

# **Supplementary Materials: Life Cycle Assessment of Post-Combustion CO<sub>2</sub> Capture and Recovery by Hydrophobic Polypropylene Cross-Flow Hollow Fiber Membrane Contactors with Activated Methyldiethanolamine**

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**Table S1.** Inventory data for 1 kgCO<sub>2</sub>/h (recovered) via cross-flow hollow fiber PP membrane contactor in aMDEA absorbent solution.

| All Conditions                        | Absorption Module        |                          |                           |                |                                       |              |                           |                                   | Stripping Module                  |                           |
|---------------------------------------|--------------------------|--------------------------|---------------------------|----------------|---------------------------------------|--------------|---------------------------|-----------------------------------|-----------------------------------|---------------------------|
|                                       | Inputs                   |                          |                           |                |                                       |              | Outputs                   |                                   | Inputs                            | Outputs                   |
|                                       | O <sub>2</sub><br>(kg/h) | N <sub>2</sub><br>(kg/h) | CO <sub>2</sub><br>(kg/h) | MDEA<br>(kg/h) | Ultra Pure<br>H <sub>2</sub> O (kg/h) | PZ<br>(kg/h) | CO <sub>2</sub><br>(kg/h) | CO <sub>2</sub> -loaded<br>(kg/h) | CO <sub>2</sub> -loaded<br>(kg/h) | CO <sub>2</sub><br>(kg/h) |
| Solv-80-LFR-15.10-FGFR-100-SHFR-50    | 0.016                    | 1.195                    | 0.315                     | 12.6           | 3.02                                  | 0.13         | 0.010                     | 0.306                             | 0.306                             | 0.114                     |
| Solv-80-LFR-15.10-FGFR-200-SHFR-50    | 0.061                    | 4.488                    | 1.185                     | 12.6           | 3.02                                  | 0.13         | 0.092                     | 1.093                             | 1.093                             | 0.176                     |
| Solv-80-LFR-15.10-FGFR-300-SHFR-50    | 0.169                    | 12.536                   | 3.310                     | 12.6           | 3.02                                  | 0.13         | 0.315                     | 2.995                             | 2.995                             | 0.211                     |
| Solv-90-LFR-15.10-FGFR-100-SHFR-50    | 0.009                    | 0.632                    | 0.167                     | 14.13          | 1.51                                  | 0.14         | 0.005                     | 0.162                             | 0.162                             | 0.109                     |
| Solv-90-LFR-15.10-FGFR-200-SHFR-50    | 0.016                    | 1.187                    | 0.313                     | 14.13          | 1.51                                  | 0.14         | 0.012                     | 0.302                             | 0.302                             | 0.164                     |
| Solv-90-LFR-15.10-FGFR-300-SHFR-50    | 0.023                    | 1.706                    | 0.450                     | 14.13          | 1.51                                  | 0.14         | 0.041                     | 0.410                             | 0.410                             | 0.208                     |
| Solv-Pure-LFR-15.10-FGFR-100-SHFR-50  | 0.008                    | 0.603                    | 0.159                     | 15.704         | 0.00                                  | 0.157        | 0.004                     | 0.155                             | 0.155                             | 0.144                     |
| Solv-Pure-LFR-15.10-FGFR-200-SHFR-50  | 0.014                    | 1.057                    | 0.279                     | 15.704         | 0.00                                  | 0.157        | 0.010                     | 0.270                             | 0.270                             | 0.222                     |
| Solv-Pure-LFR-15.10-FGFR-300-SHFR-50  | 0.016                    | 1.179                    | 0.311                     | 15.704         | 0.00                                  | 0.157        | 0.027                     | 0.284                             | 0.284                             | 0.221                     |
| Solv-80-LFR-16.60-FGFR-100-SHFR-50    | 0.019                    | 1.417                    | 0.374                     | 13.81          | 3.32                                  | 0.138        | 0.015                     | 0.359                             | 0.359                             | 0.125                     |
| Solv-80-LFR-16.60-FGFR-200-SHFR-50    | 0.074                    | 5.472                    | 1.445                     | 13.81          | 3.32                                  | 0.138        | 0.117                     | 1.328                             | 1.328                             | 0.174                     |
| Solv-80-LFR-16.60-FGFR-300-SHFR-50    | 0.202                    | 15.001                   | 3.961                     | 13.81          | 3.32                                  | 0.138        | 0.419                     | 3.542                             | 3.542                             | 0.197                     |
| Solv-90-LFR-16.60-FGFR-100-SHFR-50    | 0.009                    | 0.679                    | 0.179                     | 15.5           | 1.66                                  | 0.16         | 0.006                     | 0.173                             | 0.173                             | 0.097                     |
| Solv-90-LFR-16.60-FGFR-200-SHFR-50    | 0.015                    | 1.122                    | 0.296                     | 15.5           | 1.66                                  | 0.16         | 0.022                     | 0.274                             | 0.274                             | 0.151                     |
