

# ELECTRICITY

## 30.1 INTRODUCTION

The electricity sector enters the next stage of socio-economic development, supported by a number of achievements, the most important of which are: near universal coverage of electricity services; progress towards restructuring and privatisation of the electricity industry to increase its efficiency; growth of the contribution of independent power producers in the generating capacity and further progress by the Saudi Electricity Company towards improved productivity. Moreover, during the period of the Eighth Development Plan, interconnection of the electricity grids of the GCC countries was achieved, and preliminary feasibility studies of linking the national grid to those of Egypt and Yemen were completed.

Despite these achievements, there are still challenges that need to be quickly and effectively addressed in the coming years, primarily: enhancing the efficiency of the electricity service; improving the investment climate in the electricity industry to achieve a level of production that can keep pace with continued growth in demand; achieving the required level of service sustainability and urgently taking effective measures to rationalise consumption.

This chapter addresses the current conditions of the electricity sector and its development under the Eighth Development Plan, and reviews the key issues and challenges that must be addressed under the Ninth Development Plan. It also presents forecasts of demand for its services, and highlights the future vision, objectives, policies and targets set for the sector by the Ninth Development Plan.

## 30.2 CURRENT CONDITIONS

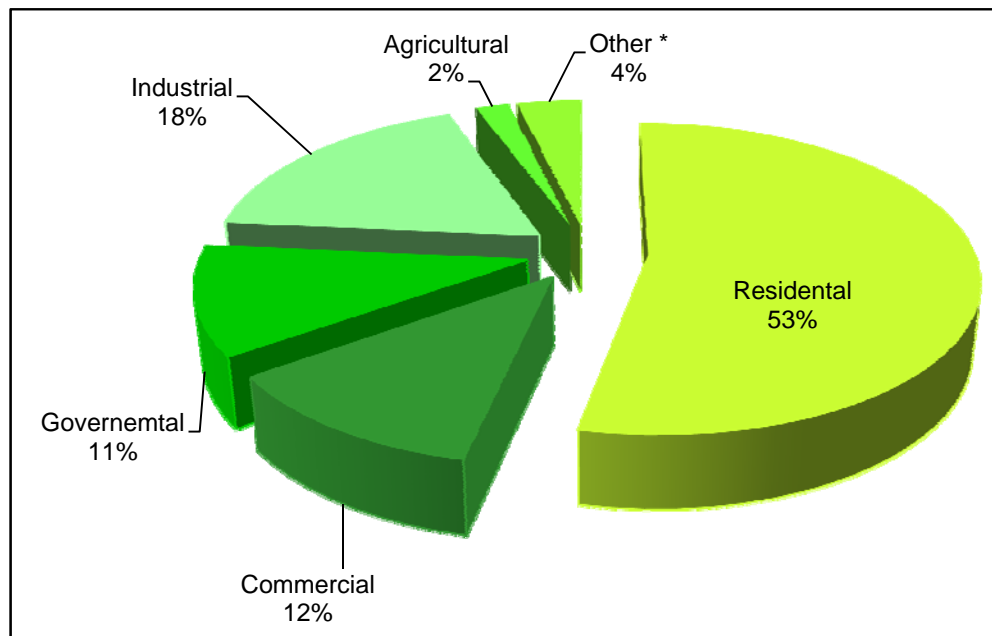
### 30.2.1 Electric Power Consumption

Over the first four years of the Eighth Plan, electric power consumption increased at an average annual rate of 5.8%, compared

with the target set by the Plan of 4.9%. Moreover, growth rates in less developed regions exceeded the average for the country as a whole, which reflects progress towards regionally balanced development.

In 2008, the residential sector accounted for about 53% of total energy consumption amounting to 181.1 billion kilowatt/hours, compared with industrial consumption at 18%, government consumption at 11%, commercial consumption at 12%, and agricultural consumption at 2% (Figure 30.1).

**Figure 30.1**  
**Distribution of Electricity Consumption by Category of Consumers**  
**2008**



\* Other includes hospitals, mosques, streets, and charities.

Source: Ministry of Water and Electricity.

