Decision aid for elaborating the National Air Pollutant Emission Reduction Plan (PREPA)

Methodology Applied
Example of results

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Structure of the presentation

- Context and objectives
- Method used
- Example of results
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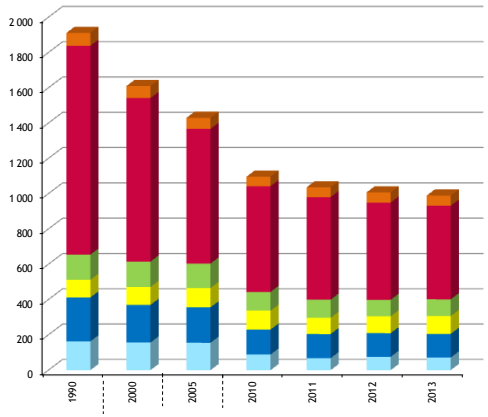
CONTEXT

EMISSIONS : Enforcement of emission reduction obligations

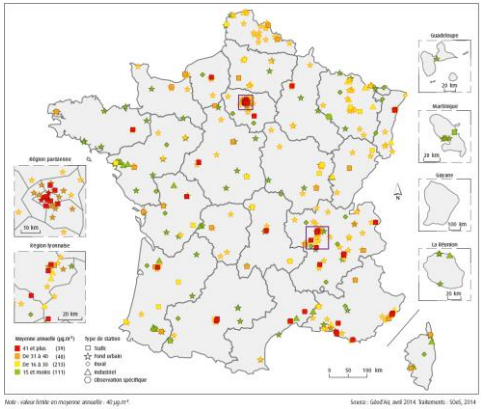


NOx Emissions – kt/year

Reductions imposed by the NEC Directive
Pre-litigation situation **for NOx emissions**

Gothenburg Protocol : reduction of emissions in 2020 for 5 pollutants ($PM_{2,5}$, SO_2, NOx, NH_3 and NMVOC)
European Directive under negotiation for emission reduction objectives (2025-2030)

CONCENTRATIONS : A challenge for many French regions



Ambient air concentrations of pollutants (NO2)

Limit values and target value exceeded for PM_{10}, $PM_{2,5}$, NO_2 and O_3

Litigation procedures for France :
*** PM_{10} : reasoned opinion (10 zones)**
*** NO_2 : Formal notice (19 zones)**

RATIONALE AND OBJECTIVES FOR THE PREPA (*)

The National Air Pollutant Emission Reduction Plan is defined by new Law: Law on energy transition and green growth (art 64 of the law, and codification in art. L. 222-9 of the environment Code)

Objectives:

→ **Reduce air pollutant emissions to improve air quality**

- → Comply with emissions ceilings (NEC)
- → Comply with air quality (AQ) concentration requirements

How?

→ Considering all sources of emissions

→ Taking into account the reduction potentials of measures as well as the associated economic, health, legal and societal challenges

→ Evaluating measures in consultation with stake holders

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

Project duration: September 2014 – July 2016

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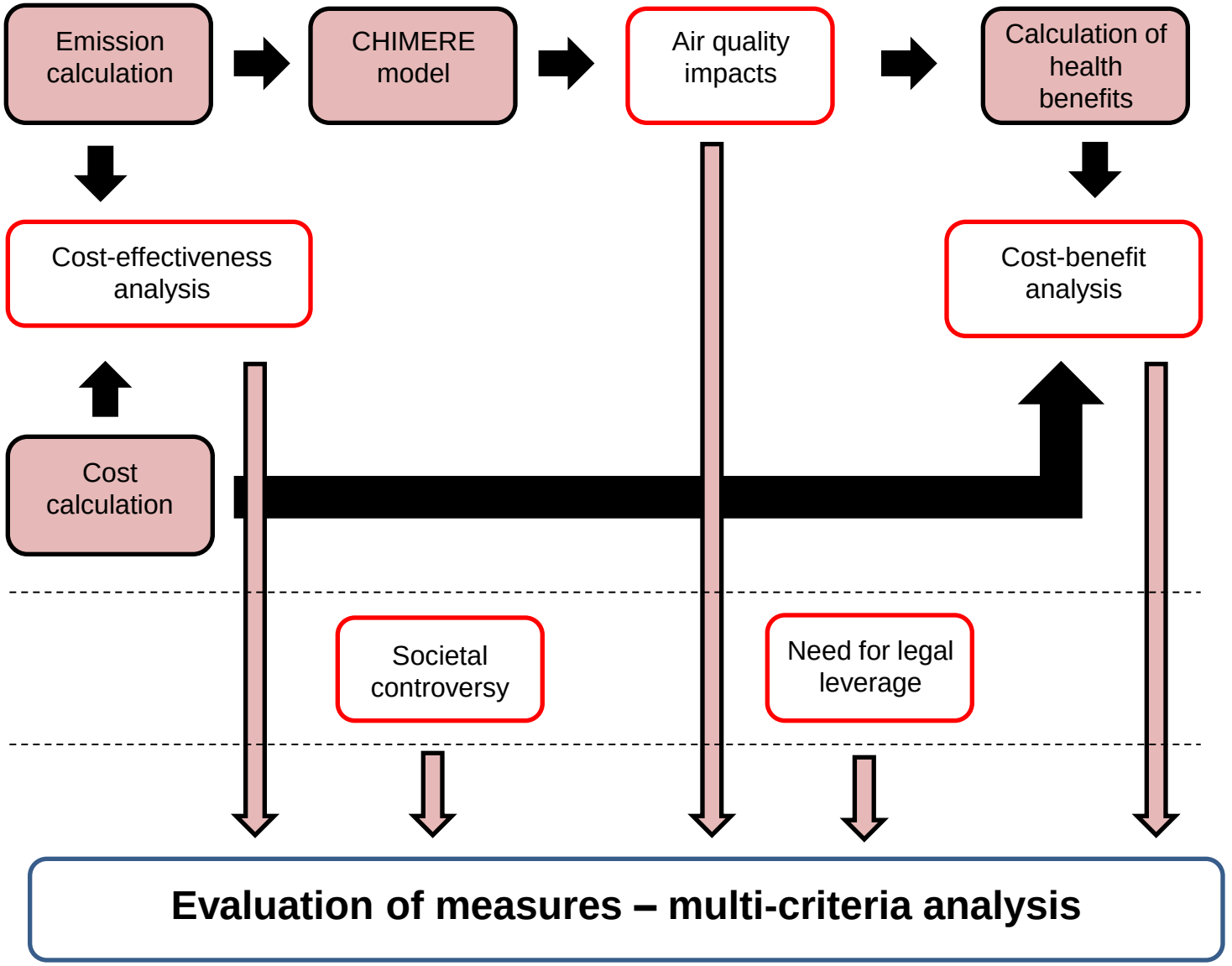
METHOD – OVERALL SCHEME FOR THE EVALUATION OF MEASURES