| Solv-90-LFR-16.60-FGFR-300-SHFR-50    | 0.025                    | 1.823                    | 0.481                     | 15.5           | 1.66                                  | 0.16         | 0.048                     | 0.433                             | 0.433                             | 0.205                     |
| Solv-Pure-LFR-16.60-FGFR-100-SHFR-50  | 0.010                    | 0.736                    | 0.194                     | 17.3           | 0.00                                  | 0.173        | 0.006                     | 0.188                             | 0.188                             | 0.154                     |
| Solv-Pure-LFR-16.60-FGFR-200-SHFR-50  | 0.015                    | 1.081                    | 0.285                     | 17.3           | 0.00                                  | 0.173        | 0.020                     | 0.265                             | 0.265                             | 0.209                     |
| Solv-Pure-LFR-16.60-FGFR-300-SHFR-50  | 0.018                    | 1.359                    | 0.359                     | 17.3           | 0.00                                  | 0.173        | 0.032                     | 0.326                             | 0.326                             | 0.229                     |
| Solv-80-LFR-18.90-FGFR-100-SHFR-50    | 0.019                    | 1.384                    | 0.365                     | 15.7           | 3.78                                  | 0.157        | 0.026                     | 0.339                             | 0.339                             | 0.119                     |
| Solv-80-LFR-18.90-FGFR-200-SHFR-50    | 0.077                    | 5.730                    | 1.513                     | 15.7           | 3.78                                  | 0.157        | 0.127                     | 1.386                             | 1.386                             | 0.172                     |
| Solv-80-LFR-18.90-FGFR-300-SHFR-50    | 0.207                    | 15.390                   | 4.063                     | 15.7           | 3.78                                  | 0.157        | 0.490                     | 3.573                             | 3.573                             | 0.202                     |
| Solv-90-LFR-18.90-FGFR-100-SHFR-50    | 0.009                    | 0.697                    | 0.184                     | 17.7           | 1.89                                  | 0.177        | 0.012                     | 0.172                             | 0.172                             | 0.085                     |
| Solv-90-LFR-18.90-FGFR-200-SHFR-50    | 0.018                    | 1.319                    | 0.348                     | 17.7           | 1.89                                  | 0.177        | 0.028                     | 0.320                             | 0.320                             | 0.148                     |
| Solv-90-LFR-18.90-FGFR-300-SHFR-50    | 0.026                    | 1.963                    | 0.518                     | 17.7           | 1.89                                  | 0.177        | 0.055                     | 0.463                             | 0.463                             | 0.199                     |
| Solv-Pure-LFR-18.90-FGFR-100-SHFR-50  | 0.010                    | 0.720                    | 0.190                     | 19.7           | 0.00                                  | 0.197        | 0.008                     | 0.182                             | 0.182                             | 0.137                     |
| Solv-Pure-LFR-18.90-FGFR-200-SHFR-50  | 0.014                    | 1.053                    | 0.278                     | 19.7           | 0.00                                  | 0.197        | 0.017                     | 0.261                             | 0.261                             | 0.178                     |
| Solv-Pure-LFR-18.90-FGFR-300-SHFR-50  | 0.019                    | 1.409                    | 0.372                     | 19.7           | 0.00                                  | 0.197        | 0.037                     | 0.335                             | 0.335                             | 0.216                     |
| Solv-80-LFR-15.10-FGFR-100-SHFR-100   | 0.032                    | 2.384                    | 0.629                     | 12.6           | 3.02                                  | 0.13         | 0.054                     | 0.575                             | 0.575                             | 0.098                     |
| Solv-80-LFR-15.10-FGFR-200-SHFR-100   | 0.114                    | 8.477                    | 2.238                     | 12.6           | 3.02                                  | 0.13         | 0.238                     | 2.000                             | 2.000                             | 0.143                     |
| Solv-80-LFR-15.10-FGFR-300-SHFR-100   | 0.169                    | 12.507                   | 3.302                     | 12.6           | 3.02                                  | 0.13         | 0.450                     | 2.852                             | 2.852                             | 0.187                     |
| Solv-90-LFR-15.10-FGFR-100-SHFR-100   | 0.009                    | 0.634                    | 0.167                     | 14.13          | 1.51                                  | 0.14         | 0.009                     | 0.158                             | 0.158                             | 0.095                     |
| Solv-90-LFR-15.10-FGFR-200-SHFR-100   | 0.015                    | 1.136                    | 0.300                     | 14.13          | 1.51                                  | 0.14         | 0.022                     | 0.278                             | 0.278                             | 0.155                     |
| Solv-90-LFR-15.10-FGFR-300-SHFR-100   | 0.024                    | 1.798                    | 0.475                     | 14.13          | 1.51                                  | 0.14         | 0.045                     | 0.429                             | 0.429                             | 0.202                     |
| Solv-Pure-LFR-15.10-FGFR-100-SHFR-100 | 0.007                    | 0.555                    | 0.147                     | 15.704         | 0.00                                  | 0.157        | 0.006                     | 0.141                             | 0.141                             | 0.116                     |

