Ex-ante evaluation of the French National Air Pollutant Emission Reduction Plan (PREPA)

Results of the final scenario

Simone Schucht (INERIS), Nadine Allemand (CITEPA), Elsa Real (INERIS)

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INERIS   énergies demain   ex AJI-Europe   ajBD   CiTEPA

STRUCTURE OF THE PRESENTATION

- The double objective of the French PREPA

- Method employed for the selection of measures

- Additional measures selected

- Results

  - Emission reductions

  - AQ impacts

  - Health benefits

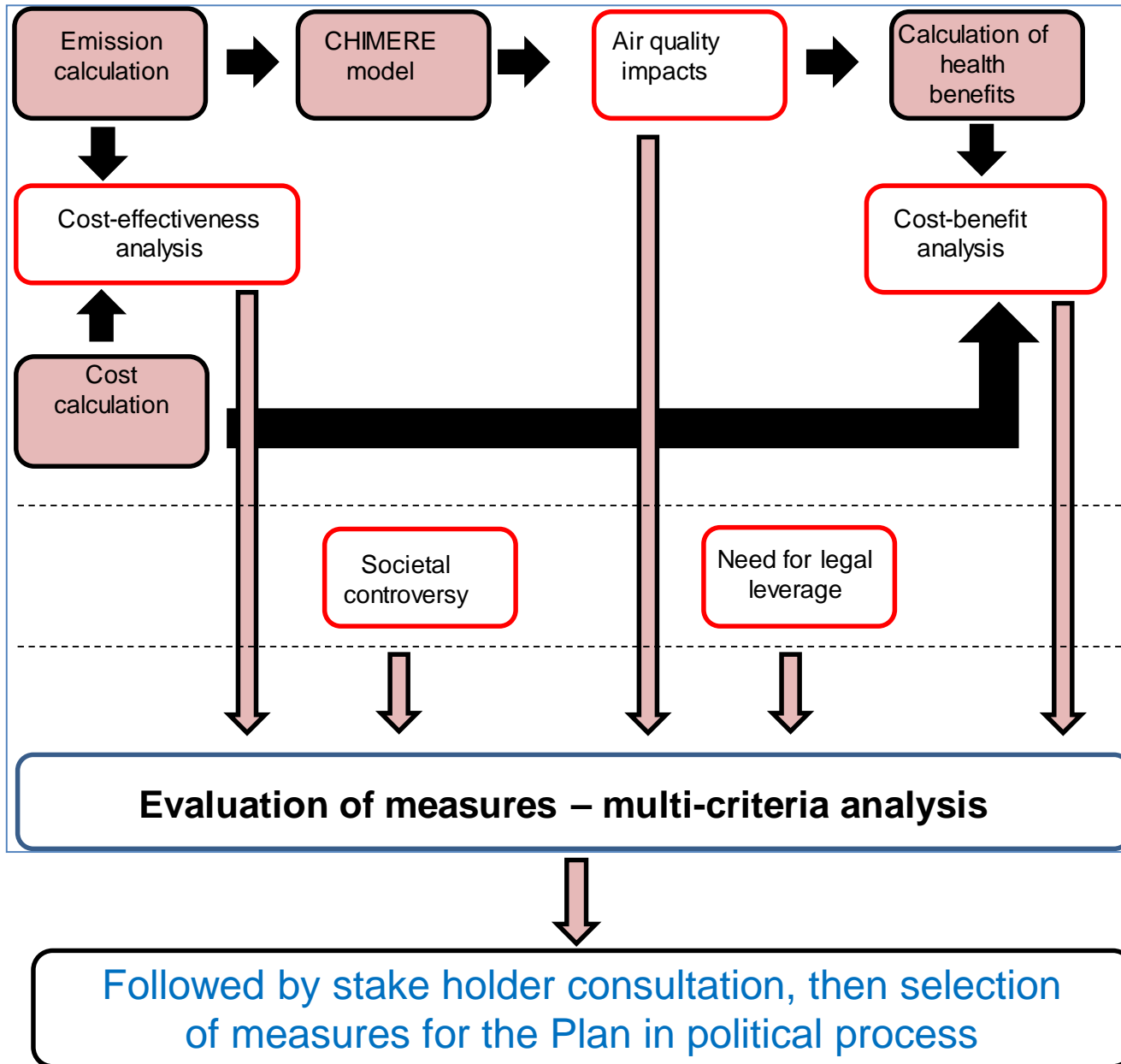- Conclusions

THE DOUBLE OBJECTIVE OF THE FRENCH PREPA (*)