TYPES OF MEASURES DEFINED

- ✓ **Measures to be assessed with the multi-criteria analysis**
  - Existing measures (ME), very recent measures whose effects are not yet visible but will be effective from today
  - Additional measures (MA), for which there is sufficient data to carry out the evaluation

- ✓ **« Knowledge improvement » measures**, to better know the challenges (efficiency, costs, constraints…) of some measures assumed interesting

- ✓ **Incentive measures** to explain to and engage the population

- ✓ **Additional measures with EU or international character** to mobilize supranational leverage

METHOD - SELECTION OF MEASURES TO BE ASSESSED (1/2)
SELECTION CRITERIA

✓ Emissions reduction potential per activity type

✓ Existing regulation, recent regulation (which will impact the emissions in the coming future) and regulations under development

✓ Measures introduced in a new French law on energy transition and green growth (LTE-CV) (new framework law engaging France for its GHG commitments, renewable energy and pollutant emission reduction)

✓ Measures used at the local level in plans for protection of the Atmosphere (PPA)

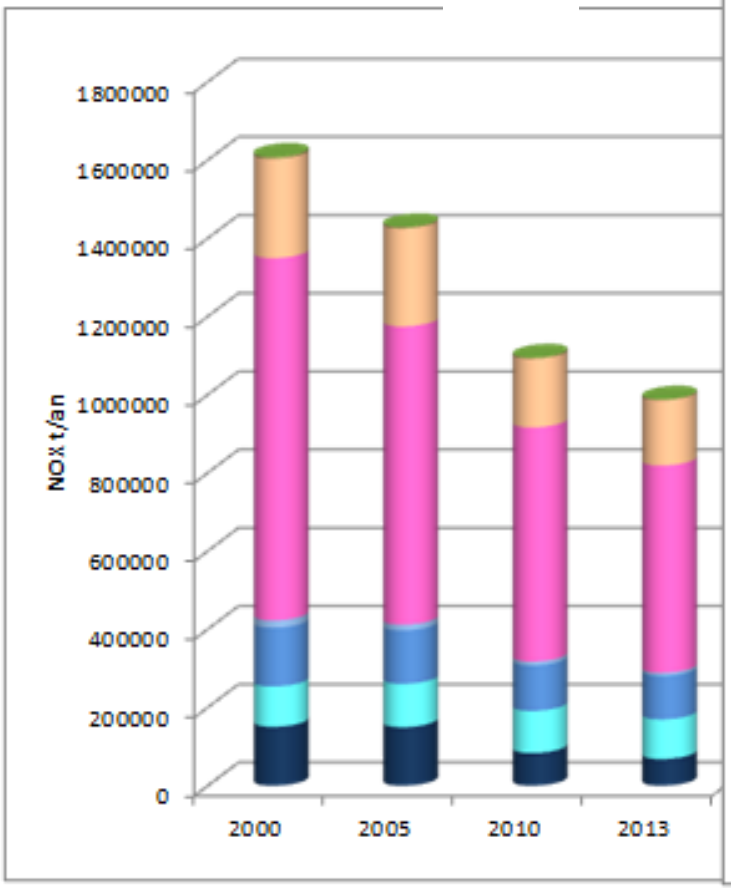
✓ Measures have to be assessable

50 measures in industry, residential, transport, agriculture studied

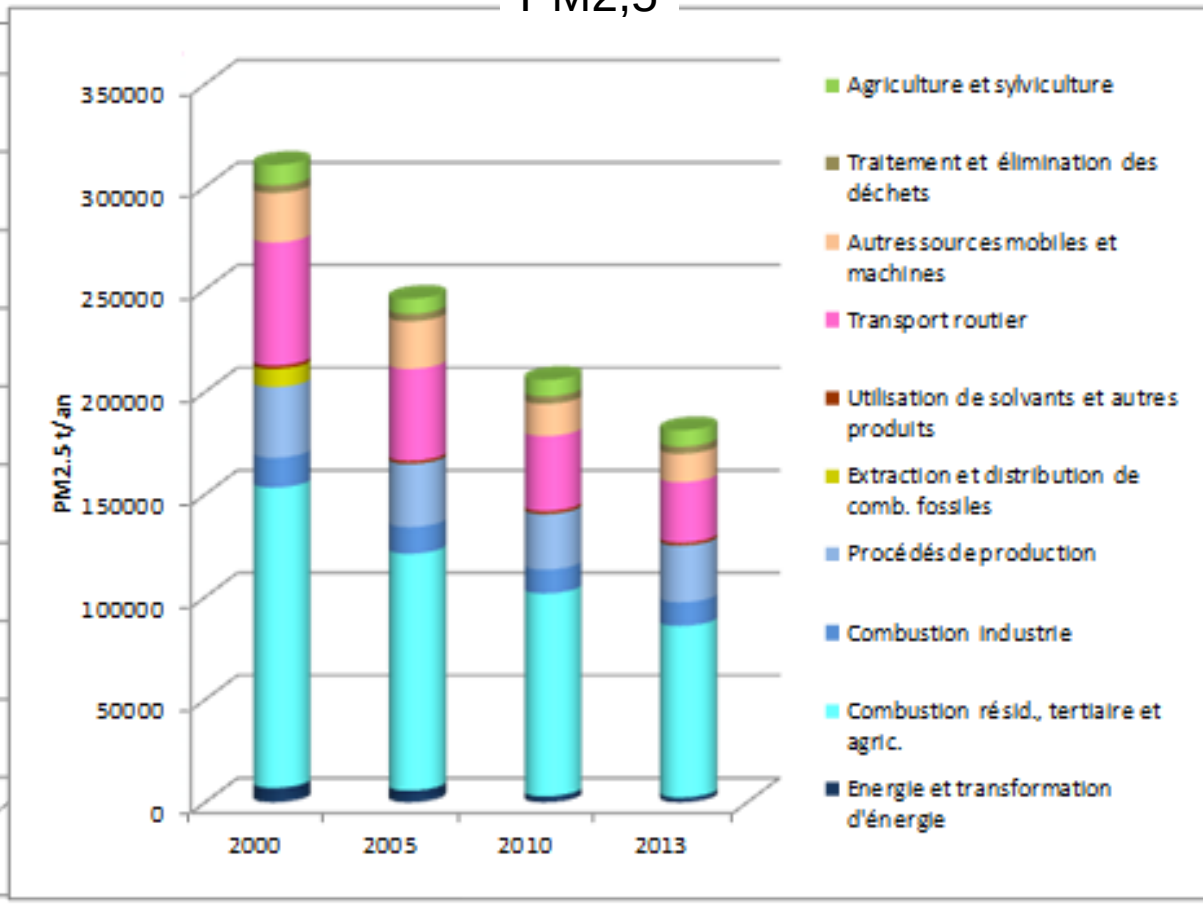
METHOD - SELECTION OF MEASURES TO BE ASSESSED (2/2) WHERE ARE REDUCTION POTENTIALS?

Aim of the Environment Ministry : **act in all sectors**

NOx



PM2,5



Measures studied and selection mode

METHOD - EVALUATION OF MEASURES (1/9)
IMPACT ON EMISSIONS

- **NEC pollutants - $PM_{2.5}$, NOx, SO_2, NH_3, VOCs**
  - emission reductions expressed in absolute value (kt)
  - emission reduction as percentage of NEC emission reduction target
    - Calculated for each pollutant
