

8.5. Mr Baines cites Dr Hicks that the dam would interrupt the flow of sediment down the river and its transport to and deposition along the coast, creating a likelihood of accelerated erosion around the Mokihinui settlement. The natural river flow delivers a contribution to coastal protection services that would be curtailed by MHP, which Meridian proposes to mitigate by building artificial protection works against the erosion. In economic terms this is a "defensive expenditure", one which serves to maintain (rather than enhance) welfare against deterioration caused by the project. However, Mr Baines, Mr Copeland and others refer to this coastal protection as a benefit to the local community, citing Mr Reinen-Hamill's claim that storm surge incursion on the coast is likely in 10-20 years in any case, implying that coastal protection would be necessary even in the absence of MHP. With respect, this is missing the point. Coastal protection will be economically worthwhile if the value at risk to properties from inundation is greater than the cost of feasible protection works, and if the community is willing to pay for this to be done. In the absence of a clear plan to provide and fund such works, or an assessment of the value at risk against cost of protection, it is not clear how much the community values such works, or whether they will be economically net beneficial. No doubt it can be perceived as a local benefit that the owners of affected properties get the protection work provided and paid for by someone else, in this case the owners and customers of Meridian Energy who are spread nationwide and will not notice the impact on profits and prices. And no doubt Meridian Energy considers this a small price worth paying for local support to secure the much larger revenue streams that it expects

from the building of MHP. But from a national perspective this is an expenditure funded by transfers with no evidence to suggest it has a positive effect on total welfare.

8.6. Another environmental effect that can be clearly fitted into an ecosystems service framework is recreation and tourism. Mr Greenaway estimates current use of the Mokihinui valley to be 5,250 visitor days per year, 70% of them engaged in whitebaiting and 60% of the total originating from West Coast residents. He forecasts an incremental rise in total visitor days of 4,880 likely to occur without MHP but with development of a new national cycleway in the valley, and a further increment if MHP proceeds and augments the track access opportunities, of 4,837 visitor days per year. In his social impact report, Mr Baines claims this would be a very significant increase in opportunities for leisure and recreation on the West Coast, and in his summary (paragraph 12.4) claims this is the most significant benefit to social well-being to arise from building the MHP, exceeding the benefit to electricity supply and prices.

8.7. If they occur these gains over present levels would be impressive – 189% increase in total visitation, 1,789% increase in visitors engaged in activities other than whitebaiting and angling – but strong caveats need to be attached to these numbers. Even assuming the forecast increases are realised, there is nothing in the evidence to identify whether the increase is new recreational activity or activity relocated from elsewhere. As people have constrained budgets and cannot expand their recreation time indefinitely, it is quite likely much of this growth will be activity transferred from other locations, reducing the net gain of the MHP-related facilities. It is simplistic to describe net recreation change, as Mr Copeland does, as just the difference between expected increase in recreation

with MHP and the loss of current recreation in the affected area, as this ignores the relocation of activity from other parts of the region and suggests the different activities are more readily substitutable than they are. Within the raw numbers there is the displacement of some activities (such as white water rafting and kayaking) and transformation of others (such as tramping to trail walking, river angling to lake fishing) so that some people lose out while others gain. This reflects the fact that the current access to the area attracts a different type of visitor from the more developed tracks likely if MHP is developed. Whether this is an efficient use of natural resources depends on the relative value of the different activities and the availability of alternative opportunities for them to take place. It also depends on the reputational effects on tourism and New Zealand's clean green image of such large power developments encroaching on natural areas.

