Electric Industry in

Iran

Past, Present, and Future

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EMIRATES
QATAR
OMAN
INDIAN
OCEAN

Facts

Year 2006 (Rank in the world)	Iran	Australia
Population	68.7 Million (20)	20.3 Million (54)
Area (sq. km)	1.648 Million (26)	7.686 Million (12)
Pop. Density Person/sq. km	42 (160)	2.7 (226)

Economy

Year 2006 (Rank in the world)	Iran	Australia
GDP Official Exchange Rate	$178.1 Billion (36)	$633.5 Billion (16)
GDP Purchasing Power Parity	$552.8 Billion (20)	$642.1 Billion (18)
GDP Per Capita (PPP)	$8,100 (83)	$32,000 (16)

Economy

Year 2006 (Rank in the world)	Iran	Australia
GDP Real Growth	4.8% (44)	2.6% (62)
Exports	$55.4 Billion (39)	$103 Billion (29)
Imports	$42.5 Billion (44)	$119.6 Billion (21)

Oil

Year 2006 (Rank in the world)	Iran	Australia
Proved Reserves bbl	133.3 Billion (3)	3.664 Billion (27)
Export bbl/day	2.5 Million (4)	0.523 Million (17)
Consumption Bbl/day	1.425 Million (18)	0.876 Million (22)

Natural Gas

Year 2006 (Rank in the world)	Iran	Australia
Proved Reserves cu m	26.62 Trillion (2)	2.55 Trillion (14)
Export cu m	3.4 Billion (26)	9.7 Billion (15)
Consumption cu m	79 Billion (9)	25.08 Billion (25)

Electricity

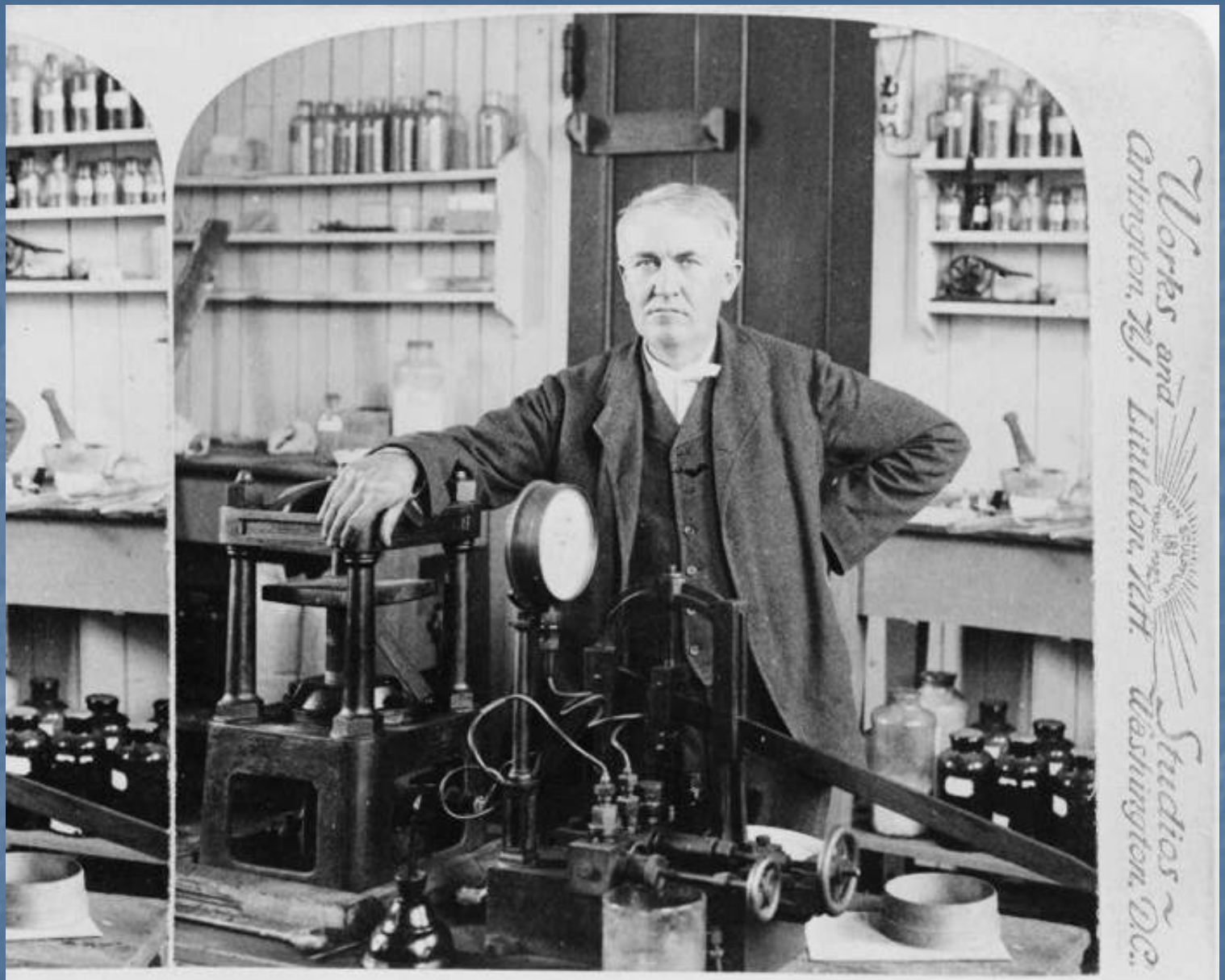
Year 2006	Iran	Australia
Production	178.1 TWh	221 TWh
Per Capita Production	2.592 MWh/person	10.906 MWh/person
Per Capita Production	296 W	1245 W

The History

of Electricity

in Iran

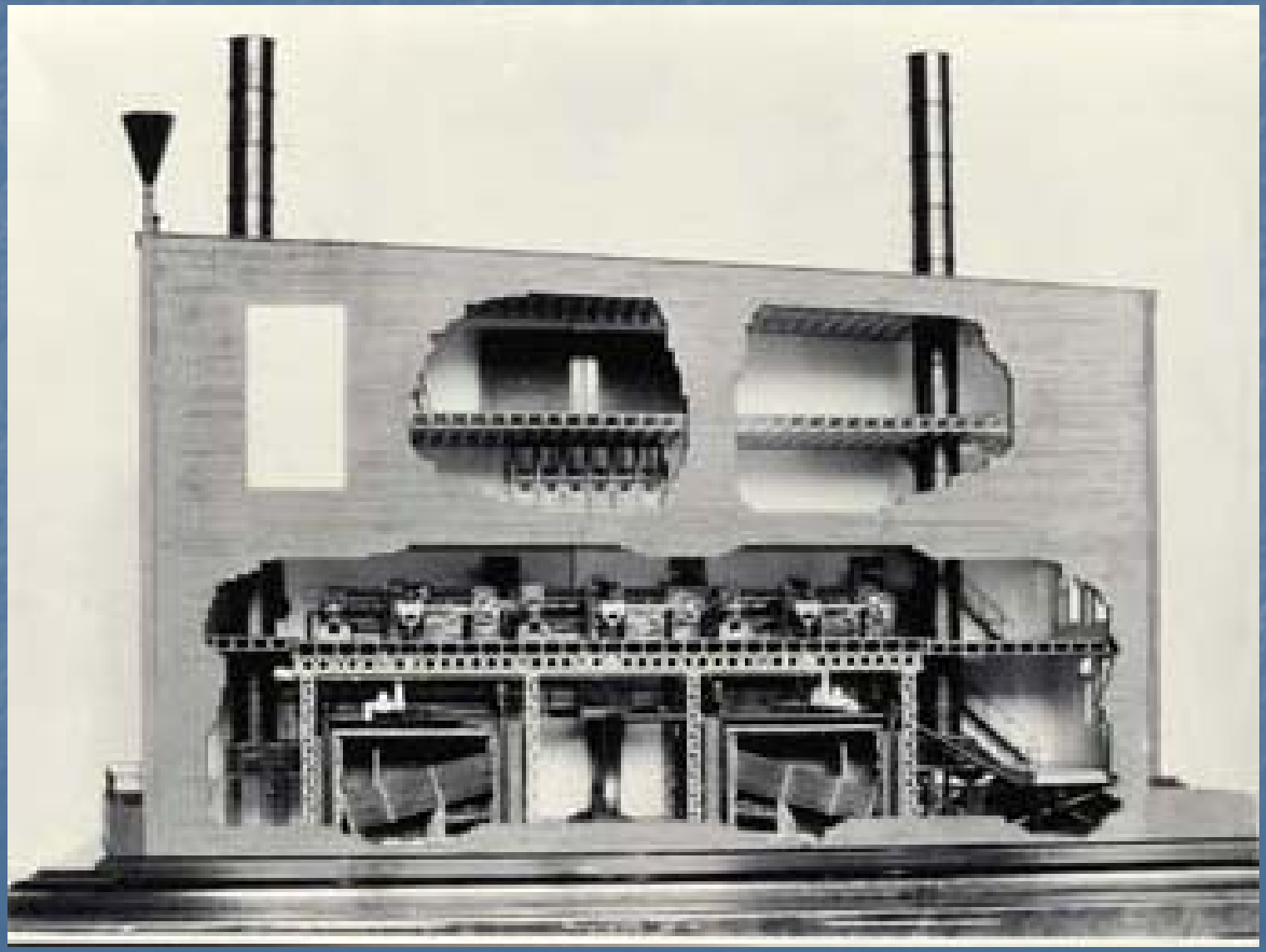
The opening of the Pearl Street station in lower Manhattan on Sept. 4 1882 by Thomas Edison, presented a complete system of commercial electric lighting and power.

