OCTOBER, 1958

GOVERNOR''S COMMISSION ON ECONOMIC AND SOCIAL TRENDS IN IOWA

("Committee of One Hundred")

Final Report of the Sub-Committee on

POWER

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At the first meeting of the Committee on Power the following objectives were adopted as a guide for study and the subsequent report:

1. To report on the present and likely future power requirements and capacities of all electric utilities in Iowa through 1968;

2. To report on the status of fossil fuel supplies in and available to Iowa, on available supplies of natural gas, and on hydro power available in Iowa;

3. To report on future possibilities of atomic and solar energy;

4. To compare electric rates in Iowa with those in surrounding states; and,

5. To consider certain other items which tend to establish trends having significant effect on the future cost of electric service, such as right-of-way needs and expanding use of electricity for home heating.

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1. Electricity Power Supply and Requirements for Iowa

a. <u>The Present Situation.</u> As of the present year, there are available for use by Iowans, a total of 1,960,000 kilowatts of electricity producing capacity. These are distributed as follows:

1,452,00 kw owned by seven investor-owned* electric companies;

191,000 kw owned by four rural electric cooperatives;

264,500 kw owned by municipal plants in 82 cities and towns; and

53,000 kw of firm power available from the Missouri Basin hydro plants of the Bureau of Reclamation. (Additionally, there is available 60,000 kw of non-firm power.)

The demand for electricity by all Iowa users in 1958 is estimated to require the use of the following capacities:

Investor-owned companies	1,296,400 kw
Rural electric cooperatives	226,000 kw
Municipal utilities	158,400 kw
Total	1,680,800

b. Projections to 1968. Although the above figures show that Iowa presently has an adequate installed generating capacity to meet its electric power requirements, more important is the question of that adequacy in the immediate future. Table 1 gives an answer to that question. It will be observed that for each of the next ten years, the estimated capacity from all sources for the production of electricity exceeds the estimated capacity requirements. Of course, the committee recognizes that the projection of power use calculations is conjectural. Yet, because of the amazing accuracy of such forecasts by power engineers in the years past, it

*Because the chairman of the Power Committee was assigned the task of writing the final draft of the report, he feels obliged to express his strong disagreement with a majority of the Committee on the matter of certain terminology used in this report. On the basis of more than thirty years association with the field of public utilities he has a strong dislike for what he regards to be "loaded" words and phrases. Two such occur in this report as it is finally presented. (More occurred in preliminary drafts.) He particularly objects to the phrase "investor-owned" in the identification of the privately-owned power companies and to the word "giant" in the description of the interconnections of the public power producers. But he was outvoted on the point of the use of the phrase "investor-owned" and so he did not bother to put the matter of the use of the word "giant" to the test of a vote. In his own writing and speaking, he shall continue to identify the private sector of the electric supply business with the simple, but effective phrase "privately-owned power companies," and the system of interconnections used by the public electricity suppliers as simply, "public power system."

TABLE 1

Estimated Annual Electricity Requirements and Capacities Available in Iowa, by Type of Ownership, 1959-1968 (in thousands of kilowatts)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
a) Requirements										
Investor-owned companies	1,371	1,468	1,568	1,675	1,789	1,910	2,040	2,180	2,331	2,488
Rural electric cooperatives	235	257	273	290	308	326	345	364	384	405
Municipal Utilities	167	178	190	201	215	228	242	257	272	290
Total	1,773	1,903	2,031	2,166	2,312	2,464	2,627	2,801	2,987	3,183
b) Capacities										
Investor-owned companies	1,535	1,645	1,756	1,876	2,004	2,139	2,285	2,442	2,610	2,786
Rural electric cooperatives	191	251	251	251	276	276	311	311	311	311
Municipal utilities	300	317	322	325	358	361	388	403	419	420
Bur. Recl. Mo. Basin*	61	61	61	75	110	135	170	170	170	170
Total	2,087	2,274	2,390	2,527	2,748	2,811	3,154	3,263	3,510	3,687

*Firm power capacity only.

feels that those presented here have a high degree of reliability.