|                                       |       |        |       |        |       |       |       |       |       |       |
|---------------------------------------|-------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
| Solv-Pure-LFR-15.10-FGFR-200-SHFR-100 | 0.011 | 0.829  | 0.219 | 15.704 | 0.000 | 0.157 | 0.015 | 0.204 | 0.204 | 0.166 |
| Solv-Pure-LFR-15.10-FGFR-300-SHFR-100 | 0.015 | 1.108  | 0.293 | 15.704 | 0.000 | 0.157 | 0.027 | 0.266 | 0.266 | 0.197 |
| Solv-80-LFR-16.60-FGFR-100-SHFR-100   | 0.041 | 3.052  | 0.806 | 13.81  | 3.32  | 0.138 | 0.076 | 0.730 | 0.730 | 0.097 |
| Solv-80-LFR-16.60-FGFR-200-SHFR-100   | 0.146 | 10.810 | 2.854 | 13.81  | 3.32  | 0.138 | 0.312 | 2.543 | 2.543 | 0.142 |
| Solv-80-LFR-16.60-FGFR-300-SHFR-100   | 0.209 | 15.479 | 4.087 | 13.81  | 3.32  | 0.138 | 0.539 | 3.548 | 3.548 | 0.174 |
| Solv-90-LFR-16.60-FGFR-100-SHFR-100   | 0.009 | 0.654  | 0.173 | 15.5   | 1.66  | 0.16  | 0.010 | 0.162 | 0.162 | 0.087 |
| Solv-90-LFR-16.60-FGFR-200-SHFR-100   | 0.017 | 1.278  | 0.337 | 15.5   | 1.66  | 0.16  | 0.026 | 0.311 | 0.311 | 0.148 |
| Solv-90-LFR-16.60-FGFR-300-SHFR-100   | 0.025 | 1.823  | 0.481 | 15.5   | 1.66  | 0.16  | 0.049 | 0.432 | 0.432 | 0.201 |
| Solv-Pure-LFR-16.60-FGFR-100-SHFR-100 | 0.008 | 0.576  | 0.152 | 17.3   | 0.0   | 0.173 | 0.006 | 0.146 | 0.146 | 0.119 |
| Solv-Pure-LFR-16.60-FGFR-200-SHFR-100 | 0.012 | 0.892  | 0.235 | 17.3   | 0.0   | 0.173 | 0.013 | 0.223 | 0.223 | 0.164 |
| Solv-Pure-LFR-16.60-FGFR-300-SHFR-100 | 0.016 | 1.189  | 0.314 | 17.3   | 0.0   | 0.173 | 0.030 | 0.284 | 0.284 | 0.200 |
| Solv-80-LFR-18.90-FGFR-100-SHFR-100   | 0.057 | 4.238  | 1.119 | 15.7   | 3.78  | 0.157 | 0.117 | 1.002 | 1.002 | 0.095 |
| Solv-80-LFR-18.90-FGFR-200-SHFR-100   | 0.142 | 10.554 | 2.787 | 15.7   | 3.78  | 0.157 | 0.324 | 2.462 | 2.462 | 0.138 |
| Solv-80-LFR-18.90-FGFR-300-SHFR-100   | 0.222 | 16.432 | 4.338 | 15.7   | 3.78  | 0.157 | 0.591 | 3.748 | 3.748 | 0.185 |
| Solv-90-LFR-18.90-FGFR-100-SHFR-100   | 0.009 | 0.695  | 0.184 | 17.7   | 1.89  | 0.177 | 0.014 | 0.169 | 0.169 | 0.078 |
| Solv-90-LFR-18.90-FGFR-200-SHFR-100   | 0.018 | 1.306  | 0.345 | 17.7   | 1.89  | 0.177 | 0.033 | 0.312 | 0.312 | 0.139 |
| Solv-90-LFR-18.90-FGFR-300-SHFR-100   | 0.026 | 1.949  | 0.515 | 17.7   | 1.89  | 0.177 | 0.064 | 0.451 | 0.451 | 0.190 |
| Solv-Pure-LFR-18.90-FGFR-100-SHFR-100 | 0.008 | 0.603  | 0.159 | 19.7   | 0.0   | 0.197 | 0.006 | 0.153 | 0.153 | 0.113 |
| Solv-Pure-LFR-18.90-FGFR-200-SHFR-100 | 0.014 | 1.075  | 0.284 | 19.7   | 0.0   | 0.197 | 0.019 | 0.265 | 0.265 | 0.173 |
| Solv-Pure-LFR-18.90-FGFR-300-SHFR-100 | 0.017 | 1.275  | 0.337 | 19.7   | 0.0   | 0.197 | 0.035 | 0.301 | 0.301 | 0.191 |

