1922.

VICTORIA.

REPORT

OF THE

SELECT COMMITTEE

ON

ELECTRICITY SUPPLY

(THE SUPPLY OF ELECTRICITY TO THE SOUTH-WESTERN DISTRICT, AND THE SUGARLOAF SCHEME FOR THE SUPPLY OF ELECTRICITY TO THE NORTH-EASTERN DISTRICT);

TOGETHER WITH MINUTES OF EVIDENCE.

Ordered by the Legislative Assembly *to be printed, 7th December,* 1922.

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EXTRACTED FROM THE VOTES AND PROCEEDINGS.

WEDNESDAY, 4TH OCTOBER, 1922.

7. **ELECTRICITY SUPPLY COMMITTEE.**—Motion made and question—That a Select Committee be appointed to inquire into and report upon—

(*a*) the proposals contained in the State Electricity Commission Bill;
(*b*) the purchase of the works and undertakings of the North Melbourne Electric Tramways and Lighting Company Limited in the municipal district of the city of Melbourne and of the city of Essendon;
(*c*) the scheme for the supply of electricity to the South-Western District of Victoria; and
(*d*) the Sugarloaf scheme for the supply of electricity to the North-Eastern District of Victoria.

—(*Mr. Lawson*)—put and, after debate—

The House divided.

Ayes, 32.		Noes, 26.	
Mr. Angus	Mr. McDonald	Mr. Allan	Mr. Murphy
Dr. Argyle	Mr. McGregor	Mr. Bailey	Mr. Old
Mr. Baird	Mr. McLachlan	Mr. J. W. Billson	Mr. Prendergast
Mr. Barnes	Mr. McLeod	Colonel Bourchier	Mr. Rogers
Mr. Beardmore	Mr. McPherson	Mr. Bowser	Mr. Slater
Mr. A. A. Billson	Mr. Morley	Mr. Brownbill	Mr. Tunnecliffe
Mr. Cameron	Mr. Oman	Mr. Carlisle	Mr. Wallace
Mr. Deany	Sir Alexander Peacock	Mr. Clough	Mr. Warde
Mr. Downward	Mr. Robertson	Mr. Cotter	Mr. Weaver
Mr. Eggleston	Mr. Ryan	Mr. Dunstan	Mr. Wettenhall
Mr. Everard	Mr. Smith	Mr. Frost	
Mr. Farthing	Mr. Snowball	Mr. Hughes	*Tellers.*
Dr. Fetherston	Mr. West	Mr. Jewell	Mr. Cain
Mr. Gordon		Mr. Mackrell	Mr. Webber
Mr. Greenwood	*Tellers.*		
Mr. Lawson	Mr. Groves		
Mr. Lind	Mr. Pennington		

And so it was resolved in the affirmative.

THURSDAY, 12TH OCTOBER, 1922.

5. **ELECTRICITY SUPPLY COMMITTEE.**—Motion made and question—That the Select Committee on Electricity Supply consist of Mr. Beardmore, Mr. Deany, Mr. Eggleston, Mr. Farthing, Mr. Lind, Mr. McLeod, and Mr. Smith, with power to sit during the sittings of the House and on days on which the House does not meet; to send for persons, papers, and records; and to report the minutes of evidence from time to time: three to be the quorum (*Mr. Lawson*)—put and, after debate—

The House divided.

Ayes, 25.		Noes, 22.	
Mr. Angus	Mr McGregor	Mr. Allison	Mr. Prendergast
Dr. Argyle	Mr. McLeod	Mr. Bailey	Mr. Rogers
Mr. Baird	Mr. McPherson	Mr. J. W. Billson	Mr. Slater
Mr. Barnes	Mr. Morley	Mr. Brownbill	Mr. Thomas
Mr. Beardmore	Mr. Oman	Mr. Cain	Mr. Tunnecliffe
Mr. A. A. Billson	Sir Alexander Peacock	Mr. Clough	Mr. Wallace
Mr. Cameron	Mr. Robertson	Mr. Cotter	Mr. Warde
Mr. Deany	Mr. Toutcher	Mr. Frost	Mr. Wettenhall
Mr. Eggleston	Mr. West	Mr. Hogan	
Mr. Everard		Mr. Hughes	*Tellers.*
Mr. Gordon		Mr. Jewell	Mr. Lemmon
Mr. Greenwood	*Tellers.*	Mr. Murphy	Mr. Webber
Mr. Lawson	Mr. Groves		
Mr. Lind	Mr. Pennington		

And so it was resolved in the affirmative.

THURSDAY, 26TH OCTOBER, 1922.

4. **ELECTRICITY SUPPLY COMMITTEE.**—Motion made, by leave, and question—That the evidence taken before the Select Committee on Electricity Supply be printed from day to day (*Mr. Lawson*)—put and agreed to.

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REPORT.

THE SELECT COMMITTEE appointed to inquire into and report upon—

(*a*) the proposals contained in the State Electricity Commission Bill;

(*b*) the purchase of the works and undertakings of the North Melbourne Electric Tramways and Lighting Company Limited in the municipal district of the city of Melbourne and of the city of Essendon:

(*c*) the scheme for the supply of electricity to the South-Western District of Victoria; and

(*d*) the Sugarloaf scheme for the supply of electricity to the North-Eastern District of Victoria

has the honour to report to your Honorable House as follows:—

1. The other two matters referred to your Committee related to the scheme for the supply of electricity to the South-Western District, and the Sugarloaf Scheme for the supply of the North-Eastern District.

2. Your Committee desires to express its gratification that the Electricity Commission are showing themselves anxious to serve the interests of the country districts of Victoria, and during the sittings of your Committee the chairman and his staff evinced the greatest anxiety to see that the country districts would, wherever possible, be enabled to benefit by their undertaking at the lowest possible price and the earliest moment.

SOUTH-WESTERN DISTRICT SCHEME.

3. The first scheme submitted to your Committee was the scheme for the supply of electricity to the South-Western District of Victoria. The Report of the Commission on this scheme has been carefully examined by your Committee. It contemplates the supply of electricity to various towns in the Western District of Victoria between Geelong and Warrnambool, with a possible extension to Koroit and Port Fairy, and with several branches north and south of the main line of transmission.

4. It is proposed in the first place to supply the power from the Geelong station of the Melbourne Electric Supply Company Limited. A five years' contract has been entered into with that company. Later on, when it is possible to supply Geelong from the Morwell scheme, this energy will be used to supply the Western District.

5. The total capital cost of the scheme is estimated at about £145,000, including Port Fairy and Koroit. The annual cost will be £20,479: and the average price for power at Warrnambool during the first period is estimated at 3·73d. When the Morwell power is available the average price will be 2·89d. It should be noted that this is the average price, and that large consumers and purchasers of power in large blocks will get their energy at considerably less than this average.

6. The scheme was attacked on the ground that the estimate of consumption made by the Commission was exaggerated, and we have carefully examined the Chief Engineer of the Commission on this point and gone into the details of his estimate. He points out that he is only assuming a consumption of ·06 kilowatt hours *per capita*, for the residents of the area served, and that, according to the experience of the Board in similar towns, this is a very conservative estimate

and if we take a country of a similar type, such as New Zealand, their schemes are based on an experience of from ·15 to ·2 units *per capita*. The survey made by the Commission is a detailed one, and your Committee thinks it should be accepted by your Honorable House.

7. The other points upon which the scheme was attacked concerned the relation of the Commission to the various municipalities. All the municipalities concerned have formally accepted the scheme, which provides for delivery in bulk to the municipalities and retail distribution by those bodies. The only way in which the municipalities are affected is by the provision that high-tension lines shall be controlled by the Commission. The reason for this was fully explained by the chairman of the Commission. He expressed the opinion that the method is not only more efficient and more economical, but that in a large scheme such as this it is absolutely essential for the Commission to control the high-tension lines, because a breakdown in these lines might affect the whole of the system.

8. Inasmuch as all the councils interested have accepted the scheme with this proviso in it, your Committee does not think any weight should be attached to the objections which have been made on this ground. The necessity for the scheme is illustrated by the position of Colac, which recently had its valuable generating plant destroyed by fire. The plant necessary to substitute for this is not obtainable in Victoria, and it would have taken probably over a year to obtain and erect a new plant, at a very heavy outlay, and then the plant would have to be scrapped when the Morwell scheme took up the running. However, the Electricity Commissioners hope to be able in about three months to have their mains extended and to be in a position to give Colac a full supply for both domestic and power purposes.

9. Your Committee invites attention of Honorable Members to the very full and comprehensive report of the Commission, with its plans, estimates of cost, and working expenses. The Commission were asked whether they had investigated the possibilities of hydro-electric schemes in the Western District with a view to supplying part of Victoria even further west, and they stated that at present they were investigating the possibilities of a supply from the Grampians, and a party is now working on this matter.

10. Your Committee therefore advises your Honorable House to approve of the scheme, which is now in course of construction.

THE SUGARLOAF SCHEME.

11. The Sugarloaf scheme contemplated the use of the water impounded by the State Rivers and Water Supply Commission in the Sugarloaf Reservoir, near Alexandra. By an arrangement with the State Rivers and Water Supply Commission it has been agreed that the Electricity Commission shall be allowed to harness water from this scheme without being charged with any proportion of the capital cost and without any charge for the water. This places the scheme on a very favorable basis.

12. The Sugarloaf scheme is really a part of the original Kiewa proposition prepared by Mr. A. G. M. Michell, and referred to in his report of 1920. As the larger scheme was not gone on with the Commission then expressed its intention of investigating the possibilities of the Sugarloaf section of it, to see whether a supply of power could be given on reasonable terms to the North-Eastern District, where it was urgently needed. The report now submitted to Parliament and now under consideration of your Committee is the result of this investigation. The capital cost of the scheme is £962,320, the annual working cost is £59,182, and it is estimated that the cost of the supply to consumers will be exceedingly low.

13. The Commission in their report state that viewed as a proposition for supplying the North-Eastern District only, which has a demand for only 6,000,000 units per annum, the scheme would not be feasible, but the metropolitan area has a constant demand at 100 per cent. load factor of about 12,000 kilowatts, and this being so, the scheme is justified, in the opinion of the Commission. It will take some five years to complete the necessary works in connexion with the Sugarloaf scheme, and in the meantime the Commission propose to run a line from the Morwell transmission system to meet the immediate requirements of the North-Eastern district. Subsequently, when the Sugarloaf power is available, this line from the Sugarloaf to Bundoora will be used to transmit the energy required to meet the basic demand in Melbourne.

14. This will mean that during the first five years of the scheme the cost charged to consumers will be higher than during the subsequent period, and on page 22 of the report of the Chief Engineer his estimate of the financial results of the proposed supply are given as follows :—

TABLE SHOWING FINANCIAL RESULTS OF PROPOSED SUPPLY TO SHEPPARTON AND WANGARATTA CENTRES OF THE NORTHERN DISTRICT OF VICTORIA.

Year.		A Combined maximum demand.	B Estimated total annual consumption at Shepparton and Wangaratta centres.	C Estimated average selling prices based on actual cost to those centres.	D Assumed average selling prices at those centres.	E Annual loss or gain based on assumed selling prices (col. D) and payments of interest and sinking fund (cols. F and G).	F Interest payments on capital expenditure.	G Sinking fund payments.	H Financial result if sinking fund payments be suspended for 3 years.	I Accumulated balance.
	Morwell energy	kw.	kw.-hrs.	pence per kw.-hr.	pence per kw.-hr.	£	£	£	£	£
1926		2,300	6,000,000	2·5	1·7	—20,000	19,150	8,613	—11,387	—11,387
1927		2,300	6,600,000	2·4	1·7	— 19,250	19,150	8,613	—10,637	— 22,024
1928		2,300	7,260,000	2·3	1·7	— 18,150	19,150	8,613	— 9,537	— 31,561
							Total	25,839		
1929	Sugarloaf energy	..	7,986,000	1·18	1·5	+10,640	..	..	..	— 20,921
1930		3,300	8,784,000	1·12	1·5	+13,900	..	..	..	— 7,021
1931		..	9,663,000	1·05	1·5	+18,100	..	..	..	+11,079
1932		4,000	10,629,000	0·97	1·25	+12,400	..	..	..	+23,479
1933		..	11,690,000	0·90	1·00	+ 4,875	..	..	..	+28,354
1934		..	12,860,000	0·84	1·00	+ 8,550	..	..	..	+36,904 available to liquidate sinking fund suspended payments with accumulated interest
1935		4,620	14,146,000	0·80	0·80	Nil				

It will be seen that for the first few years there will be a debit balance against the scheme, but this will be made up in later years and paid off by 1930. It is proposed to finance this by suspending the sinking fund and renewal charges during the first few years of the scheme. The attention of your Honorable House is directed to column " C," which shows that the selling price of the energy will start in 1926 at the rate of 2·5d. per kilowatt hour, and it is estimated that this price will be reduced to ·80d. per kilowatt hour by 1935. If this estimate is realized the large consumers in Wangaratta, Benalla, Shepparton, and other centres of the North-Eastern District will be able to get their power practically as cheap as in Melbourne.

15. The scheme was attacked on the ground that the estimates of the demand for power and the load factor were exaggerated by the Commission, and your Committee examined the Chief Engineer very closely as to his estimates. It will be seen that the load factor is estimated at 30 per cent., which seems high considering that the load factor for Melbourne is estimated at only 42 per cent.; but it was pointed out that in the district there were a number of industries such as flour-milling, which worked for 24 hours, and that this improved the load factor very considerably. With regard to the demand, the same remarks apply to this scheme as to the South-Western scheme, and the amount of consumption *per capita* of the population, which is assumed by the Chief Engineer is no greater than for similar places in Victoria which have been using power from local schemes, and is well below the consumption estimated for a country like New Zealand, which is of a similar character to Victoria.

16. One witness suggested that supplying the constant demand of the Melbourne area from Sugarloaf was unsound because the Sugarloaf energy would be dearer than energy which could be obtained from an extension of the Morwell generating plant, and this witness stated that the loss involved in this proposition would be £30,000 per annum. The chairman of the Commission in reply stated that the figures given by this witness were incorrect, and that in any case they applied to only a temporary phase of the undertaking. This witness assumed, according to the figures given in the printed report of the Commission, page 8, that the cost of energy to Melbourne

from the Sugarloaf scheme would be ·28d. per unit, whereas the cost of the same energy if supplied from an extension of the Morwell scheme would be only ·205d. per unit. From this data he deduces that the cost of energy from Sugarloaf will exceed that from Morwell by ·075d. per unit, or, roundly, £30,000 per annum. These figures were arrived at by comparing the figures on pages 19 and 20 of the report, in which the cost of the Sugarloaf scheme was increased by assuming that a standby steam plant was provided to take a special demand which arises in June, and which the Sugarloaf scheme cannot supply, because in that month the water is being stored up for irrigation purposes.