8.8. Mr Baines states the current low use of the Mokihinui valley is largely a reflection of poor accessibility, but this is countered in Mr Ian Wightwick's evidence, which describes the current access track into the Mokihinui valley as of a good standard for most of its length. In any case, low use is not necessarily a sign of low value. The visitors to a site with low accessibility often attach a much higher value to visits to such places than casual visitors to more accessible places, as reflected in the greater effort and expenditure they incur on their visits – greater time and cost in getting there, greater preparation cost in acquiring the gear, fitness and skills necessary to visit them comfortably. This is not to say that the 500 or so annual visitors currently estimated to go to the gorge area for tramping, hunting, angling or rafting are immensely valuable but rather that the applicant's witnesses have not presented a credible comparison. The net recreational gain

from MHP is the non-relocated proportion of 4,830 valued at a low casual visitor rate, to be compared against the 500 or so (perhaps more in future as unmodified rivers become scarcer), valued at a higher unit rate, who would lose their current opportunity of visiting the unmodified river and gorge.

8.9. Those relative values of different types of activity also need to be considered in light of the availability of substitutes for the site and alternative opportunities for recreation in the region. It may appear that there are enough forest filled valleys in the West Coast for there to be plenty of substitutes for the Mokihinui Gorge, but varying use patterns across areas of similar terrain suggest that visitors are more subtly discerning than that. The Mokihinui's characteristics as an accessible yet unmodified river adjacent to an ecological area and adjoining Kahurangi National Park are distinctive and cannot be readily replicated in many other locations, raising the prospect of real and unresolved welfare loss for those displaced by the MHP. According to Mr Wightwick's evidence, the historic pack track that would be partially submerged by the reservoir is part of the attraction of the area, adding loss of cultural heritage to loss of natural heritage arising from the proposal. The river provides a varied whitewater experience accessible to rafters and kayakers of moderate ability, and it is also known as a high quality brown trout fishery. The area is currently managed as a remote experience zone, with similar experiences to statutory wilderness areas and the low level of recreational use reflects the lack of promotion in keeping with that management objective. Mr Wightwick states that there are no real substitutes for the variety of characteristics in the Mokihinui valley – historic, geologic, vegetative – anywhere on the West Coast, and the increasing

accessibility posed by access roads and power boating across the MHP reservoir would fundamentally transform the role of the Mokihinui area in the regional and national conservation estate. While it is difficult to put precise dollar values on the recreation opportunities of the current valley, it has all the characteristics – scarcity, lack of substitutes, naturalness – that suggest its economic value will be high and growing higher over time, compared to the recreation attraction of an artificial reservoir. None of the evidence of the applicant's witnesses addresses these issues.

8.10. Countering the view of the applicant's witnesses that MHP is necessary for providing new generation, Mr Heaps' evidence notes that there is currently a considerable overhang of new generation plant consented or seeking consent, but relatively few are currently being built in view of the recent slow-down in demand growth. The Government's recent energy strategies and other policies with respect to climate change emissions have had an emphasis on renewable energy for some years now, so power companies wanting opportunities to expand generation in future have been staking claims to different parts of the country with favourable wind, hydro- or geothermal potential. There are substantial costs in establishing these claims – technical feasibility studies, landowner agreements, consenting – but without them companies may be left with restricted options for future development. Hence there are many more sites being consented than are likely to be built within the lapse periods of the current consents.

8.11. Such an excess of consents over likely built capacity can be efficient for companies, because it gives them options for choosing their next plant to build according to which is most advantageous at the time. But the cumulative effect of

different companies doing this can involve substantial cost on local planning processes and it may create a form of planning blight, where consents granted but not used deter other investments in a resource that may or may not have a generation plant built over it. The uncertainty caused by such an overhang also means that the probability of benefits claimed for such proposed projects being realised is less than 1, depending on each plant's likelihood of being built. Added to the other issues raised in my evidence with the applicant's economic evidence, its omission of environmental effects and assumptions of electricity demand growth, this leads me to the opinion that the quantified results of that economic analysis should be viewed as significantly overstated.