\*Electricity as an input was taken as 0.88 and 1.36 kWh for all absorption and stripping processes, respectively.

\*Sweep helium amount as an input in the stripping process was taken as 3 - 6 L/h for SHFR=50 – 100 cm<sup>3</sup>/min.

**Table S2.** CO<sub>2</sub> absorption/stripping results in aMDEA absorbent composition of 80 vol % aMDEA/10 vol % H<sub>2</sub>O.

| Conditions     | LFR<br>(L/h) | SHFR<br>(cm <sup>3</sup> /min) | FGFR<br>(cm <sup>3</sup> /min) | Conc. of CO <sub>2</sub><br>absorber out (%) | Conc. of CO <sub>2</sub><br>stripper out (%) | CO <sub>2</sub><br>recovery (%) |
|----------------|--------------|--------------------------------|--------------------------------|----------------------------------------------|----------------------------------------------|---------------------------------|
| Sol 80 % aMDEA | 15.1         | 50                             | 50                             | 0.4                                          | 6.2                                          | 83.5                            |
|                | 15.1         | 50                             | 100                            | 0.44                                         | 5.1                                          | 44.7                            |
|                | 15.1         | 50                             | 150                            | 0.51                                         | 3.4                                          | 23.1                            |
|                | 15.1         | 50                             | 200                            | 1.09                                         | 2.1                                          | 11.9                            |
|                | 15.1         | 50                             | 250                            | 1.26                                         | 1.2                                          | 6.54                            |
|                | 15.1         | 50                             | 300                            | 1.34                                         | 0.9                                          | 4.26                            |
|                | 15.1         | 100                            | 50                             | 0.46                                         | 5.1                                          | 82.8                            |
|                | 15.1         | 100                            | 100                            | 1.22                                         | 2.2                                          | 22.4                            |
|                | 15.1         | 100                            | 150                            | 1.43                                         | 1.1                                          | 9.68                            |
|                | 15.1         | 100                            | 200                            | 1.5                                          | 0.9                                          | 6.3                             |
|                | 15.1         | 100                            | 250                            | 1.63                                         | 0.8                                          | 4.58                            |
|                | 15.1         | 100                            | 300                            | 1.92                                         | 0.8                                          | 4.27                            |
|                | 16.6         | 50                             | 50                             | 0.47                                         | 5.4                                          | 73.5                            |
|                | 16.6         | 50                             | 100                            | 0.56                                         | 4.7                                          | 37.7                            |
|                | 16.6         | 50                             | 150                            | 0.65                                         | 3.1                                          | 21.4                            |
|                | 16.6         | 50                             | 200                            | 1.14                                         | 1.7                                          | 9.76                            |
|                | 16.6         | 50                             | 250                            | 1.29                                         | 1.1                                          | 6.04                            |
|                | 16.6         | 50                             | 300                            | 1.49                                         | 0.7                                          | 3.56                            |
|                | 16.6         | 100                            | 50                             | 0.93                                         | 4.3                                          | 72.7                            |
|                | 16.6         | 100                            | 100                            | 1.33                                         | 1.7                                          | 17.5                            |
|                | 16.6         | 100                            | 150                            | 1.48                                         | 0.8                                          | 7.31                            |
|                | 16.6         | 100                            | 200                            | 1.54                                         | 0.7                                          | 4.94                            |
|                | 16.6         | 100                            | 250                            | 1.71                                         | 0.7                                          | 4.07                            |
|                | 16.6         | 100                            | 300                            | 1.86                                         | 0.6                                          | 3.45                            |
|                | 18.9         | 50                             | 50                             | 0.9                                          | 5.3                                          | 74.8                            |
|                | 18.9         | 50                             | 100                            | 1.01                                         | 4.6                                          | 38.6                            |
|                | 18.9         | 50                             | 150                            | 1.08                                         | 2.7                                          | 19.7                            |
|                | 18.9         | 50                             | 200                            | 1.18                                         | 1.6                                          | 9.32                            |
|                | 18.9         | 50                             | 250                            | 1.35                                         | 0.9                                          | 4.97                            |
|                | 18.9         | 50                             | 300                            | 1.7                                          | 0.7                                          | 3.47                            |
|                | 18.9         | 100                            | 50                             | 1.18                                         | 3.8                                          | 66.1                            |
|                | 18.9         | 100                            | 100                            | 1.48                                         | 1.2                                          | 12.6                            |
|                | 18.9         | 100                            | 150                            | 1.55                                         | 0.8                                          | 7.33                            |
|                | 18.9         | 100                            | 200                            | 1.64                                         | 0.7                                          | 5.06                            |
|                | 18.9         | 100                            | 250                            | 1.82                                         | 0.6                                          | 3.49                            |
|                | 18.9         | 100                            | 300                            | 1.92                                         | 0.6                                          | 3.25                            |

\*Humidified feed gas at 50-300 cm<sup>3</sup>/min; LFR of 15.10-16.60-18.90 L/h; concentration of CO<sub>2</sub> in 14.1%; absorption temperature:44.6 °C; stripping temperature: 92.7 °C; SHFR of 50-100 cm<sup>3</sup>/min; VSS 1 in. Hg (2.54 cm Hg).

**Table S3.** CO<sub>2</sub> absorption/stripping results in aMDEA absorbent composition of 90 vol % aMDEA/10 vol % H<sub>2</sub>O.

| Conditions        | LFR<br>(L/h) | SHFR<br>(cm <sup>3</sup> /min) | FGFR<br>(cm <sup>3</sup> /min) | Conc. of CO <sub>2</sub><br>absorber out (%) | Conc. of CO <sub>2</sub><br>stripper out (%) | CO <sub>2</sub><br>recovery (%) |
|-------------------|--------------|--------------------------------|--------------------------------|----------------------------------------------|----------------------------------------------|---------------------------------|
| Sol 90 %<br>aMDEA | 15.1         | 50                             | 50                             | 0.35                                         | 9.5                                          | 98.4                            |
|                   | 15.1         | 50                             | 100                            | 0.42                                         | 9.2                                          | 84.5                            |
|                   | 15.1         | 50                             | 150                            | 0.48                                         | 8.3                                          | 58.3                            |
|                   | 15.1         | 50                             | 200                            | 0.53                                         | 7.4                                          | 45.0                            |
|                   | 15.1         | 50                             | 250                            | 1.20                                         | 7.1                                          | 39.3                            |

|      |     |     |      |     |      |
|------|-----|-----|------|-----|------|
| 15.1 | 50  | 300 | 1.27 | 6.5 | 31.3 |
| 15.1 | 100 | 100 | 0.78 | 8.0 | 84.2 |
| 15.1 | 100 | 150 | 1.00 | 7.5 | 60.4 |
| 15.1 | 100 | 200 | 1.05 | 7.3 | 47.0 |
| 15.1 | 100 | 250 | 1.13 | 7.1 | 38.4 |
| 15.1 | 100 | 300 | 1.35 | 6.0 | 29.7 |
| 16.6 | 50  | 50  | 0.41 | 8.0 | 96.6 |
| 16.6 | 50  | 100 | 0.47 | 7.6 | 78.7 |
| 16.6 | 50  | 150 | 0.53 | 7.5 | 58.8 |
| 16.6 | 50  | 200 | 1.07 | 7.2 | 47.6 |
| 16.6 | 50  | 250 | 1.22 | 7.0 | 39.2 |
| 16.6 | 50  | 300 | 1.40 | 6   | 29.3 |
| 16.6 | 100 | 100 | 0.85 | 7.1 | 81.6 |
| 16.6 | 100 | 150 | 1.05 | 7.0 | 57.9 |
| 16.6 | 100 | 200 | 1.10 | 6.2 | 41.8 |
| 16.6 | 100 | 250 | 1.26 | 6.0 | 34.4 |
| 16.6 | 100 | 300 | 1.45 | 5.9 | 29.3 |
| 18.9 | 50  | 50  | 0.75 | 7.5 | 90.3 |
| 18.9 | 50  | 100 | 0.92 | 6.5 | 76.6 |
| 18.9 | 50  | 150 | 1.06 | 6.2 | 52.4 |
| 18.9 | 50  | 200 | 1.12 | 6.0 | 40.5 |
| 18.9 | 50  | 250 | 1.28 | 6.0 | 34.5 |
| 18.9 | 50  | 300 | 1.50 | 5.4 | 27.2 |
| 18.9 | 100 | 100 | 1.10 | 6.0 | 76.8 |
| 18.9 | 100 | 150 | 1.21 | 6.0 | 54.1 |
| 18.9 | 100 | 200 | 1.34 | 5.7 | 40.9 |
| 18.9 | 100 | 250 | 1.57 | 5.4 | 32.6 |
| 18.9 | 100 | 300 | 1.75 | 5.2 | 27.4 |