### 30.2.2 Electricity Service Coverage

Coming close to achieving universal coverage of electricity services, within the framework of progressing towards regionally balanced development, was one of the most prominent achievements under the Eighth Development Plan. Notably, the number of cities, provinces, districts and villages covered by the electricity service was 11,405 at the end of 2008; an increase of 793 compared with 2004.

In 2008, the total number of subscribers throughout the country was about 5.4 million, up by about 929 thousand new subscribers during the first four years of the Eighth Plan, reflecting an average annual growth rate of 4.8 %. Residential subscribers accounted for about 82% of the total; while subscribers from the commercial sector accounted for about 13%; the government sector 2%; the agricultural sector 1% and the industrial sector about 0.13%. This development reflects the importance attached by the state to achieving full service coverage.

### **30.2.3 Power Loads**

In 2008, the asynchronous peak load was about 38 thousand MW, up from about 28.6 thousand MW in 2004; an average annual growth rate of 7.4%. Should such a rate of growth continue, it would result in doubling the peak load in about nine years, which would require a commensurate increase in generation and grid capacities to ensure availability of service at the required level of efficiency and reliability (Table 30.1).

### **30.2.4 Electrical Generating Capacity**

The total electric generating capacity consists of available generation from: the power plants of the Saudi Electricity Company; water desalination plants; and plants owned by large consumer companies, including Saudi Aramco and SABIC. In 2008, the total generating capacity available during peak load was around 39.2 thousand MW, compared with about 30.3 thousand MW in 2004; an average annual growth rate of 6.7% (Table 30.1).

The Eighth Development Plan focussed on enhancing generating capacity, through use of generators that combine high efficiency and low production cost. The share of steam turbines rose from 22% in 2000 to 33% in 2008. However, available capacity of desalination plants, which amounted to 2,444 MW, was less than the target capacity of 4,721 MW, due to delayed implementation of desalination projects that had already been approved.

The rate of growth of generation capacity was less than the growth rate of the peak load, which amounted to an annual average of 7.4%. As a result, the generation reserves dwindled to 3.3% of peak load in 2008, compared with 5.8% in 2004. Such a level of reserve is low by standards of electrical-system planning that seek to ensure reliability of supply. This is one of the main reasons for power supply interruption experienced in some regions of the Kingdom during times of peak load.

**Table 30.1**  
**Key Indicators of Electricity Sector**  
**Eighth Development Plan<sup>(\*)</sup>**

	2004	2005	2006	2007	2008	Average Annual Growth Rate (%)
Average total consumption of a residential subscriber (KW/ year)	39021	39325	39957	39703	40634	1.0
Service coverage (% of total population)	91	92	98	99	99	2.1
Subscribers	4491717	4727371	4955906	5182539	5420810	4.8
Residential subscribers	3700161	3897916	4083138	4262216	4456755	4.8
<b>Total electricity consumption (million kWh)</b>	<b>144385</b>	<b>153284</b>	<b>163151</b>	<b>169222</b>	<b>181098</b>	<b>5.8</b>
Industrial consumption (million KWH)	31975	33801	32548	30985	32421	0.3
Peak Load (MW) (**)	28599	30295	32147	35849	38000	7.4
<b>Total actual generating capacity (MW) (***)</b>	<b>30256</b>	<b>31912</b>	<b>34467</b>	<b>36539</b>	<b>39242</b>	<b>6.7</b>
Actual generating capacity of the Saudi Electricity Company (MW)	27423	28642	30310	32604	34470	5.9
Generation capacity available from the Saline Water Conversion Corporation (SWCC) and Major subscribers (MW)	2833	3270	4157	3935	4772	13.9
<b>Reserve generation (%)</b>	<b>5.81</b>	<b>5.3</b>	<b>7.2</b>	<b>1.9</b>	<b>3.3</b>	<b>-13.3</b>
<b>Total consumption per worker (MWH)</b>	<b>4971</b>	<b>5305</b>	<b>5689</b>	<b>6037</b>	<b>6396</b>	<b>6.5</b>
<b>Total subscribers per worker</b>	<b>155</b>	<b>164</b>	<b>173</b>	<b>185</b>	<b>191</b>	<b>5.5</b>
<b>Total employment</b>	<b>29047</b>	<b>28895</b>	<b>28679</b>	<b>28029</b>	<b>28315</b>	<b>-0.6</b>

(\*) Up to the end of the fourth year of the Eighth Development Plan.