    - Percentages then summed over 5 pollutants to appreciate the measure's impact on all 5 pollutants in one number

- **Impacts on 2 groups of co-pollutants – PAH/heavy metals/benzene & GHGs**
  - qualitative assessment for impact on each group (synergy, no effect, trade-off)
  - transformation in only one overall qualitative discrete indicator (1 = trade-off for both groups, … 5 = synergy for both groups)

Method - Evaluation of measures (2/9)
Cost estimation

Private costs

Taking into account:
- Investments
- Operating costs,
- Financial support received,
- Taxes payed

Costs for private actors

Public costs

Taking into account:
- Investments
- Operating costs,
- Administrative costs
- Financial support provided,
- Taxes received

Costs for public actors

Total costs

Expressed in € 2013/year, used to calculate the cost-effectiveness ratio used in the multi-criteria analysis

Provided for 2020 :
- Public and private investment
- Public and private operating costs
- Administrative costs
- Total costs to implement the measures in France

METHOD - EVALUATION OF MEASURES (3/9) COST-EFFECTIVENESS

- Costs of measures allocated to one principal pollutant (pollutant that motivates the reduction policy)

- Costs of measures motivated by GHG reduction objectives set at 0
  - ➢ costs of these measures are linked to energy & climate policy and not to air quality policy

- Cost-effectiveness expressed as costs per tonne of emission reduction of principal pollutant (€/t principal pollutant abated)

- Cost-effectiveness ratios for different pollutants made comparable through weighting with damage per tonne values for each pollutant (EEA, 2014) (criteria environmental effectiveness)

EEA (2014), Costs of air pollution from European industrial facilities: 2008 – 2012, EEA Technical Report No 20/2014, European Environmental Agency.

