



IRELAND

UNITED KINGDOM

NETHERLANDS

BELGIUM

GERMANY

LUXEMBOURG

PARIS

FRANCE

SWITZERLAND

AUSTRIA

ITALY

ANDORRA

SPAIN

CORSICA

SARDINIA (ITALY)

ATLANTIC OCEAN

MEDITERRANEAN SEA

France

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A Little About France



- ▶ Population 67.2 million (2019)
- ▶ 210,026 sq. miles (roughly size of Texas)
- ▶ 80% urban
- ▶ 306.9 people/sq.mi (U.S. 94 people/sq.mi)
- ▶ Government type: "Individual, secular, democratic, and social republic"

History of Energy Use 1850-1950

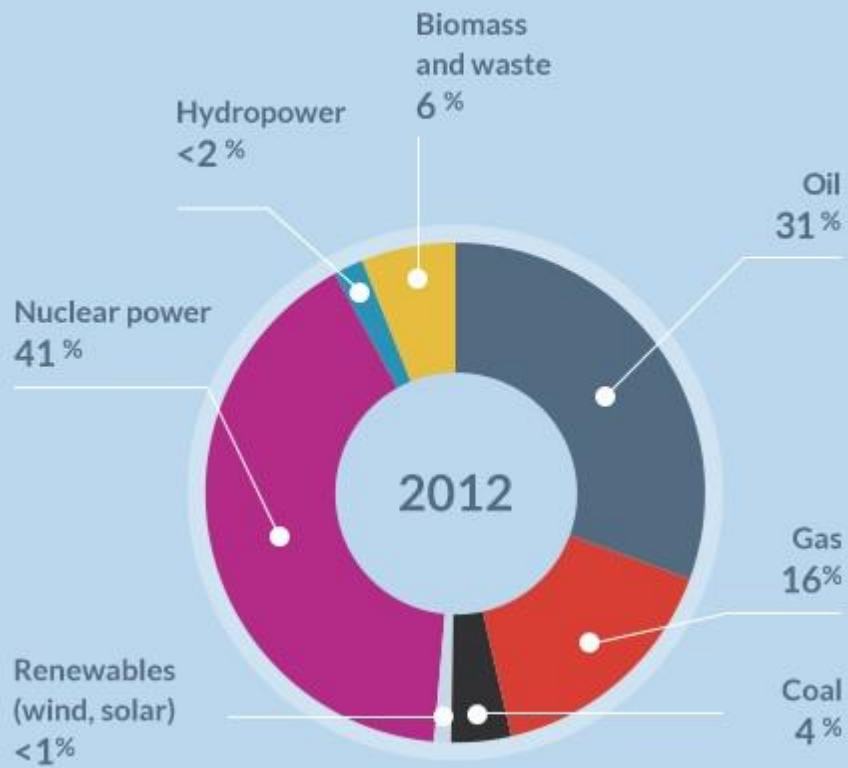
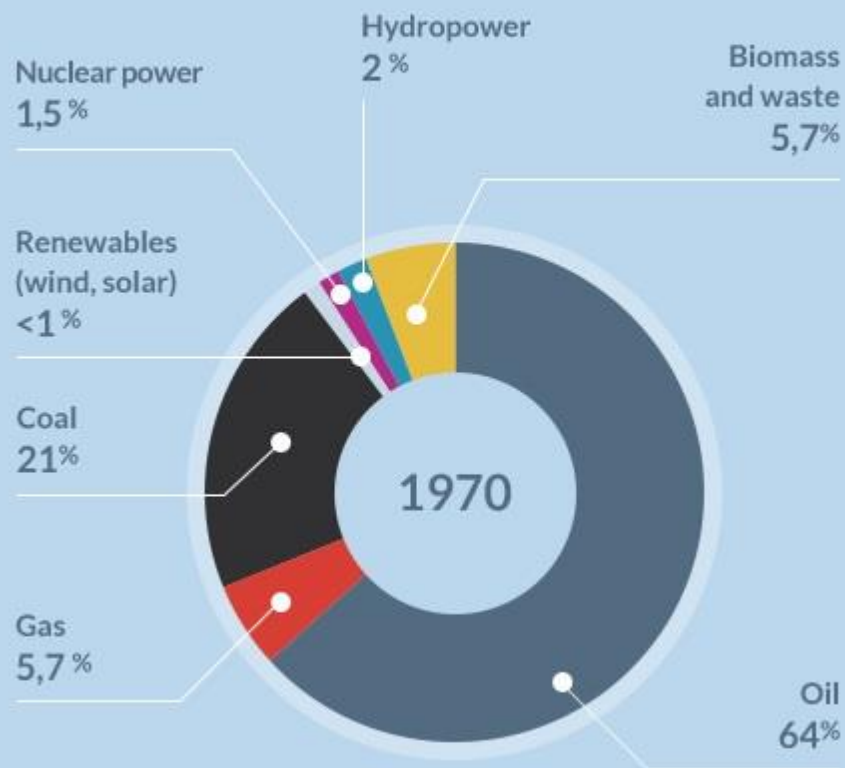
- ▶ 1850-1900 yearly coal consumption increased from 12 tonnes to 40 tonnes
- ▶ WWI ended France's oil independence
- ▶ 1928: Law was enacted to give government monopoly on oil import, processing, price
- ▶ 1946: Electricité de France nationalized electric production and distribution. Nationalization of coal production soon followed.