\*Humidified feed gas at 50-300 cm<sup>3</sup>/min; LFR of 15.10-16.60-18.90 L/h; concentration of CO<sub>2</sub> in 14.1%; absorption temperature:44.6 °C; stripping temperature: 92.7 °C; SHFR of 50-100 cm<sup>3</sup>/min; VSS 1 in. Hg (2.54 cm Hg).

**Table S4.** CO<sub>2</sub> absorption/stripping results with pure aMDEA.

| Conditions | LFR<br>(L/h) | SHFR<br>(cm <sup>3</sup> /min) | FGFR<br>(cm <sup>3</sup> /min) | Conc. of CO <sub>2</sub><br>absorber out (%) | Conc. of CO <sub>2</sub><br>stripper out (%) | CO <sub>2</sub><br>recovery (%) |
|------------|--------------|--------------------------------|--------------------------------|----------------------------------------------|----------------------------------------------|---------------------------------|
| Pure aMDEA | 15.1         | 50                             | 100                            | 0.33                                         | 12.8                                         | 88.6                            |
|            | 15.1         | 50                             | 150                            | 0.41                                         | 11.7                                         | 64.4                            |
|            | 15.1         | 50                             | 200                            | 0.49                                         | 11.2                                         | 50.5                            |
|            | 15.1         | 50                             | 250                            | 1.12                                         | 10.1                                         | 49.1                            |
|            | 15.1         | 50                             | 300                            | 1.22                                         | 10                                           | 45.3                            |
|            | 15.1         | 100                            | 100                            | 0.57                                         | 11.2                                         | 96.2                            |
|            | 15.1         | 100                            | 150                            | 0.89                                         | 11                                           | 73.8                            |
|            | 15.1         | 100                            | 200                            | 0.96                                         | 10.7                                         | 64.4                            |
|            | 15.1         | 100                            | 250                            | 1.21                                         | 10.5                                         | 57.4                            |
|            | 15.1         | 100                            | 300                            | 1.3                                          | 9.5                                          | 48.2                            |
|            | 16.6         | 50                             | 100                            | 0.42                                         | 11.2                                         | 72.6                            |
|            | 16.6         | 50                             | 150                            | 0.49                                         | 10.5                                         | 51.6                            |
|            | 16.6         | 50                             | 200                            | 1.01                                         | 10.3                                         | 49.4                            |
|            | 16.6         | 50                             | 250                            | 1.18                                         | 10.3                                         | 44.4                            |
|            | 16.6         | 50                             | 300                            | 1.27                                         | 9                                            | 39.3                            |

|  |      |     |     |      |      |      |
|--|------|-----|-----|------|------|------|
|  | 16.6 | 100 | 100 | 0.53 | 11   | 92.7 |
|  | 16.6 | 100 | 150 | 0.65 | 10   | 65.7 |
|  | 16.6 | 100 | 200 | 0.77 | 9.8  | 59.9 |
|  | 16.6 | 100 | 250 | 0.89 | 9    | 48.5 |
|  | 16.6 | 100 | 300 | 1.33 | 9    | 44.9 |
|  | 18.9 | 50  | 100 | 0.63 | 10.2 | 74.2 |
|  | 18.9 | 50  | 150 | 0.75 | 9.7  | 63.6 |
|  | 18.9 | 50  | 200 | 0.88 | 9    | 50.7 |
|  | 18.9 | 50  | 250 | 0.97 | 8.3  | 41.9 |
|  | 18.9 | 50  | 300 | 1.39 | 8.2  | 37.9 |
|  | 18.9 | 100 | 100 | 0.55 | 10   | 88.6 |
|  | 18.9 | 100 | 150 | 0.71 | 9    | 58.5 |
|  | 18.9 | 100 | 200 | 0.93 | 8.6  | 49.7 |
|  | 18.9 | 100 | 250 | 1.15 | 8.2  | 44.4 |
|  | 18.9 | 100 | 300 | 1.48 | 8    | 41.9 |

\*Humidified feed gas at 100-300 cm<sup>3</sup>/min; LFR of 15.10-16.60-18.90 L/h; concentration of CO<sub>2</sub> in 14.1%; absorption temperature:44.6 °C; stripping temperature: 92.7 °C; SHFR of 50-100 cm<sup>3</sup>/min; VSS 1 in. Hg (2.54 cm Hg).