This steam standby plant, however, is only an assumption made by the Chief Engineer in order to correctly compare the costs from the two different sources. If we eliminate the addition that was made for those charges, the difference between the two schemes is ·202d. for the Sugarloaf for the first period of the scheme as compared with ·185d. for the Morwell extension, or a difference of ·017d. per unit. After the demand at Shepparton and Wangaratta is raised during the subsequent period of the scheme the cost from the Sugarloaf will be ·187d., while from the Morwell extension it will be ·185d., or practically identical. Therefore the only loss during the first phase of the scheme would be a difference of ·017d. per unit, or about £6,250 per annum, but as against this loss the Commission would have the advantage of an alternative source of supply from water power, and thus run far less risk of industrial dislocation.

17. It should be mentioned that, as the Sugarloaf storage is mainly for irrigation purposes, it is necessary for water to be stored during the winter months to be available when required. This has necessitated the Commission using the waters of several other streams, such as the Rubicon Royston, and Snob's Creek. As these streams will be at their period of greatest flow during the winter when the water from the weir is not available, the two factors will compensate for one another.

18. It must not be assumed that the larger Kiewa scheme is lost sight of or will not be required, because the chairman of the Commission under examination stated that so much so was this a fact that they have maintained the whole of the organization for keeping Kiewa under observation, and that they have men there gauging constantly. They also regard it as one of the potential water-power schemes of the State when the demand comes that will justify the actual expenditure.

19. Your Committee felt a considerable difficulty, owing to the technical character of the scheme, in checking the statements of expert witnesses, and they therefore sought to obtain evidence in criticism of the scheme from Mr. A. G. M. Michell, who had originally collected all the data regarding Kiewa, and we obtained the following reply :—

A. G. M. MICHELL, M.C.E.,
Consulting Engineer.

150 Collins-street,
Melbourne, 30th November, 1922.

W. R. BARSTOW, Esq.,
Clerk of Committees,
State Parliament House, Melbourne.

DEAR SIR,

I have the honour to acknowledge receipt of your letter of yesterday's date, informing me of Resolution passed by the Select Committee on Electricity Supply. In reply to the Select Committee's inquiry, I beg to say that my technical views on the hydro-electric development of the Sugarloaf Weir, and adjacent rivers and creeks, have been set out in a report printed by the Electricity Commissioners in 1920, and that I have no information which would lead me to modify that report in any substantial manner, except with respect to estimates of cost, which would be subject to great reduction at the present time as compared with 1920.

A revision of my estimates would, of course, involve a considerable amount of work, and could probably not be completed in time to be of use to the Select Committee.

I have therefore no sufficient reason for asking the Committee to occupy its time in hearing evidence from me on the matter.

Yours faithfully,
A. G. M. MICHELL.

20. Your Committee strongly advises approval of the North-Eastern scheme, and suggests that the money necessary to initiate it shall be passed at the earliest possible moment.

Committee Room,
State Parliament House, Melbourne,
6th December, 1922.

MINUTES OF EVIDENCE.

TUESDAY, 28TH NOVEMBER, 1922.

Members Present:

Mr. McLEOD, in the Chair;

Mr. Beardmore,	Mr. Farthing,
Mr. Deany,	Mr. Lind,
Mr. Eggleston,	Mr. Smith.

Sir John Monash, Chairman of the State Electricity Commission of Victoria, recalled, and further examined.

Sir John Monash.—With reference to the Report of the Electricity Commission on a scheme known as the Sugarloaf-Rubicon hydro-electric scheme, I would like to begin by explaining that the genesis of this whole matter was the Report presented to Parliament by the Commission two years ago entitled, "Report on the Kiewa Hydro-electric Scheme," a report which was the subject of the investigation of a Special Committee of the Legislative Assembly at the time—about two years ago. In that Report, while the Commission was unable to recommend the adoption at the present juncture of the Kiewa hydro-electric scheme, or indeed any hydro-electric scheme at that time, the concluding paragraph of the Report foreshadowed that the Commission would continue investigations towards evolving hydro-electric schemes on a more modest scale than those considered in the 1920 Report for the service of the north-eastern towns. It was there stated that—

> "In this connexion both the Sugarloaf Weir and the Rubicon River, considered as separate schemes, and not as part of the Kiewa scheme, offer possibilities which seem sufficiently attractive to justify closer inquiry. Upon such inquiries the Commissioners propose to embark forthwith."

That inquiry was duly embarked upon, and took the greater part of two years. The inquiry began by a much more minute and much more detailed examination of the hydraulic conditions of the Goulburn River and its tributaries, in the vicinity of what is known as the Sugarloaf Reservoir. Those investigations resulted in the ascertaining of the fact that by harnessing certain other streams which were not envisaged in the original Kiewa proposals, such as Snob's Creek and the Royston River, a much greater quantity of power could be made available than was originally proposed. In the original Kiewa Report it was estimated that in that locality one could get 7,000 kilowatts of energy as a maximum for an expenditure of about, roundly, £746,000, but the result of the later inquiries conducted during the last two years have disclosed that there is available an amount of very nearly double that quantity of power at an expenditure of, roundly, £962,000. Now, that increased availability of power has arisen largely because the bringing into the scheme of these subordinate streams has enabled the periods of drought or periods of dry flow from the Sugarloaf Reservoir itself to be more adequately met. It must be realized that in a work like the Sugarloaf, which has been constructed wholly and solely for irrigation purposes, the very objective of the work is to conserve water during the times of plentiful flow, that is to say, during the rainy season—the winter season—and during that portion of the year the reservoir valves are closed down, and no water is allowed to pass from it, because if water were allowed to pass away during the times of rainfall, the position would arise that on the eve of the irrigation season that reservoir would not be filled to overflowing, and the idea is to have the reservoir filled to overflowing on the eve of irrigation, consequently the State Rivers and Water Supply Department laid down the very definite condition that no water from the Sugarloaf conservation could be used for hydro-electric purposes during certainly four months, and in some years five months, of the year. That condition would make the Sugarloaf Reservoir totally useless as a hydro-electric scheme if there were not other sources of power available in the district to deal with those months of no water. The reason for that is, of course, that a scheme which will work for seven or eight months of the year and will be shut down for the rest of the year will be quite useless from a hydro-electric point of view. You cannot ask towns to go without light and factories to go without power for four or five months of the year, and therefore a scheme based on the use of hydraulic energy, to be of any value at all, must be of a character which can be relied upon to be available all through the year, all through the day, at every hour of the day. It was therefore necessary to look for other streams which had a sufficiently ample winter flow to act as a substitute for the Sugarloaf flow during those four or five months, and to act as a supplementary source of supply to the Sugarloaf during the remainder of the year. That has been achieved in this case by bringing in the Rubicon, the Royston, and Snob's Creek, and the result of the investigations ultimately was presented to the Government and Parliament in a report which has been printed, and which is dated the 6th September of this year, and which, I think, the Committee have before them. If I am permitted now to direct attention to the report of the hydraulic engineers on page 35, you will see near the foot of the page a tabulation showing the amount of horse-power that is available in each of those five sources of supply, that is to say, available from the main Sugarloaf Reservoir, from the Rubicon, from the Royston, from the lower Rubicon, and from Snob's Creek, and there in columns are set out the calculated power available for each month of the year, and you will see that, whereas in some cases during the summer months the Sugarloaf is working at a maximum during those months, the other streams are working at a minimum, so in order to find out what total power is really available in any month of the year you add up these results in horizontal lines, and in the last column of that tabulation, under the head of "Total b.h.p.," which means brake horse-power, you will find set out the combined output of power from all these streams taken in combination. I am quoting from page 35 of the report of September, 1922. Then, having determined the output per month, that is averaged, and the net result is 19,220 b.h.p. of energy available as an average throughout the year, and I ask you to note particularly that during certain months of the year—February, March, April, and May—the output is markedly below the average. Having determined what amount of hydraulic power was available, the next step was to design appropriate hydraulic works and appropriate electric works, and then to make an estimate of what those works would cost. As a description of the scheme itself would involve my spreading out a map and getting round the table, perhaps you will permit me to postpone the actual description of the work, and proceed with the other matter. The electric scheme, which is fully described in the report of the Commission's chief engineer, sets out that

provision is made for five power-houses and for a main sub-station called the Rubicon "A" Station, to which the electricity generated in those five power-houses is led, and which becomes the focal point of the system situated some 8 miles from the Sugarloaf Reservoir. I will show you on the map presently how those five stations are there combined. After making the necessary allowances for losses in generation—frictional and other—and the necessary electrical losses associated with generation, the net result appears that at that Rubicon "A" sub-station this scheme can make available something in the nature of, roundly, 16,000 kilowatts of energy.

2354. *By Mr. Eggleston.*—That is on the average?—Yes.

2355. The minimum is 9,700?—Yes, the minimum is less. Of course a difficulty is involved there whether you speak of a daily minimum or a yearly or monthly minimum, because with the water available you can reach peak loadings very much higher than the average of the day. The question of load factor is involved there again. The next question was to determine what was to be done with it. Upon that a survey was undertaken, which is known as a power survey, of the whole of the north-eastern district, that is to say, the Goulburn Valley, the north-eastern line, and its branches to the east, and an estimation and an exact census were made of the actual power requirements or power consumption of the district at the present day, and it was ascertained that, roundly, power to the equivalent of 12,000,000 electrical units per year were to-day consumed in that territory.

2356. *By Mr. Beardmore.*—How would that work out daily?—Forty thousand units per day.

2357. What is the difference between a unit and a kilowatt?—A unit is a kilowatt working for an hour. A unit introduces the idea of time. A kilowatt is merely an abstract statement of horse-power. A kilowatt hour, that is to say, a kilowatt working for an hour, is an electrical unit. That is why you always speak of kilowatt hours when you are speaking of the total quantities. You speak of kilowatts when you are speaking of the total horse-power at any one moment of time. This consumption of 12,000,000 units per annum was vastly less than this scheme was able to provide, and obviously therefore the scheme was far too large for the service of the north-east by itself. A much smaller scheme than this would serve the north-east, but would not serve it, of course, anything so economically as the big scheme like this would. The next was to consider what could be done with that portion of the output that was not saleable in the north-east, and attention was directed to the metropolitan market. The projected growth of the metropolitan market was studied, and it was seen that, having regard to the present installations which have been authorized by Parliament at Morwell and at Newport, and having regard to the growth of the demand in the metropolis, that in 1928 a decision would have to be come to as to the installation of further power for the supply of the metropolis, which means that by 1928 it is estimated that the whole of the present schemes will be working to their full capacity. Seeing that it was recognised that in 1928 a further installation had to be made for the growing needs of the metropolis, and inquiry was then instituted as to whether such a demand could be more cheaply met from a scheme like the Sugarloaf or from Morwell by extending Morwell. That investigation was made, with the result that it was shown, and is shown in this report, that if you have to consider only the needs of the metropolis—the metropolitan demand only—that it would be actually slightly cheaper to extend the Morwell power-house than to use the Sugarloaf scheme.

2358. That is supplying the north-east?—No; supplying Melbourne. Therefore it led to the conclusion that if the problem were a question only of the supply of Melbourne alone, the Commission could not on financial grounds recommend the Sugarloaf scheme as a source of supply to Melbourne alone. Taking the Sugarloaf scheme as here described, it cannot be recommended as a scheme for the supply of the north-east alone. It cannot be recommended as a supply for the metropolis alone, but taking the two in combination, and having regard to the relative demands of the north-east and the metropolis, it presents an ideal scheme concurrently to serve both interests at the lowest possible cost. The meaning in plain English of that is that Melbourne will by 1928 be able to take something like 12,000 kilowatts of energy at 100 per cent. load factor. By that time the daily demands will have so increased that there will be a constant demand throughout the 24 hours of something like 12,000 kilowatts, and a hydro-electric scheme is an ideal scheme for supplying such a want. The balance of the energy can be made available for the north-east at rates which are mentioned in the report, and which are extremely favorable—ultimately less than 1d. per unit.

2359. How long?—When the demand in the north-east has reached 5,000 kilowatts, then the estimate is that the cost of energy at Shepparton and Wangaratta will be about .8d. How many years it will take no one can say, but I think it is not too optimistic to suppose that it will occur within five years of the initiation of the scheme. Melbourne will take a constant demand of 12,000 kilowatts in 1928 at a load factor of 100 per cent. The figures about which you just asked me are set out in the chief engineer's report on page 22, and you will see that in the seventh year after the scheme comes into full operation it is anticipated that the price of energy will come down to .8d. Naturally, if the development of the north-east is more rapid than is here supposed, the drop in prices will come earlier.

2360. You anticipate the power required is 2,300 kilowatts in 1928. Is that correct?—Yes, that is at the beginning. I would like to point out to the Committee that under the best and most favorable circumstances it would not be possible to complete this scheme till 1928, and the reason for that is this, that the greater part of the terrain in which these works are to be carried out is absolutely snowbound in winter, and it would be impossible to work at the higher reaches of these rivers except for a few months of each year, and considerable work will have to be done in small embankments and race lines and flumes and pipe lines in the very high mountain ranges 3,000 feet and over above sea level, and that is slow work, and depends entirely upon climatic conditions, and it is estimated that these works will not be able to be carried out any faster than such works as the main Sugarloaf and the Hume, which have taken years, and it is estimated that we cannot safely promise the completion of this scheme, even if at once authorized, until 1928, which is five years from now, and the plain fact is that the north-east cannot wait for five years. Something has got to be done. There are a number of towns in the north-east which have no electric supply whatever, and who want it badly, and there are a number of other owns which have small and more or less decrepit plants which are heavily overloaded, and are in a dangerous condition, and one of the most serious positions of all is in Shepparton, which is in the centre of a growing fruit-canning district and general industry district, and they are at their wits end to know what to do. The last thing the Electricity Commission wants to see, and that Parliament would want to see, would be that these

struggling municipalities should have to spend many thousands of pounds on the installation of local generating plants in a district where fuel is very dear, and producing electricity at very high cost indeed, when within five years they can get on extremely cheap hydro-electric supply. In view of that consideration the Commission is proposing that if this scheme is approved, but not otherwise, that they will at once proceed with the erection of the necessary transmission lines which would ultimately be required for the Sugarloaf scheme in its entirety, that is to say, they would at once commence to build a transmission line from Melbourne to Sugarloaf and Sugarloaf to Benalla, and branches from Benalla to Wangaratta and Shepparton, the idea being that in the first five years a supply can be given to those districts from Morwell at admittedly a higher price, and that as soon as the Sugarloaf scheme is ready to operate the Morwell connexion will be thrown out, and Sugarloaf will take up the service. That is also shown in that same tabulation to which I have referred on page 22 of Mr. Harper's report. If you will be good enough to look at the table and column "C," you will notice that we estimate that supplying power to the north-east from Morwell would cost 2.5d. per unit.