METHOD - EVALUATION OF MEASURES (4/9)
AIR QUALITY IMPACT

Impact of measure M on emissions
% reduction associated with measure M / total national emissions

> 3% for at least one pollutant (14 measures)

< 3% for all pollutants

Emission data: national data for the measure, spatialized based on the geographic distribution of emissions in **INS** (National spatialized inventory)

2010 meteorological data

CHIMERE

Initial and boundary conditions

1) **identification** of a measure simulated with CHIMERE concerning comparable activity sectors (comparable geographic impact)
2) **linearization** of impacts simulated with CHIMERE, proportionally to the ratio between the emissions of this measure and those of measure M

Concentrations estimated in each grid cell of the model (7×7 km) at an hourly resolution for a complete year => AQ maps, calculation of population exposure
Calculation of indicator for air quality limit value exceedances = PM daily, NO_2 & O_3 hourly

METHOD - EVALUATION OF MEASURES (5/9)
HEALTH IMPACTS AND BENEFITS

- **Calculation based on** :
  - ➢ population exposure to pollutants (obtained through CHIMERE modelling)
  - ➢ concentration-response functions
- **Monetization of avoided health effects** (= benefits) per measure using tangible costs (e.g. for medical treatment) and intangible costs (e.g. for life years lost)
- Presentation of results for core estimate of **health benefits** (YOLL, median)

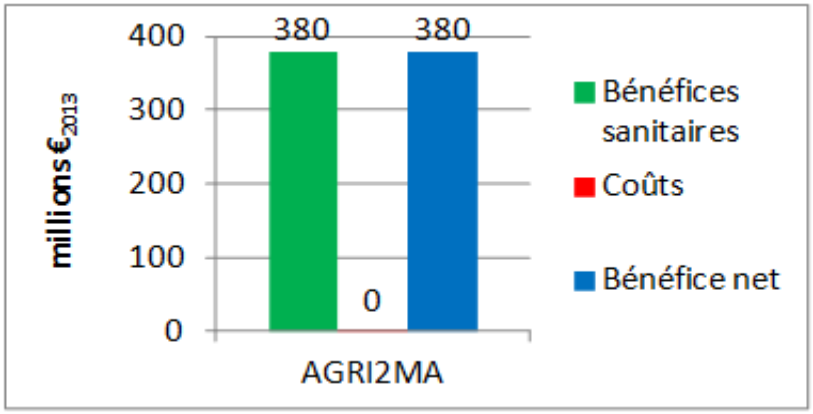
Health impact indicators	Pollutants	Unit	Monetary unit values (in € 2013)
Acute Mortality (All ages) low VOLY	O_3	Life years lost	66 286
Respiratory hospital admissions (>64)		Cases	2 550
Cardiovascular hospital admissions (>64)			2 550
Minor Restricted Activity Days (MRADs all ages)		Days	48
Chronic Mortality (All ages) LYL median VOLY	$PM_{2.5}$	Life years lost	66 286
Infant Mortality (0-1yr) median VSL		Premature deaths	1 878 288
Chronic Bronchitis (27yr +)		Cases	61 576
Bronchitis in children aged 6 to 12		Added cases	675
Respiratory Hospital Admissions (All ages)		Cases	2 550
Cardiac Hospital Admissions (>18 years)			2 550
Restricted Activity Days (all ages)		Days	106
Asthma symptom days (children 5-19yr)			48
Lost working days (15-64 years)			149
Bronchitis in children aged 5 to 14	NO_2	Added cases	675
Respiratory Hospital Admissions (All ages)		Cases	2 550
Chronic Mortality (All ages) LYL median VOLY		Life years lost	66 286

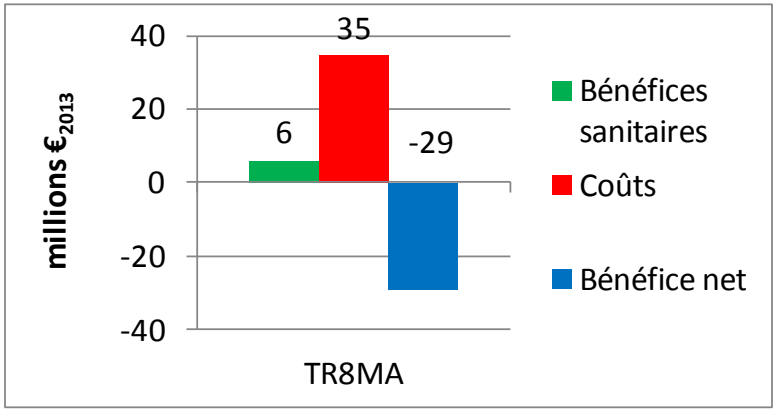
Methodology according to WHO 2014, HRAPIE project (Health Risks of Air Pollution in Europe)