- Reduce air pollutant emissions and improve air quality in order to

  - comply with emissions reduction objectives (NECD) for $PM_{2,5}$, SO_2, NOx, NH_3 and NMVOC

  - comply with air quality (AQ) concentration requirements for PM_{10}, $PM_{2,5}$, NO_2 and O_3 thus reducing limit and target value exceedances

(*) PREPA = Plan National de Réduction des Émissions de Polluants Atmosphériques (PREPA)

French National Air Pollutant Emission Reduction Plan

Project duration: September 2014 – July 2016 – January 2017

Measures assessed

- Existing
- Additional

- Technical
- Incentive
- Knowledge improvement

- European
- National
- Local

Emission calculation → CHIMERE model → Air quality impacts → Calculation of health benefits

Cost-effectiveness analysis

Cost calculation

Cost-benefit analysis

Societal controversy

Need for legal leverage

Evaluation of measures – multi-criteria analysis

Followed by stake holder consultation, then selection of measures for the Plan in political process

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ADDITIONAL MEASURES SELECTED

- Industry & energy production
    - IED (values between low and high BAT-AELs) for energy processes and refineries
- Transport
    - EURO 6c with real driving conditions test cycle
    - Replacement of public vehicle parks by low emission vehicles
    - Driving restrictions in urban areas when limit values are exceeded
    - City centre low emission zones excluding high emission vehicles
    - Promotion of clean urban transport
    - Increase in fuel taxes
    - Development of combined road/rail transport
    - Development of waterways

ADDITIONAL MEASURES SELECTED

- Non-road mobile engines (industry & agriculture)
  - Stage IIIB and stage IV of mobile engine regulations
  - Regulation on internal combustion engines

- Residential and Tertiary
  - Anticipation of eco-conception directive for small appliances
  - Reduction of the sulphur content of domestic fuel

- Agriculture
  - Reduce NH_3 volatilisation through more rapid incorporation, efficient injection, type of fertilisers…
  - Different measures for building
  - Financial support

RESULTS : EMISSION REDUCTIONS RELATIVE TO OBJECTIVES

- ## PREPA scenario
  - Compliance with Gothenburg 2020 objectives
  - Compliance with 2030 NEC objectives for 3 pollutants and 2 commitments not fully achieved for SO_2 and NMVOC

Pollutant	2020 relative to 2005			2030 relative to 2005		
	NEC Objective	Baseline	PREPA Scenario	NEC Objective	Baseline	PREPA Scenario
SO_2	-55%	-64%	-66%	-77%	-68%	-69%
NOx	-50%	-56%	-57%	-69%	-69%	-72%
NMVOC	-43%	-48%	-49%	-52%	-49%	-51%
NH_3	-4%	3%	-4%	-13%	4%	-13%
$PM_{2,5}$	-27%	-49%	-52%	-57%	-56%	-62%
PM_{10}	none	-37%	-40%	none	-41%	-46%