**Table S5.** Absolute values of the impact categories for different LFR and FGFR at the pure solvent composition and 50 cm<sup>3</sup>/min of SHFR.

| Impact category | Unit                    | LFR18.90-FGFR300 | LFR18.90-FGFR200 | LFR18.90-FGFR100 | LFR16.60-FGFR300 | LFR16.60-FGFR200 | LFR16.60-FGFR100 | LFR15.10-FGFR300 | LFR15.10-FGFR200 | LFR15.10-FGFR100 |
|-----------------|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| GWP             | kg CO <sub>2</sub> eq   | 46.438904        | 46.148639        | 45.873543        | 44.24934         | 44.033334        | 43.7348          | 42.674179        | 42.588102        | 42.190744        |
| SODP            | kg CFC11 eq             | 3.939E-05        | 3.931E-05        | 3.923E-05        | 3.660E-05        | 3.654E-05        | 3.646E-05        | 3.472E-05        | 3.469E-05        | 3.458E-05        |
| IRP             | kBq Co-60 eq            | 3.0553962        | 2.9897486        | 2.9275172        | 2.9070278        | 2.8556547        | 2.7914339        | 2.7808748        | 2.7595125        | 2.6737133        |
| OFHHP           | kg NO <sub>x</sub> eq   | 0.1343184        | 0.13399555       | 0.13368632       | 0.12479846       | 0.12454433       | 0.124226987      | 0.118329777      | 0.118228209      | 0.117799964      |
| FPMFP           | kg PM <sub>2.5</sub> eq | 0.0867738        | 0.08651682       | 0.086270816      | 0.081956319      | 0.081754094      | 0.081501537      | 0.078643105      | 0.078562062      | 0.078221472      |
| OFTEP           | kg NO <sub>x</sub> eq   | 0.1572717        | 0.156944509      | 0.156631097      | 0.14549038       | 0.145232827      | 0.144911228      | 0.137515972      | 0.13741311       | 0.136979049      |
| TAP             | kg SO <sub>2</sub> eq   | 0.2012997        | 0.200626709      | 0.199982709      | 0.188037726      | 0.187508297      | 0.186847081      | 0.178931873      | 0.17871956       | 0.177828014      |
| FEP             | kg P eq                 | 0.0134930        | 0.013345483      | 0.013204799      | 0.012902797      | 0.012786951      | 0.012642211      | 0.012447913      | 0.012400772      | 0.012206326      |
| MEP             | kg N eq                 | 0.0058623        | 0.005845974      | 0.005830151      | 0.005220104      | 0.005207159      | 0.005191009      | 0.004784972      | 0.004780007      | 0.004757995      |
| TEP             | kg 1,4-DCB              | 73.192959        | 72.068356        | 70.95706         | 66.064713        | 65.163992        | 64.042538        | 60.823358        | 60.507996        | 58.948132        |
| FETP            | kg 1,4-DCB              | 0.9340200        | 0.9262036        | 0.91866106       | 0.87577463       | 0.86959718       | 0.86188803       | 0.8336756        | 0.83128081       | 0.82080028       |
| METP            | kg 1,4-DCB              | 1.3668966        | 1.3561409        | 1.34575728       | 1.28014017       | 1.27163753       | 1.26102714       | 1.2178126        | 1.2145225        | 1.2000914        |
| HCTP            | kg 1,4-DCB              | 1.5462522        | 1.53641788       | 1.52699426       | 1.47390584       | 1.46616368       | 1.45649555       | 1.42160166       | 1.41851456       | 1.40546021       |
| HNCTP           | kg 1,4-DCB              | 27.223042        | 27.011223        | 26.805925        | 25.294511        | 25.126696        | 24.917359        | 23.92022         | 23.856329        | 23.570523        |

**Table S6.** Absolute values of the impact categories for different LFR and FGFR at the pure solvent composition and 100 cm<sup>3</sup>/min of SHFR.

| Impact category | Unit                    | LFR18.90-FGFR300 | LFR18.90-FGFR200 | LFR18.90-FGFR100 | LFR16.60-FGFR300 | LFR16.60-FGFR200 | LFR16.60-FGFR100 | LFR15.10-FGFR300 | LFR15.10-FGFR200 | LFR15.10-FGFR100 |
|-----------------|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| GWP             | kg CO <sub>2</sub> eq   | 73.93279         | 73.772695        | 73.380192        | 71.715204        | 71.468672        | 71.201661        | 70.214979        | 69.986267        | 69.743635        |
| SODP            | kg CFC11 eq             | 5.548E-05        | 5.54422E-05      | 5.53303E-05      | 5.26956E-05      | 5.26269E-05      | 5.25516E-05      | 5.08331E-05      | 5.07676E-05      | 5.07029E-05      |
| IRP             | kBq Co-60 eq            | 4.5392922        | 4.5029205        | 4.414574         | 4.3843431        | 4.3296479        | 4.2703649        | 4.2767729        | 4.2248374        | 4.1736567        |
| OFHHP           | kg NO <sub>x</sub> eq   | 0.1894300        | 0.189252854      | 0.188813885      | 0.179877265      | 0.179608225      | 0.179313271      | 0.173501371      | 0.173244684      | 0.172991332      |
| FPMFP           | kg PM <sub>2.5</sub> eq | 0.1291714        | 0.129030229      | 0.128681019      | 0.12432775       | 0.124113575      | 0.123878955      | 0.121088336      | 0.12088405       | 0.120682439      |
| OFTEP           | kg NO <sub>x</sub> eq   | 0.2167685        | 0.216588997      | 0.216144115      | 0.20495395       | 0.204681328      | 0.204382394      | 0.197073617      | 0.196813478      | 0.196556719      |
| TAP             | kg SO <sub>2</sub> eq   | 0.2911447        | 0.29077496       | 0.28986078       | 0.277814312      | 0.277253543      | 0.276639357      | 0.268901639      | 0.268366804      | 0.26783899       |
| FEP             | kg P eq                 | 0.0206695        | 0.020588229      | 0.020388516      | 0.020064405      | 0.019941446      | 0.019807335      | 0.019651644      | 0.019534578      | 0.019419116      |
| MEP             | kg N eq                 | 0.0064046        | 0.006395781      | 0.006373321      | 0.005760762      | 0.005747134      | 0.005732023      | 0.005330401      | 0.005317335      | 0.005304418      |
| TEP             | kg 1,4-DCB              | 95.275995        | 94.676727        | 93.099573        | 88.02822         | 87.091064        | 86.027111        | 83.125326        | 82.217596        | 81.317364        |
| FETP            | kg 1,4-DCB              | 1.3620365        | 1.35777593       | 1.34706961       | 1.30298771       | 1.29647486       | 1.28927403       | 1.2631604        | 1.25692361       | 1.25076071       |
| METP            | kg 1,4-DCB              | 1.9852109        | 1.97935049       | 1.96461142       | 1.89734812       | 1.88838601       | 1.87847225       | 1.83814861       | 1.82956457       | 1.82108167       |