2361. That is to commence?—Yes. We say it is not right to charge that cost, seeing that there is a certainty of a gradually reducing deficit and a gradually increasing credit as the scheme goes on, and so the recommendation of the Electricity Commission is that the initial charge to the north-east at those power centres at that load factor shall be 1.7d., which is a very reasonable charge under those conditions, and that it shall remain at 1.7d. until the Sugarloaf scheme comes into operation in 1929, when the price should be dropped to 1.5d., and again in 1932 it should be dropped to 1.25d., and so on until by the seventh year the Sugarloaf comes into operation, and the price will have dropped to 0.8d. The object of that is to act in sympathy with the drop in the cost of producing the energy, so that by the second year after the Sugarloaf comes into operation the accumulated losses of previous years will have liquidated, and the suspended sinking fund payments will also have been liquidated, so that by the seventh year after the coming into operation of the scheme the scheme will be on a level keel.

2362. *By the Chairman.*—That is putting them on the same footing practically as clause 2 of the amending Bill?—On the same principle with this difference, that instead of the subsidy being paid up by contributing parties, the loss is put to a suspense account. The councils are not interested in any way. It is only the consumers. The councils are not concerned in that aspect of the matter. If the Subsidies Bill passes, and if the councils want to take advantage of the subsidies that can be extended by legislation. They must take the initiative. I think at this stage it would be convenient, perhaps, if I attempted to explain to the Committee the nature of the works themselves. I think it would interest the Committee. The first map of all shows the Sugarloaf Reservoir—this black thing in the centre like a snail.

2363. *By Mr. Eggleston.*—How long is the reservoir?—I should say from end to end it would be about 2.5 miles fully. It is a very big conservation. Of course, it is only half its ultimate height. It is going to be very much enlarged as the needs of irrigation grow, and it will be a very much bigger affair in the future. Although the quantity of water might not increase it will double the height, and therefore double the power. On that map just below the Sugarloaf Reservoir you will see the other creeks I have been speaking about—Snob's Creek, Royston Creek, and Rubicon. You will notice that these creeks fall into the Goulburn down stream from the reservoir, which means, in effect, that we can use the waters in these streams freely at all seasons of the year without affecting the Sugarloaf Reservoir. That same map shows the site of the Rubicon "A" main station. That is a little square blotch. The power-houses are shown by little black dots. There is one on Snob's Creek, one on the Royston near its junction with the Rubicon, and two on the Rubicon, and one at the reservoir itself. In addition to that this map shows the proposed transmission line from the Rubicon "A" station south-westerly to Bundoora, where it would join with the main transmission line from Morwell, and again, although this map does not show it correctly, from Rubicon "A" there will be transmission lines running north to Benalla with branches to Wangaratta and Shepparton. That is all that that first map shows.

2364. *By Mr. Beardmore.*—These are your three distributing centres?—Benalla, Wangaratta, and Shepparton we call our power centres. It is from these points that all the trunk transmission would radiate.

2365. Can you give us the estimated cost of those three centres—Benalla, Wangaratta, and Shepparton?—You mean the cost of power?

2366. Yes?—I have given it in that table.

2367. They are not all the same?—Yes.

2368. All these centres are the same price?—Yes. That is the flat rate at those centres that any one can come and buy power at those points at those rates, and the cost of transmission is extra. The second map gives all that I have been telling you a little more clearly. You will see the Sugarloaf Reservoir shown much larger in the right-hand corner, and there again the five power-houses proposed are shown by five round black dots, and the Rubicon "A" sub-station is now marked and named. Incidentally, in reply to a question which has been raised, I would like to point out that the transmission line passes across the Acheron and the Murrindindi and the Yea Rivers, all of which streams have very promising potentialities of water power. We now have our survey parties on them, and in the near future it is quite certain that schemes for utilizing these streams will be proposed. In short, the whole of this river system is a most promising one from a hydro-electric point of view.

2369. *By the Chairman.*—You are right in the middle of all the creeks and rivers?—Yes. The Goulburn is a great source of wealth both for irrigation and hydro-electric power. Will you please turn now to the next map. I did not propose to take up the time of the Committee by explaining every part of the scheme minutely. I think it will be sufficient if I take one specific case, namely, the Snob's Creek, which is the upper of the two streams on the map now before you. At a point on the Snob's Creek, which is 2,305 feet above sea level, at that point a weir is built across Snob's Creek, and instead of the water being allowed to pass down the Snob's Creek channel at a very steep fall, it is taken along the mountain side in a race, which is marked with a heavy black line, till it gets on its extreme left to a point called "Pipe Head," where it is still at a level of 2,884 feet above the sea. In all that distance the water has only fallen 21 feet—a very flat rate, so as to lose as little head as possible, and when it comes to the point called "Pipe Head" there, the level of the river has already fallen down to 994 feet above sea level. In other words, the river has lost some 1,300 feet of head. Therefore, that is the proper place for a power-house, and a pipe is put in from the Pipe Head Reservoir down to the power-house, and there that power-house can work under a head of 1,300 feet. That is precisely what has been done in all these other cases. If you will follow it through in

the same way you will see that the black lines represent the races, and the heights are given, and in some cases very considerable heights are achievable.

2370. *By Mr. Eggleston.*—There is one—the Royston power station—only 300 feet?—Yes. We take the water out of the Royston. We take it right across the range. We use 300 feet of its head before we let it go, and then we drop it into the Rubicon and use the water over again. It is put through that power-house, and when it has done its work it rejoins the Rubicon water in that same race, and it is used again at the power-house. The Royston is diverted to the Rubicon after being passed through the turbines. That is just a brief and a sort of impressionist idea of the kind of scheme it is. I do not think the other drawings are of any importance.

2371. You use some of this water three times, do you?—Yes. The Rubicon water is used three times. The next step in the whole process, of course, is to make a very careful estimate of the cost of these things, and on these points I would like the chief engineer to speak much more fully than I, but I want to tell the Committee in a general way that it must not be supposed that these estimates of cost of works are mere guesses. They are anything but guesses, and I should say in regard to this round £960,000 that is proposed here, the greater part of that estimate is based on actual quotations received from makers. If one wants to build a generator or hydraulic turbine or transmission line, one does not merely guess what the probable cost is. One asks the makers to quote, and acts on their quotations, and to a very large extent these figures that are presented are based on actual quotations from the trade for our specific requirements. Of course, it is well-known that prices fluctuate, and when this is carried out we might have to pay more or pay less according to the state of trade, but one cannot do more than go to a specialist and ask him what he will charge you, and you use that as part of your estimate. As regards all that part of the work which relates to field works, the most careful quantities have been taken out, based on actual surveys, and the Commission has at its disposal now a vast quantity of experience with regard to brick works and earth works and concrete, and it is those figures which we use in computing the costs. On top of all that we have to make allowances for engineering and supervision, and invariably we put on 10 per cent. for unforeseen contingencies.

2372. *By Mr. Beardmore.*—Some of the engineers giving evidence made a statement that you were altogether extravagant in your estimate, and also that you were extravagant in your reckonings in regard to the power required. They said it would cost as high as 8d. at Euroa?—As regards our being high with our estimates, that is contradictory with the other gentlemen who say we have not estimated enough. We hope we will strike the happy medium between the two. As regards the 8d. at Euroa, you have seen from that paper I have shown you that we intend to sell energy at Benalla at .8d. If the gentleman is right that the energy is going to cost 8d. at Euroa, it follows that if we give it to him for nothing it will still cost 7d. I am only charging him .8d. at Benalla for that energy, and according to him it is going to cost him 7.2d. to carry it to Euroa. Probably it won't cost him more than 1d.

2373. You think you are not extravagant in your estimate as to the amount of power required?—I will get Mr. Harper to speak about that. We say this scheme will pay at 6,000,000 units sold per annum, and we know there is an existing demand of 12,000,000 units.

2374. And there is a 30 per cent. load factor?—Yes. We estimate only on being able to sell one-half of that. Those figures on page 22 show we are only estimating to begin by selling 6,000,000 in the first year up to 12,000,000 in 1934. Any electrical engineer who is accustomed to these figures will say at once that that column "B" is a most conservative forecast of rate of growth, because we are not talking merely of urban supply of electricity. We are confidently looking forward to our ability in the future to give a rural supply, which means that these closer settlements all over the place will have power for the farm. When I say "give the supply," I mean give it at rates which will pay the farmer to buy, and none of those potentialities are included in the estimates. We are only taking the existing urban demands for light and power as we have them to-day, and assuming no development. I do not want to worry the Committee by more lengthy observation, but I will be glad to answer any questions that may be asked.

Sir John Monash.—I would like to supplement what I said before lunch by one further statement, which, as it is regarded as a little more important, I have had prepared before hand, and I have copies here for the members of the Committee. It relates to a criticism voiced by Mr. Lincolne, and it is the only item of a very long statement that the Commission thinks it is necessary to answer at all. I will read this if I may—

NOTE ON MR. LINCOLNE'S EVIDENCE.

N.B.—References are to the printed report of the State Electricity Commission of 6th September, 1922, already promulgated to Parliament.

The main criticism of the Sugarloaf Scheme advanced by Mr. Lincolne is, briefly, to the effect that according to the figures given in the printed report of the Commission (on page 8) the cost of energy to Melbourne from the Sugarloaf scheme will be 0.28d. per unit, whereas the cost of the same energy if supplied from an extension of the Morwell scheme will be only 0.205d. per unit. From these data he deduces that the cost of energy from Sugarloaf will exceed that from Morwell by 0.075d. per unit, and that, on the basis of a supply of, roundly, 90,000,000 units per annum, this will amount to a surcharge upon the Melbourne market of, roundly, £30,000 per annum. He has, apparently, reached this conclusion by either an intentional or an erroneous interpretation of the report, and only by tearing certain data out of their context and entirely disregarding the accompanying explanations. In order to lucidate this matter in detail, it is necessary to refer to that portion of the printed report which contains the details furnished by the chief engineer, namely, on pages 19 and 20 of the printed report. Special attention is called to the fact that the Commission has had slightly to increase the estimates of the chief engineer for reasons which did not concern or affect the report of the latter, but which are clearly set out on page 8 of the report, in the fourth paragraph of same, as follows:—

> "Attention is drawn to the difference between the estimated costs for (*a*) and (*b*) quoted above, and estimated costs for supply under similar conditions as set out in the chief engineer's report. This is due to the necessity for taking into account interest during construction as required by a recent decision of the Cabinet."

The decision of the Cabinet was given subsequent to the date of the chief engineer's report to the Commission. The material figures are, however, not those given on page 8 of the report, but those contained in the report of the chief engineer on pages 19 and 20, and these are as follows:—

2,300 *Kilowatt Demand at Shepparton and Wangaratta.*—Average cost of delivering 88,000,000 kilowatt hours to Melbourne, excluding charges on stand-by steam plant—0.202d. per kilowatt hour.

5,000 *Kilowatt Demand at Shepparton and Wangaratta.*—Average cost of delivering 81,500,000 kilowatt hours to Melbourne, excluding charges on stand-by steam plant—0.187d. per kilowatt hour.

From Morwell Extension Plant.—The average cost of delivering energy to Yarraville terminal station is 0.185d. per kilowatt hour.

From above figures it will be seen that, in the initial stages, when the demand in the north country is not expected to exceed 2,300 kilowatts, the extra cost of energy to Melbourne will be only .017d. per unit, or about £6,250 per annum, and not 0.075d. assumed by Mr. Lincolne, but that as the demand

of the north country increases, this extra cost steadily disappears, until when the demand reaches 5,000 kilowatts it vanishes altogether. It may, however, be asked why I am, for the purposes of this statement, using figures which expressly exclude "Charges on stand-by steam plant," whereas the Commissioners' figures given on page 8 include these very charges. The answer is simple. In making a contrast between the relative merits of Sugarloaf and Morwell, as independent sources of supply for the Melbourne market alone, the Commission was bound to put both propositions on an equal basis as to their ability to provide continuity of full service. Inasmuch as the report makes it clear that in certain months of the year there may occasionally be a shortage of water necessary to maintain the full potential output of the Sugarloaf system, it is a proper procedure to charge against the Sugarloaf scheme the annual cost of a hypothetical steam plant sufficient to make up such a deficiency when it should occur—such hypothetical plant being, of course, not necessarily located at Morwell. When, however, the actual cost of supply has to be calculated, regard must be had to the fact that this hypothetical steam plant does not, in fact, exist, and will not, in fact, be erected, but that it has merely been postulated for the purpose of making a scientifically true comparison between two competitive proposals. For this reason the chief engineer has, in the passages above quoted, rightly excluded the estimated annual cost of such subsidiary steam plant. The net conclusion from these considerations is that, in order to determine whether and to what extent the metropolis is to be asked to carry any burden, direct or indirect, in order to enable a cheap supply to be given to the north country, the proper figures to analyze are not those seized upon by Mr. Lincoln with regard to the context, but those very plainly and unequivocally set out by the chief engineer in his portion of the report. These figures show conclusively that when the total demand of the north country has reached 5,000 kw. the cost of supply to Melbourne from the Sugarloaf scheme will be no greater than the cost of an equivalent supply from an extension of the Morwell power-house, and that under the worst conditions, that is to say, at the very initiation of the scheme, the burden upon the metropolis will not exceed £6,250 per annum. The Commission definitely considers this a very small price to pay, and only very temporarily, for the inestimable advantages of tapping the hydro-electric resources of the State, as well as of "insuring" the maintenance of essential public utilities in the eventuality of industrial troubles at Morwell."

2375. *By Mr. Eggleston.*- Is this altogether hypothetical. You will have to use that amount of energy to use up the deficiency?—Yes, we would have to use that amount with the available spare plant at Morwell.

2376. You say the surplus energy available at Morwell will be sufficient?—In two ways. The other units are all capable of slight overload. The boilers are capable of 25 per cent. overload, and the turbo-generators I do not know how much, but quite that much.