9. CONCLUSIONS

9.1. In this evidence I have outlined my opinion and understanding of how an appropriate economic analysis can assist decision-making in the circumstances of this case. I have discussed my opinion of the appropriate methods and framework for considering efficiency and well-being under the Act and examined the evidence for the applicant within that framework. The fundamental issue raised by the MHP application is not whether it would be a good investment for electricity generation, which is a private concern to be decided by Meridian Energy. The high level national benefit question is whether the MHP is consistent with sustainable management of physical and environmental resources, which in economic terms can be restated as a question of whether community well-being and resource use efficiency would be best served by the Mokihinui valley being transformed by the construction of a dam,

reservoir and associated works, or by retaining it in its current unmodified state?

9.2. The appropriate economic technique to apply to this question is cost benefit analysis, which can assist in framing and clarifying the pros and cons of the different options. But it cannot provide consistent values for all the effects and is more of a decision support tool than a decision rule. Uncertainty around the scale and consequence of environmental effects makes economic valuation problematic, but such effects can still be reflected qualitatively in an economic assessment to consider the effects of scarcity, substitution, and changing values over time.

9.3. The fundamental economic question raised by the MHP proposal is whether the value to the nation of the Mokihinui valley's largely non-market services would exceed the more readily quantifiable value of MHP as a source of electricity generation? It is difficult to say on the available evidence, as witnesses for the applicant have scarcely acknowledged the wider economic dimension to the choice faced over the use of the valley and give no sense of how scarce and valuable are the ecological services that would be destroyed by the building of the MHP. Mr Barry's evidence comes closest in estimating a quantifiable net present value of $64 million over 70 years for the MHP, and arguing that the non-market values would need to be bigger than that for it to be efficient not to proceed with the project. Annualised over 70 years and at the same discount rate Mr Barry uses, that amounts to about $5.5 million per year, which may appear a rather large sum relative to average conservation expenditures on other areas. But as I explain earlier his estimates are suspect and also reflect excessive optimism on the assumed growth of demand in the long term. As explained in the

evidence of Mr Heaps, electricity growth forecasts for the West Coast and New Zealand as a whole have been reduced recently, which would lower not just the demand to be met by MHP but also the national benefits from avoiding transmission losses.

9.4. Non-market values are not zero and they are likely to rise over time, as natural resources such as the Mokihinui River become scarcer relative to more readily reproducible goods such as electricity. I have shown that the applicant's economic evidence has ignored this aspect of the benefit of retaining Mokihinui in an undammed state. The applicant's case for MHP rests on:

(a) The need to meet growth in West Coast electricity demand, the forecasts of which are open to question

(b) The benefit in securing local supply against the risks of failures in long distance transmission (which is also questionable relative to possible alternatives, such as multiple smaller new generation plant distributed across the region)

(c) The benefit of reducing current and likely appreciating electricity prices on the West Coast.

9.5. The applicant has also claimed that MHP would be an efficient option for building new generation, and compared its likely LRMC with those of other plant on the West Coast and the top of the South Island. But the LRMC estimates it uses are not suited to comparing individual plant, and they are systematically understated by the exclusion of consideration of the non-market effects of ecosystem services. Were such services taken into account,

the LRMC of MHP would rise relative to other potential new generation plant that are not dependent on occupying areas with exceptional ecological characteristics. The annualised value of the Mokihinui's non-market services would not need to be $5.5 million per year to push MHP back on the priority ranking for next generation plant to build.

9.6. If the decision is to consent MHP today and the scheme proceeds, for practical purposes that is an irreversible change and its environmental qualities and ecosystem services will not be restored in the lifetimes of anyone involved in that decision. If the decision is not to consent MHP today, the hydro potential does not disappear and the country retains the option of extracting energy from the river at some point in the future, perhaps with a different design or more efficient generation plant with less environmental footprint. Economics and technologies are changing all the time, and it is hazardous to predict that MHP will remain an efficient generation choice over its 70 year expected lifetime. The question is, is New Zealand's electricity situation so dire that it needs to take that irreversible step, forego all options for better use of the valley at some future date, or are there alternatives for generation that do not require such an irreversible step? Judging by other current proposals and the various LRMC and generation expansion models, in my opinion there are many alternatives to MHP for meeting future electricity needs, both nationally and in the region.

