

## Technology Fact Sheet for Mitigation

### High efficiency boilers/heat recovery <sup>i</sup>

| Technology: High efficiency boilers/heat recovery |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| Sector : Energy                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Subsector :                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Technology characteristics                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Introduction                                      | <p>Industrial boiler systems are used for heating with hot water or steam in industrial process applications.</p> <p>The major source of GHG emissions from a boiler system is carbon dioxide (CO<sub>2</sub>) from the combustion of fossil fuels in the boiler. Other minor sources of GHGs can include methane (CH<sub>4</sub>) from leaks in the natural gas distribution system and CH<sub>4</sub> and nitrous oxide (N<sub>2</sub>O) as byproducts of combustion processes.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Technology characteristics/highlights             | <p>Improved efficiency of industrial boilers used for heat for industrial process applications by adding advanced technologies (such as advanced heat recovery, controls and burners) to the boiler system. These technology-based efficiency improvements can be achieved when retrofitting or replacing an existing boiler with new technology, when purchasing a natural gas boiler to meet new demand, and/or when switching from a fuel oil, coal or electricity based boiler to a natural gas boiler.</p> <p>Retrofit projects are defined as those that add technological components to an existing boiler unit to improve overall efficiency. Projects that involve replacement of the boiler itself are considered new capacity or early replacement projects.</p>                                                                                                                                                                                                                                                                                   |
| Institutional and organizational requirements     | <p>The combination of the fuel-specific boiler design (that meets the engineer's specifications) with a non-condensing economizer integrated into the system is already considered standard on industrial boilers. To achieve superior efficiency/CO<sub>2</sub> emissions performance, technologies such as the following can be added to the boiler system:</p> <ul style="list-style-type: none"> <li>• Condensing economizer (condensate heat recovery)</li> <li>• Combustion air pre-heaters</li> <li>• Blowdown waste heat recovery</li> <li>• Turbulators for firetube boilers</li> <li>• Electronic ignition</li> <li>• Automated tuning (O<sub>2</sub> trim control)</li> </ul> <p>The engineer's specification to establish the new "nominal thermal efficiency" for the boiler should include the following performance information, and will depend on whether the boiler uses coal, fuel oil, or natural gas:</p> <ul style="list-style-type: none"> <li>• Nominal output capacity</li> <li>• Fuel</li> <li>• Steam delivery pressure</li> </ul> |

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|                                         | <ul style="list-style-type: none"> <li>• Steam delivery temperature</li> <li>• NO<sub>x</sub> limitations</li> </ul> <p>An example of the process is where the technology added results in a thermal efficiency of 85% (nominal boiler (80%) with non-condensing economizer (+5%)). With the advanced burner and controls (+1%), condensing economizer (+1%), combustion pre-heater (+1%) and blowdown heat recovery (+1%) the efficiency is increased to 89%. Note that the condensing economizer replaces the non-condensing one with a marginal increase in efficiency of 1%.</p>                                               |
| Operation and maintenance               | Maintenance should be carried out as per the equipment manufacturers' recommendations, with precautionary measures depending on the system design or upgrade.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Endorsement by experts                  | <p>In the United States, an important objective of the Climate Leaders program is to focus corporate attention on achieving cost-effective greenhouse gas (GHG) reductions within the boundary of the organization (i.e., internal projects and reductions).</p> <p>Climate Leaders is an EPA industry-government partnership that works with companies to develop comprehensive climate change strategies. Partner companies commit to reducing their impact on the global environment by setting aggressive greenhouse gas reduction goals and annually reporting their progress to the EPA.</p>                                 |
| Adequacy for current climate            | Fits well, both for current and future climate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Scale/Size of beneficiaries group       | A majority of these (71% in the United States) are located at facilities in the food, paper, chemicals, refining, and primary metals industries.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Disadvantages                           | <p>Upstream or downstream adjustments to the physical boundary may be required:</p> <ul style="list-style-type: none"> <li>• Electricity use associated with the boiler auxiliaries (e.g., fans, pumps, conveyors) may change as a result of the new boiler.</li> <li>• Changes in CH<sub>4</sub> leakage from the natural gas distribution system, for example, from a switch from fuel oil to natural gas in the boiler. A small section of new natural gas distribution line from a nearby distribution main line will typically be installed and the leakage from this incremental section should be accounted for.</li> </ul> |
| <b>Capital costs</b>                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Cost to implement mitigation technology | <p>Implementation costs are variable depending on the industry, size and location of affected operations, and includes the following components:</p> <ul style="list-style-type: none"> <li>• Re design or design review, depending on new installations or retrofits,</li> <li>• Procurement of new equipment</li> </ul>                                                                                                                                                                                                                                                                                                          |