2377. So, as a matter of fact, it will not be necessary to go to any expense to satisfy the demand, but it is all available?—Yes.

2378. Will it be any more expensive?—The rates are there—the producing rates are there. They are very close together. We are really quibbling about the second decimal place of a penny. By the time we get to this stage we will have available 80,000 kilowatts. That is more than £700,000 a year, so that is a very small thing in relation to the whole output.

2379. *By Mr. Beardmore.*—In respect to the power for the north-east, we certainly desire to get the cheapest power as long as it will serve the district. Sugarloaf is part of the original Kiewa scheme? Yes, it is part of it, and the cheapest part of it.

2380. I presume Kiewa would supply too much power?—There would be no market for the output of power available from the larger scheme—no market yet.

2381. Would it be practicable or economical to harness Kiewa so as it would produce the same amount as Sugarloaf, and duplicate the machinery later?—No, because it would be most uneconomical to attempt to cut down the hydraulic works. The hydraulic works should be designed for the fullest utilization of the stream; therefore, to put lesser hydraulic works for a partial scheme would mean that all that money would be thrown away when you wanted to enlarge it at a later date.

2382. The hydraulic works are the most expensive part of the proposition?—Yes, but there is another reason. The Kiewa power-house would be more than twice as far as from the market. Kiewa is a very long way from Sugarloaf. Sugarloaf is much nearer to Melbourne and the north-east than Kiewa.

2383. Harnessing Kiewa for 15,000 would not be economical?—No, when once you go to work to tap the resources of a stream it is not economical to do less than take the utmost you can out of it.

2384. Then the main objection to harnessing the Kiewa, by your argument, is that the demand does not exist to absorb the power?—Yes. Taking Mr. Michel's original figures he shows that Kiewa will have an annual cost of some £350,000. You have to raise 350,000 by the sale of electricity before you can pay your annual charges. You cannot raise that sum in the country. You cannot cut a transmission line into half. When once you take a stream, and say generators, but you cannot cut a water conservation into half. When once you take a stream, and say you want to store water in it to have a permanent flow all the year round, it is not economical to do less than the utmost capacity of the stream.

2385. Yes, I follow that. It is your opinion, I presume, that at a later stage the Kiewa scheme will come into operation?—So much so is that the fact that we have maintained the whole of the organization for keeping Kiewa under observation. We have men there gauging constantly. We regard it as one of the potential water-power schemes of this State when the demand comes that will justify the actual expenditure.

2386. I suppose you cannot give any indication when?—That is very hard to say. I say quite distinctly that if we can get industries into this country, particularly the metallurgical industries such as electric furnaces and those industries like carborundum and graphite, and so on; these are industries which work the whole 24 hours for every day of the year, and they cannot ever go out, and when they mount up to, say, a constant demand of 30,000 or 40,000 kilowatts, when they approach that, then is the time for a great hydro-electric scheme like Kiewa. It might not come for ten years, but it might come in ten months if the industries come here.

2387. *By Mr. Eggleston.*—Are the raw materials for those here? Yes. It is a problem to which we will have to address ourselves in the second phase of our activities. When we have the power available, then we must set to work to lure industries to this country.

2388. Raw material for nitrogen is everywhere, is it not?—Yes. An industry of that kind possibly could be located in the north-east close to a scheme like the Kiewa.

2389. That would depend, of course, on the cheapness of the product as compared with other manures?—Yes. Of course, this aspect of the matter is not one that I have closely investigated, but I only indicate the kind of industry that would have to come here in sufficient numbers to justify a scheme directed to meeting a heavy constant daily load like 30,000 kilowatts.

2390. *By Mr. Beardmore.*—You set out here that when the Sugarloaf comes into operation, you will be able to supply power at 1.18d. to Wangaratta, Benalla, and Shepparton centres?—Yes.

2391. Can you give any indication of what the cost will be carried on further?—Mr. Harper has that all worked out, and he will be glad to give it to you. He has a tabulated list of towns

2392. It seems to me that the north-east is much more favorably situated than the south-western and

Gippsland schemes?—The reason of that is quite plain. The point is the length of transmission and the number of people served per mile of transmission. The north-east is a triangular area where you could reach the centre of gravity of the population with a much shorter distance than you could in a case like the south-western district, which is strung a long thin line the same as Gippsland. These are unfavorable cases. There is no hinterland to the south-western or Gippsland. The population has grouped itself round the main railway and the main road.

2393. Gippsland, considering they have the coal in their centre, their charges come out relatively higher than the north-east?—We cannot help laws of nature. If you build a railway train to serve a town of 500 people you cannot expect the traffic cost to be as favorable as if it were 5,000 people.

2394. No. Did Messrs. Coane Brothers report on the Sugarloaf?—Yes, their report is bound up with the Commission's report, and signed by them.

2395. Did any other engineer than Mr. Michel examine their report on the Kiewa?—Only so far as Mr. Coane reported on the Sugarloaf portion of the Kiewa. Messrs. Coane are carrying on the Kiewa gaugings and observations, and have been doing so for two years.

2396. The data you are working on are on Mr. Michel's figures?—Before 1920 on Mr. Michel's figures, and since 1920 on Mr. Coane's figures.

2397. You are going to harness the Sugarloaf Weir. What about the Hume Reservoir, which is a much bigger proposition, near to Albury. Is that practicable?—Yes, but before the Hume Reservoir can be of any use for hydro-electric power we must find supplementary sources of power for the months of the year when the flow will have to be stopped while the reservoir is filling.

2398. You have not that data yet?—We have not started yet. The Hume Reservoir is an Inter-State work, and we have done no more than place ourselves in communication with the Commission that has charge of the work, to ask them whether they are prepared to let us investigate the matter from the point of view of outlet works to safeguard the hydro-electric possibilities of the future.

2399. The New South Wales Government are already making inquiries round the Hume Reservoir as to the possible power that can be sold, and I was wondering whether the Victorian Commission would have control over that?—I am quite sure that we would, although I am not able to give any reasons for that belief. I am quite sure that, as much of the water stored in the Hume Reservoir will be Victorian water, we will have the right to a proportion of the energy developed from its flow. We say there will be a demand in 1928 for all that the Sugarloaf scheme can produce.

2400. *By the Chairman.*—The Sugarloaf scheme supplemented by the Morwell?—The Morwell is only a temporary measure.

2401. Where do you propose to provide the additional over and above the Sugarloaf and Rubicon?—The scheme of 1920 is not the scheme of 1922. The report you have before you clearly sets that out. The 1922 scheme is a much larger scheme as regards Sugarloaf, although not much more costly than the 1920 scheme.

2402. Taking it all together, that means by simply confining yourself to the Sugarloaf and the other small supplies connected with it, that you save an outlay of nearly £3,000,000?—Two million five hundred thousand pounds I should say.

2403. Should at any time the demand increases beyond present expectations, the Kiewa can be fallen back on?—Yes.

2404. Because in the meantime we are saving interest on £2,500,000?—Yes. The Kiewa scheme is in no sense abandoned. In point of fact, all the hydrological surveys are in full swing, and the transmission line is being surveyed from Kiewa to Sugarloaf.

2405. It is simply power in reserve?—Yes.

2406. *By Mr. Eggleston.*—With regard to the survey of the rivers, I notice in Messrs. Coane's report there is not much detail of any of the gaugings on the smaller rivers?—Quite true. That is one of the disabilities we are suffering from right along the line. We have very little information of any of the smaller rivers, and very little information of the larger rivers in the higher reaches. The whole of the hydrological investigations of the State made hitherto and the climatological investigations are confined to those areas where irrigation comes in. People have been interested in the flow of the Goulburn at Nagambie, but not at Sugarloaf. The result is that when we start on these hydrological investigations we have only indirect methods. We have few direct stream gaugings. We have to rely on inferences that are to be drawn from rainfall, and the way we proceed is this: Take Snob's Creek, for instance.

2407. You have no details for Snob's Creek?—We have some, but they only cover a year or two. One has to go to Snob's Creek, and actually measure by actual survey the catchment area up to the point where the diversion weir comes. Say, for the sake of argument, it is 1,000 acres. We have to go to the rain gauges kept in that district over a series of years, and we find one there, say, 5 or 10 miles away, and we find that the average rainfall is, say, 30 inches. We then have to make a deduction of the behaviour of similar country elsewhere to find out the percentage of rain flowing off. Let us say that we have in some other ranges more accurate information about another stream. We may say we can rely on a 30 per cent. or 40 per cent. flow, and from these figures we have to draw a deduction that the flow off of this stream will be so many cubic feet per second.

2408. Do you test the soil, too?—Yes, from the point of view of absorption. A rocky formation has a better runoff than agricultural soil. That is what an engineer in a new country is thrown back upon. They endeavour to make sound deductions from analagous cases. We have to make a conservative estimate. If you have the choice of, say, a 40 per cent. or a 50 per cent. flow, you would take the lower figure for the margin of safety.

2409. *By Mr. Beardmore.*—I presume you have not made any gauges of the Sugarloaf during a drought year?—Yes. We have the most minute information about the behaviour of the Goulburn at Sugarloaf, extending over 40 years. I want to amplify my answer to Mr. Eggleston. I do not say that we have no information at all about the other creeks. We have gaugings for two or three years past, but that is not conclusive. We have to verify these gaugings by the calculations of rainfall I have spoken of. Mr. Coane is of opinion that the last two years have been record low years for those creeks, and that his gaugings of the last two years are a very reliable guide.

2410. *By Mr. Eggleston.*—He could tell to a certain extent by marks on the banks I should say?—Yes, and by the experience of old residents.

2411. And in taking rain gaugings, he would take them probably from lower down the river where the rainfall would be less?—Yes. On page 33 Mr. Coane said—

> Rainfall observations on the catchment areas of the Rubicon and Royston have been taken by nipher gaugings since 1919, and, as far as can be judged from these short records, indicate an annual fall of rain and snow amounting combined to approximately 65 inches. The discharges of these mountain streams were not recorded until gaugings were commenced on

the Rubicon and Royston Rivers in 1919. Regarding the minimum flow, no gaugings are available over periods of extreme drought, but it is agreed by those who have known the district for many years that the summer of 1919-1920 was an unusually dry one. Gaugings taken during that season showed that the combined flow of the Rubicon and Royston Rivers did not fall below 21 cubic feet per second. This is about two-thirds of the normal discharge that we have allowed for in framing the estimates of power obtainable during an average autumn. The winter flow is, however, always in excess of diversions that would be economically practicable for power development purposes.

Absolute accuracy does not matter so much in a case of a combined scheme like this where you have the winter flow cared for by one set of streams, and the summer flow cared for by another set of streams.

2412. Those streams come in mainly for the winter flow?—Yes. Suppose any of these streams failed entirely in any one summer, it won't seriously affect the scheme.

2413. The only other thing was the power survey. Have you details of that?—Yes. Mr. Harper will be prepared to speak about that in detail.

2414. It is freely suggested that this is an attempt to show that the Commission can supply country districts, and so affect the opinion of members of Parliament who represent country districts, but I mean I presume that you took the report absolutely on its own merits?—Entirely. I cannot understand the point of view which imputes to the scientific man anything in the shape of bias, conscious or otherwise. These are scientific problems based on the arithmetical working out of results, and it is entirely foreign to the mentality of scientific men to impart any colour into their results, and in this whole matter of supply right throughout the country we have in every case sought with particular concern a supply which is the most economical and most efficient, and here, far from it being the case that we have been, so to say, pushed into a particular direction, we have actually foreshadowed it in 1920—two years ago. We informed Parliament and the public two years ago that we were going to do this thing, and we have done it, and we have reported at the earliest possible moment, but the initiation of the inquiry took place right at the beginning of the Commission. It started in 1919, and was referred to in 1920, and has been finally reported on in 1922, so there is no other motive behind the investigation but the motive of seeking the most efficient method of giving electrical service to the country.

2415. With regard to that, the Ministry might say we want a power supply for the North-eastern District, and the Morwell scheme will be unfavorably received unless we do that, and you say to the Minister, "This is a question of policy for you, and if you direct us to do it, we will do it?"—The whole tenor of our report negatives that. The Commission are not composed of men who are likely to father a report which they disbelieve in, merely because the Ministry of the day happens to tell them that they want a report.

2416. *By Mr. Beardmore.*—It is really stated that the Government asked the Commission to bring into operation some hydro-electric proposition to serve the North-east to placate the members living there?—I give that a categorical denial. The Commission has been fully impressed with the necessity as per its charter and instructions from Parliament to exploit the whole resources of the State for power. Those resources are brown coal, black coal, and water power, and we would have been neglecting our duty if we neglected to investigate water power. We have investigated it, and in one case—Kiewa—we have investigated it and said it is too big, and now we have found a smaller scheme for which a market is available, and we do recommend it.

2417. *By Mr. Eggleston.*—Is there any possibility of any water scheme in the Western District like the Grampians?—Yes, a possibility. We have a survey party there now. The Otway forest requires investigation, but members must realize that those are most lengthy matters. Most of these places are inaccessible. Then you must be thoroughly sure of your hydraulic data in times of both good flow and dry years, and you must be sure of a market being available to give you a revenue for your outlay.

2418. *By Mr. Farthing.*—Have the upper reaches of the Yarra any hydro-electric possibilities?—Yes.

2419. Worth considering?—I am sure they are, but it is a question of to what extent one may dare to interfere with the purity of the water supply of Melbourne. I am in close touch with the engineer of the Melbourne Water Supply in respect of hydro-electric possibilities of a series of storage reservoirs in the Yarra basin which are projected for the future supply of Melbourne. Far up stream from the Maroondah Dam there are other storages projected, and there will be from these a constant outflow of water right down the Yarra Valley, and these present very effective possibilities for hydro-electric power, always, of course, assuming the question to be settled of accessibility of the country for power-houses. The solution may lie in the direction of some modern automatic power-houses. There are such things as automatic power-houses.

2420. It comes within the range of Morwell?—Only in respect of an additional area now being asked for. On the southern flank of the Baw Baw, the east and west Tanjil take their rise within certain territory the Board now wishes to reserve, but not in a way that is likely seriously to interfere with the Morwell power-house. There are other hydro-electric possibilities in this country. The Snowy River presents possibilities, but it is so far away.

2421. *By Mr. Lind.*—I had that in mind. One survey party has been there already. The main Snowy River has proved disappointing, but there is one of the tributaries which has proved very attractive, and we are going to have closer surveys made.