2. Electric Transmission Facilities in Iowa.

Electric power generated in the various plants in the state, together with power flowing into the state, is transmitted through distribution systems and over integrated and interconnected high-voltage, transmission systems. The investor-owned power companies of the state have formed the Iowa Grid, sections of which were placed in initial operation in July, 1948. The plants and systems of the member companies in Iowa are interconnected by transmission lines operating at 69 kw or higher voltage. A few of these interconnections are normally operated open, being closed only to provide emergency service or to replace the output of generating units which are down for scheduled or emergency maintenance. The majority of these interconnections are normally closed and the systems operate in parallel to take full advantage of economy energy transactions, reduced spinning reserve, less emergency, and total capacity.

Some Iowa companies, whose service facilities are adjacent to the state line, have effected interchange agreements with operating companies in neighboring states to take advantage of lower fuel cost and excess capacities.

Additional power lines in the 161 kv voltage class, and perhaps higher voltages, will be required. It is contemplated that such will be built in Iowas as systems increase in size and generator units of larger capacity are installed.

The rural electric cooperatives and the municipal utilities are developing the first phases of a giant power system* in Iowa. The rural electric cooperatives already have 115 kv and 69 kv transmission lines in service and have generating plants throughout the state producing power. In the past few years, municipal utility plants have connected to these transmission lines for emergency interchange, purchase, and supply of power. These interconnections likewise will provide cheaper power as well as emergency power when generating units are out of service for repairs. These systems are being interconnected by areas and regions and as the giant power system further develops, transmission lines of higher voltages will

*See Footnote on Page 2.

necessarily be provided to interconnect the 115 kv and 69 kv lines.

Since April, 1957, a technical planning committee consisting of two members from each investor-owned company, has been meeting at least once every sixty days to develop methods to coordinate the installation of new capacity so that units of larger capacity can be planned. In 1958, five companies entered into an interconnection agreement. In this agreement, participants will equalize their total plant capacities on the basis of the load of each company. Capacity deficiencies will be made up by one participant purchasing the output from the excess capacity of another, thus enabling the purchaser to defer installation of new generating capacity for one or two years and so permitting it to install a larger and more efficient unit.

The giant power system of the rural electric cooperatives and the municipal utilities offers similar opportunities of interconnection and savings. In the western part of Iowa the cooperatives are now wheeling low-cost hydro power from the Missouri River to many towns, in addition to serving 25,000 farms and rural establishments.

Finally, there are interconnections in the state between private and public producers for the supply of emergency interchange power and the purchase of power. These interconnections provide interchange of energy and utilize the maximum use of power generating capacity. It can be visioned that one day all the electric utilities in Iowa will be interconnected for purposes of economy, pooling of resources, and continuty of service.

3. Atomic Power.

Although considerable progress has been made in the field of nuclear power during the past few years, much work remains to be done before it becomes competitive with conventional generating processes. While certain types of reactors are currently being developed and constructed, there is still considerable doubt as to the particular type of reactor that will ultimately be the "best" for power generation.

It is a well-known fact that the water reactors employing pressurized and boiling cycles are by far the most advanced reactors of those being developed today. This is primarily true because this particular type of reactor has had the largest amount of money spent on its development and associated research. No doubt, one of the other specific reactor types would also have been further advanced had similar amounts of money been spent on its development.

There is no reactor known at the present time which can produce power in the United States at a cost equal to or less than the cost of hydro or fuel-burning plants. All of the reactors considered to date show promise of considerable improvement and may in time become competitive. Before this goal can be realized, however, in addition to technical improvements, it will be necessary to gain experience in design, construction, and operation.

The thermal efficiency of power reactor systems must be improved by increasing the temperature of the working fluid if these systems are to be competitive with conventional power. The primary objective of the higher thermal efficiency is to reduce fuel cost as well as to take full advantage of the lower capital cost per kilowatt accompanying greater thermal efficiency.

Fuel cycles, including fabrication and reprocessing of fuel elements, although involved, offer a fertile field for cost reduction. Since fluid-fuel reactors as well as solid-fuel reactors are involved, this problem cannot be generalized and must be solved for each reactor type.

Even though the development of nuclean power has progressed considerably during the past few years, and there are indications that it will eventually become competitive with conventional fuels, it would be prudent to investigate all reactor types before concluding that any one is a better type simply because it is the furthest advanced today.