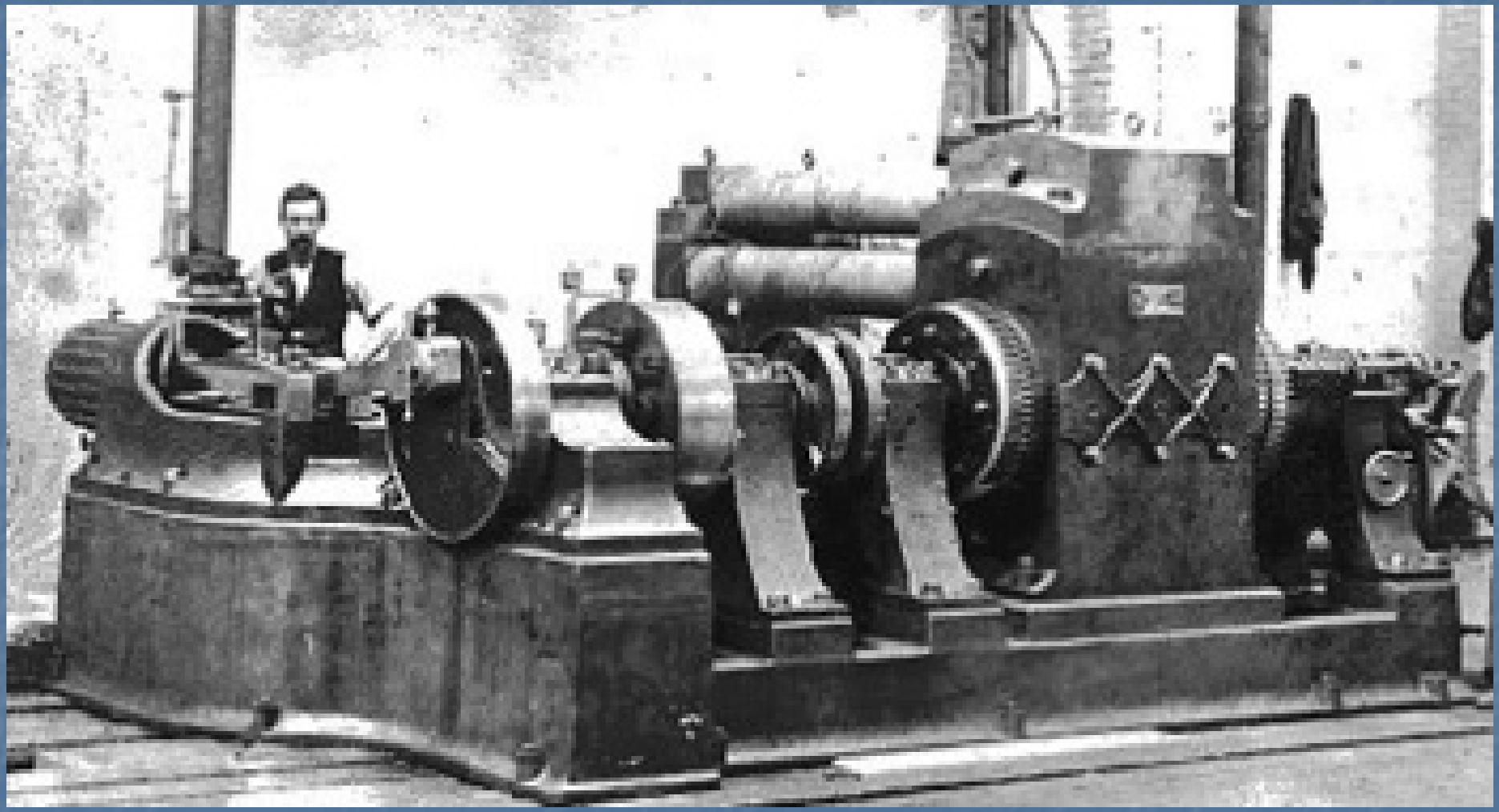


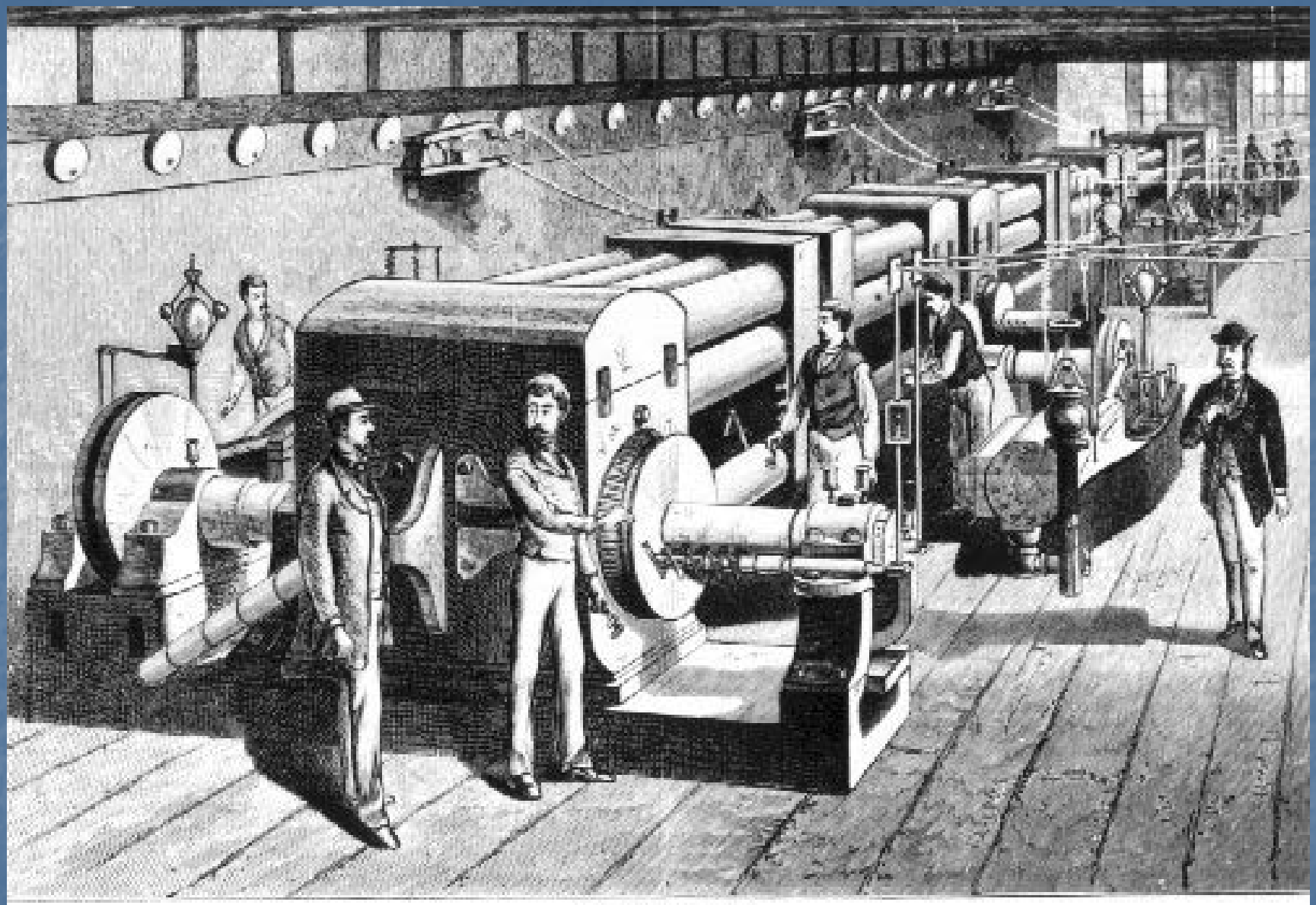
Works and Studios
Arlington, Va. Littleton, N.H. Washington, D.C.

The most famous Inventor of the Age—Thos. A. Edison in his Laboratory, East Orange, N. J., U. S. A.