Translated into the ARP-FR model

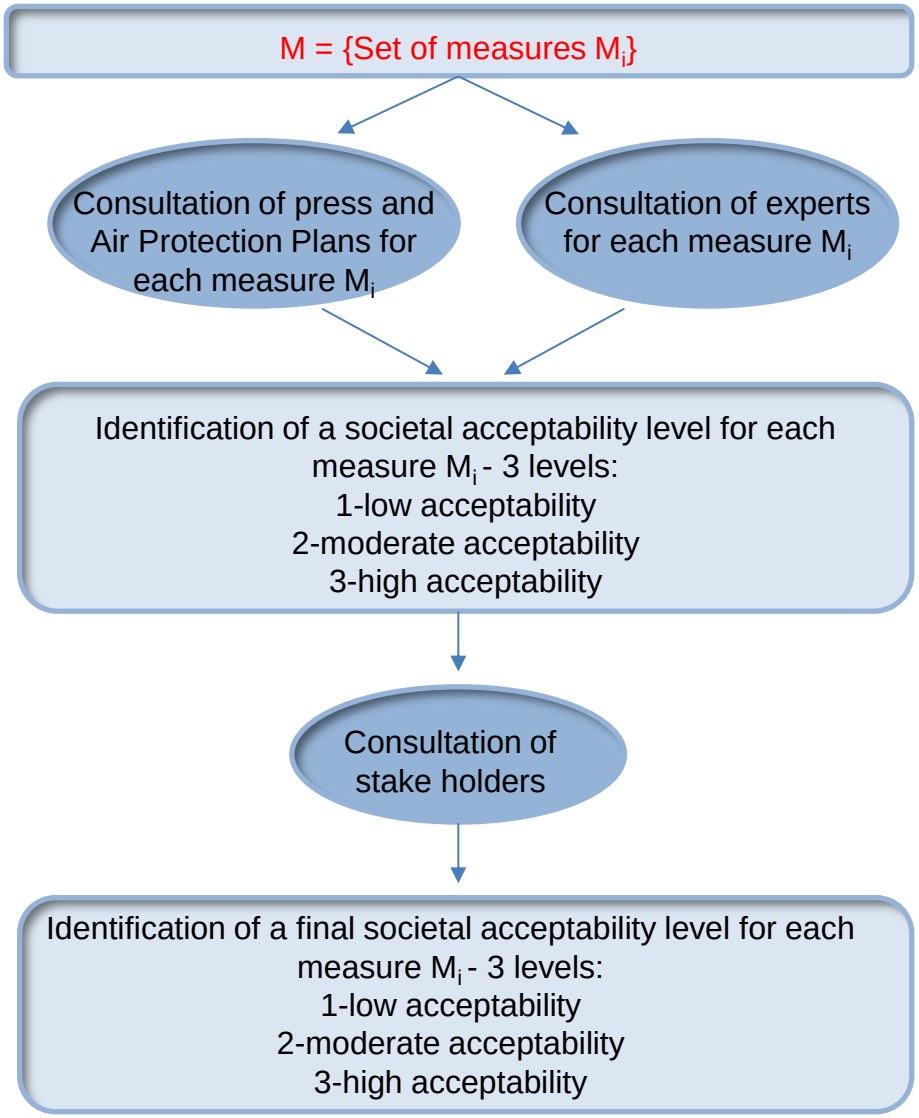
METHOD - EVALUATION OF MEASURES (6/9)
COST-BENEFIT PERFORMANCE OF MEASURES

- **Presentation of net benefits**
  - ➢ for each measure : monetized health benefits minus costs, in € 2013
  - ➢ preferable to benefit/cost ratio as for some measures benefits = 0 and costs < 0 (no impact on air quality, financial savings)
  - ➢ the higher the value of this criterion, the higher the benefit to society





Method - Evaluation of measures (7/9)
Level of Controversy



Analysis of press and regulatory documents :

- 242 French press references
- 17 Air Pollution Protection Plans

Scores collectively corrected by the consortium members in a work session.

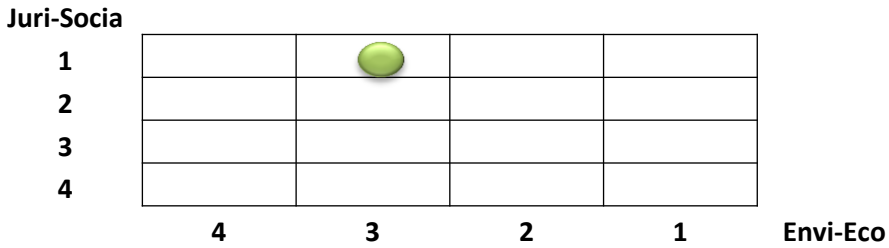
Method - Evaluation of measures (8/9)
Need for Legal Leverage

- **Documentary and regulatory research to assess the need for a legal leverage**
  - Necessary incentive or regulation existing?
  - Regulatory or incentive framework in contradiction to implementation of measure?
  - Absence of incentive or regulation?