Both the private and public power producers in Iowa have been concerned with this new fuel for the generation of electricity. Some are members of study groups; others are participants in actual construction projects. (See Exhibit 1.) In these ways, they will obtain the information that they need. But until such time as nuclear power becomes competitive with conventional generations in Iowa, the activities

- Exhibit I -

Major Atomic Reactor Installations, Under Way or Proposed

Project	Approximate Electrical Rating (MW)	Status	Approximate Completion Date
Boiling Water, Enriched Uranium Fuel	180	Under construction by Commonwealth Edison Co.	1960
Pressurized Water, Enriched Uranium Fuel	275	Under construction by Consolidated Edison Co. of New York, Inc.	1960
Pressurized Water, Enriched Uranium Fuel	134	Under construction by Yankee Atomic Elec. Co.	1960
Boiling Water, Enriched Uranium Fuel	22	Proposed by Elk River Elec. Coop.Assoc.AEC in process of selecting contractor	1960
*Boiling Water, Enriched Uranium Fuel	66	Northern States Power Co.and Assoc.Proposal under third round accepted by AEC.	1962
*Sodium-Cooled, Fast Breeder	100	Under construction by Power Power Reactor Dev.Co.	1960
Sodium-Cooled, Fast Breeder	20	Under construction by Argonne Nat'l.Laboratory	1960
Sodium-Cooled, Graphite-Moderated	75	Contract for construction between AEC and Consumers Power Dist.of Nebraska	1961
Sodium-Cooled, D_2O-Moderated	10	Proposed by Chugach Elec. Assoc. and Nuclear Dev. Corp.of Amer. AEC has authorized some research and development.	1962
Organic-cooled, Organic-Moderated	12.5	Proposed by City of Piqua, Ohio.Contract under negotiation between AEC and Piqua.	1961
Liquid Metal-Fueled Reactor Experiment	20 (heat)	Contract between AEC and Babcock & Wilcox Co. and Brookhaven Nat'l.Laboratory	1959
Aqueous Slurry	70-150	Pennsylvania Power & Light Co.,Baltimore Gas & Elec. Co.and Westinghouse Elec.Corp. Proposal to AEC under third round.	1963
D_2O-Cooled, D_2O-Moderated, Pressure-Tube	17	Carolinas-Virginia Nuclear Power Assoc.,Inc. Proposal to AEC under third round.	1962

Project	Approximate Electrical Rating (MV)	Status	Approximate Completion Date
High-Temperature, Gas-Cooled, D_2O-Moderated, Pressure-Tube	50	East Central Nuclear Group and Florida West Coast Nuclear Group. Proposal to AEC.	1963
Boiling Water, Enriched Uranium Fuel	60	Announced February 1958 by Pacific Gas & Elec.Co.	1962

*Projects in which Iowa electric light and power companies are participating.

of Iowa producers will be limited to such participation as described above.

4. Hydroelectric Power in Iowa.

Because of its topography, Iowa has little electric hydro potential other than for small, run-of-the-stream plants. Firm power has been made available to twelve cooperatives and nine municipal plants in Iowa from hydro plants in the Missouri Basin. Additionally, some dump power is available at low dump-power rates to Iowa investor-owned companies. During 1957, energy received in Iowa from the Missouri Basin plants amounted to 343,000,000 kwh.

It has been suggested that an over-all study of the Mississippi River and its tributaries north of Cairo, Illinois, be made by the Corps of Engineers. If that were to be done, whatever hydro power possibilities were found would, if subsequently developed, benefit Iowa in some measure.

5. Iowa Coal Supply.

At the present time, most of the electric requirements of Iowa are supplied by coal-burning plants. The only large resource of coal in the state is located in its south-central countries. Recent estimates show coal reserves in Iowa to be in the order of 14,232,000,000 tons. Use of Iowa coal is not sufficiently extensive at the present time, being in the order of 1,500,000 tons per year. Its quality is below that of coal produced in several of the bordering states. Iowa coal presently varies in cost from 21 to 30 cents per million btu depending upon the type and distance of transportation. Estimates indicate that available coal reserves in Iowa are about 30 times greater than the projected coal requirement for the state through the year 2000. The states to the south and east of Iowa have coal resources of higher quality and mining installations sufficiently developed to permit the economical use of this coal in Iowa.