History of Energy Use 1950-present

- ▶ 1950s: Natural gas mining begins in southern France. Cheap oil drastically cuts coal use.
- ▶ Late 1960's: Issues in Suez and Algerian independence cause major energy crisis leads to development of nuclear power.
- ▶ 1970's: Oil embargo by OPEC in 1973 convinces need for energy independence
- ▶ 1980's-present: Renewable energy scrapped in favor of nuclear causes lag in renewables compared to the rest of Europe

Choose two years to compare energy mix trends:

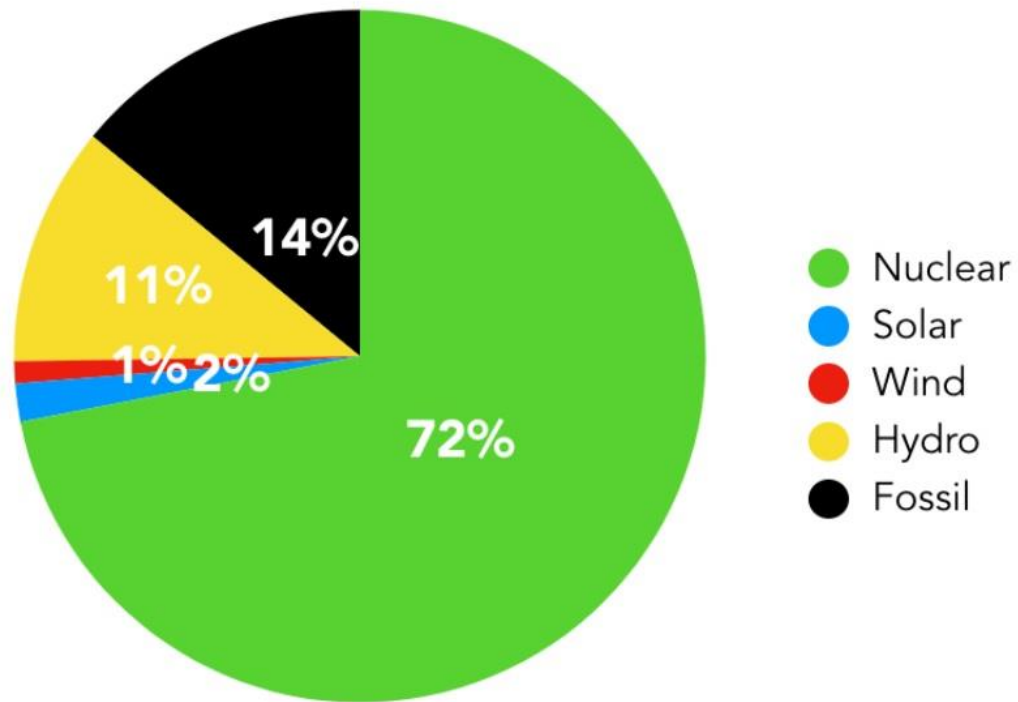
1970 and 2012



Energy mix source: 2009 International Energy Agency statistics.