9.7. Put another way, in terms of the total economic values at stake, and given uncertainties about the future, which decision would New Zealand at large regret least if the future turns out differently than currently expected? If MHP is not consented, other plant will be built to meet future generation replacement and growth requirements, at

a cost difference that the current evidence does not reliably demonstrate will be significantly greater than with the MHP. The benefits forgone by not building MHP would be greater the higher the future demand growth on the West Coast turns out to be. But building MHP when the predicted high growth does not arise would diminish the potential benefit, and regardless of future electricity demand, would certainly result in loss of ecological qualities which are of indeterminate value but irreversible, and which evidence of ecologists shows is more significant than the Mokihinui's current protection status would indicate.

9.8. The purpose of an economic CBA in a public policy setting is twofold: first, to give some assurance that the benefits of a project exceed its costs, and second, to give assurance that it is an efficient use of available resources. The evidence for the applicant addresses the first through its CBA, and the second through its comparison of LRMC of prospective plant, but both these are deficient in excluding economic consideration of the environmental effects.

9.9. In conclusion, the applicant's evidence on the economic effects of the MHP is incomplete in omitting consideration of the ecosystem services at stake, and rather optimistic in predicting long term benefits of MHP over 70 years. It is insufficient and cannot be relied on to make a sound assessment of the full economic implications of MHP.

APPENDIX 1

CV Peter Clough Senior Economist

KEY QUALIFICATIONS

- Over 20 years experience in applied economics research, in fields of Agricultural, environmental and natural resource economics; Non-market valuation (Amenity and safety); Cost benefit analysis; Economic Impact analysis
- Specialisation in applying economics to the natural environment and public sector issues – regulation of externalities, provision of public goods, biodiversity, biosecurity, fisheries, forestry, energy, resource management, tourism
- Familiarity with public policy processes from numerous public client contracts and secondments in government agencies in New Zealand and United Kingdom
- Experience in managing contracts and research teams to client expectations

EDUCATION

- Post-Graduate Diploma in Agricultural Economics, Massey University, 1986
- Master of Science (Land Management), University of Reading, UK, 1980
- Bachelor of Arts (Geography/Land Economy), Cambridge University UK, 1978

EMPLOYMENT RECORD

1997 – the present: Senior Economist, Resource Economics, New Zealand Institute of Economic Research (NZIER), Wellington, New Zealand

1996-1997 Economist, English Nature (Nature Conservancy Council for England), Peterborough, UK

1987-1996 Research Economist, New Zealand Institute of Economic Research, Wellington

1981-1987 Research Officer, Centre for Agricultural Policy Studies, Palmerston North

1978-79 Trainee Accountant, Peat Marwick Mitchell & Company, London, UK

OTHER PROFESSIONAL ACTIVITIES

- 2003-2004 Executive Committee, New Zealand Agricultural and Resource Economics Society (NZARES)
- 1984-1990 New Zealand Branch Committee, Australian Agricultural Economics Society (AAES)
- 1984-1990 Member of Wellington District Committee, New Zealand Walkway Commission

EXAMPLES OF RELEVANT EXPERIENCE

Prepared economic reports for the Assessment of Environmental Effects in support of applications for consents for the proposed Mahinerangi Windfarm (2006), Kaiwera Downs Windfarm (2007), Turitia Windfarm (2008), Wairau Hydro-power Scheme (2009), Puketoi Windfarm (2011) and for reconsenting of Patea Hydro-power Scheme (2007) and Matahina Hydro-power Scheme (2008)

"Realistic valuation of our clean green assets" NZIER Insight 19, October 2010 http://nzier.org.nz/sites/nzier.live.egressive.com/files/NZIER%20insight%2019%20-%20Realistic%20valuations%20of%20our%20clean%20green%20assets.pdf