6. Natural Gas Supply.

In general, Iowa is supplied by three natural gas companies -- Northern Natural Gas Pipeline Company, Natural Gas Pipeline Company of America, and Michigan-Wisconsin Pipeline Company. Towns and cities supplied from Northern Natural Gas Company's pipeline system do not have capacity limitations; consequently current needs can and are being taken care of adequately. Large industrial customers can be supplied normally upon one year's notice.

The capacities of Natural Gas Pipeline Company and Michigan-Wisconsin Pipeline Company are presently committed, and increased supply to towns and cities taking their supply from these systems is restricted. It is expected that these restrictions will be removed within a year when additional gas transmission lines are placed in service. Current industrial needs will be supplied at that time, with large customers being supplied normally upon one year's application.

Natural gas will, in general, be available in Iowa for industrial development during the next few years and there are approximately 100 communities for which gas service has been planned. Much delay has been encountered in obtaining necessary regulatory approvals in certain cases before gas service could be extended to new communities.

It would therefore appear that the firm and interruptible gas supply in Iowa will be adequate during the next few years to satisfy the needs for industrial development since Iowa is better supplied with natural gas service than most states.

7. Right-of-Way Problems.

a. General. As the loads of all electric power suppliers in Iowa increase and the capacities of the individual generator units become larger, they will of necessity become more interconnected. One of the problems associated with the development of interconnections is that of obtaining suitable rights of way. The solution to this problem becomes more difficult as these lines become more numerous and their operating voltages become higher.

With the development of interconnecting transmission lines will come the development of larger, bulk power substations which, because of their physical size and the right-of-way requirements of the lines which terminate or originate at them, must be located outside of the corporate areas they serve. In order to transmit power from these bulk substations to load centers, it will be necessary to construct sub-transmission lines having voltages of 13.8 kv to 69 kv within the corporate limits of cities.

b. Urban Right-of-Way Problems. Many city zoning ordinances as they are now written or are being rewritten for new subdivisions, provide for only 8-foot easements and consequently do not permit the use of 10-foot crossarms required for higher distribution voltages. Easements of the 8-foot width are inadequate for present-day distribution systems, let alone the requirements for sub-transmission or transmission lines.

New subdivisions are being laid out primarily for scenic beauty and consequently have many curves and courts which do not lend themselves to economical construction of distribution lines. Many ordinances prohibit the installation of pole lines along the street so that easements must be obtained along the rear of the property. With the trend toward outdoor living, many owners resist lot-line construction and attempt to get special permission from zoning commissions to have the distribution lines along the street. Since it is difficult to build extensions without many corners, this tends to increase the cost of construction. Such conditions not only tend to delay construction but also to increase its cost.

Many city planning commissions tend to favor underground distribution systems. The cost of these systems is considerably higher than conventional overhead-type construction and most people decide in favor of overhead systems when confronted with the added cost which must be paid to the utility either in excess facility charges or in higher rates.

While the development of the metal-clad, unit type substation during the 1930's has done much to overcome the resistance to locating distribution substations within residential areas or commercially-zoned areas, some added investment is required for landscaping and beautification of the lot. Most objections to these installations are with reference to noise, appearance, or fear of television and radio interference. Such fears are groundless.

Substations in the 34.5 kv and higher voltage class, must be of open-type construction and considerable expense is encountered in attempting to camouflage these installations by landscaping. Adjacent land owners often feel that these installations reduce the value of their land and so attempt to get damages.

Unless zoning ordinances provide for a local board of appeal, requests for spot zoning for a proposed substation can well become a political football since the lack of an appeal board merely leaves the problem with the local city council. Local councils can avoid these problems by having such appeal boards in their communities.

It is obvious that a few of the urban right-of-way problems can be taken care of by proper planning, that is, by making needs known at the time a subdivision is laid out. It is also important that zoning and planning commissions know of the utility requirements so that zoning ordinances can provide sufficient width for easements, so that reliable utility service can be provided economically and safely.

c. Rural Right-of-Way Problems. In developing giant power and grid transmission lines, utilities have the responsibility to construct them at the lowest cost consistent with good construction practice. All of these requirements can generally be satisfied by building the shortest line possible between points to be interconnected. This, of course, may require that the lines be constructed diagonally rather than parallel to section lines or established roads. Diagonal lines usually present many right-of-way problems. With the present trend in the rural areas toward having permanent fences along boundary lines, with all other fences being temporary in nature, it is generally impossible because of tower or pole spacing to avoid structures in the middle of cultivated fields.