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|                                                                                     | <ul style="list-style-type: none"> <li>• Shipping costs</li> <li>• Project management</li> <li>• Retrofitting or new installation equipment purchase or hire</li> <li>• Hiring of specialist personnel</li> <li>• Site specific structural modifications</li> <li>• Commissioning and testing personnel &amp; equipment</li> <li>• Overall production shut down and commissioning time costs</li> <li>• Adjustment of Health and Safety policies</li> </ul> |
| Additional cost to implement mitigation technology, compared to “business as usual” | All costs are additional since the baseline scenario is ‘doing nothing’.                                                                                                                                                                                                                                                                                                                                                                                    |
| Long term cost (i.e. 10, 30, or 50 years) without mitigation technology             | <ul style="list-style-type: none"> <li>• Expenses from increased commodity prices,</li> <li>• Loss of savings potential,</li> <li>• Potential loss of competitive advantage due to high in-house costs</li> </ul>                                                                                                                                                                                                                                           |
| Long term cost (i.e. 10, 30, or 50 years) with mitigation technology                | Maintenance and upgrades of installed equipment.                                                                                                                                                                                                                                                                                                                                                                                                            |
| Development impacts, direct and indirect benefits                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Direct benefits                                                                     | <p>Other than savings from increased efficiency, benefits can be multiple:</p> <ul style="list-style-type: none"> <li>• Reduced health and safety hazards due to heat losses</li> <li>• Marketing potential</li> <li>• Reduced operational expenses</li> <li>• Profit increase potential</li> <li>• Potential to attract investments</li> </ul>                                                                                                             |
| Reduction of vulnerability to climate change, indirect                              | The technology does not provide reduction of vulnerability, as compared to traditional boiler systems.                                                                                                                                                                                                                                                                                                                                                      |
| <p>Economic benefits, indirect</p> <p>Employment</p> <p>Growth &amp; Investment</p> | <p>Jobs for retrofits, new installation, measurement of energy savings and green house gases reduction monitoring.</p> <p>Can create investment in:</p> <ul style="list-style-type: none"> <li>• Development of new technologies</li> <li>• Use of natural gas</li> <li>• Monitoring capability</li> </ul>                                                                                                                                                  |
| <p>Social benefits, indirect</p> <p>Income</p> <p>Education</p> <p>Health</p>       | <p>Income generation and distribution from the above-mentioned employment and investment benefits.</p> <p>Capacity Building for new technologies &amp; education in energy efficiency</p> <p>With new efficiency measures such as piping insulation, health and safety risks may be reduced as compared to traditional systems.</p>                                                                                                                         |

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| Environmental benefits, indirect    | Reduction in GHG emissions, local pollutants, ecosystem degradation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Local context</b>                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Opportunities and Barriers          | <p><b>Opportunities:</b><br/>Several small boilers can also be grouped together in parallel to provide staged heating capacity. This approach is usually more economical and efficient than using a single large boiler because:</p> <ul style="list-style-type: none"> <li>• The boilers can be staged to operate at or near their highest efficiency points</li> <li>• Small boilers are more efficient than large commercial boilers</li> <li>• Multiple boilers provide redundancy, which can reduce system downtime</li> <li>• Small boilers can reduce installation costs because each boiler is small enough to be handled without a crane.</li> </ul> <p><b>Barriers:</b></p> <ul style="list-style-type: none"> <li>• High initial investment</li> <li>• Existing boilers may still have a long operating life, preventing investment</li> <li>• A change of boiler system requires modification of operation and maintenance schedules.</li> </ul> |
| Market potential                    | Various suppliers may distribute the technology; however this could be encouraged by government subsidies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Status                              | Not prevailing practice in Mauritius. Limited experience in industry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Timeframe                           | Implementation can be planned in the short to medium term in cost effective ways. For new projects, design, procurement and installation can utilize the new technology potential. For existing operations, implementation can be planned to coincide with major equipment replacements and/or retrofitting operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Acceptability to local stakeholders | The technology is easily acceptable to stakeholders, who may also be neutral in its regard.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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<sup>i</sup> This fact sheet has been extracted from TNA Report – Technology Needs Assessment Reports For Climate Change Mitigation – Mauritius. You can access the complete report from the TNA project website <http://tech-action.org/>