Pearl Street Station



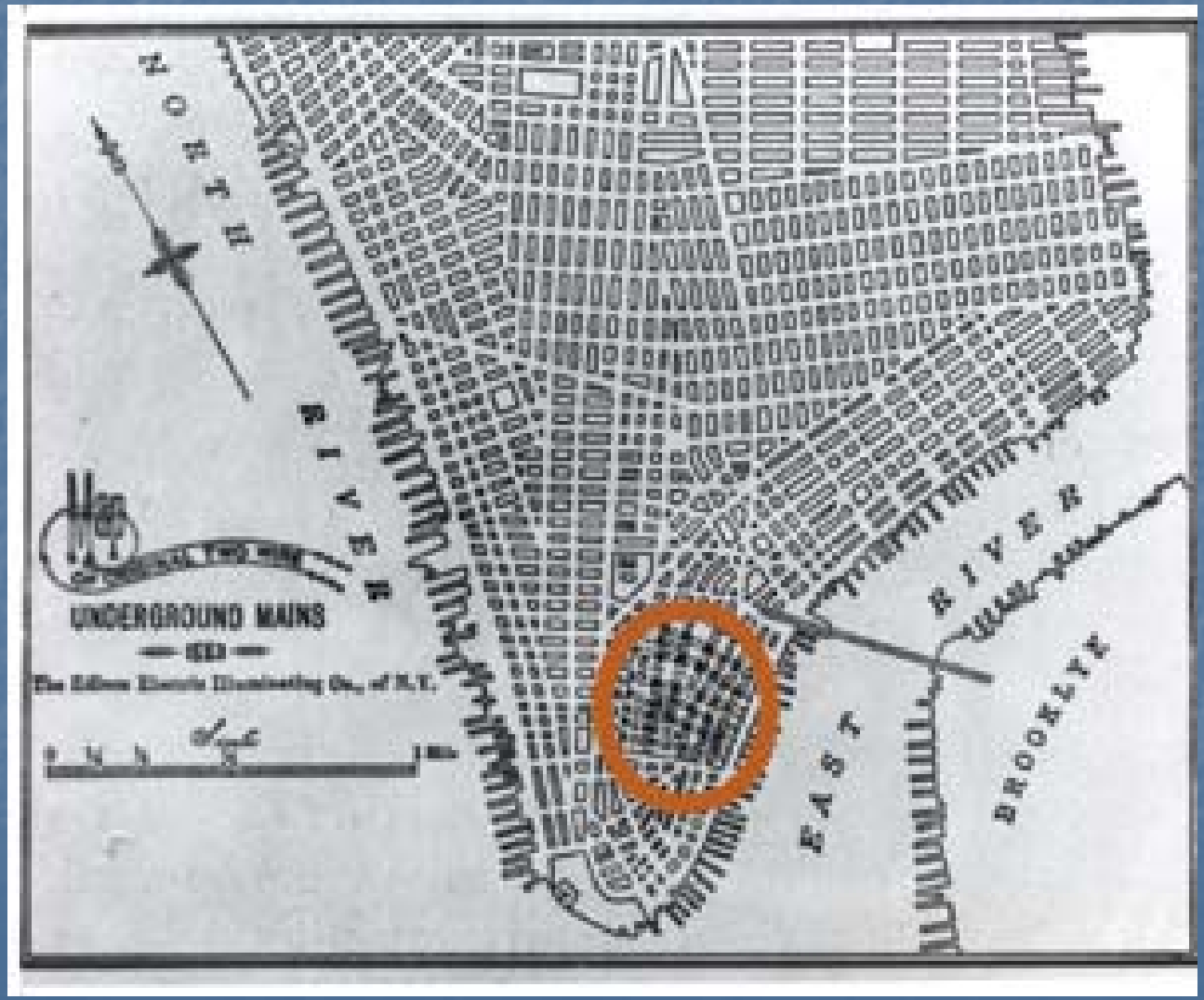




THE DYNAMO ROOM.

FIRST EDISON ELECTRIC LIGHTING STATION IN NEW YORK.

Pearl Street in Manhattan



Three years later, in 1885, a 3000 W electric generator was installed in one of the Nasseredin Shah's Palaces.

Nasseredin Shah Ghajar

19 years later, in 1904, the permission to establish the first Iranian commercial power plant was given to one of Tehran's merchants.

The power station was installed in Tehran and commissioned in 1906, concurrent with the Constitutional Revolution.

Hossein Amin-ol-Zarb

With his Staff at Office

Holding the King's Constitutional Decree

Elected to the First Parliament

Specifications

- Power: 400 kW
- Voltage: 220/380 V
- Manufacturer: AEG (Germany)
- Prime mover: Steam Machine (3 boilers)
- Fuel: Coal

- Another 100 kW generator was added to the station soon.
- Around 1921, two diesel generators, each 50 hp and from Belgium, were added.

The power station used to work for 5 to 7 hours every night just to supply lighting.

Gradually, more private companies were involved in generation and distribution of electric power.

Some industries and factories started to build their own power stations.

In 1931, the idea of having electricity 24 hours a day was approved by the government.

In 1936, a department called "Tehran's Electricity Foundation" was established in the municipality.

In 1937, a thermal power station, built by Skuda (Czechoslovakia) with 6.4 MW power (4*1.6 MW) was commissioned.

- In 1940, Radio Iran started to work.
- Public interest towards having electricity, especially to listen to the news about WWII, increased.

Private industrial power stations were called to supply the network's high demand.

In 1969, "Iran Power Generation, Transmission and Distribution Management Co. (TAVANIR)" was established.

Since then, installing and commissioning of all power generation stations, high voltage substations and transmissions systems of 230 kV and 400 kV has been done by TVANIR.