France 2019 Electricity Generation

France's Electricity Mix



Source: BP Statistical Review of World Energy 2019

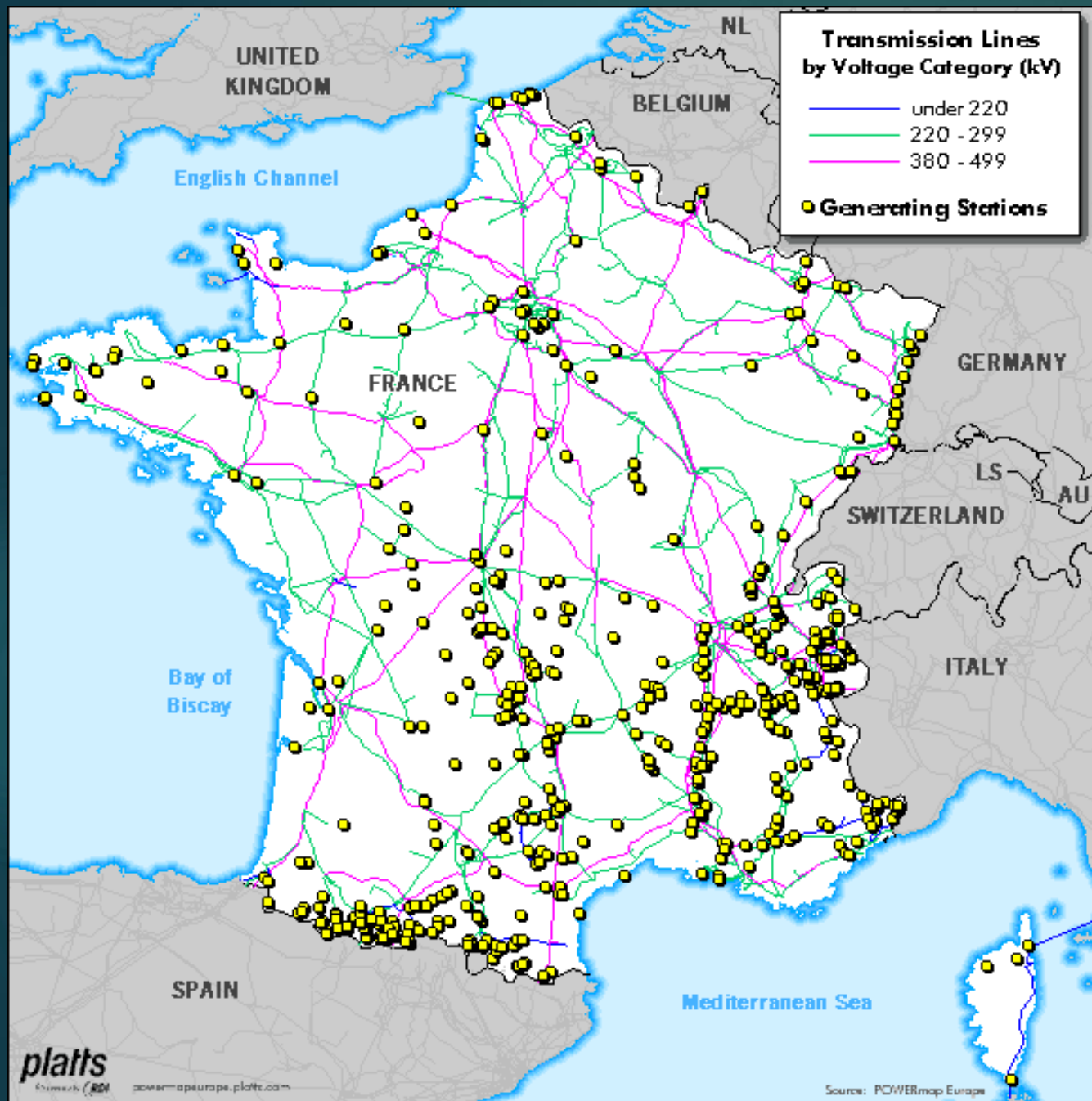
France vs. United States

	GDP (Million USD)	Total Energy Use (Mtoe)	CO₂ Emissions (Mt)	Electricity use/Capita (kWh)	CO₂ Emission/ Capita (Mt)
France	2,708,600	135	293	6,660	4.37
United States	21,427,100	2,258	5100	12,200	15.9



edf Électricité de France

- Largely owned by French government
- LLC with government owning 85% of shares
- Produces ~20% of power for European Union
- €3 billion yearly profit exporting electricity (40 TWh)



