



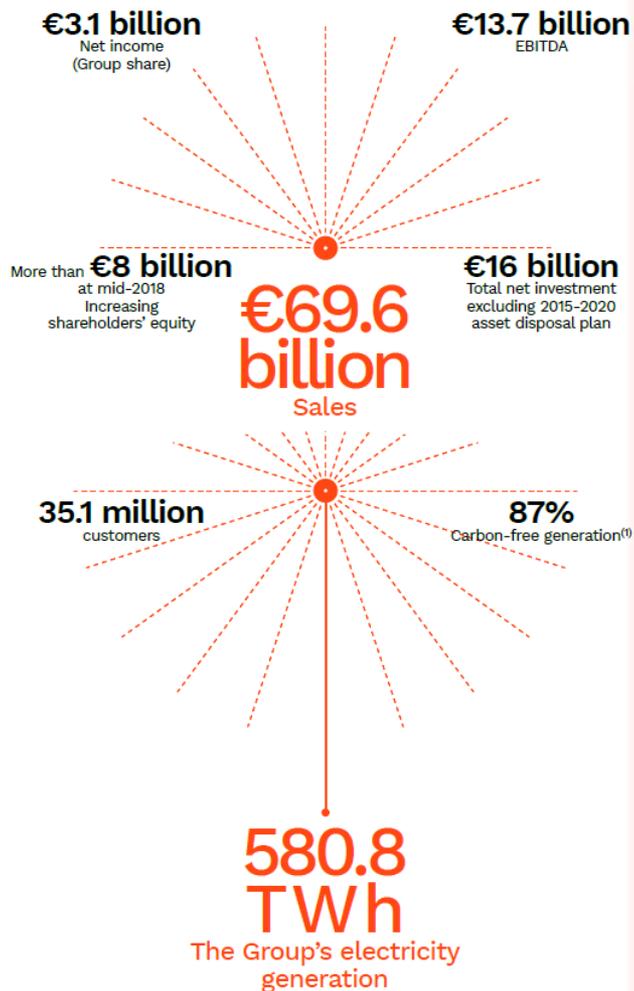
USE OF HIGH PERFORMANCES ENGINES PLANTS IN FRENCH ISLANDS

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TFTEI Annual Meeting
Brussels, October 16th, 2018



EDF GROUP : WHO WE ARE



EDF group is the world's leading electricity company and global leader for low-carbon energy production. Particularly well established in Europe, the Group covers all businesses spanning the electricity value chain – from generation to distribution and including energy transmission and trading activities. A marked increase in the use of renewables is bringing change to its energy generation operations, which are underpinned by a diversified and complementary energy mix founded on nuclear power capacity. EDF offers products and advice to help residential customers manage their electricity consumption, to support the performance of its business customers, and to help local authorities find sustainable solutions.

⁽¹⁾ Direct emissions excluding life cycle analysis of generating plant and fuel.

DID YOU KNOW ?



France, the second largest maritime domain in the world

THE EU LEGISLATIVE FRAMEWORK FOR ISLANDS

TFUE art. 349

EU outermost regions: These regions are formally part of EU, however the TFUE recognizes their specificities.

EU overseas countries and territories: These regions are not formally part of the EU.

EU island means an area of at least 1 km², located at a distance of at least one km from the continent, that has a permanent resident population of at least 50 people, has no permanent link with the continent and does not host an EU capital (Malta and Cyprus are not EU islands)