Evidence presented to the Hearings Committee of the Taranaki Regional Council, regarding reconsenting of the Patea Hydro Electric Power Scheme, Stratford 2009

Evidence to the Environment Court for the Bayley Trust, on the economics of native vegetation clearance and biodiversity offsets on private land, 2007

"Coastal retreat – Cost benefit approach to management of coastal land use in face of erosion"; Report to Whakatane District Council, August 2007

Cost benefit analysis and Section 32 Analysis of the National Policy Statement and National Environmental Standards for Electricity Transmission, for the Ministry for the Environment, Wellington 2006

Evidence presented to the Waitaki Water Allocation Board on results of regional cost benefit analysis and economic impact analysis of uses of water in the Waitaki catchment, prepared for Ministry for the Environment, Timaru 2004

"Sustainable infrastructure – a policy framework" Report to the Ministry of Economic Development's Infrastructure Audit, Wellington 2004 http://www.med.govt.nz/irdev/econ_dev/infrastructure/reports/nzier/index.html

Evidence presented to the Environment Court for the Natural Gas Corporation, on economic implications of requiring new gas-fired

electricity generation plant trees to offset carbon dioxide emissions, New Plymouth 2002

"Encouraging private biodiversity – Incentives for biodiversity conservation on private land"; *Working Paper 00/25*, The Treasury, Wellington 2000 www.treasury.govt.nz/workingpapers/2000/twp00-25.pdf

"Cost-benefit analysis and wildlife conservation: a sustainable application?"; *Indian Journal of Applied Economics*, 7(2) 203-215, 1998

"Planning and sustainable management: a re-examination of the peri-urban problem"; *Review of Marketing and Agricultural Economics*, 64 (3) 277-289, 1996

"Soil conservation and the Resource Management Act" (with DL Hicks); *Technical Paper 93/2*, Ministry of Agriculture and Fisheries, Wellington, March 1993. 52 pp.

"Energy demand forecasts - some initial results" (with various authors); report to the Ministry of Commerce, Energy and Resources Division, August 1991

"Allowing for multiple-site visitors in travel cost analysis" (with AD Meister); *Journal of Environmental Management* 32 (2) 115-125, London, 1991

"Reports on the economic evaluation of life" (with AD Meister); *Road Research Unit Bulletin 86*, Transit New Zealand, Wellington 1990. 70 pp.