- ## Assessment based on energy scenario without additional measures
  - Low carbon strategy published since should help reduce SO_2 further
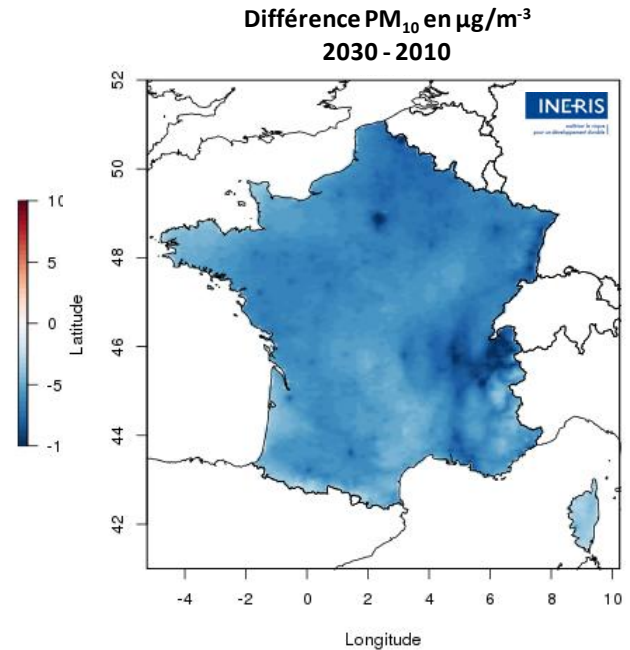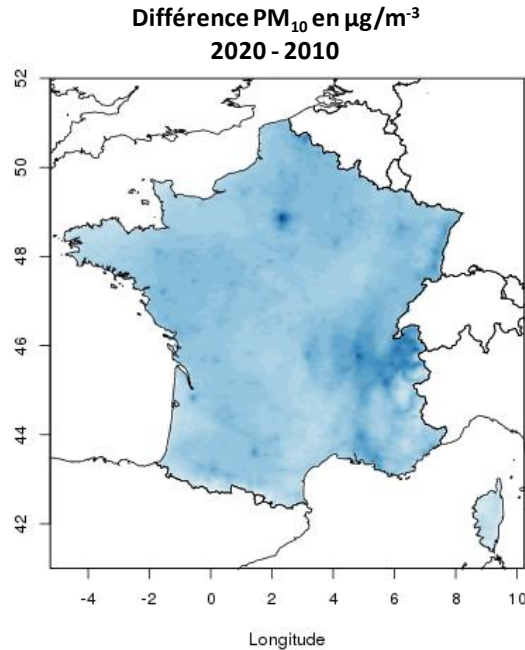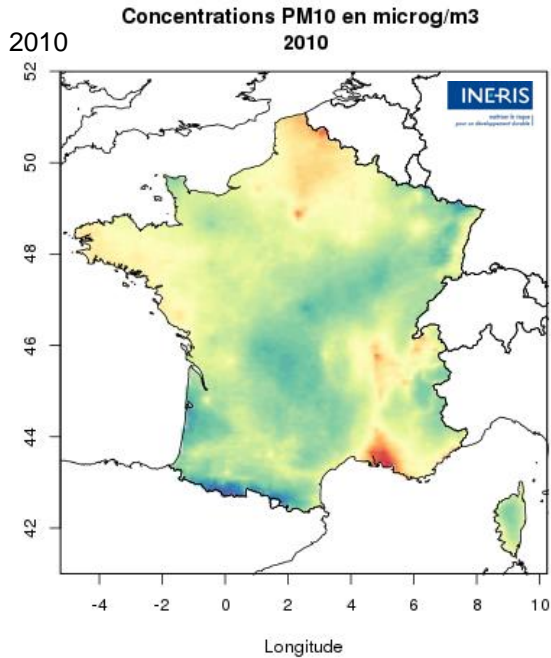- ## Some additional measures necessary for VOC

RESULTS : EMISSION REDUCTIONS RELATIVE TO OBJECTIVES

- Additional measures dominating additional emission reductions

  - SO_2 – reduction of sulphur concentration in domestic fuel oil to 10 ppm

  - NOx - Euro 6c & alignment of diesel with gasoline taxes

  - MNVOC – new wood combustion equipment

  - $PM_{2.5}$ & PM_{10} - new wood combustion equipment & alignment of diesel with gasoline taxes