The problem of arriving at a fair and equitable cost for rights of way which cross cultivated fields is usually at the bottom of most right-of-way problems. Basically, cultivable ground in a certain area has about equal value so that a structure within a cultivated field which removes a certain portion of the field from cultivation should be worth a certain amount regardless of whether it is near the end of the field or near the center. As a matter of fact, a structure near the end of a field may remove more land from cultivation that one near the center. The relative value of land that is comparable in its use and productivity should be the same and the amount paid for right of way should be equal. It is important, therefore, that utilities establish relative allowances that are commensurate with the value and use of the land so that each owner will be treated alike.

To date, experience with recently established county planning commissions has not been sufficient to indicate the effect of these commissions on right-of-way problems. A realistic attitude of state commissions, consistent and fair treatment to land owners, and cooperation with zoning and planning commissions can help simplify right-of-way problems.

8. Solar Energy.

Solar energy will no doubt be developed to a limited extent for use in laboratories and experimental applications where information is required without regard to cost. Solar energy and the problems associated with it offer considerable challenge and when solved will provide the world with an abundant energy source.

It is very doubtful that this energy source will be developed to the point where it is competitive with conventional energy sources within the forseeable future. It must be recognized, however, that its economic application -- even on a limited basis -- can contribute substantially to the conservation of conventional fuels.

9. Comparison of Iowa Electric Rates with Rates for Similar Service in Adjacent States.

Tabulated in Table 2 are comparisons of electric rates for commercial and industrial service in Iowa and the states of Illinois, Missouri, Minnesota, Wisconsin, South Dakota and Nebraska. The rates shown are arithmetical average rates in cents per kilowatthour which were in effect as of January 1, 1957, in cities having a population of 50,000 or more.

If we consider the entire demand and consumption range shown in Table 2, the variation from the average rates in the state of Iowa would be as follows:

TABLE 2

A Comparison of Rates for Commercial and Industrial Electric Service in Cities of 50,000 Population and over in Iowa and in Surrounding States, expressed in Cents per Kilowatthour for Specified Amounts of Consumption with Specified Demands, January 1, 1957.

Commercial Service

Demand, in kilowatts	1.5	3.0	6.0	12.0	30.0
Consumption in kilowatthours	150	375	750	1,500	6,000
Rates, in cents per kilowatthour, in:					
Iowa	4.22¢	3.81¢	3.49¢	3.30¢	3.62¢
Illinois	4.32	4.03	3.84	3.84	2.99
Missouri	4.53	3.74	3.77	3.58	2.68
Minnesota	4.48	3.87	3.85	3.85	2.83
Wisconsin	3.27	2.86	2.77	2.67	2.37
Nebraska	3.37	3.05	2.80	2.56	2.10
South Dakota	4.65	4.38	4.18	4.02	3.33

Industrial Service

Demand, in kilowatts	500	500	1,000	1,000
Consumption, in kilowatthours	100,000	200,000	200,000	400,000
Rates, in cents per kilowatthour, in:				
Iowa	1.920¢	1,426¢	1.835¢	1.363¢
Illinois	1.856	1.318	1.668	1.223
Missouri	1.777	1.270	1.700	1.263
Minnesota	2.069	1.600	1.936	1.498
Wisconsin	1.934	1.473	1.776	1.311
Nebraska	1.574	1.124	1.533	1.071
South Dakota	1.984	1.519	1.922	1.471

Source: Federal Power Commission.