- **Transformation of results into indicator taking 3 levels**
  - Level 1 - strong need for leverage - the measure requires the development of regulatory leverage to avoid it working counter to what is foreseen in existing regulatory texts
  - Level 2 - moderate need for leverage - the measure requires regulatory adaptations but there is no major risk of conflict with existing regulation
  - Level 3 - no need for leverage - the measure requires no update of regulation

METHOD - EVALUATION OF MEASURES (9/9)
MULTI-CRITERIA ASSESSMENT

Criteria	Scale
Environmental impacts	
C_{env1}: Emission reduction impact (relative to NEC "ceiling")	Decreasing, percentage
C_{env2}: Air quality impact - impact on number of exceedances	Continuous, increasing, values < 0 or > 0
C_{co}: Impact on co-pollutants (2 groups: a) GHGs, b) heavy metals, PAH, benzene)	Discrete, increasing, 5 levels, 5 being the most favourable (1 = trade-off for both groups, … 5 = synergy for both groups)
Economic efficiency	
C_{eco1}: Cost-effectiveness ratio, weighted by damage costs	Continuous, decreasing
C_{eco2}: Cost-benefit assessment (net benefits)	Increasing, expressed in €
Acceptability	
C_{acc}: Social acceptability and level of controversy	Increasing, qualitative scale, 3 levels, 1=low, 2=moderate, 3= high acceptability
C_{jur}: Legal acceptability and need for regulatory leverage	Increasing, qualitative scale, 3 levels, 1=strong, 2=moderate, 3= low need for leverage



- Characterisation of each measure reflecting the multiple dimensions
- Method : outranking, multi-criteria assessment based on an aggregation procedure
- Tool: ELECTRE III
- 2 partial multi-criteria analyses - ranking over two dimensions
  - Social & legal acceptability
  - Environmental & economic efficiency

METHOD – STAKE HOLDER CONSULTATION

From first results (report 1 (more than 600 pages)) obtained , 5 meetings with representatives from industry, agriculture, local authorities, non governmental organisations to collect their remarks and advices

✓ First general meeting to present the PREPA and the results

✓ 3 specific meetings:
- Transport
- Industry and residential sector
- Agriculture

Stake holders had around one month for comments on the first version of report and assessment

<u>A new version of report provided taking account of all comments received (more than 400 comments, revision of some calculations needed…</u>

✓1 final meeting to present the results (still pending)

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ACT OF 26 AUGUST 2013 FOR COMBUSTION INSTALLATION OF 20 TO 50 MW AND ACT OF 25 AUGUST 1997 MODIFIED (IN 2013) (1/4)