  - NH_3 – all additional measures

RESULTS : AQ IMPROVEMENTS

- PM$_{10}$ – annual mean concentrations

Concentrations PM10 en microg/m3 2010 | Différence PM$_{10}$ en µg/m^{-3} 2020 - 2010 | Différence PM$_{10}$ en µg/m^{-3} 2030 - 2010
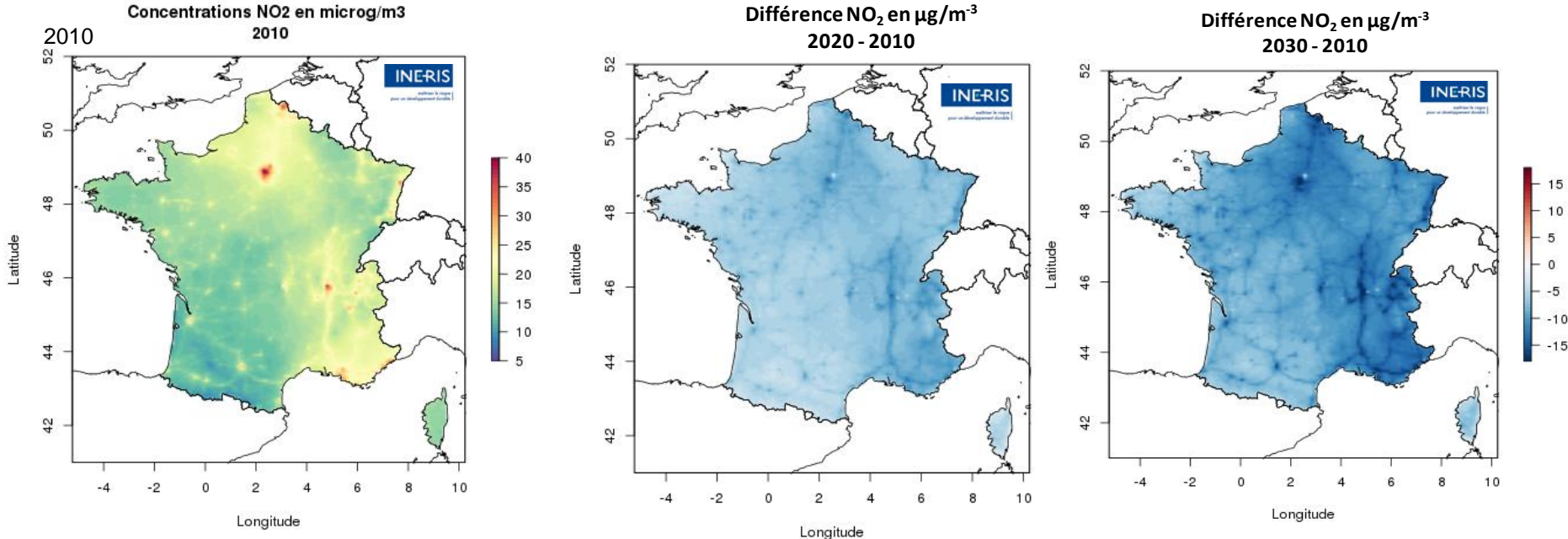
- 2010
  - High concentrations mainly in urban centres
  - Limit values exceeded mainly around traffic measurement stations
- 2020 & 2030
  - Emission reductions mirrored in decreasing concentrations (esp. in 2030)
  - Particularly in regions with important transport and residential emission sources