(\*\*) Million kilo watt hour.

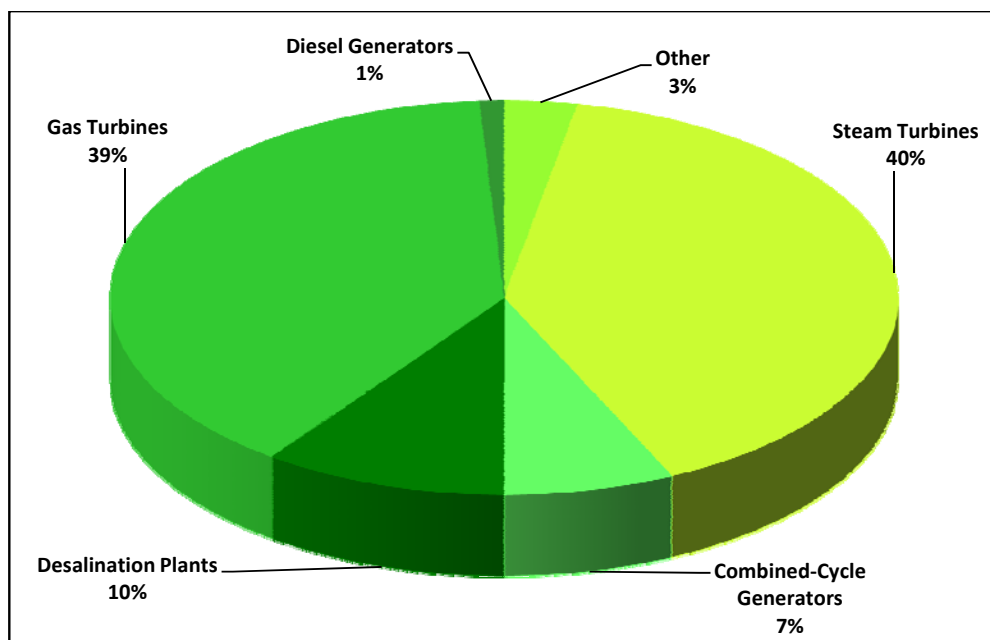
(\*\*\*) Asynchronous Load.

Source: Ministry of Water and Electricity.

### 30.2.5 Generated Electric Power

In 2008, electrical energy generated from all sources was about 204.2 billion KWH, with production of steam-turbine stations constituting 40% of the total; up from about 31% in 2000. The share of major co-generators went up to about 3%, while the share of all other generation sources declined. Notably, gas-turbine stations are still second in production after steam plants. The total production from steam-turbine stations, combined-cycle power stations and power imported from desalination plants, which are characterised by high efficiency, accounted for 57% of total energy produced, while its share of total generating capacity was about 45% (Figure 30.2).

**Figure 30.2**  
**Percentage Distribution of Electric Power Generated**  
**by Type of Generation**  
**2008**



*Source: Ministry of Water and Electricity.*

### 30.2.6 Fuel Consumption in the Electricity Sector

Development of consumption of fuel in the power plants of the Saudi Electricity Company was in line with the forecasts of the Eighth Development Plan, and also with the Council of Ministers directive to

use heavy fuel oil instead of other petroleum products that have a higher value in the global market, such as diesel oil and crude oil. Over the period 2000 to 2007, consumption of heavy fuel oil increased at an average annual rate of about 15.7%, which represents about three times the rate of growth in total consumption of about 5.1%. Natural gas came in second, with an average annual growth rate of 10.4%, while consumption of diesel oil changed little and consumption of crude oil decreased at an average annual rate of 3%.

### **30.2.7 The Electrical Grid**

Total length of the transmission network increased from 33.7 thousand km in 2004 to 39.8 thousand kilometres in 2008, with the addition of 6.1 thousand km of electric transmission lines over the first four years of the Eighth Development Plan. Work is underway to implement a number of projects linking together major regions of the Kingdom. Upon their completion, all regions would be linked electrically by a high-voltage 380 KV double circuit network, under a uniform electric system that allows energy transfer and exchange between load centres. This should prepare for the creation of an independent entity for the national transmission network, within the framework of the process of restructuring and privatisation underway.