2422. *By Mr. Eggleston.*—I should say a good deal depends on whether there is a port. There is no port?—There is no port yet. The point is that the sooner the State starts making proper records of the behaviour of the streams, the more we are paving the way for future generations to carry out all these works. We think the money spent on these surveys is a splendid investment for the State.

2423. *By the Chairman.*—All these hydro schemes have been surveyed and the levels taken and carefully computed, and the rainfall compared also?—Yes, and better than that, in connexion with the Goulburn we have 40 years river gaugings by the Water Supply Department.

2424. *By Mr. Eggleston.*—Is the Sugarloaf irrigation dam complete?—It is being filled, but it is not complete yet. Water is entering it. We are relying to some extent on the Sugarloaf water conservation in case anything goes wrong at Waranga.

2425. *By the Chairman.*—So far as the North-eastern scheme is concerned, it is the result of careful survey, and all the data available is used?—Yes, and it is not the opinion of a single man. We have all our scientific men working together, and we are acting on a consensus of their opinion.

2426. In the meantime, while the hydraulic power is being perfected, you will be able to give them a supply much earlier by the overflow from Morwell?—Yes.

2427. You are giving the same chance to these people there that you are giving under clause 2 of the Bill?—Yes.

2428. Giving them a supply before they could expect it naturally, and before they could be called upon to be responsible for it?—Yes.

2429. The source of supply, notwithstanding the fact of its having been conveyed that distance, will turn out much cheaper than would any steam generated power be locally?—I am quite sure of that.

2430. And as against that, you have in the one case the regular supply which can be depended upon, as against a perfunctory supply which might be received from different municipalities from different small plants in their own areas?—Exactly, and with all the uncertainties of the fuel supply.

2431. In the one case you have a national scheme? —Yes, with big reserves of power behind them.

2432. And, of course, so far as the question of establishing industries is concerned, everything turns upon the supply being sure?—Yes.

2433. Cheap electricity and plenty of it?—Yes, and reliable.

2434. And, of course, your object now is that as soon as this scheme is passed and you get parliamentary authority, you will then construct the lines, and give them an earlier supply than they would ever possibly get?—Yes, anticipating it by three years.

2435. *By Mr. Eggleston.*—If these metallurgical industries started, would it not be possible to get them started at a place like Westernport, where there is a magnificent harbor, and transmit to there?—I am looking somewhat into the future in my answer, but I should say that, while Westernport has considerable claims, there is another place which has even greater claim, and that is Corner Inlet.

2436. I thought of mentioning Welshpool, but is that not a difficult place to convert into a port?—I understand you can get 15 or 16 feet of draft there quite easily, and you have a magnificent brown coal field right up on the water's edge, and you have possibilities of great industrial development. That is, of course, for the next generation. We won't see that. There are all the factors present at Corner Inlet for a great industrial metropolis as if they were designed by nature for the purpose.

2437. *By Mr. Deany.*—On the question of load factor, Mr. Lincolne says, "The Commission has estimated that the load factor of the North-eastern district will be 30 per cent., and our estimates of energy cost are based on this figure. I have not the least hesitation in saying such a figure is ridiculous"?—Mr. Lincolne did not make the survey, and we did. It is very easy for him to say it is ridiculous.

2438. *By the Chairman.*—In your report on page 9 you say, "The territory which can be so served embraces that important triangle of country bounded on the north by the River Murray from Echuca to Wodonga, on the south-east by the north-eastern railday (including its eastern branches) to Euroa, and on the south-west by a line drawn, roughly, from Euroa to Echuca." You are not likely to have any competitor there in that area except this particular scheme?—That is so. There is no other possibility. With steam power you always have the fuel problem.

2439. *By Mr. Eggleston.*—You would denude the whole countryside?—Yes, I think they have done that already.

2440. *By Mr. Beardmore.*—You consider that if you do not go on with the Sugarloaf scheme, it would not be practical or economical to supply the Morwell power to the north-east?—I do not say that. I do not say it would be uneconomical. We have not investigated it from that point of view, but we think there would be many of the smaller towns where the charges would creep up to such a figure that it would be cheaper for them to have a local scheme.

2441. *By the Chairman.*—If a regular and cheap supply of electrical power could be secured, the possibilities of ordinary farm work are enormous?—Yes.

2442. At present they are using a large number of small petrol engines on the farms?—Yes. I am not speaking now with any final or definite conclusions, and I do not know whether Mr. Harper will bear out what I say, but my impression is that if you get three or four farms per mile of line, you can give a rural supply to the farmers. I mean a total of three or four farms on both sides of the line. You can give them a supply of energy which will be cheaper to them than any alternative form of energy that they can use.

2443. *By the Chairman.*—Of course, to a great extent the future development of the demand depends upon the manner in which it is supplied and the way in which they begin to use it?—Yes, and it depends to some extent on the way it is sold. It is part of every electrical undertaking to have a staff of people going round teaching the people how to use electricity. They have demonstration trains with carriages fully equipped with appliances, and they send it down the line, and let the people have a look at it. That is what they do in America and in England, and that is the way to sell power, and that is the way to lift up the standard of comfort of the people.

2444. It appears, judging from the reports, that we are laying the foundation of a huge scheme, and if all the deductions are correct we will be able to supply cheap power to the whole of Victoria for all time to come?—I won't say the whole of Victoria, but the whole of the more thickly populated portions of Victoria.

2445. If you get a cheap and reliable supply, there is no question about it that the demand will increase? —That is so.

The witness withdrew.

Herbert Reah Harper, recalled, and further examined.

2446. *By the Chairman.*—You are going to give us some points in connexion with electrical supply?—Yes, Mr. Chairman. Sir John has described the hydraulic works in fairly good detail, and I would like to supplement those remarks by a few particulars on the electrical side. At each of these five stations in the Sugarloaf group it is intended to install one turbine generator, with the exception of the Snob's Creek station, where there will be two. Now, these stations will all be worked automatically from a central sub-station called the Rubicon "A" station, and the automatic operation of such stations means a great deal in the economy of supplying power. Stations of this design are now pretty common in America, and are giving every satisfaction; in fact, they are now introduced in connexion with the suburban railways here. Several of the sub-stations, particularly that on the Dandenong line will be worked quite automatically with no attendant, and the machinery will start up and shut down as the trains enter and leave the section. These water-operated stations will be started up and shut down by the attendant at the central sub-station marked on the plan as "Rubicon sub-station 'A.'"

2447. *By Mr. Eggleston.*—Is that a generating station?—No, only a control station. The stations will all be coupled up with 6,000 volt lines to the Rubicon "A" sub-station. From the latter a transmission line will be run to Melbourne to convey the surplus energy from the Sugarloaf group of stations, and transmission lines will be run from Rubicon station to Benalla, where they will branch, one going to Wangaratta and the other to Shepparton. These are what may be called the main transmission lines, and will convey energy at 66,000 volts. That is a voltage which will

render very satisfactory service, and has been in operation for several years in America. In every instance it has proved quite reliable. Then it is intended to send portion of the energy which is generated at the Sugarloaf to the north-east, and in the course of two or three years this will amount to 2,500 kilowatts. You will get a good idea of these operations by looking at the third drawing attached to the report. The lower curve represents the output from the Sugarloaf group which is required for the north-east during the first two or three years, and the balance of the square represents the amount of energy to be sent to Melbourne. The square I am indicating is bounded by the line "C" at the top. The whole of the space under curve "C" represents the total energy which can be developed at Sugarloaf, and the difference between the total area and the area enclosed by the curve "A" will represent the amount which can be sent to Melbourne in the first stage. Later on, as the demand in the north-east grows, less will be sent to Melbourne, and the second curve "B" shows the output to the north-east at a time when we expect about 12,000,000 kilowatt hours to be absorbed thereat. As a matter of fact, this represents the requirements of the north-east to-day, as it is estimated that the equivalent of about 12,000,000 kilowatt hours is being used by the industries using power in some form or other to-day in that territory.

2448. *By the Chairman.*—And the space between "C" and "B" I take it shows the power you can provide if necessary?—That is so. As the north-east cannot absorb the whole of it, the balance will be diverted to the Melbourne market, the only market that can absorb it. We estimate that it will not be for two or three years that Melbourne will be able to absorb a steady load of 16,000 kilowatts throughout the 24 hours. The night demand is still well below 16,000 kilowatts, but in two or three years the Melbourne demand at the time of its daily minimum will be equal at least to 15,000 or 16,000 kilowatts.

2449. And this graph simply represents distribution possible from the Sugarloaf and Rubicon group?—That is so. On page 16 of the report is indicated first of all the total capital expenditure on the Sugarloaf and Rubicon group, which is the amount I have already mentioned (£551,370 sterling). That comprises the total expenditure on the five water-power stations, and the group has a capacity of 16,640 kilowatts as a maximum which is the figure mentioned on the diagram.

2450. *By Mr. Eggleston.*—Would it be capable of supplying that all through the year?—No, that is the maximum output for an average year.

2451. *By Mr. Beardmore.*—Do you quote the minimum?—That is the maximum demand, which is not maintained throughout the year. The curve on diagram No. OM433 gives an idea of the capacity of the Sugarloaf scheme, and indicates the capacity of the scheme during a period of one year. It has a load factor of about 79 per cent., assuming that the plant is maintained in such good order that every foot pound of energy in the water can be converted into electricity and conveyed to the markets. That, however, is too good a thing to hope for. Therefore, we allow an availability factor of about 90 per cent., which, as is obvious, is 10 per cent. less than the maximum possible with the scheme. If you will look now at the diagram you will see that against the Sugarloaf scheme in this report has been charged an amount to cover the water power deficiency in the month of June. You will notice in this month the output is 11,900 kilowatt, while the maximum available at Rubicon "A" station at any time is 15,750 kilowatts, and it is the capital charges on this difference which is charged up against the Sugarloaf scheme in the shape of steam plant to meet the deficiency during the month of June.

2452. *By Mr. Eggleston.*—There is a still greater deficiency in April?—Yes, but that is unimportant, because the demand in Melbourne is much lower in that month. We know that in Melbourne there will be 5,000 kilowatts of demand, which will appear each year at the commencement of June, and continue on until about September, and therefore the inability of Sugarloaf to give a continuous output at the maximum for the four winter months is a measure of the extent of the standby plant which should be debited against the scheme on that account. That is why in this report a charge to cover the capital charges of steam plant is debited against the Sugarloaf scheme to meet this deficiency in the worst month of the four. However, 3,850 kilowatts is only a very small portion of the capacity of one of the generators which will be kept in reserve in the Morwell and Newport stations. Further, the charge to meet this deficiency made against the Sugarloaf scheme is really academic in form, and does not represent any actual or likely expenditure.

2453. *By the Chairman.* I take it these figures on the graph for the different supply are based upon the river gaugings for that supply?—They are the kilowatts which represent the maximum amount of energy available during any month of an average year.

2454. But that average depends on the amount of water you have?—Yes.

2455. And this is how you can deliver that available water supply power—it depends on the average water supply available throughout the year?—Yes.

2456. And these are not supposititious figures, but figures based on gaugings of the streams?—They are based on 40 years' observation or gauging of the streams in question, the Delatite and the Goulburn. Then, having clearly ascertained the amount of power available under the Sugarloaf scheme, it became necessary to ascertain how this amount of energy could be absorbed. There were two markets available, the north-east and Melbourne. It was found that by taking a portion of the supply from the Sugarloaf for the needs of the north-east a supply could be made available at two centres, Wangaratta and Shepparton, at extremely low prices. I think it may safely be said that when the Sugarloaf scheme is in operation (that is the second stage in table 2) we shall have a supply available at these two places at a price that will compare favorably with those possible in Melbourne. Industries will have no cause of complaint as to the cost of energy, for they will be as well off in the north-east as they are to-day in Melbourne. An industry which requires a 24 hours' supply of power (provided it was not too remote from Wangaratta or Shepparton centres) would be able to obtain its power at a price no higher than at which it can be obtained in Melbourne to-day. This is an important factor in problems of decentralization and the establishment of new industries in country districts. The market in the north-east was very carefully surveyed, and the power requirements critically examined about twelve months ago. An estimate was made by a very careful officer, who examined every factory and its requirements, and the figures obtained were brought to Melbourne and analyzed very carefully. The result of the analysis was, as Sir John Monash has just explained, that a demand was shown to exist to-day equivalent to 12,000,000 kilowatt hours. Although that is sufficient to justify the scheme, it does not indicate what the future has in store for that area when energy will be available at the low prices set out in this table. In addition to the existing power requirements there should be in the near future a very big demand for

energy for railway purposes. It is not at all difficult to estimate what that would amount to in the course of a few years.

2457. *By Mr. Eggleston.*—Would the Railway Department take a favorable view of that?—Yes.

2458. Where there are only one or two trains?—There is a very big night traffic on that line—goods traffic.

2459. *By the Chairman.*—It looks as if a good deal of the railway work could be done with electricity provided the power were available at the right price?—I think a price to-day could be offered to the Railway Department which would make them consider very favorably the electrification of the whole of the north-east lines, and that alone would call for about 30,000,000 kilowatt hours.

2460. *By Mr. Beardmore.*—This is the busiest line in the State, or one of them?—Yes, and what is most important is the fact of the load being at its maximum at night time. Many of the goods trains run during the night when there is no other demand for power, and therefore I do not think it can be claimed that our view is in any way unreasonable when we say the possibilities of the north-east are such that a load of 5,000 kilowatts may be expected to develop within a few years. A schedule of the industries will give some idea of where this demand exists. There are woollen mills, which, as you all know, form an industry which is only in its infancy, and for which there is a very wide field. The woollen mills to-day require a quarter of a million kilowatt hours, the tanneries a quarter of a million, the quarries 100,000, pumping (irrigation and town) three-quarters of a million. Then we have flour mills requiring 2,000,000 kilowatt hours, which are the best consumers of the lot, because they run steadily throughout the 24 hours. There are butter factories which in the north-east require half-a-million, making a total, excluding Shepparton, of about 10,000,000 kilowatt hours, and including Shepparton, of about 12,000,000 kilowatt hours. In Shepparton there are several industries which give promise of very great expansion in the future, particularly the canning industry.

2461. *By Mr. Farthing.*—What would be the amount of energy required for the average butter factory?—They vary very greatly in size, but the average would be 150 to 200 horse-power. A butter factory requires steam for heating purposes, and one must bear that in mind when forming estimates.