|       |            |           |            |            |            |            |            |            |            |            |
|-------|------------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|
| HCTP  | kg 1,4-DCB | 2.4286222 | 2.42322689 | 2.40984976 | 2.35527488 | 2.34708083 | 2.33809183 | 2.30579952 | 2.29797902 | 2.29025945 |
| HNCTP | kg 1,4-DCB | 38.146586 | 38.0316    | 37.740198  | 36.196146  | 36.019649  | 35.823549  | 34.883817  | 34.714446  | 34.546969  |

**Table S7.** Absolute values of the impact categories for different LFR and FGFR at the 90 % of solvent composition and 50 cm<sup>3</sup>/min of SHFR.

| Impact category | Unit                    | LFR18.90-FGFR300 | LFR18.90-FGFR200 | LFR18.90-FGFR100 | LFR16.60-FGFR300 | LFR16.60-FGFR200 | LFR16.60-FGFR100 | LFR15.10-FGFR300 | LFR15.10-FGFR200 | LFR15.10-FGFR100 |
|-----------------|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| GWP             | kg CO <sub>2</sub> eq   | 45.091657        | 44.586525        | 44.086073        | 43.102624        | 42.554324        | 42.187741        | 41.668617        | 41.25712         | 40.81333         |
| SODP            | kg CFC11 eq             | 3.724E-05        | 3.709E-05        | 3.694E-05        | 3.469E-05        | 3.453E-05        | 3.442E-05        | 3.305E-05        | 3.293E-05        | 3.280E-05        |
| IRP             | kBq Co-60 eq            | 3.0454324        | 2.926053         | 2.8093069        | 2.8958667        | 2.7651491        | 2.6825815        | 2.7901411        | 2.6945218        | 2.58988029       |
| OFHHP           | kg NO <sub>x</sub> eq   | 0.1274938        | 0.126903574      | 0.126324021      | 0.118807502      | 0.11816074       | 0.117751914      | 0.11303125       | 0.112560807      | 0.112038748      |
| FPMFP           | kg PM <sub>2.5</sub> eq | 0.0833436        | 0.082873907      | 0.082412805      | 0.078962903      | 0.07844822       | 0.078122905      | 0.076001318      | 0.075626819      | 0.07521161       |
| OFTEP           | kg NO <sub>x</sub> eq   | 0.1485789        | 0.147980833      | 0.147393464      | 0.137832488      | 0.137177037      | 0.136762714      | 0.130746869      | 0.13027015       | 0.129741005      |
| TAP             | kg SO <sub>2</sub> eq   | 0.1917251        | 0.19049544       | 0.189288332      | 0.17963242       | 0.178284969      | 0.177433296      | 0.171551396      | 0.170570855      | 0.16948398       |
| FEP             | kg P eq                 | 0.0133211        | 0.013052013      | 0.012788223      | 0.012755914      | 0.012461097      | 0.012274803      | 0.012350644      | 0.012135661      | 0.011898575      |
| MEP             | kg N eq                 | 0.0053638        | 0.005333842      | 0.005304211      | 0.005044436      | 0.005011479      | 0.004990632      | 0.004365892      | 0.004342057      | 0.004315237      |
| TEP             | kg 1,4-DCB              | 70.025159        | 67.936293        | 65.859138        | 63.312022        | 61.017422        | 59.563861        | 58.640058        | 57.000249        | 55.101353        |
| FETP            | kg 1,4-DCB              | 0.9002367        | 0.88589403       | 0.87176652       | 0.84671547       | 0.83098883       | 0.82104285       | 0.80902452       | 0.79763434       | 0.78486259       |
| METP            | kg 1,4-DCB              | 1.3153025        | 1.29556164       | 1.27611346       | 1.23550095       | 1.21385455       | 1.20016431       | 1.17988527       | 1.16421161       | 1.14662599       |
| HCTP            | kg 1,4-DCB              | 1.5064254        | 1.48844386       | 1.47078233       | 1.44034783       | 1.42064221       | 1.4081858        | 1.39260833       | 1.37828015       | 1.3623668        |
| HNCTP           | kg 1,4-DCB              | 26.028087        | 25.638537        | 25.254155        | 24.259822        | 23.83254         | 23.562232        | 23.032374        | 22.723674        | 22.375452        |

**Table S8.** Absolute values of the impact categories for different LFR and FGFR at the 90 % of solvent composition and 100 cm<sup>3</sup>/min of SHFR.