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The project for linking the grids of the GCC countries has reached an advanced stage, with the start of the experimental operation of the first phase, which included linking the electricity grids of Bahrain and Saudi Arabia, Qatar and Kuwait by the end of 2008. This network will form an important part of the Arab electrical grid and will enable, upon being linked with the Arab Network, to export electric power to the Arab and European markets. The project is one of the outcomes of Gulf and Arab coordination and cooperation.

### **30.2.8 Employment**

According to data from the Ministry of Water and Electricity, employment in the electricity sector was in 2008 about 28.3 thousand workers, of whom 84.9% were Saudis. The number of workers in this sector declined at an annual average rate of 0.6% over the first four

years of the Plan, which was accompanied by significant improvement in labour productivity, with the number of subscribers per worker increasing at an average annual rate of 5.5%, and the power sold per worker increasing at an annual average rate of 6.5%, compared with the target of 6.5% per annum set for both indicators by the Eighth Development Plan.

In terms of indigenisation of jobs, particularly engineering and technical ones, the percentage of Saudization in 2008 was about 61.7% among engineers, 80.3% among technicians, 91% among administrators, and 97.7% among other workers.

### **30.2.9 Institutional and Organisational Development**

Under the Eighth Development Plan, the electricity sector continued pursuing restructuring and privatisation, with the Regulatory Authority of Electricity and Cogeneration taking several measures, including:

- Completing the development plan of restructuring the electricity industry.
- Completing a study on mechanisms for the design of electricity tariffs and their review mechanisms.
- Preparing and issuing a code for electricity transmission, while the codes for electricity distribution and standardization are being prepared.
- Preparing a long-term plan for both the electricity sector and the desalinated water sector.

Notably, nine entities have been licensed to operate in the electricity sector.

## **30.3 ISSUES AND CHALLENGES**

### **30.3.1 Return on Investment**

Economic and institutional reforms undertaken by the Kingdom over the past few years have noticeably improved the investment climate

and business environment. However, drawing investment to certain activities depends entirely on returns that are competitive with alternative investments. Since electricity revenues come from energy sales, return on investment in the electricity sector depends in a major way on electricity tariffs, as well as on productivity of the electricity utilities. Hence, striking a balance between revenues and costs of electricity to ensure competitive returns on investment are necessary for drawing the private sector to make large investment in the electricity sector.

Stability of electricity tariffs over the past period and developments in service costs and productivity have contributed to low returns on investment, consequently affecting the ability of the Saudi Electricity Company to finance new projects and operations. Dealing efficiently and effectively with these challenges calls for periodic reviews of electricity tariffs. However, a balance needs to be struck between improving returns on investment and the social dimensions of the tariff structure.

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### **30.3.2 Rationalising Growth of Electrical Loads**

Rapid growth of consumption of electricity has increased pressure on electrical loads. If it continues, it would require doubling production capacity approximately every ten years. It is natural for growth of electrical services to be relatively high in cases of rapid economic growth, like that of the Kingdom. Nonetheless, observed growth of electricity consumption in Saudi Arabia is unusual, and is the result of a conjunction of a number of economic, social and environmental factors that need to be reviewed and evaluated. Measures to rationalise consumption did not achieve the desired goals. Hence, implementation of energy conservation policies remains an urgent need; most notably reform of electricity tariffs; application of energy-saving standards covering all electric devices, machinery and equipment; and use of thermal insulation in all buildings and facilities.



### **30.3.3 Building a Comprehensive Database**

Now that near universal coverage of electricity services has been achieved, the need arises for enhancing efficiency of the electricity sector by building a comprehensive database including detailed information on electrical system failures and their causes and repercussions, as well as on the technical procedures for fault repair, mechanisms for maintaining reliability of supply and sustaining voltage levels, and other information and data necessary to achieve reliability and sustainability of the service.

Such a database would provide information on appliance efficiency and quality and identify issues that require further development, it would enhance planning processes, improve operational efficiency, enhance monitoring and service reliability, and raise efficiency of procurement.