2462. *By the Chairman.*—There is a tremendous quantity of steam used in washing and cleaning the cans and things?—Yes, that must be borne in mind. In connexion with this matter of power requirements, I would like to read an extract from a report written by Mr. Parry in 1918 on the hydro-electric development in New Zealand. Mr. Parry is a well-known engineer who has since returned to England, and become one of the leading men in one of the largest electrical manufacturing companies. In dealing with the possibilities of hydro-electric power supply he said—

> In considering the design of a power supply system it is, first of all, necessary to determine the total amount of power that will be required. This, of course, bears some relation to the population that will be served when the power supply is available, and can be estimated in that way. The late Coleridge plant, with its present capacity of 8,000 h.p., is supplying an area with a population of 100,000, or, roughly, 0.083 h.p. per unit of population. The demand for power is growing rapidly, and if the plant were available to supply it, there is no doubt but the horse-power per unit of population would very considerably increase. Owing to the impossibility of securing extra plant, the supply of power for ordinary cooking and heating has had to be severely curtailed, but there is no doubt that the demand for power for these purposes will increase enormously as soon as we are in a position to supply and its value becomes more generally known. During the last financial year, applications for 3,500 h.p. for smelting purposes were refused on account of the insufficiency of the plant at Lake Coleridge. Some of the best supplies of the smaller towns in the North Island, such as Tauranga, New Plymouth, Hawera, and Te Aroha, have from 0.14 to 0.09 h.p. per inhabitant of area served. The three latter are working under severe restriction, due to the limitation as regards the source of supply and high prices, and the figures given in consequence are very much less than would result from an unrestricted supply at cheaper prices. The power supply by the Dunedin Corporation from Waikori is equivalent to about 0.125 h.p. per head of the population served, but the growth of the load has been checked by the impossibility of getting any more power from the present source. There is evidently a demand for more power in Dunedin, as this Department has received application from a Dunedin firm for 1,000 h.p. at Christchurch.
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> In other countries, the use of electric power *per capita* is considerably greater. In a table appearing in the *Electrical World* of the 11th May, 1918, on the use of water power for electric power generation, the following figures are given:—Norway, 0.468 per unit of population; Canada, 0.316 per unit of population; United States, 0.071 per unit of population. These refer to electricity generated by water power alone, but in the United States particularly there is considerably more generated by steam than by water power. The proportion has been stated as 4 to 1 in favour of steam, so that the consumption per head in the United States would be nearer 0.35. In Canada, also, the consumption per unit of population would be increased if the steam generating plants were included.
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> In California, which is one of the States using water power to a large extent, the Pacific Gas and Electric Company has a plant capacity of 270,643 h.p., equivalent to 0.235 h.p. per inhabitant in the area served by it—about 35,000 square miles. When we consider that there are seven other companies with an additional aggregate plant of 266,500 h.p. operating in almost the same area, and all inter-connected, the peak load of the combined systems is about 0.46 h.p. *per capita*.
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> The Ontario Power Commission supplies power to an area of about 51,000 square miles in Canada, and, although as yet large portions of this area are not reticulated, they have a peak load on their system of 157,048 h.p., equivalent to about 0.136 h.p. per inhabitant. These figures are the more remarkable when we consider that the average price charged in California and Ontario is more than is the case in the Government undertaking at Lake Coleridge.
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> The scheme outlined below for the supply of the North Island, 44,000 square miles in area, provides for a maximum demand of 0.2 h.p. per inhabitant on the present population. During the period of construction, however, the population will in all probability increase by at least 2½ per cent. per annum, or 25 per cent. in ten years, which would be about the time necessary to completely carry out the proposal suggested. . . . .
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> The scheme submitted herewith has been designed and estimated on the basis of being able to supply 0.2 h.p. per unit to a present-day population of 650,000, or 0.16 h.p. to the prospective population ten years hence.

Now, this report shows that one-fifth of a horse-power is a reasonable consumption *per capita* of the area served, and our estimates of power requirements are away below this. If we take the north-east, with a population of 71,000 in the area to be served, then according to the New Zealand report there would be 14,000 horse-power required in that area as soon as a suitable and cheap supply is available. We have provided in the first stage for something like 3,000 horse-power, and in the final stage for 7,000, which is half of what Mr. Parry thought four years ago New Zealand's development was demanding. The same thing applies to the south-western district. We have there provided for a demand of 1,000 kilowatts, which is equal to about 1,500 horsepower, but the population is somewhere in the region of 60,000, which according to the New Zealand standard would require 12,000 horse-power. The scheme, however, will be commercially sound with 1,500 horse-power only.

2463. What has been their experience in New Zealand in that regard?—They are still working on that basis in New Zealand. Of course, the scheme is only in course of construction, but there is every indication that this rate of development will be realized as soon as the schemes are in full working order.

2464. Are they not favorably situated there for water power?—Yes. In Switzerland the consumption is about 900 units *per capita*, while in the north-eastern area we have based our scheme on a consumption of 170 units per head. In some districts in America the

consumption rises to a large figure, up to 2,000 in one place—Montana. That is a very special case. In other places, however, the consumption is as high as 1,200. In the north-east of England the consumption is, roughly, 300 units per head. I think you will agree that the figures we have taken for the north-east of Victoria are very reasonable, and in no way absurd.

2465. *By Mr. Beardmore.*—Can you give us any idea of the cost of power at Beechworth or Yackandandah or Tallangatta or Wodonga?—I have not the Beechworth figures, but we have made estimates of the price at which power can be conveyed to several other points in the north-eastern area. On the assumption of a cost at one of the centres of 1d per unit, I think energy could be made available at Yarrawonga at an average price of 4.9d. That is much cheaper than it could be generated by locally operated plant. Beechworth is not far from Wangaratta, but distance is only one element in the calculation. We have also to bear in mind the population and the demand for power. If we assume Beechworth would require over a quarter of a million kilowatt hours, then I think the average price would be somewhere about half of the Yarrawonga figure. Of course, there are mining centres in that locality which call for special considerations.

2466. No doubt you are aware there are tremendous areas of tailings in those districts which might possibly be worked profitably with cheap power?—Yes. Energy might be supplied at about 3½d. at some of these places.

2467. What about Chiltern and Wodonga?—Wodonga is the most costly of the list, as it is right at the end of a very long line. Energy there would cost about 7d. on the average. Although high it is a little less than at which it could be produced there by a local plant. I understand that at the present time they are paying 10d. for light and power. At Cobram we expect that a supply could be given at an average price of about 2½d. on the average. There is also Echuca, with a pretty large demand, nearly 1,000,000 kilowatt hours, and I think it could be met at a price of less than 3d., which is about half of what it could be generated for by a local plant. Mooroopna being very close to the centre could be supplied at about 1.57d. Kyabram would probably be 2½d. In Shepparton itself, where there is a demand for 1,000,000 kilowatt hours, our estimate is 1d. a unit in the first stage of the scheme. That makes the position of Shepparton and Wangaratta as favorable as that of Melbourne in regard to industries being established there, because if you take an industry requiring 100 per cent. load factor you can practically divide these average costs at the centres, Wangaratta and Shepparton, by three.

2468. *By Mr. Lind.*—There are three places, are there not?—Yes, Shepparton, Wangaratta, and Benalla.

2469. *By the Chairman.*—Of course, you recognise that a supply of cheap electric power might mean a wonderful impetus to the treatment of the refractory ores in the Beechworth and other mining districts?—Yes.

2470. And I take it you have not overlooked that there may be a tremendous development on some of these fields?—It may pay to treat the ores electrically.

2471. *By Mr. Eggleston.*—I notice the Eldorado mine or town is marked at 5,000,000 kilowatts?—Yes. Of course, the treatment of ores would be a splendid industry for the application of cheap electric energy. Running night and day and using large quantities of power, it is possible that we might be able to supply current at these centres in the region of a third of a penny per unit for metallurgical purposes, but that would have to be where there was a 24 hours steady demand.

2472. *By Mr. Lind.*—Would it not be particularly valuable where the ores are refractory?—Yes.

2473. *By the Chairman.*—There are half-a-dozen rich propositions which could be worked profitably with cheap energy, but which cannot be looked at now?—I believe that is so.

2474. But, of course, that is a side issue which may only arise if you can supply electricity at a low price?—Yes. Of course, I might add that in the figures I am giving now an allowance has been made for the fact that branch lines and sub-stations have to be built from the three centres as shown on the map.

2475. *By Mr. Beardmore.*—Could industries be established favorably if they had to pay 3d. or 4d. for energy?—Where power is a small item in the total cost of production, it would not make much difference, but it would be a serious matter in, say, metallurgical processes, where electrical energy is a prime factor in the cost of production. You must have cheap power then, and that is why in so many cases metallurgical industries have been attracted to Norway. They can get their power there for less than £1 per horse-power year.

2476. *By Mr. Eggleston.*—Does cyaniding require much power?—I cannot say definitely, but I think it would be required mostly for mechanical purposes.

2477. *By Mr. Deany.*—Would the price that you have given be the average price at Wodonga?—Yes, for power purposes it would be lower. It might be 3d., and a 24-hour consumer might get it for 1½d.

2478. *By Mr. Eggleston.*—I suppose there is a good deal of demand which might be improved for domestic electrical supply?—That is a field so far untouched, and no allowance has been made in our survey for such. I think we are on the eve of big developments in that direction.

2479. Is not the method of producing heat by electricity rather expensive?—It depends on a favorable price for energy delivered at a high load factor.

2480. Seeing that you get heat by the resistance of the metal to the current, is that not in essence expensive?—Not at all. The process is highly efficient, but its commercial application depends on the price of energy. In Switzerland electrical boilers are replacing fuel fired boilers on a commercial scale.

2481. *By Mr. Beardmore.*—Did you take any part in the survey of the Kiewa?—I have been all over the district with Mr. Mitchell.

2482. Did you check the figures?—No, as a personal labour that would be rather hazardous and impossible to check survey figures along those precipitous faces.

2483. But I mean, did you check the figures supplied?—No, that was Mr. Mitchell's section of the work, and he prepared the whole scheme.

2484. As a hydro-electric engineer, do you agree with the evidence of Sir John Monash that it would be impracticable to harness the Kiewa at half-power and double it later?—It would be distinctly uneconomical. It could not be developed in that manner without making the energy cost frightfully high to the north-east.

2485. Of course, we must have the cheapest power?—A hydro-electric scheme can only be developed successfully by making provision to use the full output. You cannot carry out such a scheme in sections, because, as Sir John pointed out, you must make your water races and water works of the maximum capacity. I do not know of any special treatment of the Kiewa which would enable us to get a smaller amount of power at a reasonable price. It must be the whole or none.

2486. It was only my idea as a layman that you might harness up the Kiewa supplies for 15,000 kilowatts, and then double it later?—You could not do that without making it exorbitant in price; in fact, it would mean a frightful burden of capital expenditure for the north-east to carry.

2487. *By the Chairman.*—In regard to your scheme for this district, have you made any allowance for the consequent increase on the introduction of cheap power, or have you only taken the present demand?—We have made no allowance for increases. We have only taken the power that is being used in the north-east to-day in some form or another; in other words, what they actually require to-day, without any allowance for increasing demands, though I think the prospect for such is very promising.

2488. *By Mr. Beardmore.*—I understood Sir John Monash to say you had practically cut the possibilities in half?—Yes, from 12,000,000 down to 6,000,000 for the first stage of the scheme.

2489. *By Mr. Smith.*—I notice in this map that you follow the course of the railway line practically from Euroa to Echuca?—Yes, it will be found that two-thirds of the population of a shire is settled along railway lines, so it will be advisable to take our branch transmission lines practically along the railway routes.

2490. You mentioned the possibility that the north-eastern line be electrified, and you thought the Railway Commissioners would look upon that with favour?—Yes.

2491. In that event, would it be possible for the same poles or towers to be used for the electrical development of the railway?—It is possible, but as a general rule we find the most economical route for the main transmission line is a straight line from the generating station to the main market. We do not follow roads or rail as a rule, because with lines operating at voltages of 66,000 and over, it does not pay to tap them at any point except where the demand is very large. It is far better to go straight to the main market.

2492. In other words, if the railway line took a curve and there happened to be a shorter route, you would take it?—Yes, and if the railways required energy for the Sydney railway line, we would probably run a special transmission line down the Goulburn Valley from Sugarloaf to Seymour. Another aspect that cannot be overlooked is the fact that wood fuel in the north-east is becoming scarcer and more expensive. That is a big factor with the man who has to produce power in some form or other, and only recently we had a visit from the Eldorado mine manager who said he was up against it for fuel, and would welcome a supply of power at the price at which I thought we could supply it.

2493. *By the Chairman.*—I suppose we may assume that all these figures and calculations you put before us are reliable and not inflated, and they have been carefully looked into?—They are not inflated, and can be relied upon. They have been pondered over and studied by many men who are competent to handle them properly.

2494. And in regard to taking into consideration the increase which may arise in the demand for power, you say you have taken exactly what it is, and not what it may be?—Yes, and if we can double the amount of power or kilowatt hours taken by the north-east, we shall be able to correspondingly reduce the price at Wangaratta and Shepparton centres. I can safely say these figures are based on existing requirements, and are in fact conservative estimates.

2495. You realize how easy it may be to speak of what may take place in the future, but which may never eventuate?—Yes.

2496. Of course, we all know it is a region which is bound to develop with cheap power, but there is the difficulty of the distance from the centres of supply?—Yes, but I visited that area recently, and I was astonished at its possibilities. There is also the high cost of fuel which is rising all the time.

2497. Then we can rest perfectly satisfied that the calculations and figures supplied to us now are based on actual facts?—I think you can place every confidence in these figures.

The witness withdrew.

The Committee adjourned.

WEDNESDAY, 6TH DECEMBER, 1922.

Members Present:

Mr. McLEOD, in the Chair;

Mr. Beardmore,	Mr. Lind,
Mr. Deany,	Mr. Smith.
Mr. Eggleston,	

Sir John Monash, Chairman of the State Electricity Commission, recalled, and further examined.