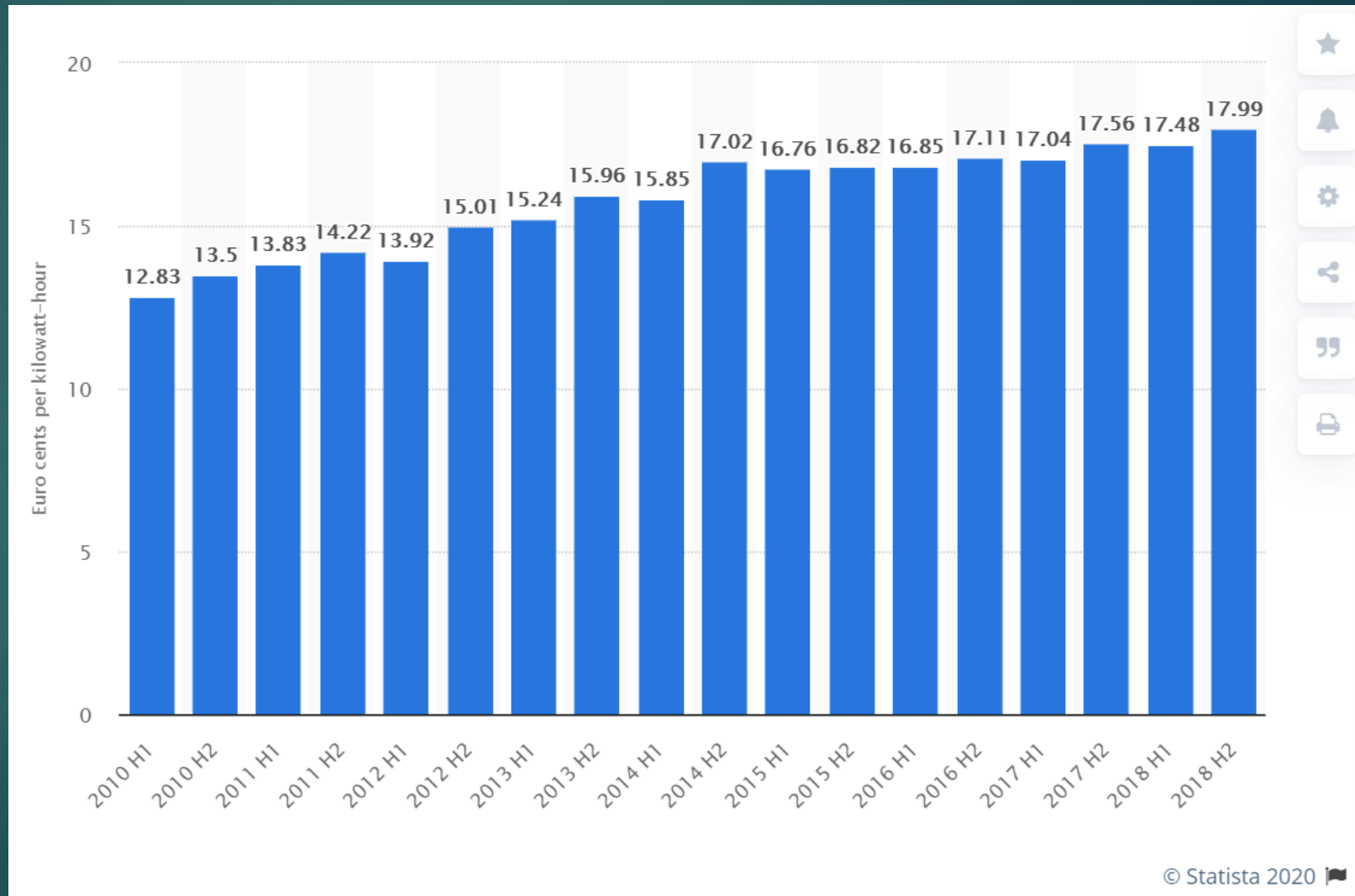
The Electric Grid

- 2nd largest European consumer of energy after Germany
- Largest exporter of electricity in the world

Electricity prices for households in France from 2010 to 2018, semi-annually

April 23rd, 2020
€17.99 = \$19.39

2020 National avg.
US = \$13.19/kWh



Graveline's Nuclear Power Plant

- ▶ France's Largest NPP
- ▶ Produces 5,460MW
- ▶ Consists of six 910MW pressurized water reactors (PWR) units commissioned between 1980 and 1985
- ▶ Owned by EDF
- ▶ 6th Largest NPP in the world