Directive 2009/72/EC

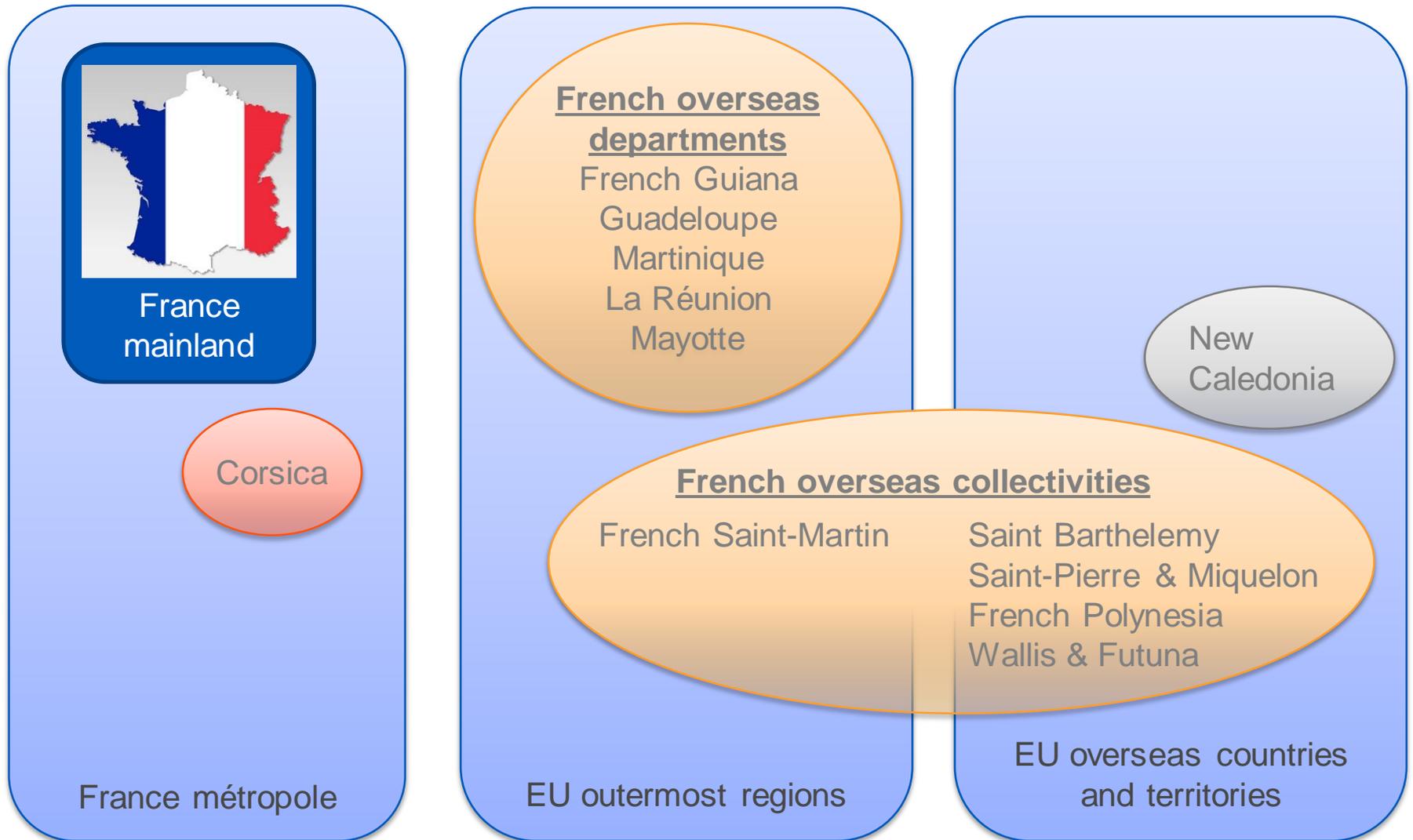
Small Isolated System (SIS) means any system with consumption of less than 3000 GWh in the year 1996, where less than 5 % of annual consumption is obtained through interconnection with other systems.

Micro isolated system (MIS) means any system with consumption less than 500 GWh in the year 1996, where there is no connection with other systems.

→ EU environmental legislation (IED 2010/75/EU, MCPD 2015/2193,...) recognizes the specificities of SIS.

France métropole : scope for national emission inventory for EU legislation (NECD, CLRTAP,...)