Spatialisation via INS, Meteo 2010, boundary conditions NECD compliance

- ## NO$_2$ – annual mean concentrations

Concentrations NO2 en microg/m3 — 2010

Différence NO$_2$ en µg/m^{-3} — 2020 - 2010

Différence NO$_2$ en µg/m^{-3} — 2030 - 2010

- ## 2010
  - Highest concentrations close to agglomerations and traffic axes
  - Limit values exceeded over the whole territory, majority close to traffic measurement stations
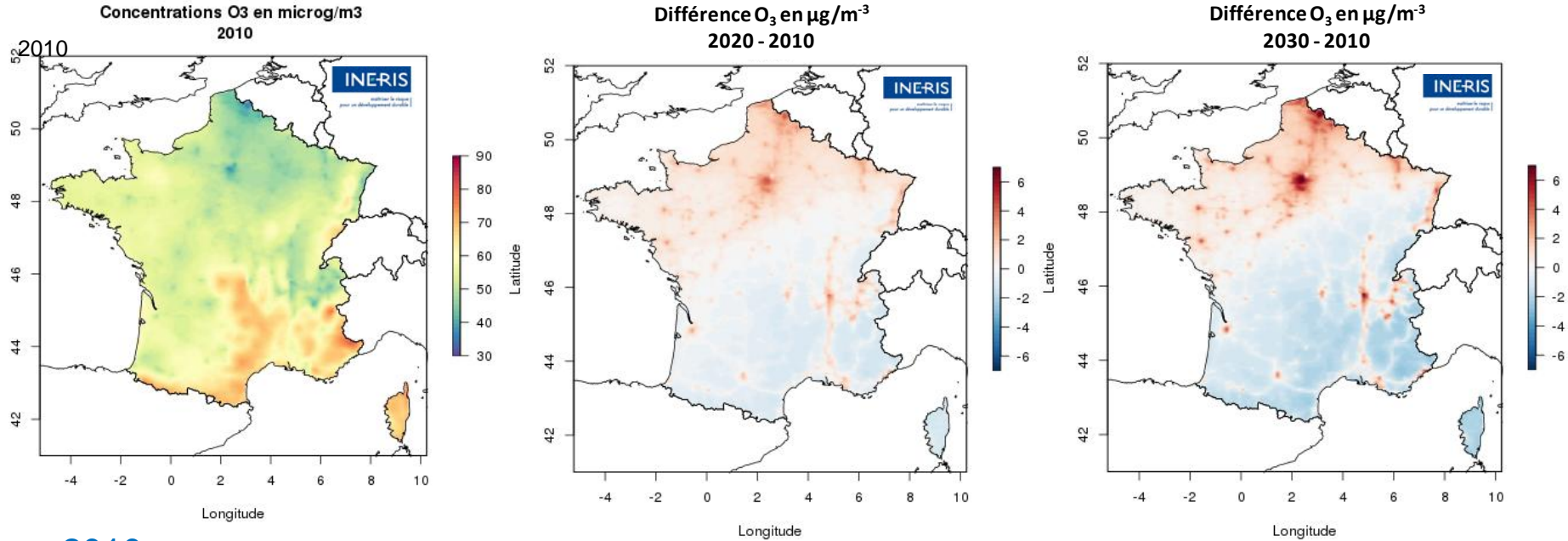- ## 2020 & 2030
  - Strong reduction in concentrations in proximity to transport
  - Particularly in 2030 and close to major roads and agglomerations

Spatialisation via INS, Meteo 2010, boundary conditions NECD compliance

Results : AQ improvements

- O$_3$ – annual mean concentrations (!)

Concentrations O3 en microg/m3 2010 — Différence O$_3$ en µg/m^{-3} 2020 - 2010 — Différence O$_3$ en µg/m^{-3} 2030 - 2010

- **2010**

  - Highest concentrations in the south (more sunshine), peaks mainly in rural areas (far from precursor emission sources)
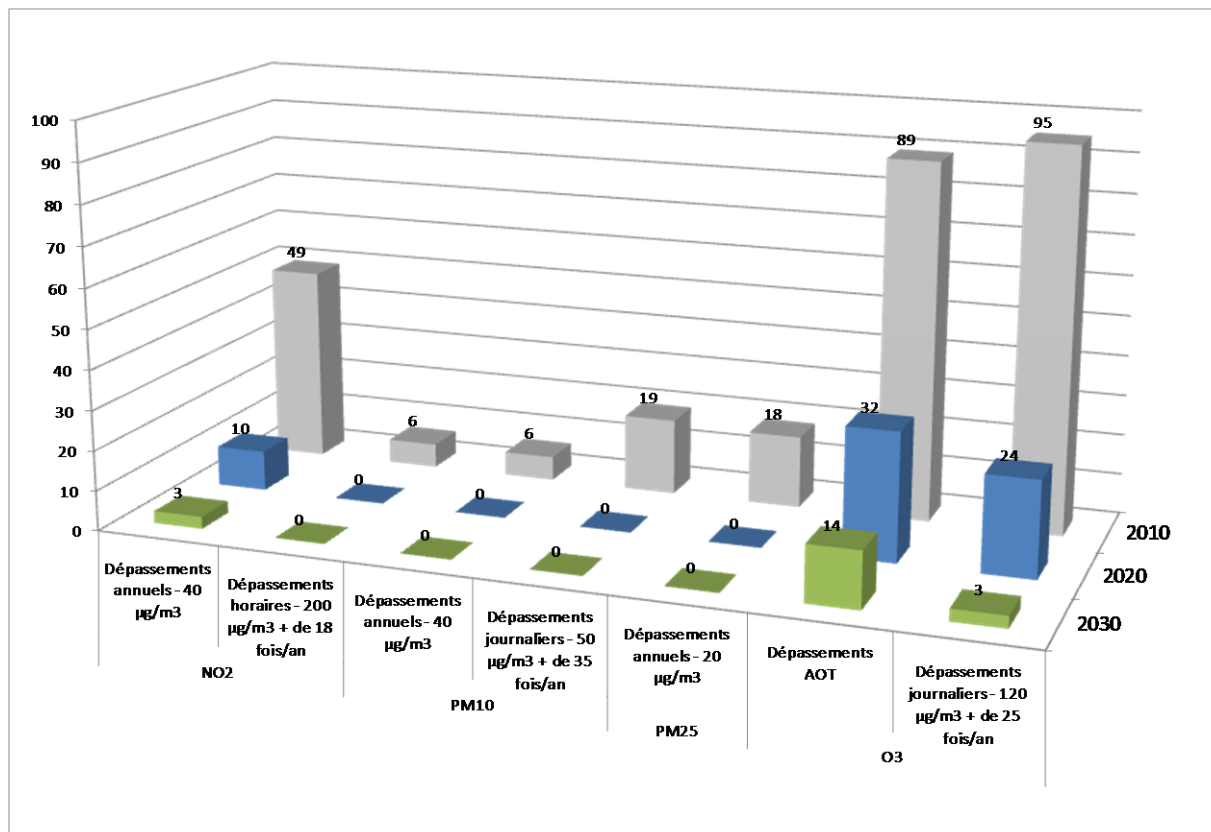
- **2020 & 2030**