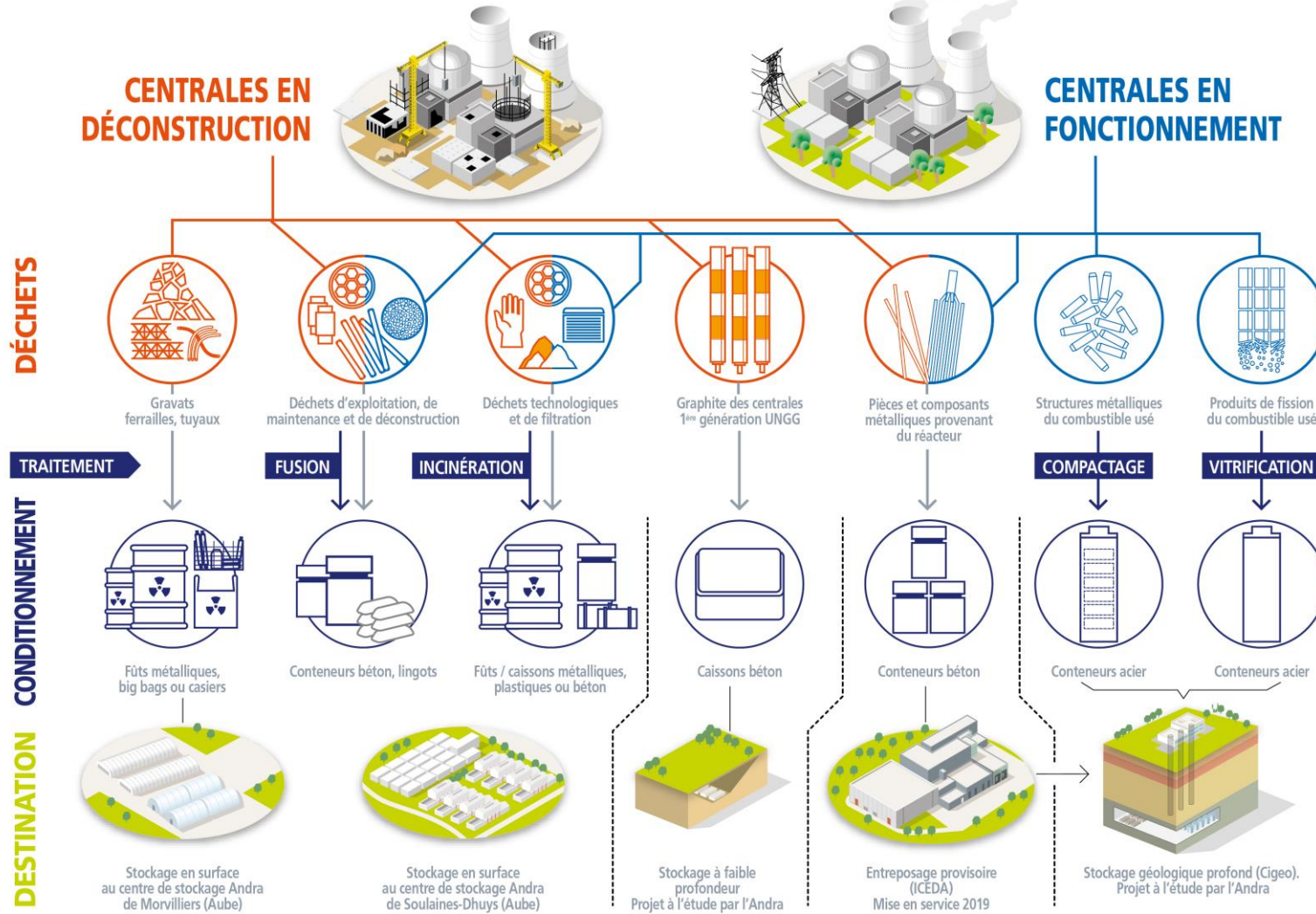


Nuclear Waste

- ▶ France reprocesses fuel for Uranium and Plutonium
- ▶ French law requires retrievable design
- ▶ About 17% of the country's electricity comes from reprocessed fuel



LA GESTION DES DÉCHETS RADIOACTIFS

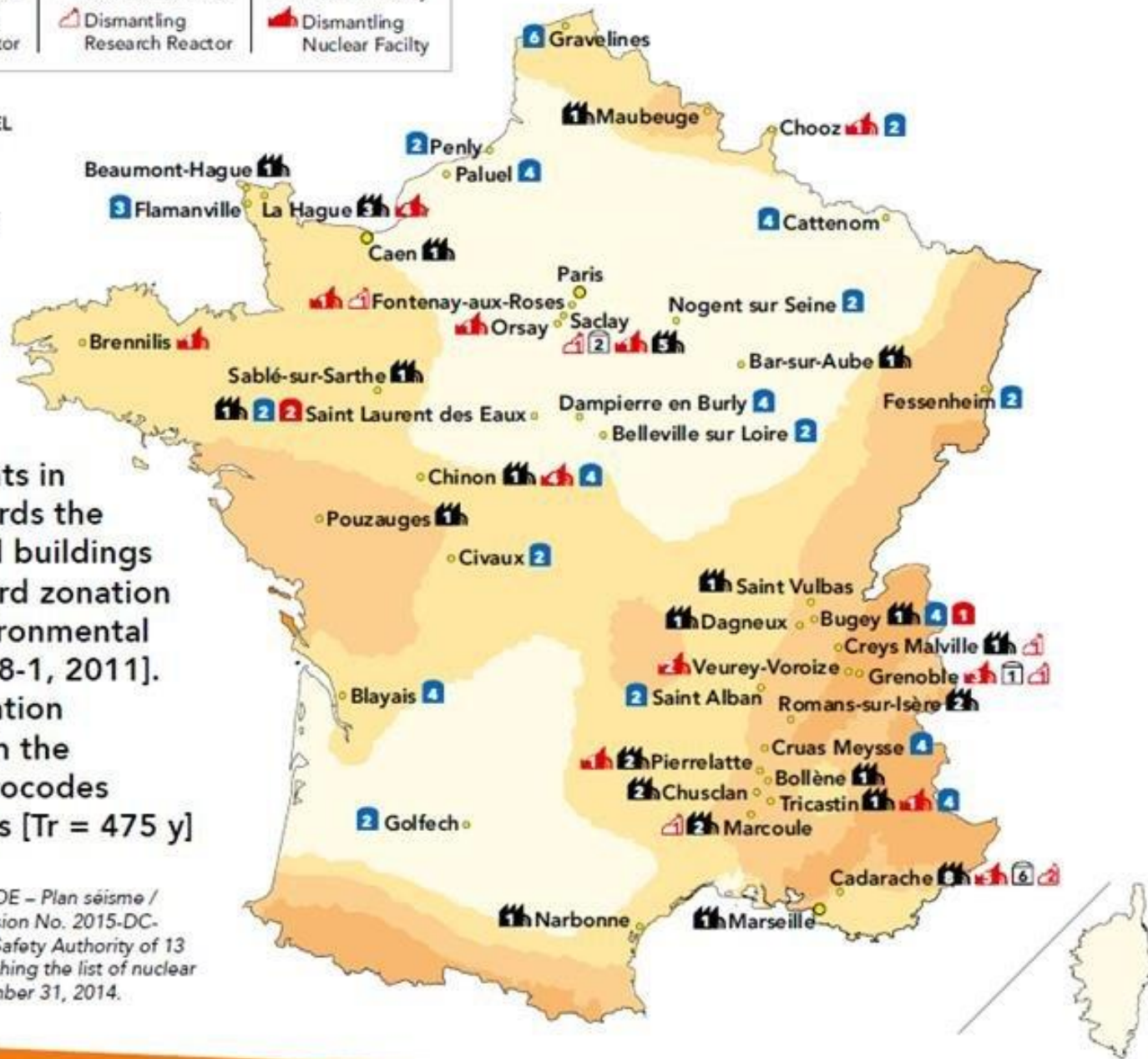
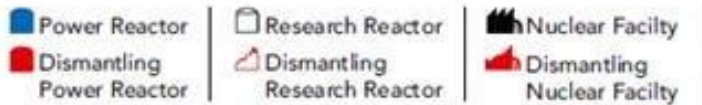