Changes

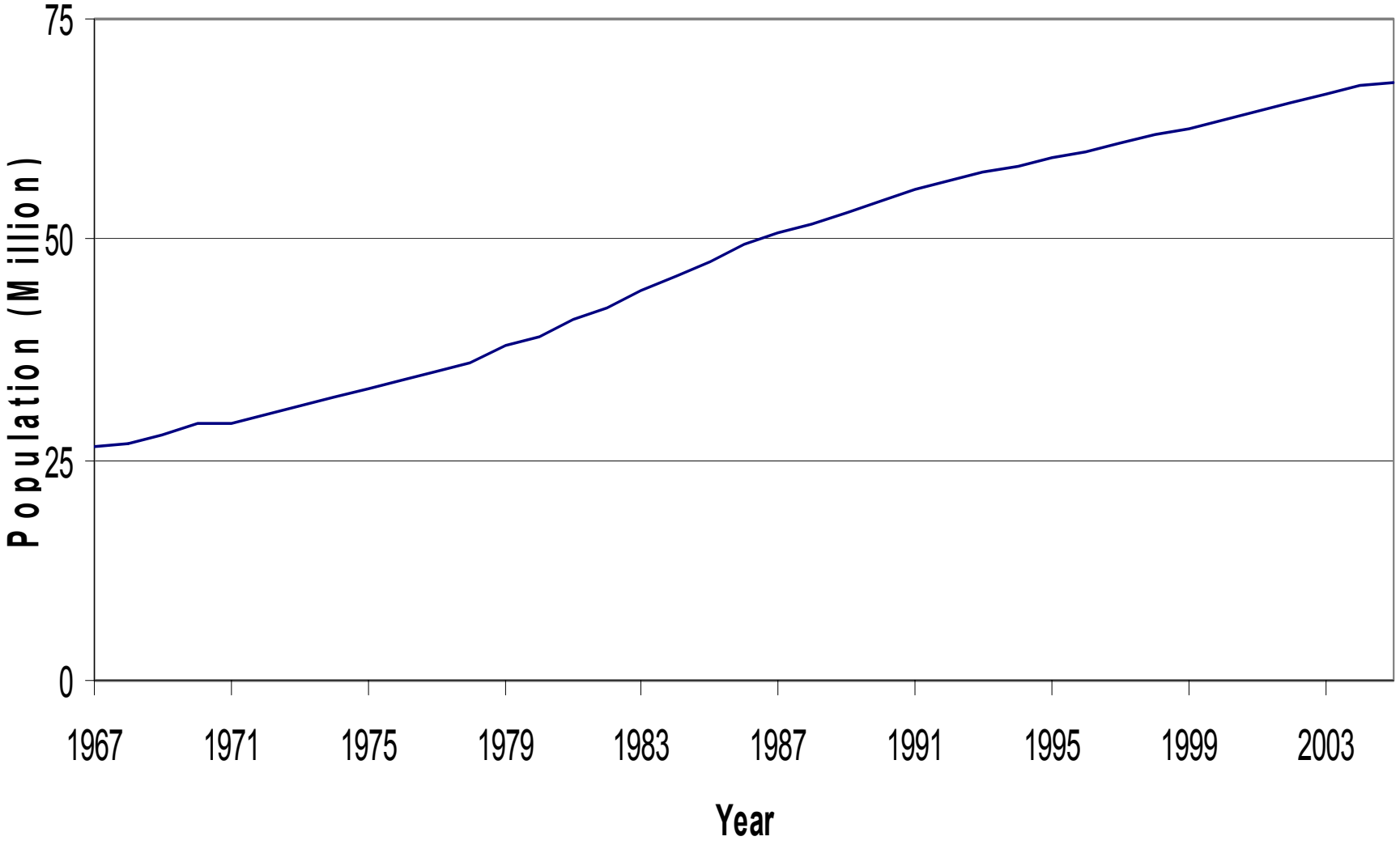
Since

1969

Important Dates

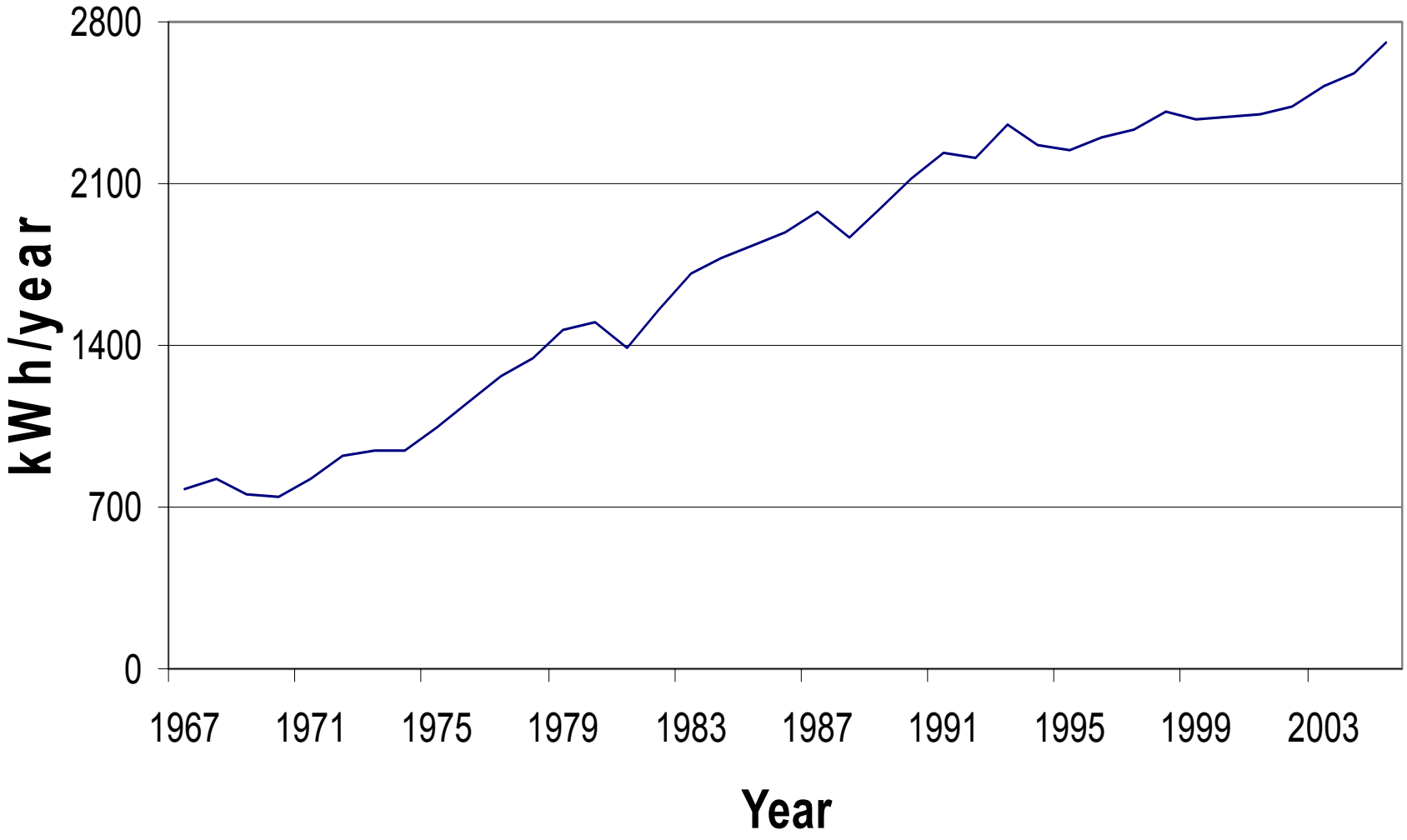
- 1969: Establishment of TAVANIR
- 1979: Victory of the Islamic Revolution
- 1980: Start of the Iraqi-imposed war
- 1988: End of the Iraqi-imposed war

Iran's Population (1967 to 2005)



Time Period	The Average Rate of Growth in Population
1967 – 1978	2.9 %
1979 – 1988	3.6 %
1989 – 1994	2.0 %
1994 – 2005	1.5 %

Average Houshold Consumption



Re-Emergence of Private Sector in Production

In recent years, private sector has been encouraged to enter the power generation market.

The first private power station was commissioned in Esfahan in 2005.

Chehelsotoon Power Station

Esfahan

- Power: 954 MW (6*159 MW)
- Gas Cycle
- Fuel: Natural Gas
- First unit started: August 2005
- Last unit started: Fall 2006

Under Construction Power Stations to be Commissioned from 2004 to 2008

- Government Sector: 4,000 MW
- Private Sector: 12,000 MW
- Total: 16,000 MW

Nuclear

Power

in Iran

- 1956: Nuclear research started at the University of Tehran (U of T).
- 1958: Iran joined the IAEA.
- 1967: The first 5 MW research reactor was supplied to Iran by the USA and installed in U of T by AMF.

- 1967: 5545 kg of enriched uranium and 112 kg of plutonium was supplied to Iran by the USA.
- 1968: Iran joined the NPT.
- 1970: The Iranian Parliament ratified Iran's joining to the NPT.

- 1974: The US Government, under President Ford, approved Iran's Nuclear Energy Plan.
- 1974: USA, Germany, France and UK agreed to install 23,000 MW of nuclear power stations in Iran.

- 1974: US$ 1 Billion was loaned by Iran to the French Nuclear Energy Commission to build the uranium enrichment facilities belonging to Eurodiff Consortium. In return, 10% of the consortium's share was transferred to Iranian ownership.

- 1974: An agreement was signed between Iran and France to build 5*1000 MW nuclear stations in Iran and supply the needed uranium.
- 1974: contract for 2*900 MW power stations in Bandar-Abas was signed by Iran and France's Framatome.

- 1974: A contract was signed by Iran and Germany's Craft Work Union to build 2*1293 MW nuclear stations in Bushehr.
- 1975: The work at Bushehr began and 10% of the equipment was transported before the Islamic Revolution.

- 1975: Iran and US signed a US$ 6.4 Billion agreement to build 8 nuclear power stations in Iran.
- 1977: A contract was signed between Iran and France to build 2*900 MW nuclear stations in Darkhoin. US$ 2 Billion was paid to France.

- 1979: Victory of Islamic Revolution brings all the activities to halt and all the agreements are cancelled, mostly bilaterally.
- 1988: After the Iraqi-imposed war, Germany refuses to finish Bushehr.

- 1990's: Bushehr project is transferred to Russian companies to complete.
- 2007: More than 15 years past, and more than US$ 1 Billion paid to Russia for 1*1000 MW capacity, Bushehr is not completed by Russia yet.

US Secretary of State
Henry Kissinger in 1975:

Introduction of nuclear power will both provide for the growing needs of Iran's economy and free remaining oil reserves for export or conversion to petrochemicals.

Former US Secretary of State Henry Kissinger in 2005 in Washington Post:

For a major oil producer such as Iran, nuclear energy is a wasteful use of resources.

Henry Kissinger in an interview with Dafna Linzer from Washington Post was asked why he reversed his opinion?

Kissinger responded with some surprise during a brief telephone interview. After a lengthy pause, he said: "They were an allied country, and this was a commercial transaction. We didn't address the question of them one day moving toward nuclear weapons." (March 27, 2005)

Coal-generated

Power

in Iran

- The first coal power station in the Middle East is to be built in Tabas, Iran.
- The capacity is to be 2*300 = 600 MW.
- In 2001 agreement was reached with Russia to build the plant.

- In 2003 the contract was signed.
- In June 2006 Russia cancelled the contract.
- Negotiations are being held with Slovakia.

Green

Power

in Iran

- 1975: The first activities regarding renewable energies started in the Ministry of Energy (MOE).
- 1975: A contract was signed with Italy's ENEL to study and examine the geo-thermal potentials of the country.

- 1981: Some projects in the field of biogas and small hydro stations were carried out by MOE.
- 1993: The Department of Renewable Energies was established in the MOE.