  - Limited reduction in O$_3$ concentrations, mainly in the south (where concentrations are high), due to NOx emission reduction

  - Increase in concentrations where ozone concentrations are lower (e.g. Paris region, northern France, close to traffic) => ozone destruction regime

Spatialisation via INS, Meteo 2010, boundary conditions NECD compliance

RESULTS : REDUCTION IN AQ EXCEEDANCES

- Exceedances of limit (NO_2, $PM_{2.5}$, PM_{10}) and target (O_3) values

- PM_{10}
  - majority of exceedances in urban background stations and close to traffic in 2010
  - no exceedances in 2020 and 2030 (annual/daily mean)
- NO_2
  - majority of exceedances in stations close to traffic in 2010
  - Strong reduction in exceedances => 3 exceedances of annual mean in 2030, none of hourly mean

- O_3
  - 2010 majority of exceedances in Southern France
  - peak concentrations strongly reduced by 2030
  - exceedances persist for AOT and daily mean in 2030 but number significantly reduced

RESULTS : HEALTH BENEFITS

- Avoided annual health impacts from $PM_{2.5}$ - 2030 rel. to 2010 – examples:

  - 180,000 life years lost

  - 11,200 premature deaths (=> -30%)
    => same magnitude as in Holland 2014, CBA for TSAP N° 11 report

  - almost 5 million working days lost

  - 12,000 cases of chronic bronchitis

  - 59,000 cases of bronchitis in children

- Avoided annual health damage ($PM_{2.5}$, O_3, NO_2)

  - 2020 rel. to 2010: 11 billion € ($€_{2013}$)

  - 2030 rel. to 2010: 17 billion € ($€_{2013}$) => -40%

  - Low benefit estimate : VOLY, median, 66% of chronic NO_2 mortality

ARP-France model (developed by EMRC)

Methodology according to WHO 2014, HRAPIE project (Health Risks of Air Pollution in Europe)