2498. *By Mr. Eggleston.*—We want to know, firstly, whether you wish to add anything to your report regarding the South-Western scheme?—Yes, there are a few observations that might be useful to the Committee. In the first place, I would like to draw attention to the very regrettable occurrence of the burning down of the Colac Power House. That has deprived Colac and district entirely of its electric service, and the Colac Council has determined not to take any steps to restore that power house, in the expectation that they will get the service from the South-Western district scheme by the end of April, as we think we can give it to them then. That is an additional reason why the scheme should be approved so that that service might be restored at the earliest possible moment. Then, further, as regards estimates for the scheme, I am in a position to inform the Committee that the estimates of capital cost, as time goes on, and as contracts are being closed, prove to be entirely adequate. In fact, the Commission expects to make quite substantial savings from the figures indicated in Table 1, page 8, of the report, particularly in such matters as sub-stations, switch gear, and so on; there will be savings of certainly not less than £7,000, and they may run into £10,000. I would like to emphasize the fact that since I gave evidence the Committee has been made acquainted with the fact that every single one of the Western District councils, on being specially appealed to by telegram, have disclaimed any desire to criticise the scheme, and in fact there is a complete consensus of agreement with the scheme on the part of the Western District councils. In addition to that, since the scheme was first launched and mooted, the prospects of an expanded business have almost week by week improved. We are already considering a supply to Birregurra and Winchelsea, and to several branches such as Cobden, Lismore, and the soldier settlements to the north of Colac. They all need actual investigation, and such as prove to be payable will naturally be additional customers of the scheme, and will increase the annual consumption of energy, and it has been repeatedly explained to the Committee that an increase in consumption means a lowering of operating costs, and consequently the possibility of lower prices. Then apart from the communities on the direct route there is also under active investigation the Lonsdale Peninsula, which will be a branch from the South-Western District scheme—that is to say, Queenscliff, Drysdale, Lonsdale, Point Lonsdale, Ocean Grove, Barwon Heads, and all those communities. That will be a branch from the South-Western District line. Then there are possible exten-

sions beyond Warrnambool, which is the present terminus of the works in progress. We think on the whole, therefore, that our estimate of consumption will be fully realized, and we think, further, that our estimates of cost will prove adequate; we have got good grounds for both beliefs.

2499. With regard to the power demands, Messrs. Lincolne aud Demaine made a survey, and you discarded that?—Yes, in certain portions.

2500. You gave us a fairly detailed basis for the north-eastern power survey; are there any estimates in Australia as to the demand for power distributed?—Yes, it varies in different districts, but it fluctuates between not very wide limits. Mr. Harper can give you those figures as to the number of kilowatt hours sold *per capita* in different communities. That is a very safe basis to go on, always remembering that under existing conditions the consumption is limited by the capacity of the existing plant. Take Castlemaine, which has only a 60-kilowatt installation. Obviously the number of kilowatt hours per annum sold in Castlemaine *per capita* is not a true criterion of what the community could use.

2501. But by a system of comparison between this country and other countries you can do that?—Yes, and I would like to make this statement also. The Commission now has a very definite experience in quite a number of cases such as the township of Morwell, Lilydale, Dandenong, Frankston, and Mornington; in every one of those cases the supply is now being given based upon estimates of consumption made beforehand, and in every one of those five cases the preliminary estimates of consumption have been substantially exceeded, and the rate of development also has been substantially exceeded, showing that the basis which the Commission uses is a conservative basis.

2502. I want to be very careful about this, because our Parliament is extremely sceptical about estimates, and the experience of the Railways Standing Committee has been that the estimates have almost invariably been wrong?—We are fully aware of that state of public feeling and of the feeling of Parliament, and that makes us doubly careful. Most of us are men who have been associated all our lives with forecasts of revenue and expenditure, and we have been trained to be conservative, and take a conservative attitude. Nothing would be more foolish in our own interests than to be too optimistic, and afterwards have to carry the baby. As Sir Robert Gibson put it here, his reputation as a competent business man woud be utterly ruined, and so would mine, if we associated ourselves with anything in that direction, and our bias, therefore, has rather been to go the other way.

Mr. Deany.—I have just had a letter from Warrnambool this morning enclosing a copy of your letter to the council on the high-tension lines and transmission. There seems to be some misunderstanding. I find this on page 186 of the evidence previously presented:—

> Mr. DEANY.—I just want this cleared up. You know a statement giving evidence on the South-Western District scheme, said:—"Long afterwards, when we commenced to make inquiries as to what high-tension branch lines they wanted, a gentleman from Warrnambool—ex-Councillor Downing, who was then a councillor—came along and said that he objected—that his Council wanted to supply these high-tension branch lines themselves. We said that it was an astonishing attitude. We were prepared to foot the bill, to take the responsibility for the full care and maintenance, and that the Council would not be prejudiced one way or the other."

In reply to that Mr. Lincolne said:—

> It is clearly understood, of course, that where high-tension lines are erected by the Commission in any area, the annual cost of same (including interest, depreciation, and maintenance) shall be a charge on the local undertaking.
>
> That is in direct contradiction to your statement?—I do not think so. It is a charge against the scheme as a whole.
>
> Of course, Mr. Lincolne says it is a charge against the local undertaking?—Yes.
>
> The CHAIRMAN.—It is not debited to the local authority?—No."

Sir John Monash.—"Local authority." No; there is some confusion there. The "local authority" there means the local authority from which the branch springs; it is not a charge on that authority, but a charge on the community which is served.

2503. *By Mr. Deany.*—Yes, you explained that in some evidence. Supposing a high-tension line were taken from Warrnambool to Koroit, it would not be a charge against Warrnambool?—No; but it would be against Koroit.

2504. According to this evidence it would not be a charge agaiust Warrnambool, but it would be against the whole scheme?—You cannot expect the people of Colac to pay for an extension to Koroit, but the high-tension line raises quite a different query there. Take that letter which was written to Warrnambool, which said that there was one sub-station to be built at Warrnambool. Now, since the scheme was first mooted, Warrnambool has decided to ask for an Order in Council, not merely within the borders of the city, but extending into the Warrnambool shire. They have the option of doing one of two things—either to run a low-tension distribution from our single sub-station all over the place, or to ask us to build more than one sub-station; that is to say, to put other sub-stations in strategically economic places. Now, the latter of the two alternatives is much cheaper. It is much cheaper to carry high-tension electricity to distributing centres than to use a single distributing centre and take all the low-tension distribution from it; consequently we have proposed to Warrnambool that we will give them in the city two minor sub-stations, and, if they want any outside the city limits, to give them in suitable places. Now that is a charge against distribution, because if those sub-stations were not so built, it would cost them very much more to perform the same service with low-tension distribution.

2505. Apparently that was not made very clear. In that extract of the evidence that I read you say—

> We were prepared to foot the bill—to take the responsibility for the full care and maintenance.

?—Yes, certainly; that means to find the capital to carry out the work, but the capital has to earn its return.

2506. But they took it from that that they would not be called upon?—They always have the alternative to carry out the distribution from centre by low tension, which would cost them very much more. The whole cost to them of those sub-stations is £200 or £300 a year, which is infinitely smaller than the cost of taking low-tension distribution over long distances, quite ignoring the electrical losses in a long transmission on low tension. As a matter of fact, that was explained very fully to Councillor Jordan at the time of the elections. I personally explained the whole position to Councillor Jordan, who wished to have information about it.

2507. They seem to have doubts about the whole thing, but I can see that this arrangement is a much better arrangement for them?—Yes, for the city of Warrnambool. They are not being forced to take it. That is our offer to them—to build sub-stations in localities which would greatly cheapen their cost of distribution, provided they found the annual cost of the expenditure involved. Somebody has to find it.

2508. Yes, I think that is a fair charge on reticulation?—Yes, it is a method of cheapening the reticulation.

2509. I would like to say that with the exception of this, I think the Warrnambool City Council is quite satisfied. I attended there with Mr. Lincolne some two or three weeks ago, and we cleared up all misunderstandings?—Yes, if any further explanation is neces-

sary I am quite prepared to go down, because I am quite sure as business men that they would see the point at once.

2510. Yes, the vote they took was a unanimous vote, so that was very satisfactory after all the misunderstandings?—Thank you.

2511. *By Mr. Eggleston.*—Well, now, with regard to the North-Eastern scheme, you have recommended that the distribution be done by the Commission?—Yes, or by a specially created body.

2512. And that municipal distribution in that area is impossible?—Yes.

2513. *By Mr. Lind.*—For the whole of the north-east?—For the whole 28 municipalities covered by the scheme.

2514. *By Mr. Eggleston.*—I do not know whether we want to come to a decision on a general question like that?—I should hardly think so, because, after all, the Commission will do nothing to prejudice this question.

2515. Supposing Parliament decided that they could not disregard the claims of the municipalities?—We would do nothing in the meanwhile to prejudice the position.

2516. Would you say that is vital to the scheme?—I do not say it is vital, but it would be a disadvantage to the consumer.

2517. I mean supposing Parliament came to a decision adverse to your view, it would not affect you?—I do not think that on those grounds the north-east should be left without electricity.

2518. *By Mr. Lind.*—If the municipalities decided that they should be retailers, would you still be satisfied to supply them in bulk?—I would rather put it—if Parliament decided that the municipalities should be retailers. No council has a right to get an area as a right.

2519. *By Mr. Beardmore.*—But what about those who have areas?—Nobody can touch that franchise or those privileges except Parliament; we cannot touch them.

2520. *By Mr. Lind.*—What effect would that have on your scheme if there were a number who had orders and refused to come in?—I should say that those who refused to come in would be somewhat disadvantaged in the matter of economic distribution, but that is not a sufficient reason to deprive them of the service.

2521. *By Mr. Beardmore.*—You do not anticipate that there will be some who will refuse to come in?—No; I say that in a few years public opinion will swing heavily round the other way, because experience in the country as regards electric supply has been disastrous; the service has been indifferent, and the councils have been losing money and charging high rates. As soon as it is realized that this way a cheaper and better service can be given, I think one municipality after another will see that it is not a legitimate municipal business at all. I am speaking with the knowledge of a large number of requests that we have received from municipalities to take their works over. Quite a number in Gippsland have come and said—"For goodness sake take the whole thing out of our hands: we do not want it."

2522. *By Mr. Lind.*—Take Wangaratta; there are at present industries there consuming quite a lot of power and energy; is the Commission in a position to go in there and supply those private firms in opposition to the council?—Not in opposition to the council; if they have a franchise we must respect that franchise. May I explain generally what the position is. The position is really stronger than is generally believed, because under the Electric Light and Power Act there is no such thing as a monopoly. It is stated specifically that the issue of an order to any undertaker, whether a council or a private person, is not to be taken as giving that undertaker a monopoly, and there is power reserved by law to issue another order to another undertaker in the same territory. In spite of that being the law we have definitely refused to consider any such proceeding, because we think it smacks of repudiation, and means injury to the people who have invested their capital there. Although there is power under the law for it, and although there is precedent for it in other countries, we do not do it, and do not intend to do it. We respect existing Orders in Council and existing franchises, and the only authority that can make any change is Parliament.

2523. *By Mr. Beardmore.*—That is not the point; take the case of Wangaratta, where there might be big industries like flour mills needing electricity; you have power under this Bill to go in and pick the eyes out of it?—Only with the consent of the council or company, being an undertaker. To begin with, it is not picking the eyes out of the scheme. If everyhody gets electricity at cost, it does not matter whether "A" or "B" supplies it.

2524. But you would kill their industry if you were to supply two or three of the biggest users?—It would not affect it. Supposing for the sake of argument that you cut the town in half, and "A" supplied one half and "B" supplied one half, and both supply at cost; if they supply at cost, they neither gain nor lose.

2525. But if "B" is only doing half the business they could not afford to run the plant?—But there is only half the investment.

2526. But it is already an investment?—You are considering the sale of electric service like the sale of sugar or flour; it is not. You could take all the high load factor customers out of a scheme and deal with them separately without affecting the resl of the scheme. It is purely a matter of arithmetic. However, the Commission has no intention of picking the eyes out as people allege, except with the consent of the people. Take a case in point. Let me quote Castlemaine again. I quote it because it is a glaring case. The town is using 60 kilowatts of energy. It is a privately-owned plant; it is reasonably well run; the company has no capital to expand. Thompson's, of Castlemaine, require 2,000 kilowatts of energy. Do you think it is likely that the Castlemaine council, which has got no order by the way, would want to get an order specially for the purpose of supplying Thompson's? They would be only too glad to say to us—"Look, we do not want to be bothered with this; you supply them direct and we will make our own arrangements to supply the town." It would be the tail wagging the dog. It would be disastrous to Thompson's to have to take a big block of power like 2,000 kilowatts from a town using 60 kilowatts.

2527. *By Mr. Deany.*—The same argument applies to Warrnambool. It is ridiculous to say that a mill should buy from the local council?—Yes, if your objective is the supply of power at the best possible price to the consumer, then you must make such arrangements as will permit of direct supplies being given to big customers.

2528. *By Mr. Lind.*—Good! That has brought something to my mind which has been agitating the minds of people quite a lot; they do not seem to understand your position, and evidently they have lost sight of the first Acts. I know the position, but I am going to put this question for the benefit of other people; my own mind is quite clear on it—have you got in mind as your objective the monopoly of this State?—The answer is that Parliament has done that four years ago. Parliament said "There shall be a State scheme of generation and nobody in the State shall be allowed to put in a generating scheme of any kind without the permission of the State."

2529. *By Mr. Beardmore.*—The Electricity Commission?—That is the Electricity Commission acting under the Governor in Council. That is under the first Act.

It has been definitely decided by Parliament that there shall be a State monopoly for the generation and supply of electricity.

2530. *By Mr. Lind.*—Well, you have told us from time to time that you are still prepared to let municipalities, or those having orders, go on, and are not desirous of entering compulsorily, as it were, their domain?—Absolutely; that is absolutely the position. I have stated that in a carefully prepared written document which has been embodied in your report. In spite of the objective clearly enunciated by Parliament, we want to exercise our powers without injury to existing interests

2531. *By Mr. Deany.*—Still I suppose eventually, in the best interests of the people generally, you would step in?—Only when Parliament gives us the right to—when public opinion is sufficiently educated to make the demand come from the public itself, as it will surely do, and it is then for Parliament to say.

2532. If that day does not come along, and Morwell is not the big scheme we hope it will be, what then?—I would not say that; it will not reach its full utility until that comes about. You must not envisage such undertakings as the Melbourne Electric Supply and the Melbourne City Council, which are well managed and skilfully organized. You must envisage a large number of undertakers in the country who do not know what efficient service means. For instance, Morwell has to-day a better service than any other rural town or urban community except Ballarat, Bendigo, and Geelong.

2533. *By Mr. Eggleston.*—In a comparison you made in regard to getting power from black coal you took the price of Newcastle coal at 32s. per ton?—That was the price at that time.

2534. But supposing it comes down to anything like the pre-war level?—Then there would be closer competition between black and brown coal, but brown coal would carry the day easily, because even at 65 per cent. moisture it would not take more than two and a half tons of brown coal to equal one ton of black coal, and if you calculate two and a half tons at 3s., that would be 7s. 6d., and Newcastle coal would never come down to that.