- 1996: The Renewable Energies Organization of Iran (SUNA) was Established in the MOE.
- 2000: SUNA became an independent organization under the government control.

Current

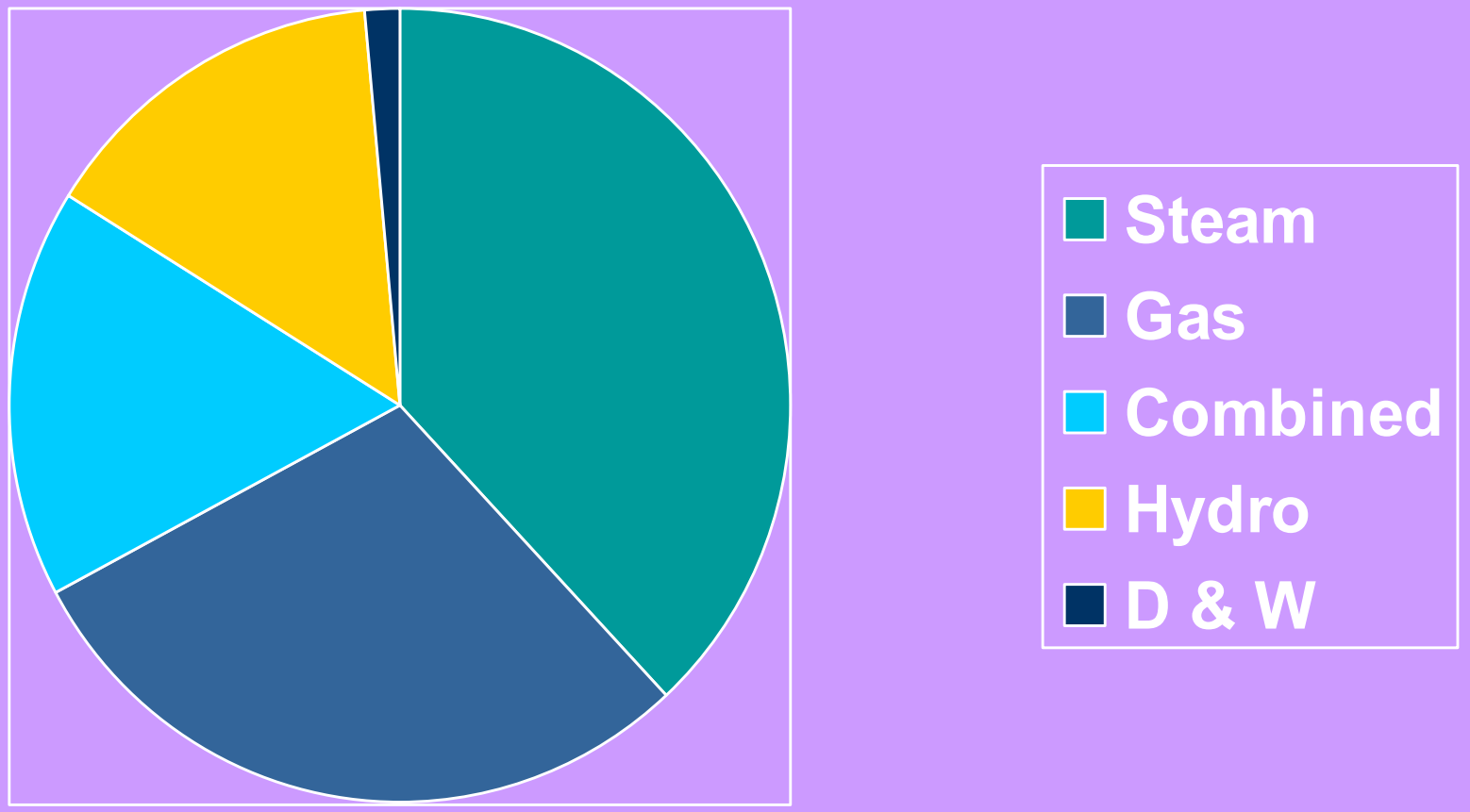
System

Situation

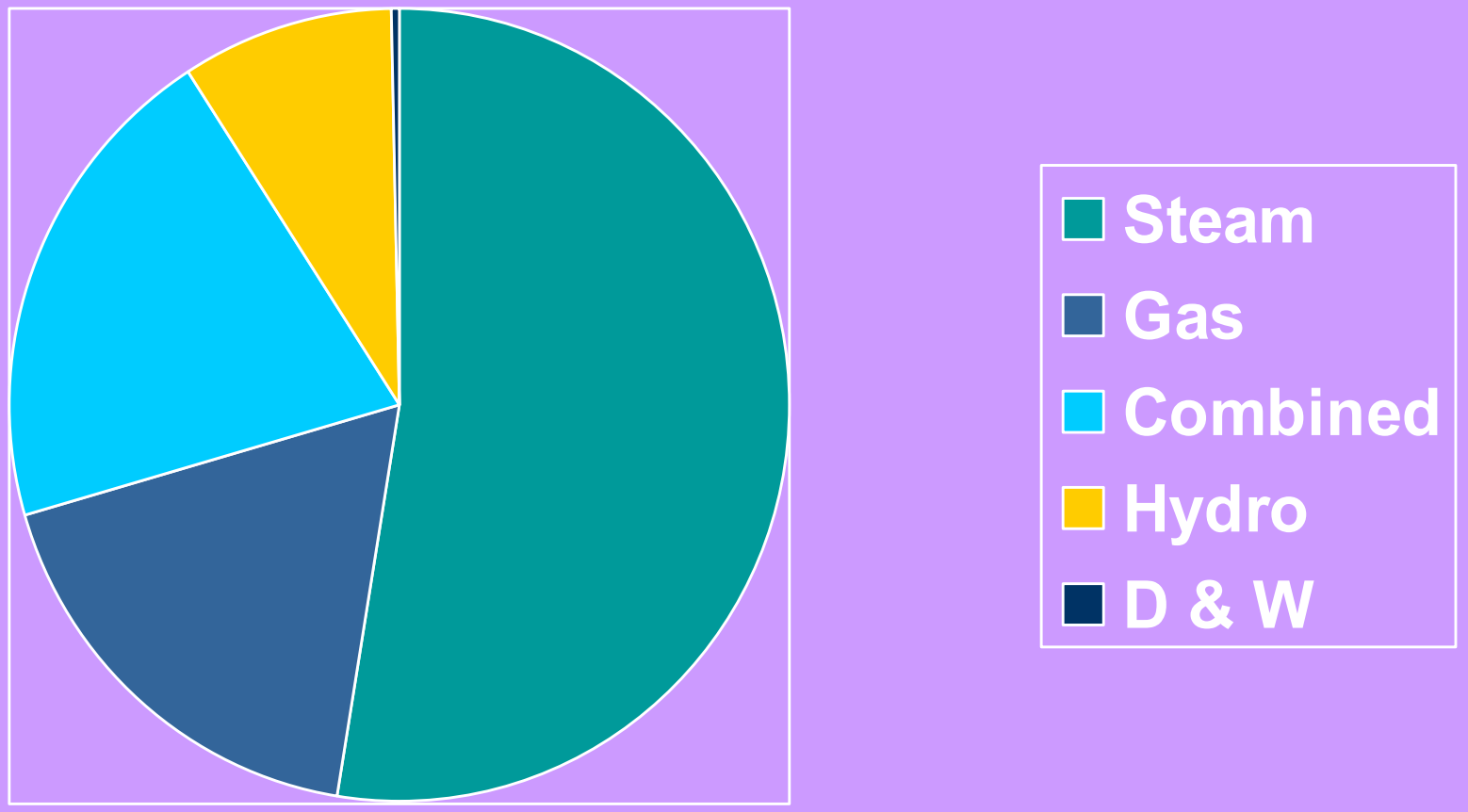
Power Generation

Year 2005	Installed Capacity		Production TWh	
Steam Cycle	15.56 GW	37.9%	93.383	52.5%
Gas Cycle	12.05 GW	29.4%	32.128	18.0%
Combined Cycle	6.83 GW	16.7%	36.194	20.3%
Hydro	6.04 GW	14.7%	16.085	9.0%
Diesel & Wind	0.53 GW	1.3%	0.281	0.2%
Total	41.01 GW	100%	178.071	100%

Installed Capacity



Production



Thermal Capacity Installed During the Past 10 Years

Gas Cycle	63%
Combined Cycle	23%
Steam Cycle (Base Load)	14%

Fuel Consumption

Year 2005	%
Natural Gas	77.8
Residual Petroleum	15.9
Gas Oil	6.3

Exchange with Neighboring Countries in 2005

- Total Export: +2761 GWh
- Total Import: -2074 GWh
- Net Export: +687 GWh
- % of Total Production: +0.4%

Generation Capacity Installed by the Industrial Centers

- Total Power: 3212 MW
- Diesel Fueled: 94.4%
- Thermal and Gas Cycle: 5.6%

Power Figures

Year 2005	GW	Annual Growth
Average Actual Power	37.05	9.6%
Maximum Production	30.76	11.4%
Peak Demand	32.302	10.4%
Peak Time	August 26, 2005 – 21:03	

Transmission

All thirty provinces are interconnected by 400 kV and 230 kV transmission lines.

