Improvements of the TFTEI Cost Calculation Tool for Emission Reduction Measures in LCPs

TFTEI Technical Secretariat

25 June 2015

Agenda

- ❑ Current tool and methodology
- ❑ Implementation of new developments
- ✓ Improvement of user-friendliness
- ✓ Part load operation
- ✓ EPA-Method for NOx
- ❑ Update of documentation
- ❑ Improvement of database
- ❑ Next steps

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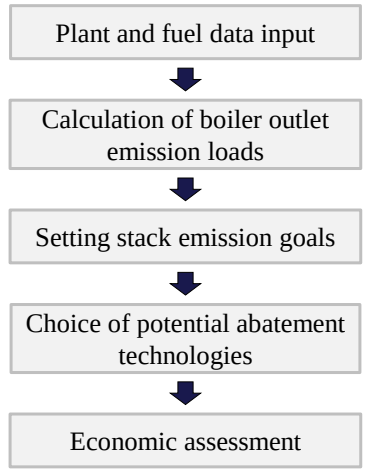
General cost methodology

Fuels	Coal, oil, gas, solid biomass (wood) in co-combustion with coal
Fuel approach	Detailed and general approach
Plants	Boilers
Pollutants	NO_x, SO_2, PM
Technologies	NO_x: LNB, SCR, SNCR SO_2: wet FGD, lime spray dryer, (dry process to be included) PM: FF, ESP

⇒ **Implemented in a VBA supported EXCEL-Tool**

General cost methodology



Current tool and methodology

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Revision of the Front Page

	NO_x	SO_2	Dust
Natural Gas	Natural Gas - NOx incl. Primary Measures SCR SNCR		
Liquid Fuels	Liquid - NOx incl. Primary Measures SCR SNCR	Liquid - SO2 incl. Fuel Substitution LSFO Flue Gas Desulfurization LSD Flue Gas Desulfurization DSI Flue Gas Desulfurization with Fabric Filter	Liquid - Dust incl. ESP
Solid Fuels (coal and bio-mass)	Solid - NOx incl. Primary Measures SCR SNCR	Solid - SO2 incl. Fuel Substitution LSFO Flue Gas Desulfurization LSD Flue Gas Desulfurization DSI Flue Gas Desulfurization with Fabric Filter	Solid - Dust incl. ESP PJFF

Parameter Check

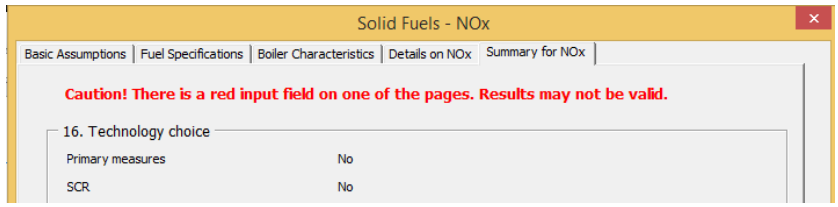
- Emission calculation has been modified in order to facilitate data collection for the user

⇒ Parameters that are only relevant for a specific pollutant have been taken out of consideration for other pollutants

⇒ Examples:

  - Carbon in ash content
  - Ash retained in boiler

Warning on Summary Page



- Instead of not showing the next VBA sheet unless all input fields are filled, they are now displayed from the beginning
- A red warning is shown on the summary page, if any input field is empty or outside the expected range
- This does not influence the appearance of the sheets for specific technologies, they still only appear if selected

VBA Programming

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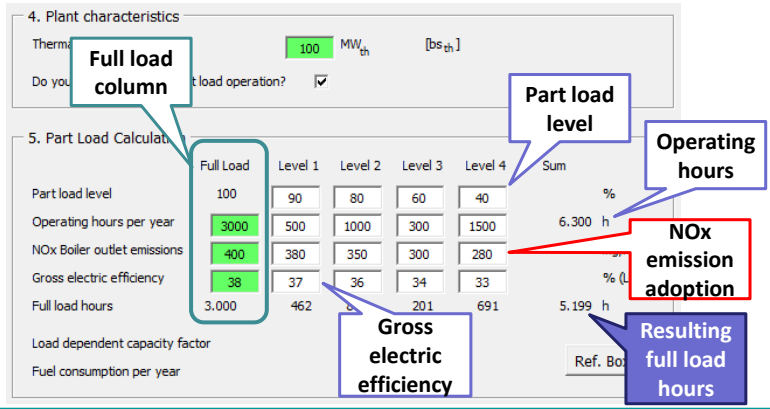
VBA Implementation

- Part load operation is implemented as an option in the VBA sheet for every fuel and pollutant



Part Load Calculation

- Total operating hours and the load dependent capacity factor are calculated from the part load input.
- The following parameters are calculated for both, full load and annual average operation:
  - Fuel consumption
  - NO_x emissions
  - Flue gas volume
- For design parameters, full load operation is taken into account, for consumption parameters (except electricity) annual average values (considering part load) are used.