THE STATUS OF FRENCH ISLANDS



THE CHALLENGES OF ELECTRICITY IN SIS

- Extreme variations of electricity demand, on both daily and seasonal bases
- Increasingly fluctuating input from renewable power sources (“sunset effect”), with no connection to mainland grid to ensure the security of supply
- Lack of space, water, infrastructure and restricted fuel choice (i.e. natural gas)

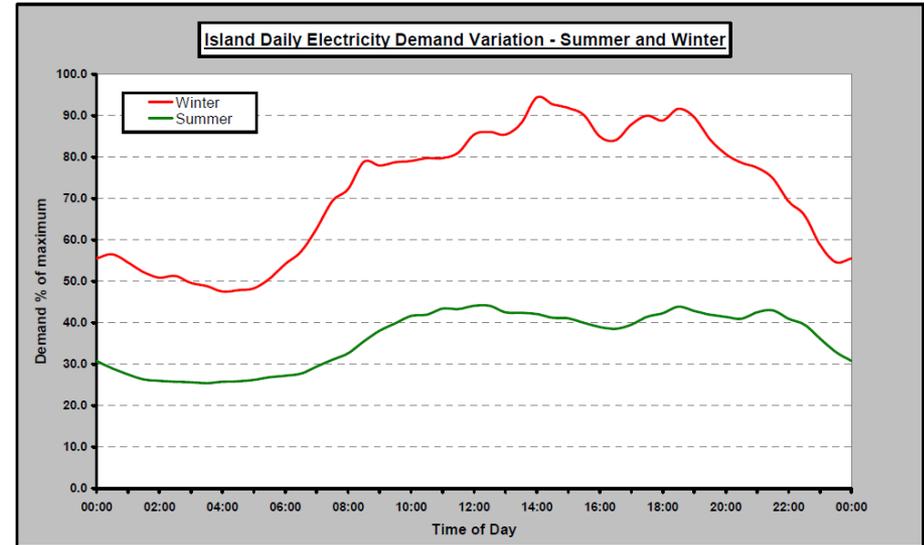


Figure 2: Daily demand fulfilled by island diesel plant – averages for summer and winter

Source : EURELECTRIC



The use of land based stationary engines is commonplace in island communities, since they often represent the best choice of generation plant to meet the issues identified above.

Stationary engines offer good operational flexibility, quick to start-up and efficient to operate across a range of power demands.

THE ELECTRICITY MIX IN FRENCH OVERSEAS DEPARTEMENTS

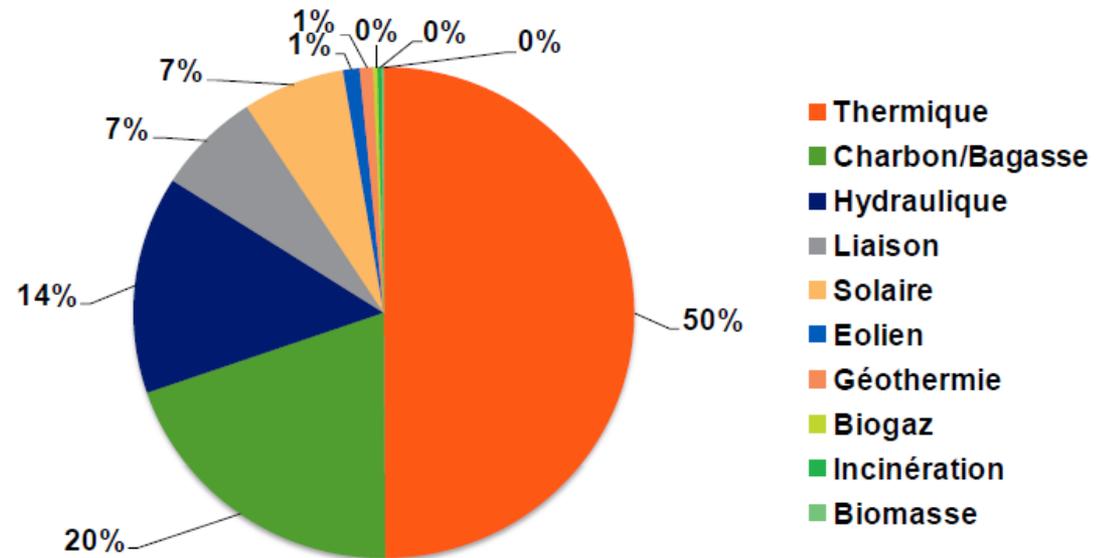
Today...