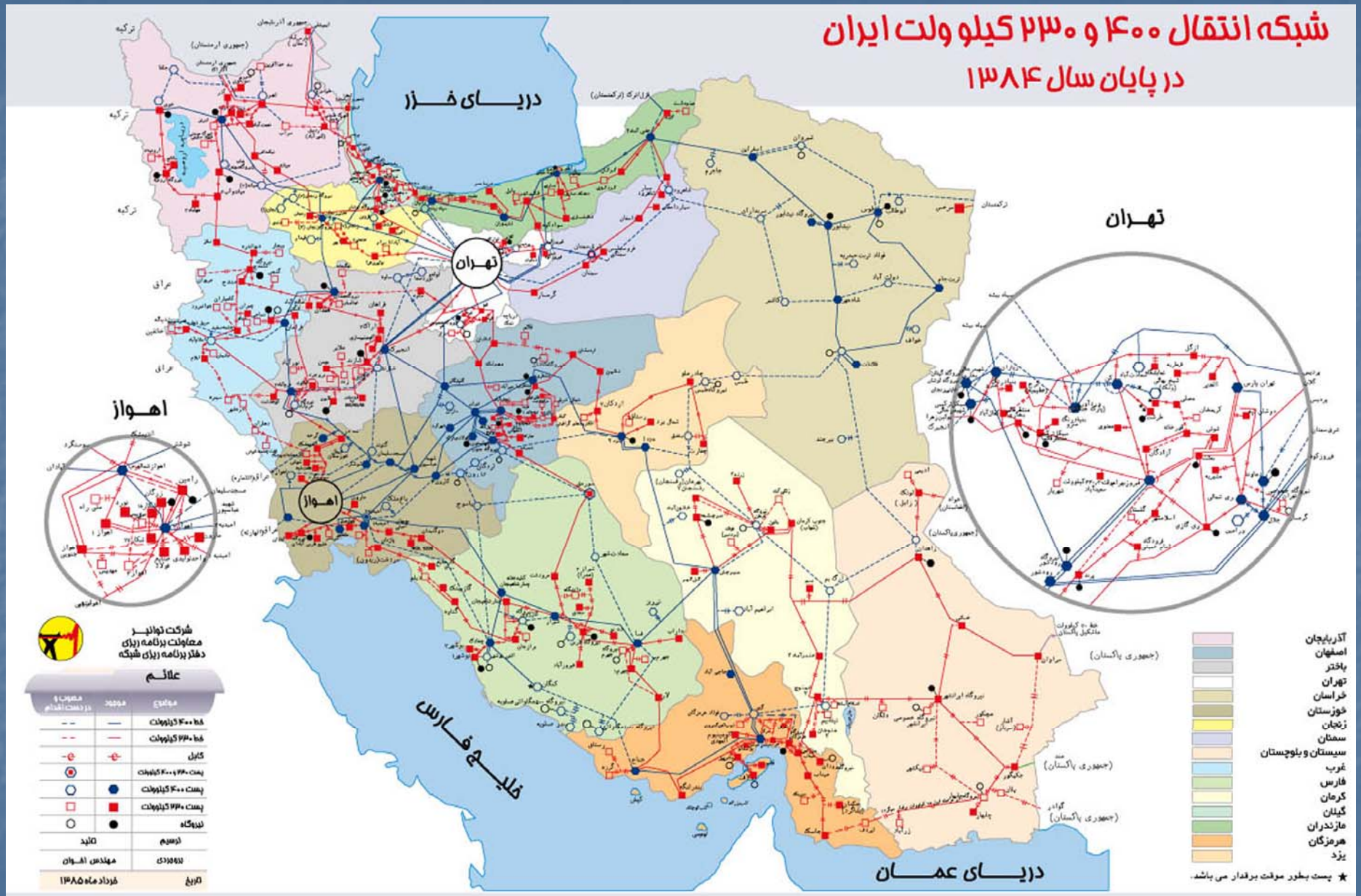
The national grid is connected to 7 neighboring countries of: Turkey, Armenia, Azerbaijan, Turkmenistan, Pakistan , Iraq , and Afghanistan.

Transmission Lines

Voltage (kV)	Existing (km)	Under Construction	%
400	12,138	4,952	40.7
230	24,931	3,128	12.5
132	17,047	2,821	16.5
63	36,720	3,283	8.9

Substations

Voltage (kV)	Existing number	Existing MVA	Being Added MVA	%
400	52	28,370	14,720	51.8
230	205	51,601	12,285	23.8
132	329	17,249	6,279	36.4
63	900	40,620	6,710	16.5


شبکه انتقال ۴۰۰ و ۲۳۰ کیلو ولت ایران
در پایان سال ۱۳۸۴
دریـــای خـــزر
تهـران
اهـواز
خلیـج فـارس
دریـــای عمـــان
ترکیه
عراق
ترکمنستان
(جمهوری ارمنستان)
(جمهوری آذربایجان)
(جمهوری پاکستان)
شرکت توانیر
معاونت برنامه ریزی
دفتر برنامه ریزی شبکه
علائم
موجود
در دست اقدام
خط ۴۰۰ کیلوولت
خط ۲۳۰ کیلوولت
کابل
پست ۴۰۰ و ۲۳۰ کیلوولت
پست ۴۰۰ کیلوولت
پست ۲۳۰ کیلوولت
نیروگاه
ترسیم
کنید
رویه‌زدی
مهندس افـوان
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آذربایجان
اصفهان
باختر
تهران
خراسان
خوزستان
زنجان
سمنان
سیستان و بلوچستان
غرب
فارس
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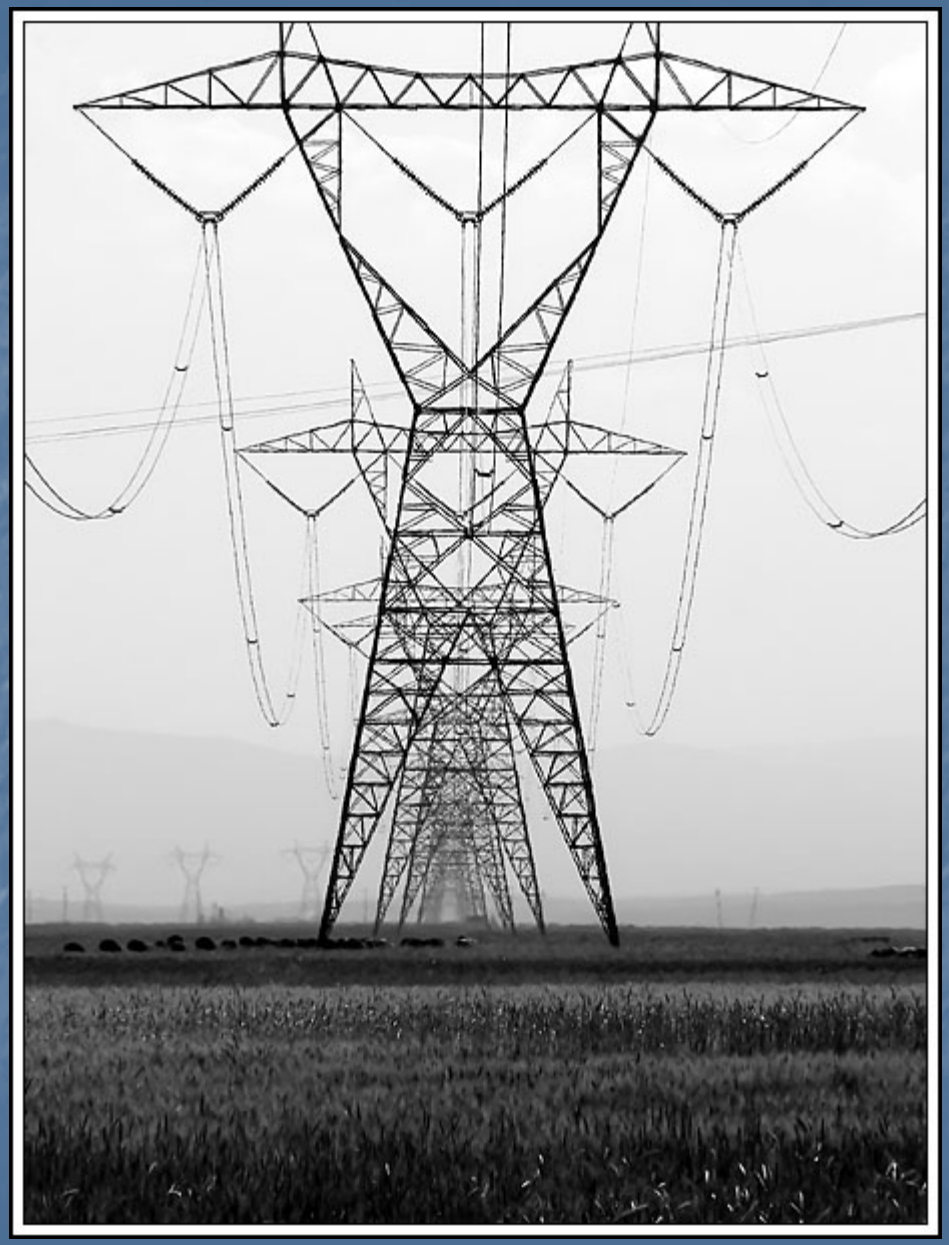
★ پست بطور موقت برقدار می باشد.