Health impacts from exposure to $PM_{2.5}$, O_3 & NO_2

AQ modelling with CHIMERE

CONCLUSIONS

- Decision support project providing stakeholders and decision makers with comprehensive information
    - comprehensive assessment of emission reduction strategies and individual measures according to multiple evaluation criteria
- Final decision of measures included in PREPA scenario by the Environment Ministry
- Emission reductions in 2020
    - emission reduction obligations (Gothenburg/NEC) met for all pollutants
    - important over-compliance except for NH_3
- Emission reductions in 2030
    - some additional efforts necessary to meet 2030 NEC objectives for SO_2 and VOCs
    - NH_3 emission reductions in the future depend completely on additional PREPA measures
- Significant AQ improvements for NO_2, $PM_{2.5}$ and PM_{10}, less so for O_3
    - only few AQ limit value exceedances in 2030 (NO_2),
    - target value exceedances persist for O_3 though number significantly reduced
- Important reductions in health effects and costs
    - premature mortality due to $PM_{2.5}$ reduced by 30% in 2030 rel. to 2010
    - health benefits equal 17 billion € in 2030 rel. to 2010

> => All documents related to the PREPA (evaluation & legal) published at:
> http://www.developpement-durable.gouv.fr/politiques-publiques-reduire-pollution-lair

THANK YOU FOR YOUR ATTENTION!

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ANNEXE

RESULTS : HEALTH BENEFITS

- ## Avoided health impacts

Avoided health impacts	Unit	Polluant	2020 relative to 2010	2030 relative to 2010
Acute Mortality (All ages)	Premature deaths	O$_3$	78	100
Respiratory hospital admissions (>64)	Cases		224	408
Cardiovascular hospital admissions (>64)	Cases		914	1 668
Minor Restricted Activity Days (MRADs all ages)	Days		-98 246	-303 362
Chronic Mortality (all ages) LYL	Life years lost		-718	-1 559
Chronic Mortality (30yr +) deaths	Premature deaths		62	79
Chronic Mortality (All ages) LYL	Life years lost	PM$_{2.5}$	-117 105	-179 241
Chronic Mortality (30yr +) deaths	Premature deaths		-7 263	-11 236
Infant Mortality (0-1yr)	Premature deaths		-26	-38
Chronic Bronchitis (27yr +)	Cases		-7 793	-11 900
Bronchitis in children aged 6 to 12	Cases		-36 634	-58 707
Respiratory Hospital Admissions (All ages)	Cases		-3 429	-5 228
Cardiac Hospital Admissions (>18 years)	Cases		-2 404	-3 612
Restricted Activity Days (all ages)	Days		-11 761 319	-17 896 995
Asthma symptom days (children 5-19yr)	Days		-419 181	-671 753
Lost working days (15-64 years)	Days		-3 255 274	-4 962 541
Bronchitis in children aged 5 to 14	Cases	NO$_2$	-60 683	-98 178
Acute Mortality (All ages)	Premature deaths		-1 097	-1 761
Respiratory Hospital Admissions (All ages)	Cases		-9 717	-15 169
Chronic Mortality (All ages) LYL	Life years lost		-16 798	-23 810
Chronic Mortality (30yr +) deaths	Premature deaths		-13 308	-19 445

RESULTS : HEALTH BENEFITS

- ## Avoided health damage

Avoided health damage, million Euro/year	Polluant	2020 relative to 2010	2030 relative to 2010
Acute Mortality (All ages)	O_3	5	7
Respiratory hospital admissions (>64)		1	1
Cardiovascular hospital admissions (>64)		2	4
Minor Restricted Activity Days (MRADs all ages)		-5	-15
Chronic Mortality (all ages) LYL		-48	-103
Chronic Mortality (30yr +) deaths		78	99
Chronic Mortality (All ages) LYL	$PM_{2.5}$	-7 762	-11 881
Chronic Mortality (30yr +) deaths		-9 095	-14 069
Infant Mortality (0-1yr)		-48	-72
Chronic Bronchitis (27yr +)		-480	-733
Bronchitis in children aged 6 to 12		-25	-40
Respiratory Hospital Admissions (All ages)		-9	-13
Cardiac Hospital Admissions (>18 years)		-6	-9
Restricted Activity Days (all ages)		-1 243	-1 892
Asthma symptom days (children 5-19yr)		-20	-32
Lost working days (15-64 years)		-486	-741
Bronchitis in children aged 5 to 14	NO_2	-41	-66
Acute Mortality (All ages)		-73	-117
Respiratory Hospital Admissions (All ages)		-25	-39
Chronic Mortality (All ages) LYL		-1 113	-1 578
Chronic Mortality (30yr +) deaths		-16 664	-24 349