- Thermal generation is the main source of electricity
- Liquid fuels fired stationary engines and open cycle gas turbines are the main technologies used

... and tomorrow in French overseas departments

- 50% renewable energy in 2020
- Full energy autonomy by 2030

Stationary engines play a key role in the energy transition of French overseas departments.

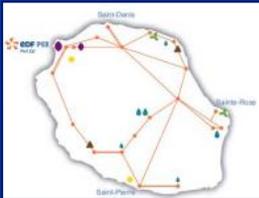


Source : bilan SEI 2016

EDF GROUP NEW ENGINES PLANTS

La Réunion « Port-Est »

12 MAN 18V48/60, 220 MW
commissioned in 2013



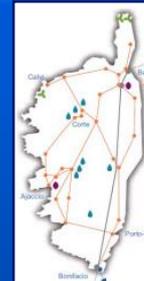
Martinique « Bellefontaine »

12 MAN 18V48/60, 220 MW
commissioned in 2014



Guadeloupe « Pointe-Jarry »

12 MAN 18V48/60, 220 MW,
commissioned in 2015



Corsica « Lucciana »

7 MAN 18V51/60 dual fuel, 120 MW,
commissioned in 2014

This vast programme was decided by the French government in 2006 to take over from the ageing power plants built in the 70'.

EXAMPLE : BELLEFONTAINE (MARTINIQUE)



Each stack supports the flue gas ducts of 6 engines of 18 MWe composing one large combustion plant according to IED 2010/75/EU.