State	Commercial	Industrial
Illinois	+ 13.3%	- 8.8%
Missouri	+ 4.0%	- 9.0%
Minnesota	+ 9.6%	+ 8.9%
Wisconsin	- 13.8%	- 1.6%
Nebraska	- 20.2%	- 19.6%
South Dakota	+ 24.4%	+ 6.2%

An inspection of the above figures indicates that Iowa's competitive position with respect to light industry taking power under commercial rates is quite favorable when compared with similar rates in Illinois, Missouri, South Dakota, and Minnesota. Commercial rates in effect in Wisconsin and Nebraska are lower than those charged in Iowa. With the exception of Minnesota and South Dakota, the industrial rates are lower in each of the other states bordering Iowa. Iowa's competitive position in attracting new industry, however, is quite favorable in view of the fact that the cost of power used in the average industry represents less than one per cent of the value of the finished product.

Information about large light and power customers in Iowa and the surrounding states is presented in Table 3. Although the kilowatthour sales to the average large light and power customer in Iowa are the lowest of the states considered, the sales to this class of customer in Iowa represent approximately the same per cent of total sales as in the other states. It is also noted that the number of large light and power customers in Iowa represents a greater percentage of the total number of customers than in any of the adjoining states.

TABLE #3

Number and Consumption of Large Light and Power Customers in Iowa and Surrounding States, 1957

Name	Number of Customers	Per Cent of All Customers	Kwh Sales Per Customer	Per cent of All Sales
Iowa	8,778	0.95	233,197	35.3
Illinois	24,067	0.79	513,566	46.7
Missouri	3,634	0.26	1,066,318	41.8
Minnesota	2,643	0.25	819,901	33.4
Wisconsin	3,234	0.26	1,125,850	27.0
Nebraska	890	0.19	613,483	18.2
South Dakota	77	0.04	1,259,740	9.6

10. Electric Space Heating.

Use of electricity for many types of heating appliances has been making rapid strides during the last quarter of a century. Such major electric appliances as the electric range, the electric water heater, and the electric dryer have met public acceptance on a nationwide basis. The saturation of electric ranges and electric dryers in some cities and towns and farm homes in Iowa is over fifty per cent, and the electric water heater is gaining in popularity both for urban and farm use.

Electric space heating for farm and urban homes is becoming more popular, and many successful installations in homes with proper ceiling, wall, and floor insulation are in service with well-satisfied users. A recent article in Readers Digest predicts, "by 1970 electric heating will be found in forty per cent of all new homes built and will be consuming more than 70 billion kilowatthours of electricity annually." At the end of the 1957-1958 heating season, approximately 450 homes of rural electric cooperative members and a substantial number served by municipal and power company electric systems had complete all-electric home heating. This is more than double the number in operation one year earlier. The demand for electric house heating has been growing at an accelerating rate since promotion began on a small scale about 1953. In a recent survey on one rural electric cooperative, almost 300 members indicated an interest in receiving immediate information on electric house heating.

11. The Electric Heat Pump.

The electric heat pump has become very popular in the southern states, as it provides both cooling in the summer and heating in the winter, simply by reversing the refrigerant flow in the mechanism from the compressor. Furthermore, it operates at better than a 2:1 ratio of heat gain from the atmosphere or water or earth. Manufacturers of heat pumps are already making installations in Iowa and adjacent states. They promise newer and more efficient equipment for this climate in the near future The heat pump may well become popular in Iowa because of its more than one hundred per cent heat efficiency, although the cost is somewhat higher than radiant heat with a conventional air conditioner for some summer cooling.

12. Summary.

Conventionally, reports such as these close with a list of recommendations. When the Power Committee met on October 7 and approved the substance of the report as here presented (the Chairman assumes responsibility for the actual language and form as well as for certain omissions) it chose not to make specific recommendations. Instead, it directed the chairman to prepare a brief summary.

The first thing that should be explained is the silence of the report concerning the absence of a state public service commission in Iowa. Silence must not be interpreted as lack of consideration. On this point, two, if not three, strong positions were taken by various members of the Committee. Rather than have strong contradictory statements presented on this point, the unanimous decision of the committee was to omit all reference in this document.

The Committee feels that the power needs in Iowa are adequately served. The several producers of electricity are alert to the needs of their respective customers and expect to stay well ahead of all prospective demands that may be made upon them. Furthermore, new processes of power generation as well as new uses of electricity are under active consideration.

One major problem does face the producers of electricity in Iowa, namely, archaic laws and practices relative to the matter of land acquisition for substation location and rights-of-way. In these regards, both improved legislation and greater public understanding are urgently needed.