- The 90% of least radioactive waste is sealed in drums, metal boxes or concrete containers. Final storage is handled at three Andra centres located in the Manche and Aube departments.
- The 10% of most radioactive waste is currently conditioned in stainless steel containers and placed in intermediate storage at AREVA's La Hague plant.

Maintaining Nuclear

- ▶ Assurance to operate for 50 years
- ▶ France's Environmental Code
- ▶ 10-year interval comprehensive safety tests
- ▶ French National Plan for the Management of Radioactive Materials and Waste (PNGMDR) is revised every 3 years
- ▶ Nuclear operators are responsible for financing the management of their waste and the dismantling of their nuclear installations –DP2D





Nuclear plants in France towards the conventional buildings seismic hazard zonation [French Environmental code, D563-8-1, 2011]. Seismic zonation performed in the frame of Eurocodes requirements [Tr = 475 y]

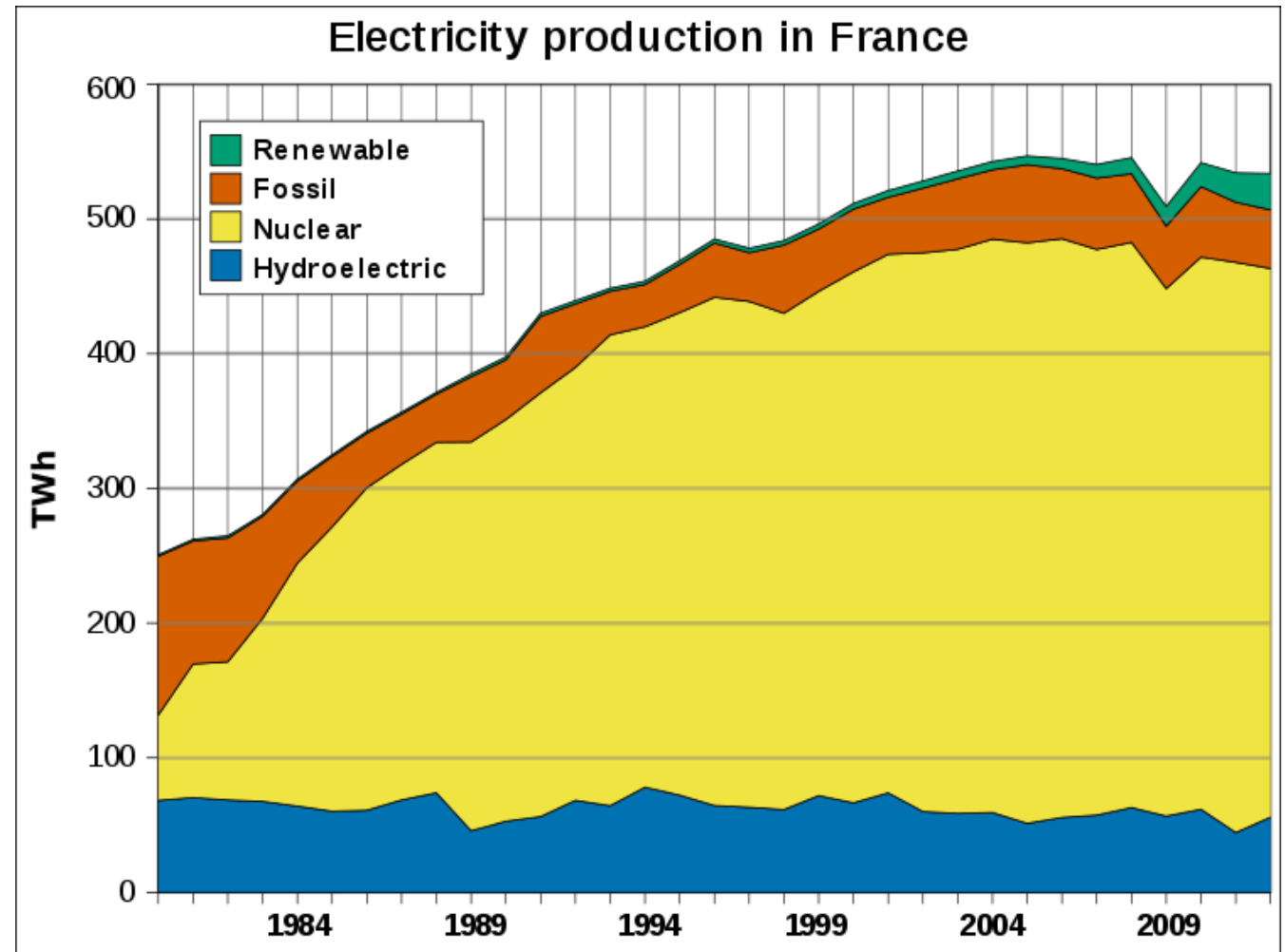
Zonation map : MEDDE – Plan séisme / Nuclear Plants : Decision No. 2015-DC-0493 of the Nuclear Safety Authority of 13 January 2015 establishing the list of nuclear installations at December 31, 2014.