FUEL AND WATER CONSUMPTION

- **Low fuel consumption**

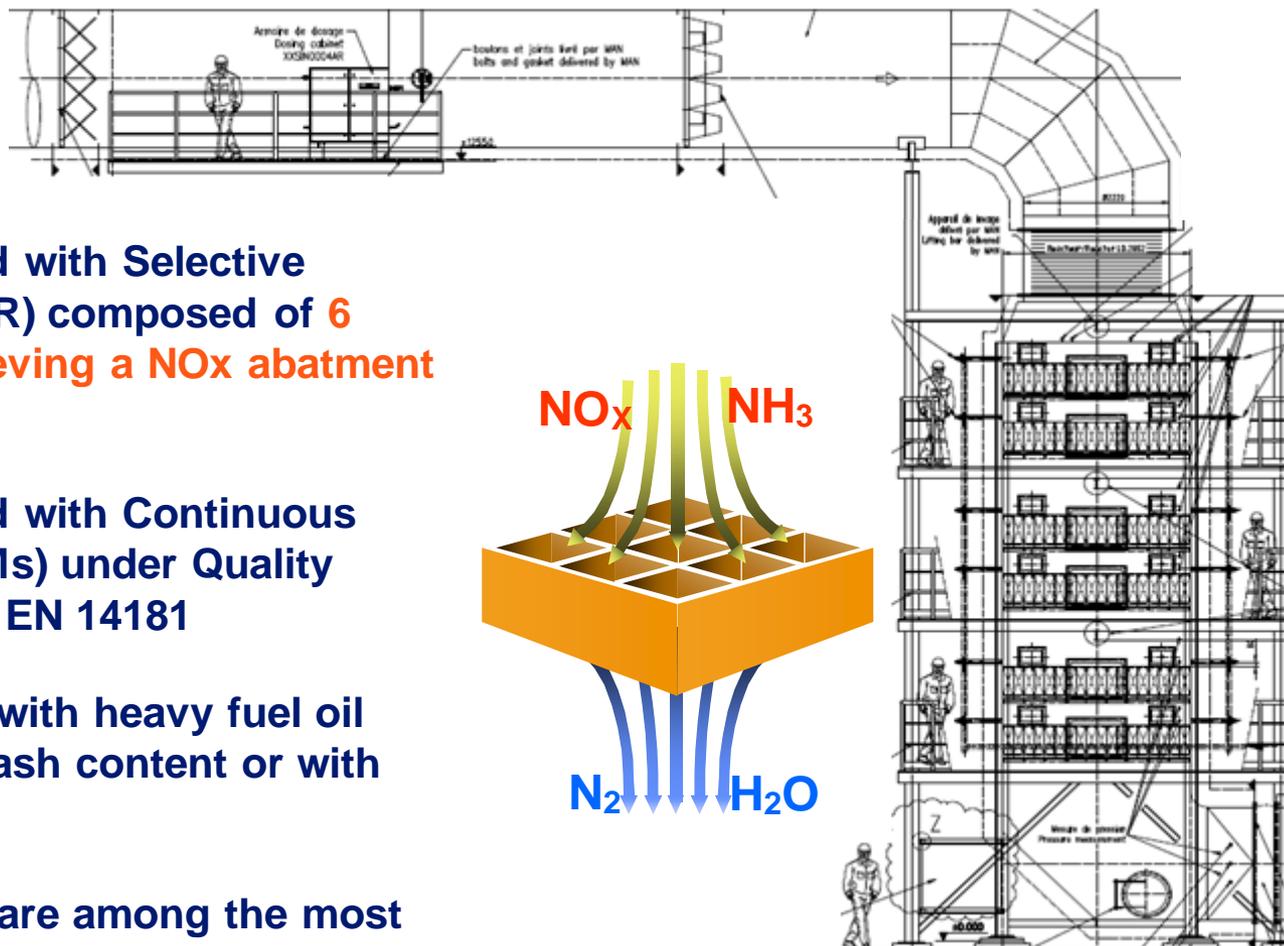
- An energy efficiency improved by 15% compared to the previous engines

- **Low water consumption**

- Desalination unit
- Demineralized water production unit
- Dry air-cooled cooling system, allowing a water consumption reduction of 700 000 m³/year



FLUE GAS TREATMENT



- All engines are equipped with **Selective Catalytic Reduction (SCR)** composed of **6 layers of catalysts**, achieving a **NO_x abatement of 85%**.
- All engines are equipped with **Continuous Emission Monitors (CEMs)** under **Quality Assurance** according to **EN 14181**
- The plants are supplied with heavy fuel oil with low sulfur and low ash content or with gasoil (in Corsica)
- EDF PEI engines plants are among the most efficient and least polluting in the world.

Source : Johnson Matthey

ENVIRONMENTAL PERFORMANCES

All Emission Limit Values (ELV) are expressed in mg/Nm³ at 15%O₂ reference and dry flue gas - D / M / Y : Daily / Monthly / Yearly averages

Pollutant	EDF PEI French national regulation	LCP BAT Conclusions Existing LCP <i>Applicable only in 2030 for SIS</i>	LCP BAT Conclusions New LCP (iv) <i>Applicable only in 2025 for SIS</i>
NOx	M: 225 (i)	Y: 125-625 D: 150-750 (iii)	Y: 115-190 D: 145-300
CO	M: 250	Y: 50-175 (iv)	Y: 50-175 (iv)
SO ₂	M: 565	Y: 280 D: 280	Y: 45-100 D: 60-100
Dust	M: 40	Y: 5-35 D: 10-45	Y: 5-10 D: 10-20
NH ₃	M: 5 (ii)	15	15

- (i) possibility to relax the ELV up to 625 mg/Nm³ depending on the local authority
- (ii) possibility to relax the ELV up to 20 mg/Nm³ depending on the local authority
- (iii) 1150 – 1900 for plants that cannot be fitted with secondary abatement techniques
- (iv) indicative