## **30.4 DEMAND FORECASTS**

The outlook for the electricity sector is determined by: expected development of the economy, electricity prices and structure of tariffs, number of new entrants to be covered by the supply, and measures applied to rationalise electrical loads and consumption.

The national economy is expected to continue to grow at the same pace as during the last years of the Eighth Development Plan. However, demand forecasts used here do not take into account any price changes or modifications to the structure of tariffs that may be introduced. Indeed, should prices and the tariff structure be reviewed, and measures to rationalise consumption be enhanced, then this would reduce the forecasts set forth in Table 30.2.

### **30.4.1 Total Consumption of Residential Subscribers**

Economic growth forecast for the period of the Ninth Plan indicates that the GDP will increase at an estimated average annual rate of 5.2%, compared with 6.3% for non-oil GDP. Moreover, population growth is

expected to average 2.1% per annum. On the basis of these forecasts, total consumption of residential subscribers is expected to grow at an average annual rate of 2.1%, from 42,820 kWh in 2009 to 47,563 kWh in 2014 (Table 30.2).

**Table 30.2**  
**Key Indicators of Electricity Sector**  
**Ninth Development Plan**

Description	2009	2014	Average Annual Growth Rate under Plan (%)
Average total consumption of residential subscribers (KW/year)	42820	47563	2.1
Service coverage (% of total population)	99.2	99.8	0.1
Subscribers	5666978	6970573	4.2
Residential subscribers	4660945	5734926	4.2
Electricity consumption (million KWH) (*)	199581	272768	6.4
Peak load (MW) (**)	41043	54938	6.0
Actual generating capacity (MW)	45424	65824	7.7
Actual generating capacity of Saudi Electricity Company (MW)	39078	50043	5.1
Generation capacity available from SWCC and major subscribers (MW)	6346	15781	20.0
Reserve generation (%)	10.7	19.8	13.2
Total consumption per worker (MWH)	6720	8782	5.5
Total subscribers per worker	204	260	5.0
<b>Total employment</b>	<b>29701</b>	<b>31058</b>	<b>0.9</b>

(\*) Million kilo watt hour.

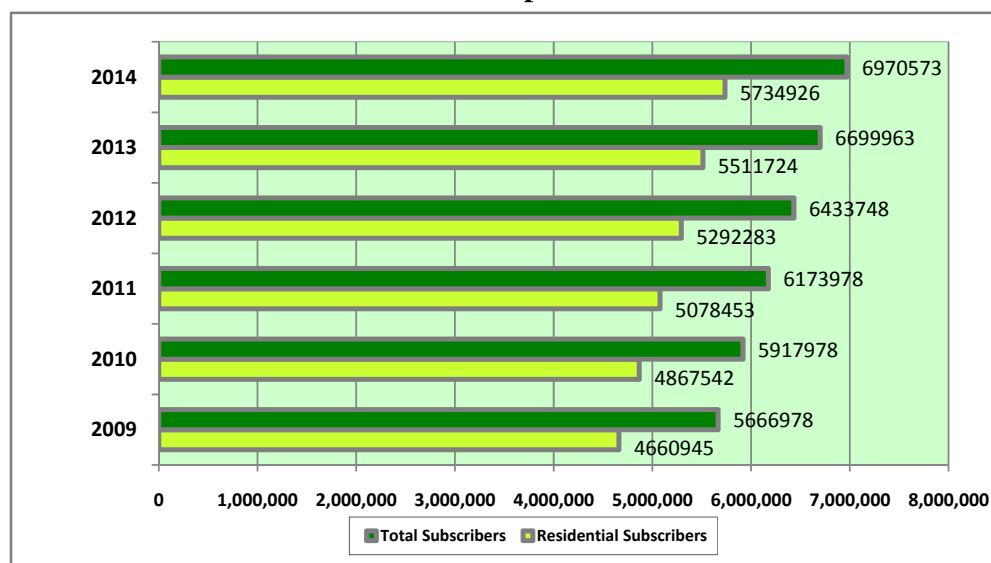
(\*\*) Asynchronous Load.

Source: Ministry of Water and Electricity.