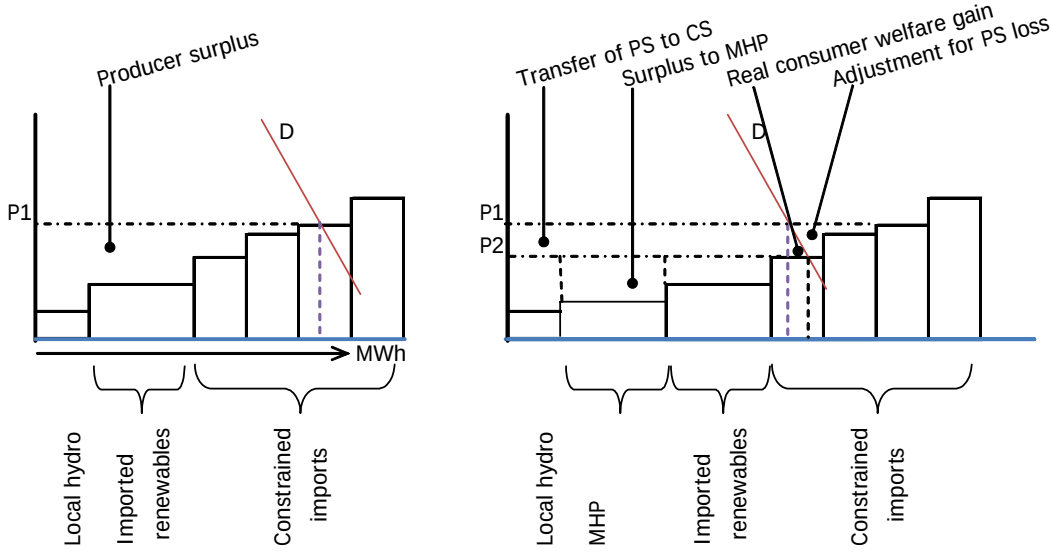
APPENDIX 2

EFFECTS OF INSERTING NEW GENERATION INTO THE WHOLESALE ELECTRICITY MARKET

1 This appendix explains the effects of inserting new generation into the wholesale electricity market to examine more closely the reasoning behind Mr Barry's Figure 3 in his Appendix 2.

2 When renewable generation is inserted into the dispatch stack it generally has low SRMC, because its "fuel", water or wind, is essentially free. That situation is altered when water can be stored and withheld to later periods when it is more valuable, but MHP has limited storage and its use is further constrained by undertakings Meridian Energy has made to operate as run-of-river generation during whitebaiting season so as not to disturb normal flow patterns. This means MHP's SRMC may be a little higher than that of other West Coast generation because of the value of its storage, but not as high as imported renewables that face additional transmissions costs. Higher still will be those generators that have what might be called "constrained" fuel, including the main hydro-storage generators in the Waitaki valley and thermal generation in the North Island. Thermal fuels influence prices across the wholesale electricity market, even in the South Island which has no substantial thermal plant, not primarily because electrons are dispatched from Taranaki or Waikato to meet demand in the South Island (although that does happen some of the time), but because water is stored in the South Island to preclude the need to use so much high cost thermal generation. If electricity generated by that water is dispatched instead to the West Coast it is not available for deferring thermal at the margin and moderating the marginal price, so that water has an opportunity cost that raises the SRMC of stored hydro-generation.

3 The effect of adding MHP to the stack is illustrated in the stylised supply and demand diagrams below. The left hand diagram shows the dispatch stack serving the West Coast demand without MHP, with a mix of local hydro, imported renewables (hydro and wind) and imported constrained sources (stored hydro and thermal generation). Price is determined by the price required by the supplier on the margin to supply the quantity determined by the demand curve, and between the stepped profile of the supply line and the price line producer surplus is earned by all the generators except the marginal supplier.



4 Insertion of MHP as a low cost supplier near the bottom of the stack shunts the higher cost constrained imported power out of the dispatch stack, lowering the price from P1 to P2 required by the new marginal supplier, and increasing quantity demanded slightly by movement down the demand curve. It also shows four separate components of change in the economic surpluses:

a. A direct transfer of producer surplus to consumer surplus on the existing level of consumption, caused by the lowering of price

b. A producer surplus earned by MHP, which is additional surplus caused by MHP's displacement of real resource costs of the generation that formerly occupied the margin

c. A real consumer welfare gain in the small triangle under the demand curve on new consumption induced by the price reduction

d. An adjustment for loss of producer surplus that displaced plant formerly inside the margin would have earned in the absence of MHP, which Mr Barry in his Appendix 2 not unreasonably estimates to be ½ the change in price multiplied by quantity from the displaced plant.

5 From this the main effect for consumers of adding low cost renewable generation to the stack would be the transfer of producer surplus to consumers on existing consumption. In comparison, the real welfare gain on new consumption will be rather small given the low price elasticity of demand. The gain in producer surplus for MHP would be substantial, both because it needs to be to justify the costs of investment and earn a return, and also because it comes about by displacing marginal plant incurring real resource costs. The adjustment for producer surplus loss at the margin is also likely to be small, although the steeper the supply curve at the margin, the larger it will be. Putting these components together, however, I would expect the welfare relevant component of economic surplus (excluding the mutually offsetting transfer element) would be predominantly a gain in producer surplus. If it is not, then the new low cost generator cannot be earning much more surplus than generators it has displaced from the margin, and it is questionable whether it would be an efficient addition to the stack or a viable investment for its owners.