Dates for compliance with new emission limit values from 2016 to 2018

Impact on SO_2 , NOx and PM

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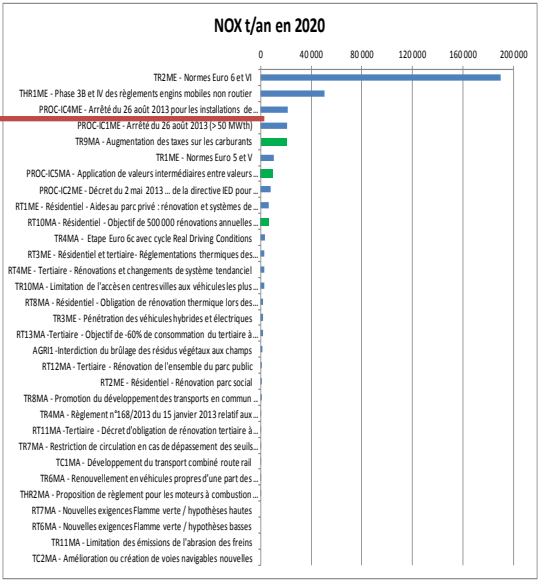
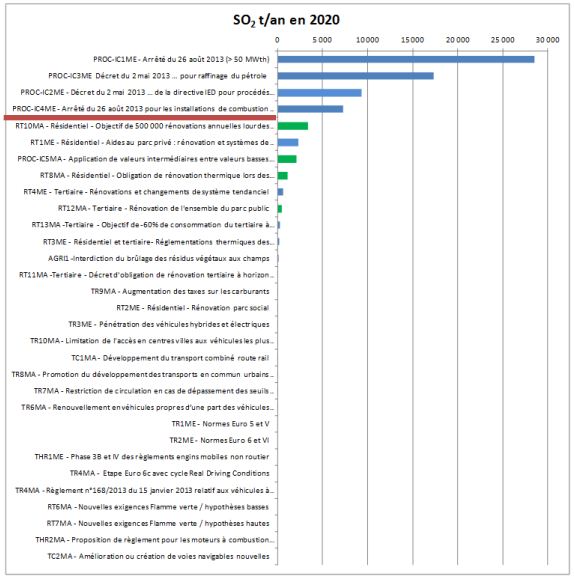
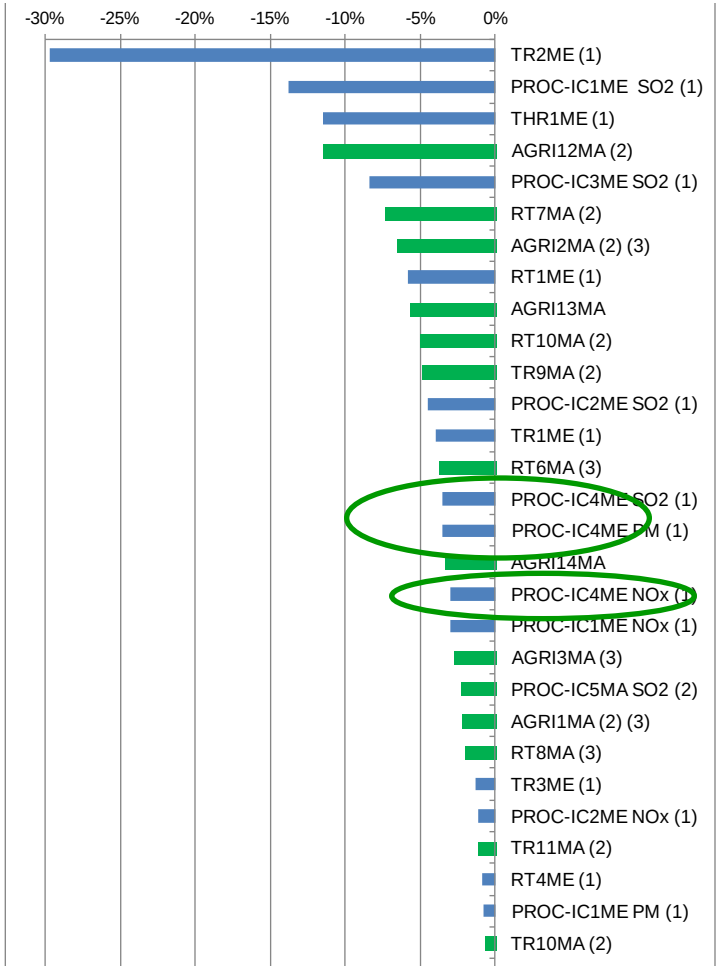




Potential of emission reduction in 2020 (kt/year)

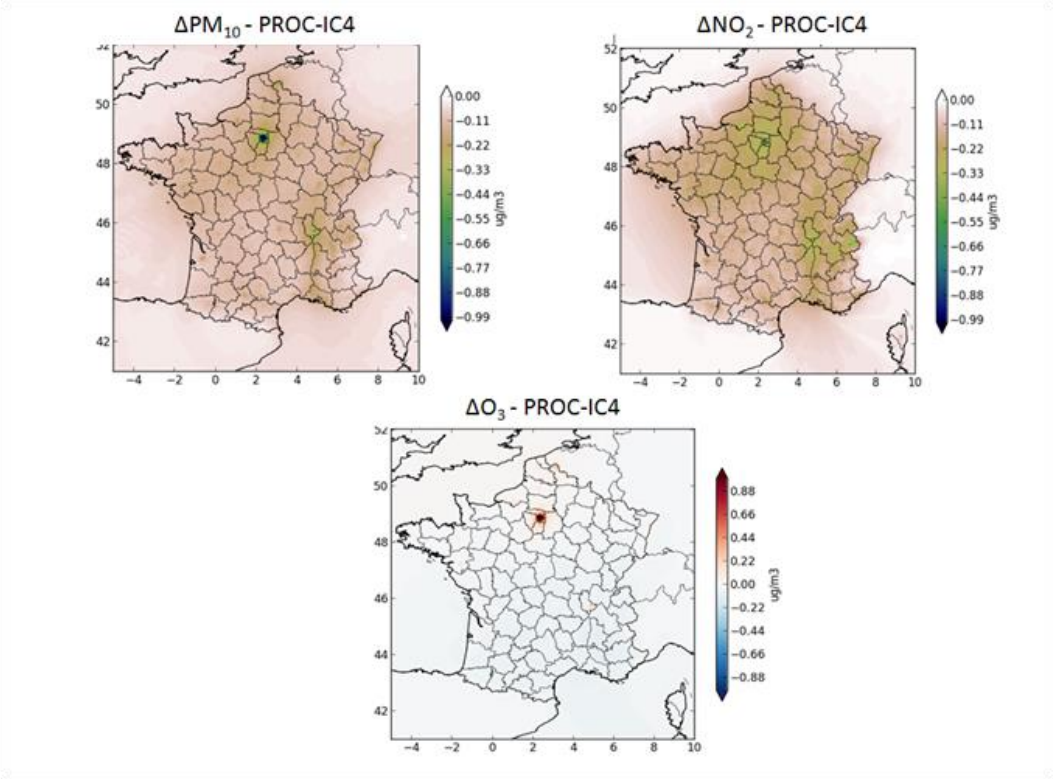
Emission reduction as percentage of NEC emission reduction target *