Distribution

Facts in 2005

- 100% of urban population has access to electricity.
- 98.6% of population in villages with more than 20 households has access to electricity.

Facts in 2005

- Total number of customers in the country: 19,652,000
- Growth compared to the previous year: 4.5%

Facts in 2005

- Total energy consumption in the country: 132.9 TWh
- Growth compared to the previous year: 6.8%

Energy Consumption

Consumption	%
Household	33.2
Industrial	32.4
Agricultural	12.4
Public	12.3
Miscellaneous	6.4
Streets' Lighting	3.2

Distribution Network

Network In 2005	Length (km)	Growth Compared to 2004
Arial 20 kV	293,000	4.5%
Ground 20 KV	12,000	6%
Arial 0.4 kV	7,100	4.5%
Ground 0.4 KV	2300	7.2%

Future

Plans for

Electricity

- In year 2005, a 20-year development plan, called the "Panorama Document" (PD), was approved for the country.

- The country's need to electricity is expected to increase from 41 GW in 2005 to 141 GW in 2024.

Installation Growth Rate

Year	Capacity	Avg. Growth/year
1979	7 GW	6.89% (25 years)
2004	37 GW	
2005	41 GW	6.72% (19 years)
2024	141 GW	

Per Capita Installed Capacity

Year	Capacity (GW)	Population (Million)	W Per Person
1979	7	36.0	195
2005	41	68.7	603
2024	141	91.2 (est.)	1546
2006 Australian Situation ~30 GW/20.3 Million			1478

Capacity to be Installed During the PD Years

Thermal Power	60 GW
Nuclear Power	20 GW
Hydro Power	15 GW
Renewable Power (Wind, Solar, Geothermal)	5 GW

Capacity to be Installed During the PD Years

Development Plan (DP)	Years	Per Year	Total
4th	2005 to 2009	4 GW	20 GW
5th	2010 to 2014	5 GW	25 GW
6th	2015 to 2019	5 GW	25 GW
7th	2020 to 2024	6 GW	30 GW

Planned Private Sector's Share in New Capacity Installation

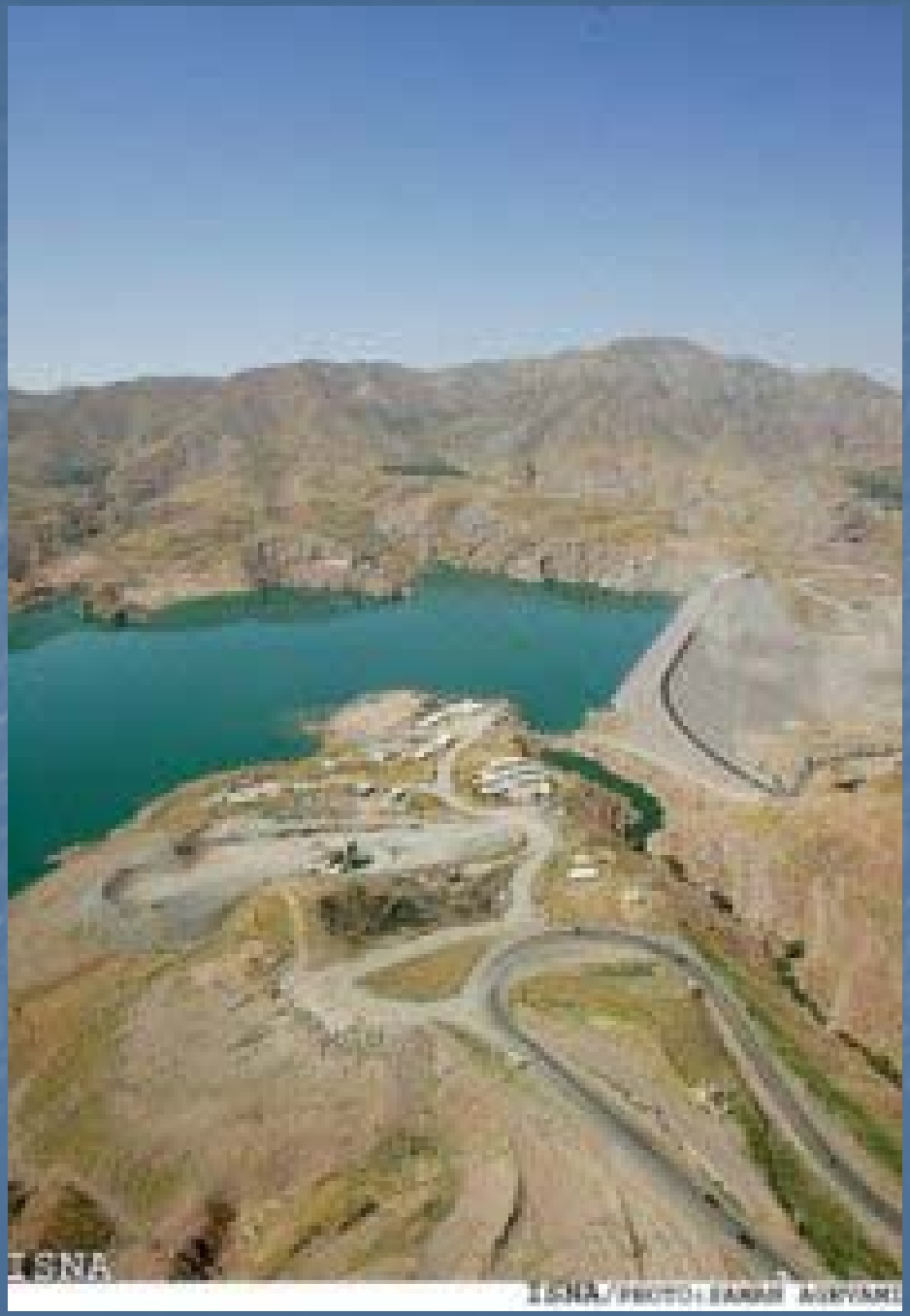
2006	25%
2007	35%
2008	50%
2009	75%
2010	100%

Planned Renewable Energies in the Total Capacity (Excluding Hydro)

2006	Less than 1%
2009 (End of 4th DP)	1.5%
2024 (END of 7th DP)	3.5%

Hydro Power in Iran

Total Installed Capacity in Mid-2006	6.3 GW
Total Capacity Expected To be Installed in 2009	11.2 GW
Commissioned Capacity + Under Installation & Study	25.0 GW


ISNA

Solar

Power

in Iran

- A 250 kW solar power station was built in Shiraz from 1996 to 2006.
- The main goal was to create the national knowledge base.

- A 467 MW Thermal-Gas-Solar power station is being built in Yazd.
- Steam Cycle: 1*132 MW
- Gas Cycle: 2*159 MW
- Solar Unit: 17 MW

Geo-Thermal

Power

in Iran

- The country's total Geo-Thermal potential is estimated between 7,000 MW to 8,000 MW.