Seismic Concerns, following Fukushima

Nuclear plants are designed to withstand an earthquake twice as strong as the 1000-year event calculated for each site

France's Nuclear Future

- ▶ The majority of the 58 nuclear reactors will reach 40 years of operation within the next 15 years- closure or refurbishment
- ▶ Development of low carbon electricity and renewables
- ▶ Ongoing revisions on lifetimes and regulations
- ▶ Power consumption and exports



Fossil Fuels

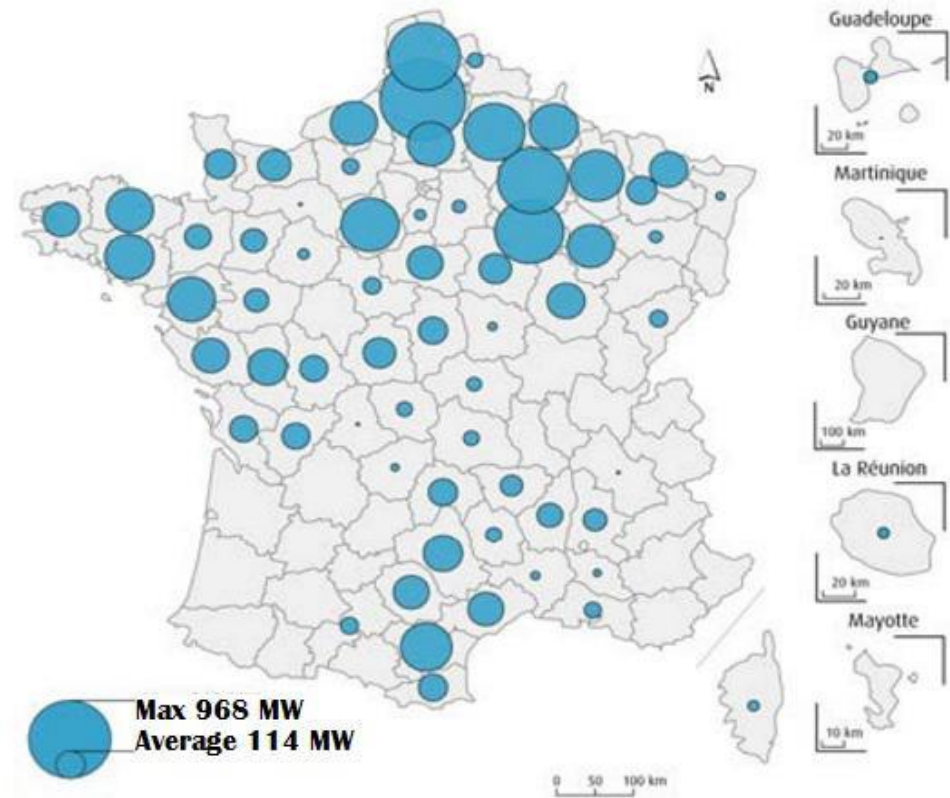
- ▶ 2015 fossil fuel consumption
 - ▶ 30% Oil
 - ▶ 14% Natural gas
 - ▶ 3% Imported Coal
- ▶ France banned use of hydraulic fracking in 2011
- ▶ Residential Consumption
- ▶ 4 working LNG terminals