2535. I think that is all we wanted?—Well, Mr. Harper will give you the power survey figures for the Western District.

The witness withdrew.

Herbert Reah Harper, Chief Engineer, State Electricity Commission, recalled and further examined.

2536. *By Mr. Eggleston.*—You have some information to give us in regard to the power survey for the South-Western scheme?—Yes, but before I go into the details of our estimated power consumption for the South-Western district, I might say that since my last appearance before this Committee I have received the latest return from the Public Works Department of New Zealand, dealing with the hydro-electric possibilities over there. On the last occasion I referred to some statistics that were published in the previous report, and I thought these later figures might be of interest. With your permission I will read a few extracts, viz.—

The basis of the general system laid out for the Dominion as a whole is a supply of 1 horse power to each five head of population, or 0.2 horse power per head. This was the basis laid down by Mr. Parry in 1918, and no reason has been found to depart from it. It is admittedly ample for all present purposes, but is not excessive considering the possible and probable development of electric cooking and special electric industries; and in advantageous circumstances it is exceeded elsewhere.

Then it goes on to refer to figures obtained from Canada as to the development there, and says:—

In addition to this evidence, the following are the amounts of electric power actually installed in the various provinces of Canada as compared with the supply available in the four metropolitan districts of New Zealand:—

	Total Electric Horse Power installed.	Horse Power per Head of Population
Ontario	1,212,650	0.41
Quebec	1,015,385	0.43
British Columbia	305,315	0.58
Manitoba	97,247	0.17
Nova Scotia	46,948	0.09
Alberta	33,187	0.05
New Brunswick	30,180	0.08
Yukon	3,199	3.17
Saskatchewan	Nil	Nil
Canada (total)	2,762,880	0.31
Tasmania	66,000	0.32
New Zealand	74,000	0.06
Canterbury District	10,000	0.09
Dunedin District	8,000	0.11
Auckland City	17,200	0.20
Wellington City	10,000	0.12

The Canadian figures for the various provinces are particularly instructive, illustrating both the large proportion of power per head of population in the industrial provinces and the comparatively small proportion in the purely agricultural and pastoral provinces. As compared with the proposed allowance for New Zealand of 0.2 horse power per head of population, the large industrial provinces of Canada now use 0.41 to 0.58 horse power per head, whereas the agricultural and pastoral provinces use from 0.05 to 0.08 horse power per head. The demand over the whole Dominion of Canada is 0.31 horse power per head. The relative proportion of industrial to agricultural industries in New Zealand will be approximately the same as in Canada, and the provision of 0.2 horse power per head is thus a comparatively conservative provision.

Then a little lower down, Mr. Birks, who has prepared this publication, says:—

The curve shown in figure 3 gives the output of electric power in the eleven western States of America in which the conditions are generally fairly comparable with those in New Zealand, and a forecast to 1930, based on developments actually in hand.

Then he gives the horse power per head, and it ranges from 0.061 in 1921, to 0.106 in 1925, and 0.156 in 1930. Then he says:—

The forecast of the development is conservative, and will still leave in 1930 an unsatisfied demand of 60,000 horse power. In fact, based on the experience in Canada and the western States of America, a much larger development is required than is included in the present programmes of the Government and the present local authorities.

That deals with the development in Canada.

2537. The Canadian demand may be stimulated by the extremely low price of the current—three cents?—True, but I do not think there will be much difference in price between the Ontario hydro-electric scheme and the Morwell scheme in Victoria, because they are very similar in principle. In the Morwell scheme, as the Chairman mentioned, nine-tenths of the cost is capital, and that is getting very close to the conditions under which a hydro-electric scheme operates. It may be a little higher—perhaps 95 per cent.—in the hydro-electric scheme. In the Morwell scheme the coal cost is comparatively low as compared with a black coal scheme, where the cost of coal might easily amount to 40 or 50 per cent. of the total cost of operation. I anticipate that when we get Morwell energy to the South-Western district, the prices given in alternative "b" of the South-Western District Report will be lowered.

The report on the South-Western district sets out on page 8 in Table 3 the estimated annual consumption of energy on which we have based the scheme, as follows:—

Colac	275,000
Camperdown	200,000
Terang	110,000
Koroit	110,000
Port Fairy	110,000
Warrnambool	670,000
Total kilowatt hours	1,475,000

I think we will have no difficulty in getting that business within two or three years, and as soon as the Morwell energy is available I think the business will increase by leaps and bounds. The population of the whole district was taken as 64,000, of which we expect about 40 per cent., or 24,000, will be served by this scheme. That is on the assumption that that population of 24,000 is concentrated in a strip a mile wide on each side of the line. We have not taken into consideration any of the large milk factories, such as the Trufood Company, at Glenormiston, or Nestles', near Warrnambool, or the Glaxo Company at Port Fairy. We realize that at present we cannot get their business, but I think that it is only a matter of time when we will. The experience in all parts of the world shows that wherever a public supply system is in operation, a manufacturer prefers to buy his power rather than make it himself.

2538. Do those people make their own power?—Yes.

2539. They require steam for heating purposes, do they not, and to that extent it makes it difficult to compete?—Yes.

2540. But you say that with improvements in electrical development it will enable you to give them heating more efficiently?—We are looking forward to the time when we will be able to supply energy for making steam as cheaply as it can be raised by fuel on the premises of the manufacturer.

2541. *By the Chairman.*—Does that 24,000 include the whole population, or the consumers?—No; the population servable by the scheme; the total population of the shires through which the scheme passes is about 64,000 Further, there is likely to be considerable developmeut once we get our scheme going in supplies to farms and stations, for which no provision has been made so far.

2542. *By Mr. Lind.*—You are really seriously considering that aspect, because the feeling is rather general that the Commission has no intention of supplying power to farms; now we want you to say definitely whether you are seriously considering that or not?—It is one of the main objects of our transmission liue schemes throughout the State—to take to the people living in the country some of the conveniences that the people living in the town enjoy—lighting, power, and heating, and I do not think any of our transmission schemes woud be justifiable unless we had that in front of us as one of the main objects.

2543. *By Mr. Eggleston.*—A squatter would not care what the rate was?—No, as long as he got the conveniences.

Mr. Lind.—No. but what about the struggling farmer; I think that in some evidence given by Sir John Monash recently, we were told that the farmers would have to be within half-a-mile.

Sir John Monash.—No; three customers to the mile of route.

The Witness.—That is the basis on which the Ontario Commission operates; an average of three farms per mile justified them in running rural lines, on a subsidy basis.

2544. *By Mr. Beardmore.*—Can you proceed definitely on that ratio?—I could not say that; I would not like to give an exact figure, but it is somewhere on that basis, and I thing it is in connexion with rural lines that subsidies mainly would be required, because the main lines, going to centres such as Ballarat, Bendigo, and Castlemaine will probably be justifiable on their own account. The expenditure on them would be covered by the revenue within a few years, but it is on the rural lines—the branch lines—where subsidies would be mostly required.

2545. *By Mr. Deany.*—On the question of the annual estimated consumption, you know that Mr. Lincolne disputed that. He says that the Commission estimated the consumption at Warrnambool at 670,000 units per annum, but he put it down at 368,000. On page 5 of your report on the South-Western district I find this:—

> It is considered—*vide* Messrs. Lincolne, MacDougall, and Demaine's report—that under favorable conditions a total demand double that estimated in this report could be secured, with, moreover, an appreciable improvement in the load factor.

There is something very contradictory in that from Mr. Lincolne's point of view?—Well, we estimate that within a few years 675,000 units will be consumed at Warrnambool, and we have no hesitation in working on that estimate.

2546. *By Mr. Eggleston.*—What is the proportion as compared with the New Zealand figures?—Let me take the whole of the Western District figures.

2547. *By Mr. Deany.*—According to this, Messrs. Lincolne and Demaine evidently think the same as you do?—I think Mr. Lincolne has taken a very narrow view of to-day's requirements in the Western District, and has made no allowance for growth. It is no good designing a scheme involving £120,000 capital expenditure unless you allow for the future, and we estimate that our figures of consumption will be obtainable within three years.

2548. It is really contradictory taking this report and his evidence before this Committee?—Reverting to what I was saying, we have based our scheme on a consumption of 1,500 horse power, and that spread over the population of 24,000 to be served, means a consumption of .06 horse power per capita. That is less than one-third of what New Zealand expects to develop.

2549. *By the Chairman.*—Practically you base your estimates of consumption on their figures?—A good deal less than their figures; there is a very big margin.

2550. *By Mr. Beardmore.*—Are you basing the cost on to-day's requirements?—The cost of what?

2551. The cost of the different kinds of power?—It is based on an estimate of cost at the time we give the supply, and the requirements of, say, two or three years ahead. Now, Colac's estimated annual consumption is 275,000 kilowatts an hour in our report. Our experience of small towns in Victoria, shows that to-day the small generating plants in operation are supplying about thirty to thirty-five units per head per annum for lighting alone. On that basis alone Colac would consume 144,000 for lighting, and that is practically half of what I have allowed for the total consumption, but, in addition, they have a certain number of motors installed, and as soon as an adequate supply is available in the town at a reasonable price, that consumption will be doubled quite easily. Any town that has only a small amount of power consumption will consume at least sixty units per annum for every person in the town.

2552. *By Mr. Deany.*—Colac could not supply their customers?—There is one town in the Western District to-day generating 45 units per capita; it has a small plant and a limited output, and it is direct current design instead of alternating current, with the limitations associated with that type of plant. Well. if we take 60 units per capita as a reasonable consumption for a town of Colac's size, and a population of 4,800, you get a figure which is much more than we have provided. This makes no allowanee for farms, or for special industries, which will be established as soon as the main supply is brought into the town. There are seven establishments within 10 miles of Colac for the treatment of milk, in which a large amount of power is used. There is also a quarry, and during six months of the year that will use 50 horse power. Then inquiries have already been made of the Commission with a view to taking a branch line from Colac to Cororooke, Alvie and Beeac, and we are also investigating the possibility of supplying Birregurra and Winchelsea, all of which have not been mentioned in our report to you, and they mean additional load. Take Camperdown,

which is 29 miles from Colac; the present population is 3,300. At present there are 450 consumers, and those should increase to 750 or 800 later on, quite easily. The number of units generated in the town are 96,000, or 31 units per capita. This should be raised to 60 units per capita as soon as the supply is available. That brings it up to a total of nearly 200,000 units, which we have allowed in our estimate. I think that result will be achieved easily within two or three years.

2553. *By the Chairman.*—There are six municipalities there which have arrived at an agreement, but it was stated here that there were several other municipalities, such as Queenscliff, which were negotiating for connexion with the system?—Yes, that would necessitate a branch line in the other direction, and it would hardly affect the scheme in the Western District.

2554. But they would have to depend on your lines for supply?—Yes, later on, when the Morwell energy is being brought down from Yarraville. Naturally, every additional load we get on the scheme will affect favorably the price to all consumers. Then from Camperdown sub-station there are extensions being talked of to Derrinallum and Lismore, and inquiries have also been made with regard to supplies for Pomborneit and Cobden. These have not been included in our estimate, and I have no hesitation in saying that all our figures are on the conservative side. Then there is Terang, which is 14 miles from Camperdown, and which has a population of 2,255. At present there are over 400 consumers, and when the direct current supply is replaced by the alternating current supply, the estimated consumption in the report of 110,000 kilowatt hours per annum should be easily reached and exceeded. That also leaves out of consideration any supply to Noorat, which is 3 miles from Terang, and to several large milk factories in the neighbourhood, which we have left out of our estimates for the time being. Then there is Cobden, which is 10 miles south of Camperdown. It has a population of 550, and the estimated consumption is 20,000 units, which was not included in the scheme, and would all be additional. In the Shire of Hampden there is under consideration a municipal water supply proposal, in which 100,000 units would be required. These extras will cause the total to easily exceed the figures we have put forward in the report. Mortlake is another branch line, 13 miles north-west from Teraug. The population is 800, and at present there are 160 consumers. 36,000 kilowatt hours can be taken as the present consumption, and if that is added to the load estimated to be consumed at the centre of Terang, I think we will have no difficulty in reaching the estimated consumption in the report. Then there are butter factories and pumping requirements at Mortlake to-day averaging about 62,000 units.

2555. I understood from the evidence given in the early part of the inquiry that the applications already made by the municipalities you have entered into an agreement with, justified the scheme without any additional applications coming in?—Yes.

2556. The present number of municipalities justified you in proceeding with the scheme without consideration of any increase through development later on?—Put it another way—that the requirements to-day in the South-Western district for power fully justify the figures we put forward.

2557. *By Mr. Beardmore.*—And the price you propose to charge will not be prohibitive in any sense?—No.

2558. That is what appeals to me—will it encourage industry?—The price is a favorable one to-day, and it will be so for the first three years. It will build up a load, and when the scheme is joined up with Morwell, with its lower price for energy, I think you will find that the consumption will go up in leaps and bounds in that district. The city of Warrnambool, of course, is a big factor in the scheme, and we estimate a consumption of 670,000 kilowatt hours per annum. We have taken no consideration of any large industry, but there is no reason why we should not get, ultimately, the woollen mills, where probably 1,000,000 kilowatt hours would be required. We have at the present time a quotation before them for their consideration, but we have not been advised yet as to whether they propose to take a supply from our system. I know it is only a matter of time before they will require a supply, as manufacturers in other parts of the world are giving up manufacturing their own power if they can buy it at a reasonable price.

2559. *By the Chairman.*—I suppose you have simply to fall back on the history of electric supply all over the world or even the State; if you give them cheap power they are bound to commence using it, and possibly start other things which would possibly buy cheap power?—Yes. Then Koroit is rather interesting. It is 10 miles from Warrnambool. It has a population of 2,200. The present consumption is 102,500 kilowatt hours from their own plant. This is equivalent to 45 units per capita. We have estimated the consumption at Koroit at 110,000 a year, so it will be seen that we are on the conservative side. We have not taken into account the various branch lines of supply that will be required, such as to Stoneyford, Pomborneit, Cobden, Winchelsea, Birregurra, Nalanjil, Beeac, Alvie, and Cororooke. There is a market available in those places for 220,000 kilowatt hours.

2560. *By Mr. Beardmore.*—In the South-Western District it is a settled community and a rich community, and it should warrant a scheme there with the existing settlement?—Yes.

2561. *By the Chairman.*—Is there any further statement you wished to make?—No; I do not think there is anything else unless you have some further questions to ask.

The Committee adjourned.

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