### 30.4.2 Subscribers

The total number of subscribers is expected to rise from about 5.7 million in 2009 to about 7 million in 2014; an increase of 1.3 million subscribers. These including about 1.1 million residential subscribers, at an average annual growth rate of 4.2%. Coverage is expected to rise from 99.2% to 99.8%. Figure 30.3 shows the expected evolution of the number of subscribers (residential and total) during the Ninth Development Plan, while Table 30.3 shows the expected evolution of the number of subscribers of all categories by administrative region.

**Figure 30.3**  
**Number of Subscribers**  
**Ninth Development Plan**



Source: Ministry of Water and Electricity.

**Table 30.3**  
**Forecast of Peak Loads and Number of Subscribers**  
**by Administrative Region<sup>(\*)</sup>**  
**Ninth Development Plan**

Region	2009		2014		Average Annual Growth Rate under Plan (%)	
	Peak Load*	Subscribers*	Peak Load*	Subscribers*	Peak Load	Subscribers
Riyadh	10.149	1360.80	13.439	1660.58	5.78	4.06
Makkah	10.226	1684.81	13.399	2059.13	5.55	4.09
Madinah	1.608	389.09	2.064	475.54	5.12	4.09
Qassim	1.654	288.10	2.100	351.57	4.89	4.06
Eastern Region	11.950	841.25	15.828	1045.54	5.78	4.44
Asir	1.497	323.75	1.904	408.58	4.93	4.76
Tabuk	0.763	154.41	1.100	188.72	7.59	4.09
Hail	0.587	121.46	0.735	148.21	4.60	4.06
Northern Borders	0.312	51.13	0.407	63.55	5.46	4.45
Jazan	1.196	183.35	2.510	231.39	15.98	4.76
Najran	0.370	80.62	0.510	101.74	6.63	4.76
Baha	0.303	110.21	0.386	139.09	4.96	4.76
Jawf	0.427	78.00	0.555	96.94	5.38	4.44
<b>Total</b>	<b>41.042</b>	<b>5666.98</b>	<b>54.937</b>	<b>6970.58</b>	<b>6.01</b>	<b>4.23</b>

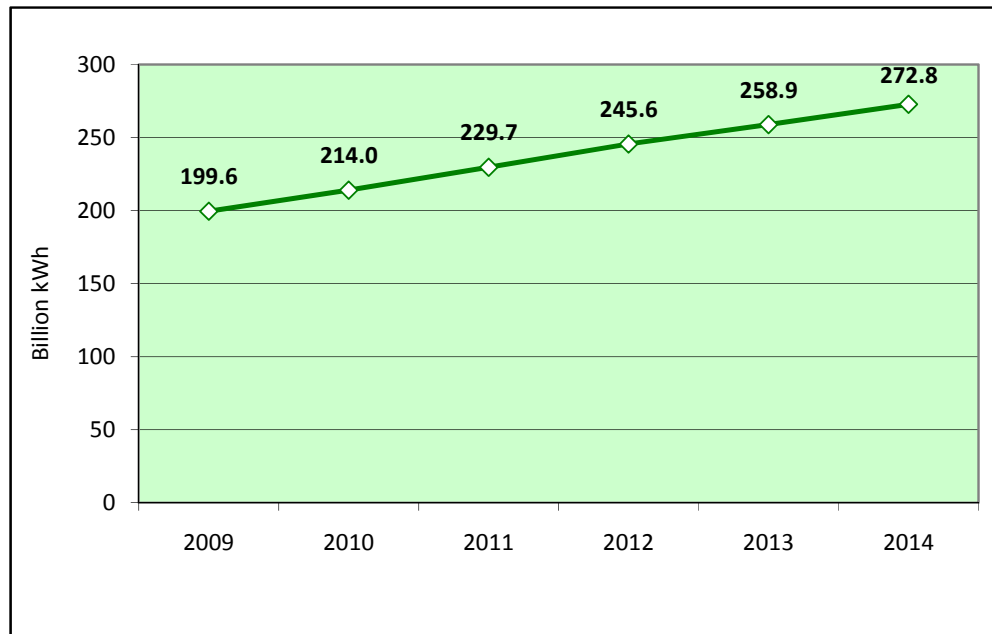
(\*) Thousand MW for peak load; number of subscribers in thousands.