Renewable Energy

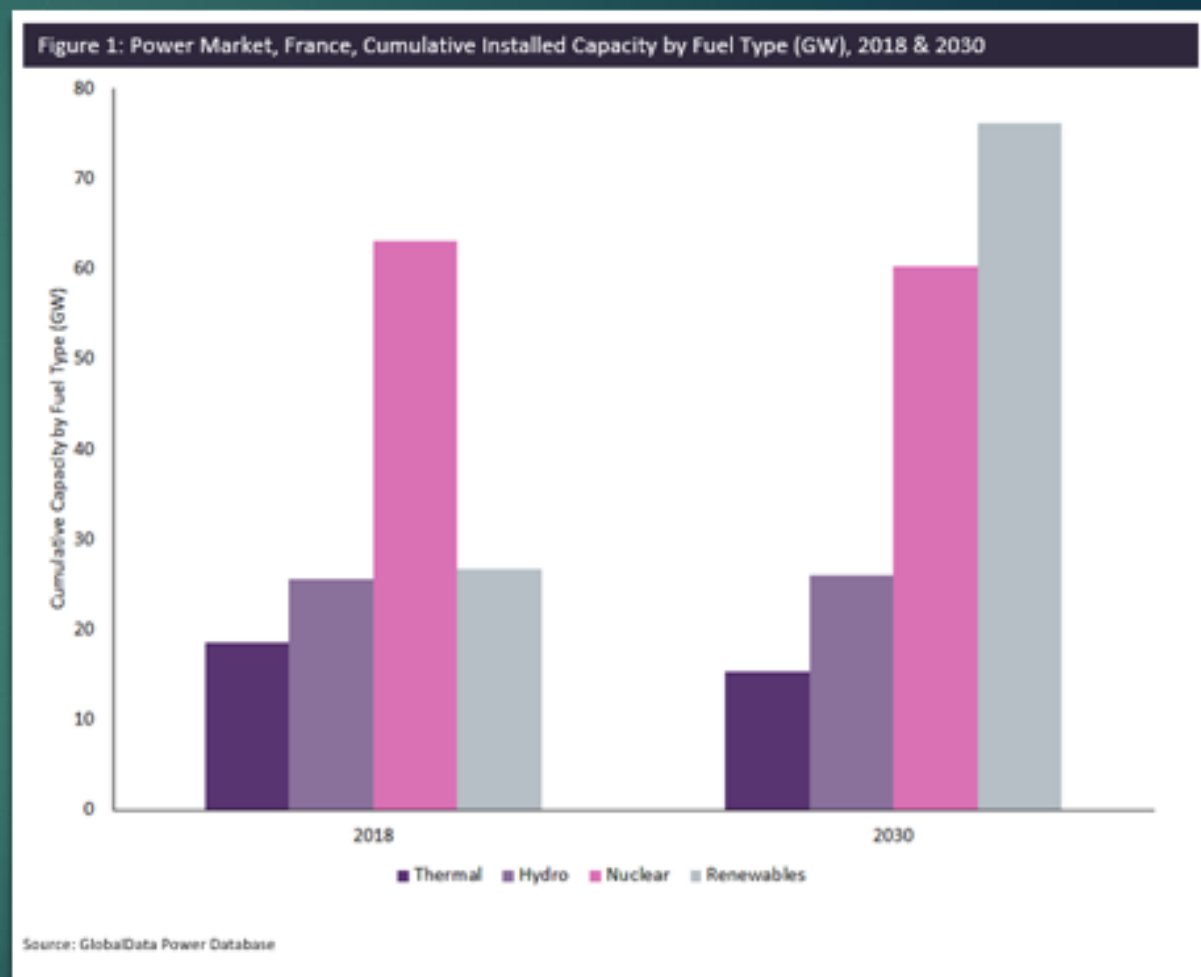
- ▶ Non-hydro renewable capacity in France is expected to reach 25.3 GW by 2030 (from 8 GW in 2018)
- ▶ In 2019, Renewables were responsible for 23% of France's power
- ▶ Interest in Wind expansion

France installed wind power capacity at June 30, 2016



Paris Climate Accord Expectations

- ▶ A 40% emissions reduction by 2030, compared to 1990 levels.
- ▶ A 75% emissions reduction by 2050, compared to 1990 levels.
- ▶ Increase the share of renewable energy in final energy consumption to 32% by 2030
- ▶ Reduce energy consumption by 50% by 2050



France's Energy Future

Energy Transition for Green Growth Act (ETGGA) 2015

- ▶ Cut greenhouse gas emissions 40% of 1990 levels
- ▶ Cut fossil fuel 30% by 2030
- ▶ Reduce nuclear to 50% of electric share by 2025
- ▶ Increase renewable to 32% by 2030 and to 40% of electricity
- ▶ Cut energy consumption 50% of 2012 level by 2050
- ▶ Cut waste going into landfills by 50% by 2050

Works Cited

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- ▶ <https://www.gouvernement.fr/en/cop21-france-s-national-commitments>

An aerial photograph of Paris, France, taken at dusk or dawn. The Eiffel Tower is prominent on the left side of the frame. The city's dense urban landscape is visible, with numerous buildings and streets. The sky is a mix of dark blue and orange, suggesting the time is either early morning or late evening. The overall tone is somewhat somber and contemplative.

Questions?