EDF PEI EXPERIENCE

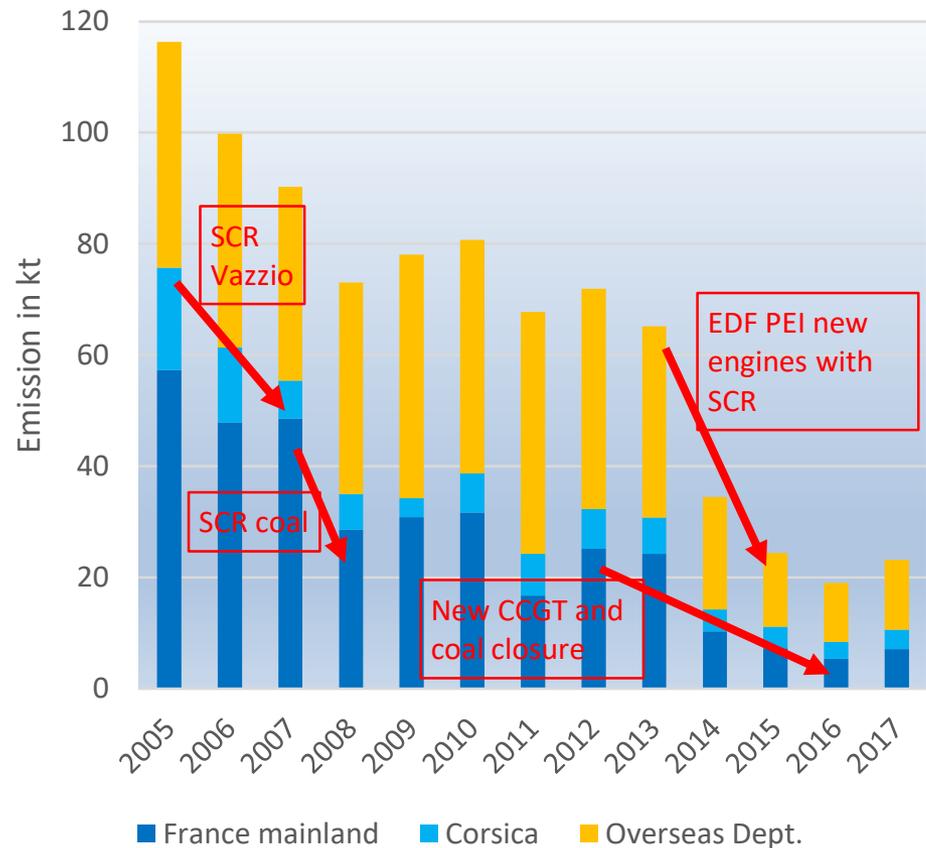
- **A world wide reference**
 - More than **700 MWe** commissioned between 2013 and 2015
 - More than **800 000 hours of operation** (total for the 4 sites since the commissioning)
- **The NO_x ELV of 225 mg/Nm³ @15%O₂ revealed to be extremely challenging**
 - Because high efficiency plant means low flue gas temperature, preventing high rate denox
 - Because of peak load operation and catalyst poisoning by the fuel oil
- **Many modifications had to be tested and implemented in collaboration with the supplier**
 - Nozzle ring, compressor bleed, flue gas recirculation, composition of the first layer of the catalyst...



A SIGNIFICANT CONTRIBUTION TO THE DECREASE OF FRANCE NOx EMISSION

- The investments undertaken by EDF Group to build new, efficient and clean power plants in Corsica, La Réunion, Guadeloupe and Martinique have allowed a **decrease of NOx emissions by a factor 6 since 2005**.
- This drastic decrease of NOx emission is in line with the results achieved by EDF Group in France mainland.
- Altogether these emission reductions represent a significant contribution to reaching the 2020 NOx national emission ceilings for France.

EDF Group NOx emissions
Power generation in France



THANK YOU FOR YOUR ATTENTION