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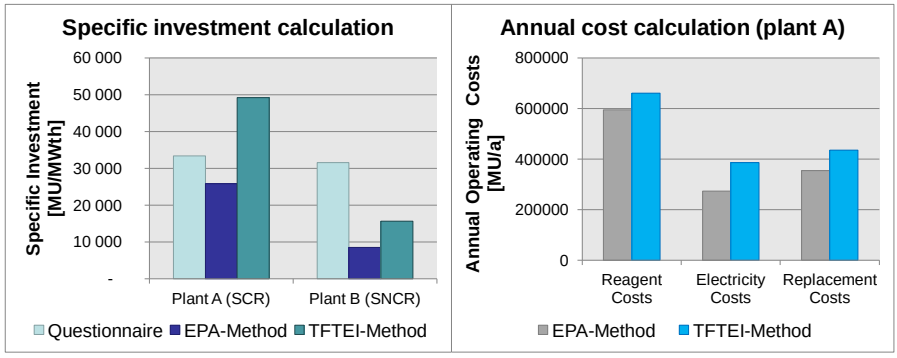
Overview

- ❑ US EPA provided a methodology for emission reduction cost calculation *(Reference: Air Pollution Control Cost Manual, US EPA, 2002)*
- ❑ The EPA method is implemented in the TFTEI tool for SO_2 and PM and shall also be used for NO_X
- ❑ The document addresses SCR and SNCR systems (no 1° measures) within these restrictions:
  - Only coal fired systems
  - SNCR with urea as reagent and from 0 to 50% NO_X reduction
  - Minimum boiler size: 75 MW_{th}
- ❑ Methodology is more detailed and complex
  - More input data is necessary
  - Accuracy of results may be better (further testing is necessary)
  - Factors for cost calculation are up to 15 years old and hardly perspicuous

Quantitative Comparison

Plant A	Plant B
Coal fired	Coal fired
1500 MW_{th}	620 MW_{th}
Equipped with SCR	Equipped with SNCR

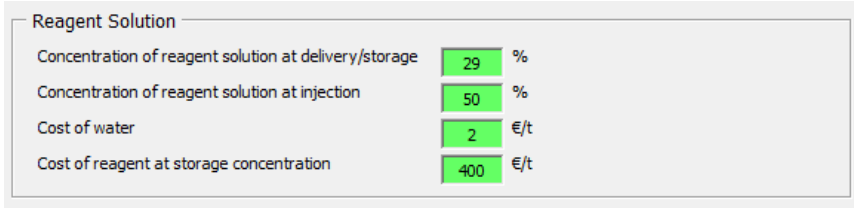


Qualitative Comparison

	EPA	TFTEI
Advantages	Lower dependence on single parameters	Literature based reference data
	No experience with existing plants necessary (no assumption of specific investments)	Higher transparency (no empirically determined factors), less complex calculations
	More precise technical process reproduction in the economical equations	Higher flexibility through specific investment adaptation
	Documentation and calculation example available	Less input parameters necessary
Disadvantages	Many technical parameters necessary	Strong dependence on specific investments
	No individual influence parameter (e.g. specific investment) that takes the complexity/ circumstances of the system into account	Neglect of technical configuration (e.g. water consumption, tank size, size of the reactor, etc.)
	Few information on origin of cost factors	Less detailed consideration of economic factors (contingencies, engineering, etc.)

Implemented Aspects

- Only some minor contents of the EPA method have been implemented so far, as the results are not expected to become better if EPA is implemented with its current cost factors.
- Example: **Reagent dilution calculation**



- Main advantages:
  - ⇒ Reagent cost does not have to be converted to pure reagent (as it is usually bought as an aqueous solution).
  - ⇒ Cost of additional water can be calculated.

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User Manual

- The user manual has been updated in order to suit the needs of the now implemented VBA programming.
- Due to the facilitations caused by the VBA programming, it is now shorter and less complicated.
- For expert users, a detailed documentation of the VBA programming is currently written to allow further improvements or trouble-shooting.

Technical Document

- The new implementations have been introduced into the technical document
- This is especially relevant for
  - Part load operation
  - Reagent dilution calculation

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Improvement of the database

- ❑ Goal:
  - Reducing the dependency of the cost methodology of the specific investment value.
  - Providing data for the TFTEI clearing house
- ❑ EPA provides a methodology but the cost factors are outdated, so that the results might become worse if it is applied without modification.
- ❑ TFTEI survey for NO_x from 2012 is lacking of many technical parameters and the response was very low.

⇒ A new questionnaire is currently being developed to gather new/better data sets.

Improvement of the database

LCP survey

- Anonymous web-based survey that is easy to use and adopts to the characteristics of the considered technology
- Target group:
  - Operators of LCP with NOx reduction technology implemented
- Contents:
  - More detailed technical parameters
  - Total investment
  - Annual operating costs
- Time schedule:
  - Distribution of the questionnaire within the following weeks

⇒ **Results can also be introduced into the TFTEI clearing house**

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Next Steps

- Sending out the questionnaire to members of TFTEI and other plant operators
- Promotion of the tool
  - Publication on new TFTEI web-site
  - Visit to IIASA
  - Workshop with EECCA countries

Next Steps

Thank you very much for your attention!

TFTEI Technical Secretariat

CITEPA

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