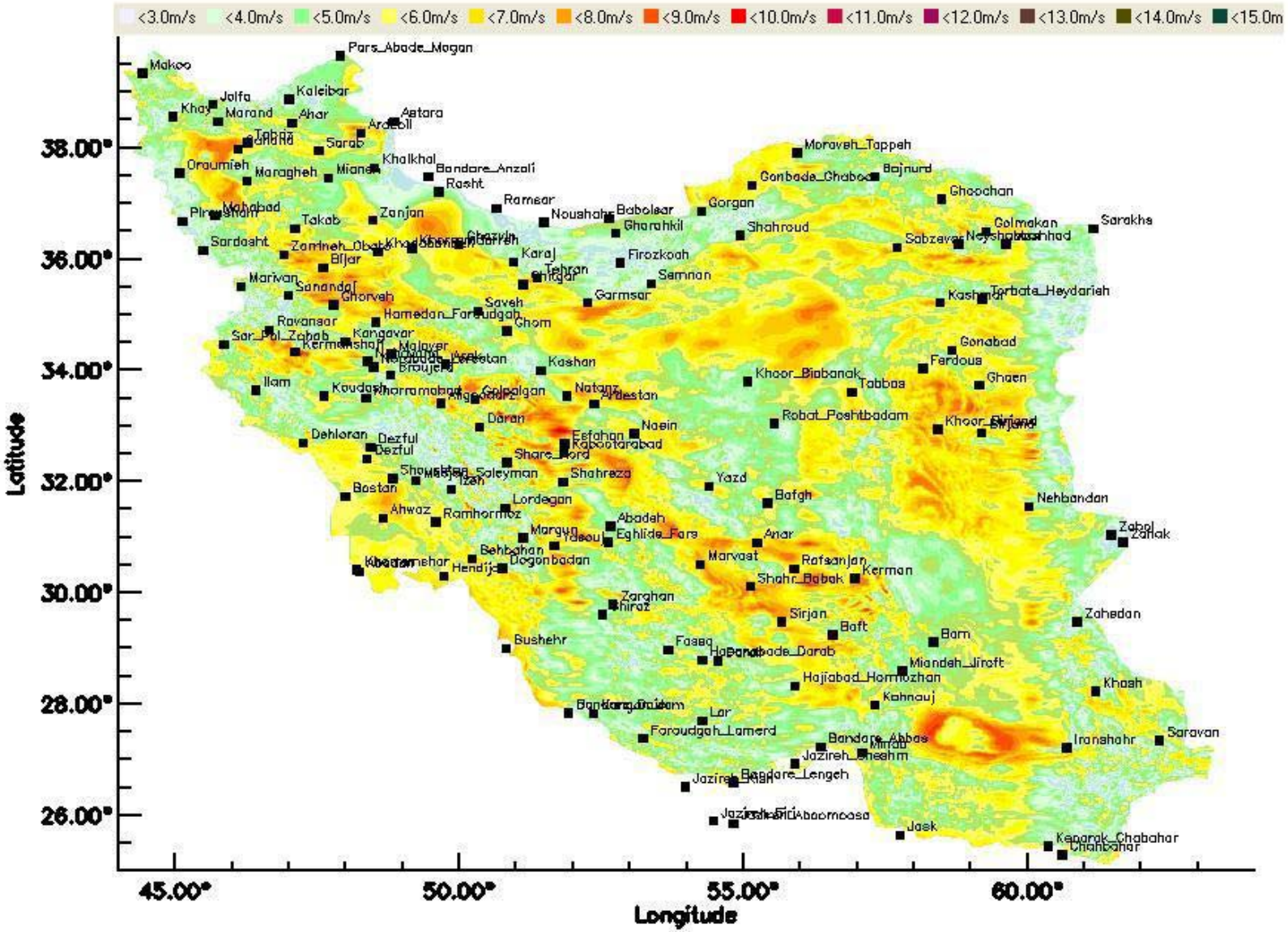
- Building a 100 MW Geo-Thermal power station is under study in Meshkinshahr (NW Iran) by foreign contractor.

Wind

Power

in Iran

Update Draft Zero Windmap Iran in 80 m above ground



- 150 stations for measuring the wind patterns and speeds are established throughout the country.

- The country's complete Wind Atlas is being prepared and is expected to be ready within the next 2-3 year.

- Three main Wind Tunnels have been identified in the country:

  1)North-West to South

  2)West to East

  3)East to South (Herat)

- The country's total wind potential is estimated between 20,000 MW to 30,000 MW.
- Currently, 6,500 MW wind potential has been identified.

- Two Wind Farms have been installed in the country and are under expansion.
- The total installed capacity at the end of 2006: 40 MW.

Manjil Wind Farm (N Iran)

Phase	Units	Total	Situation
I	22*660 kW	14.52 MW	Commissioned
II	45*660 kW	29.70 MW	Under Construction
III	85*660 kW	56.10 MW	Later Stages
Total		100.32 MW	

Binalood Wind Farm (NE Iran)

Phase	Units	Total	Situation
I	20*660 kW	13.2 MW	Commissioned
II	15*660 kW	9.90 MW	Year 2006
III	8*660 kW	5.28 MW	Year 2007
Total		28.38 MW	

Binalood Wind Farm (NE Iran)

- 320 days of good wind every year.
- Only one change in wind direction per day.
- Average wind speed: 8.3 m/s
- Total region's potential: 2,000 MW

Policies to Encourage Private Sector in Green Power Generation

- Feed-in Tariffs are approved.
- Buying prices for wind power per kWh:

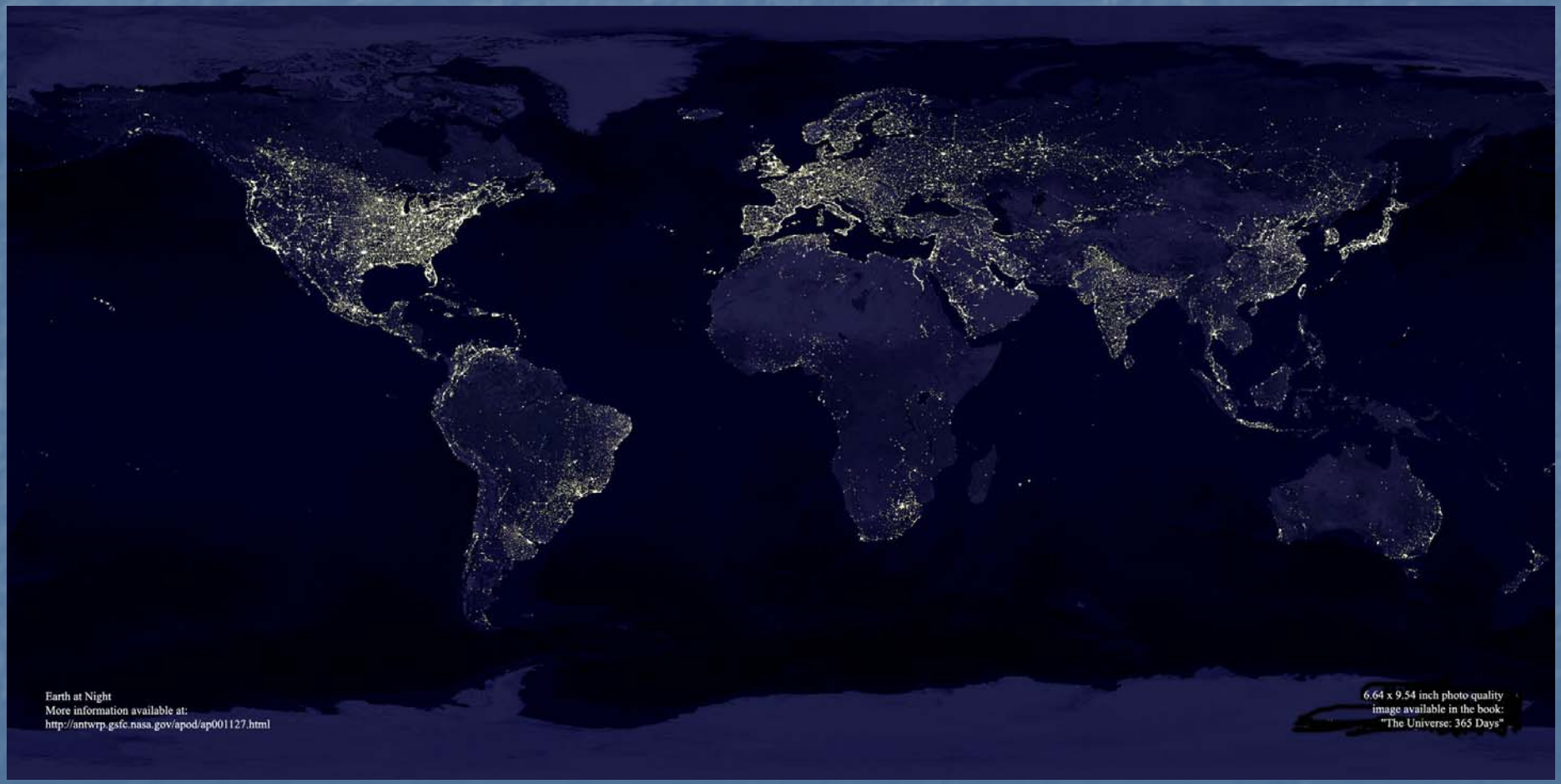
  20 Hours a day: 650 Rials (9 cents)

  4 Hours a day: 450 Rials (6.3 cents)
- Avg. selling price: 120 Rials (1.7 cents)

- A factory manufacturing 660 kW wind turbines started its work in Iran in Summer 2006.
- Besides supplying the domestic needs, Armenia is the first country to import some of these Iranian turbines.

ISNA/PHOTO: AFP

Earth at Night



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Thank You!