Source: Ministry of Water and Electricity.

### 30.4.3 Electricity Consumption

Electricity consumption is expected to increase from about 199.6 billion kWh in 2009 to about 272.8 billion kWh in 2014, an average annual growth rate of 6.4% (Figure 30.4).

**Figure 30.4**  
**Forecast of Electricity Consumption**  
**Ninth Development Plan**



*Source: Ministry of Water and Electricity.*

### 30.4.4 Peak Load

The electrical peak load is targeted for marked improvement under the Ninth Development Plan. It is expected to rise, but at a relatively lower rate than consumption, at an average annual rate of growth of around 6%, rising from about 41 thousand MW in 2009 to about 54.9 thousand MW in 2014; an increase of 13,895 MW. Table 30.3 shows the expected peak loads by region.

### 30.4.5 Targeted Productivity Improvement

Forecasts indicate continued improvement of labour productivity in the electricity sector, albeit at lower rates than under the Eighth

Development Plan. The two indicators of productivity, number of subscribers per worker and the rate of consumption per worker, are forecast to increase at an average annual growth rate of 5% and 5.5%, respectively, while employment in the sector is forecast to grow at an average annual of 0.9%, from 29,701 workers in 2009 to 31,058 in 2014 (Table 30.2).

### **30.4.6 Actual Generating Capacity**

Coverage of expected demand under the Ninth Plan, represented by peak loads requires increasing available generating capacity to match load increases, as well as to raise reserves, in order to secure the required level of service reliability and efficiency. The level of reserves, which was estimated in 2008 to be 3.3% only, is well below the required level. Assuming that it needs to be raised to the required level, the required generating capacity in 2014 should be about 65.8 thousand MW; i.e., the required additions to the 2009 level of 45.4 thousand MW, are about 20.4 thousand MW. The Saudi Electricity Company is expected to supply about 11 thousand MW of this increase, with the balance of about 9.4 thousand MW provided by stations of the General Organisation for Water Desalination and independent producers in the private and public sectors (Table 30.2).

## **30.5 DEVELOPMENT STRATEGY**

### **30.5.1 Future Vision**

A highly reliable and efficient electricity service to meet the demand for electricity for various uses in all parts of the Kingdom.

### **30.5.2 Objectives**

- Providing a highly reliable and efficient electricity service to meet the demand for electricity by all sectors and facilities.
- Providing electricity at the lowest economic, social and environmental cost, while balancing returns on investment with social considerations.

- Enhancing the role of the electricity sector in maximising the value added of national resources and its integration regionally and internationally.
- The transfer, indigenisation and production of electricity technologies.
- Developing sources of power generation that are complementary to oil and gas based generation.
- Encourage energy conservation and the rational use of electricity.

### **30.5.3 Policies**

- Upgrading of residential electricity services, and providing a clear and stable regulatory framework for the electricity industry.
- Maintaining comprehensive coverage of electricity services.
- Compiling comprehensive data on electric-system failures and reliability of service.
- Enhance productivity and economic efficiency of all activities and facilities of the electricity sector.
- Completing restructuring of the electricity sector and privatisation of its activities.
- Achieving competition in the electricity industry to encourage private-sector investment and ensure freedom of choice for consumers.
- Specifying the electricity tariff structure and periodically reviewing it.
- Promoting energy conservation and rationalisation of electricity consumption of all categories of subscribers.
- Completing network connection with the Gulf and the Arab Networks to promote exchange and export of electric power.
- Encouraging programmes, projects and activities aimed at transfer, development and indigenisation of electricity technology.

- Developing the use of solar and wind energy for electricity production.
- Develop the use of nuclear energy for electricity production, water desalination and other peaceful uses.
- Supporting energy conservation programmes and the development of energy sources that are complementary to oil and gas.

#### **30.5.4 Targets**

- Providing electricity to about 1.3 million new subscribers, including about 1.1 million residential subscribers over the years of the Ninth Plan.
- Increasing actual generating capacity by about 20.4 thousand MW during the Plan.
- Raising generation reserves to 19.8% of total peak load by the end of the Plan.
- Improving labour productivity in the electricity sector at an average annual rate of 5% over the period of the Plan.

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