*the higher the value of this criterion, the higher the measure has an important role in 2020 compared to the Gothenburg protocol targets

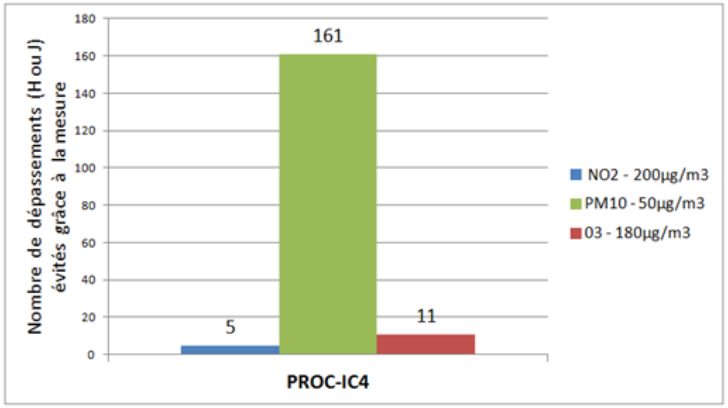
ACT OF 26 AUGUST 2013 FOR COMBUSTION INSTALLATION OF 20 TO 50 MW AND ACT OF 25 AUGUST 1997 MODIFIED (IN 2013) (2/4)

Significant impact on PM_{10} and NO_2 concentrations



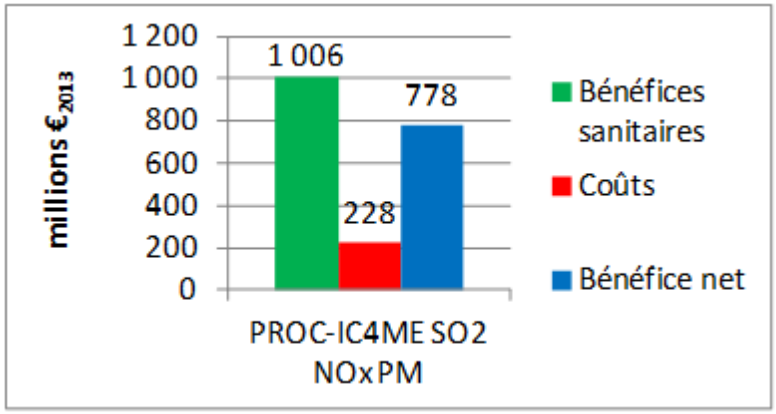
Impacts on average annual concentrations in 2020 due to the measure (compared to a situation without the measure)

ACT OF 26 AUGUST 2013 FOR COMBUSTION INSTALLATION OF 20 TO 50 MW AND ACT OF 25 AUGUST 1997 MODIFIED (IN 2013) (3/4)



Number of exceedances of the daily mean value for PM10 and information and recommendation values for NO_2 and O_3 (hourly value) avoided by the measure

Significant reduction in the exceedances of PM_{10} daily average limit value (50 µg/m³)



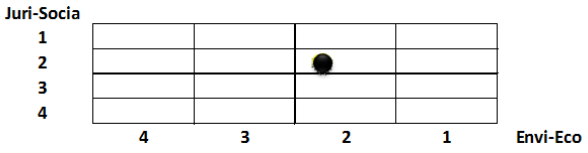
Performance benefit costs

Costs of the measure lower than benefits
Large net benefit

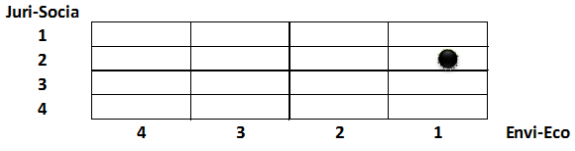
ACT OF 26 AUGUST 2013 FOR COMBUSTION INSTALLATION OF 20 TO 50 MW AND ACT OF 25 AUGUST 1997 MODIFIED (IN 2013) (4/ 4)

Legal leverage	No special needs (3)
Level controversy and acceptability	Controversy noted (1) but less correct today as the act has been implemented
Operationnality in 2020	The deadlines for compliance ranges from 2016 and 2018 according to size plants and fuels used. The reduction techniques are available

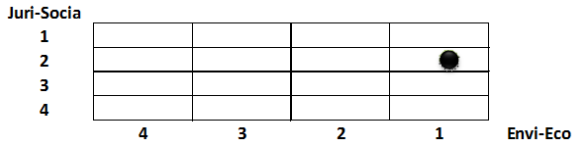
SO_2



NOx



PM_{10}



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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
- Transparent presentation of evaluation results
  - Hypotheses communicated
  - Criteria ranking results presented individually
  - Overall multi-criteria results presented for two dimensions
- Stakeholder meetings confronting assessment results to stakeholder views
- Final decision of measures to be included into the National Air Pollutant Emission Reduction Plan lies with the Environment Ministry
- PREPA decree to be published soon

THANK YOU FOR YOUR ATTENTION!

ACKNOWLEDGEMENTS

Thanks also to the
CITEPA, INERIS, AJBD and Energies Demain teams