| Impact category | Unit                    | LFR18.90-FGFR300 | LFR18.90-FGFR200 | LFR18.90-FGFR100 | LFR16.60-FGFR300 | LFR16.60-FGFR200 | LFR16.60-FGFR100 | LFR15.10-FGFR300 | LFR15.10-FGFR200 | LFR15.10-FGFR100 |
|-----------------|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| GWP             | kg CO <sub>2</sub> eq   | 72.688827        | 72.183294        | 71.691276        | 70.712           | 70.27367         | 69.774503        | 69.340164        | 68.827049        | 68.413689        |
| SODP            | kg CFC11 eq             | 5.337E-05        | 5.322E-05        | 5.308E-05        | 5.082E-05        | 5.069E-05        | 5.054E-05        | 4.9201E-05       | 4.905E-05        | 4.893E-05        |
| IRP             | kBq Co-60 eq            | 4.5512806        | 4.4324553        | 4.3179855        | 4.405017         | 4.3035754        | 4.1867903        | 4.3163293        | 4.1929083        | 4.09897164       |
| OFHHP           | kg NO <sub>x</sub> eq   | 0.1827125        | 0.182126074      | 0.181558602      | 0.174044722      | 0.173543603      | 0.172963466      | 0.168352845      | 0.167741681      | 0.167274525      |
| FPMFP           | kg PM <sub>2.5</sub> eq | 0.1258264        | 0.125359702      | 0.124908167      | 0.121460351      | 0.121061527      | 0.120599993      | 0.118565902      | 0.118079584      | 0.117707972      |
| OFTEP           | kg NO <sub>x</sub> eq   | 0.2081843        | 0.207590042      | 0.207014923      | 0.197456632      | 0.196948801      | 0.196360821      | 0.190456519      | 0.189837148      | 0.189363667      |
| TAP             | kg SO <sub>2</sub> eq   | 0.2817934        | 0.280571438      | 0.27938935       | 0.269738894      | 0.268694729      | 0.267486509      | 0.261833622      | 0.260560454      | 0.259587649      |
| FEP             | kg P eq                 | 0.0205467        | 0.020279168      | 0.020020715      | 0.019989548      | 0.019760957      | 0.019496987      | 0.019622722      | 0.019344238      | 0.019131786      |
| MEP             | kg N eq                 | 0.0059116        | 0.005881811      | 0.005852836      | 0.005593212      | 0.005567717      | 0.005538039      | 0.00491897       | 0.004887803      | 0.00486388       |
| TEP             | kg 1,4-DCB              | 92.471528        | 90.407219        | 88.381755        | 85.847348        | 84.078084        | 81.994944        | 81.475433        | 79.301875        | 77.619048        |

|       |            |           |            |            |            |            |            |            |            |            |
|-------|------------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|
| FETP  | kg 1,4-DCB | 1.3308296 | 1.31659724 | 1.30277807 | 1.2777968  | 1.26562593 | 1.25147824 | 1.24215849 | 1.22728904 | 1.21588801 |
| METP  | kg 1,4-DCB | 1.9371606 | 1.91757307 | 1.89855055 | 1.85803446 | 1.84128351 | 1.821807   | 1.80524417 | 1.78477694 | 1.76908092 |
| HCTP  | kg 1,4-DCB | 2.3920555 | 2.37419071 | 2.35689849 | 2.32654503 | 2.31127833 | 2.29359899 | 2.28137617 | 2.26275474 | 2.24851807 |
| HNCTP | kg 1,4-DCB | 37.021195 | 36.634935  | 36.259161  | 35.26681   | 34.936361  | 34.551326  | 34.095151  | 33.69102   | 33.380595  |

**Table S9.** Absolute values of the impact categories for different LFR and FGFR at the 80 % of solvent composition and 50 cm<sup>3</sup>/min of SHFR.

| Impact category | Unit                    | LFR18.90-FGFR300 | LFR18.90-FGFR200 | LFR18.90-FGFR100 | LFR16.60-FGFR300 | LFR16.60-FGFR200 | LFR16.60-FGFR100 | LFR15.10-FGFR300 | LFR15.10-FGFR200 | LFR15.10-FGFR100 |
|-----------------|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| GWP             | kg CO <sub>2</sub> eq   | 52.832398        | 45.991014        | 42.882716        | 50.817791        | 44.084039        | 41.182734        | 48.022901        | 42.315403        | 40.036555        |
| SODP            | kg CFC11 eq             | 3.814E-05        | 3.587E-05        | 3.484E-05        | 3.587E-05        | 3.362E-05        | 3.265E-05        | 3.390E-05        | 3.198E-05        | 3.125E-05        |
| IRP             | kBq Co-60 eq            | 5.4395671        | 3.6411504        | 2.8254311        | 5.2629964        | 3.4829696        | 2.7224329        | 4.7361354        | 3.224195         | 2.6586325        |
| OFHHP           | kg NO <sub>x</sub> eq   | 0.1325863        | 0.123686204      | 0.119630576      | 0.124675319      | 0.115849454      | 0.112070842      | 0.117619497      | 0.110119077      | 0.107247573      |
| FPMFP           | kg PM <sub>2.5</sub> eq | 0.0893955        | 0.082313183      | 0.079086857      | 0.08534422       | 0.078321837      | 0.075315731      | 0.081154857      | 0.075187282      | 0.072908557      |
| OFTEP           | kg NO <sub>x</sub> eq   | 0.1519639        | 0.142944185      | 0.13883374       | 0.142266325      | 0.133321574      | 0.129491933      | 0.134044502      | 0.126442985      | 0.123531741      |
| TAP             | kg SO <sub>2</sub> eq   | 0.2069743        | 0.188432671      | 0.179986759      | 0.195869002      | 0.177484906      | 0.169615395      | 0.18456895       | 0.168946397      | 0.16298338       |
| FEP             | kg P eq                 | 0.0185768        | 0.014520356      | 0.012675687      | 0.017965787      | 0.013946514      | 0.012227297      | 0.016644445      | 0.013229553      | 0.011936791      |
| MEP             | kg N eq                 | 0.0054738        | 0.005020228      | 0.004812572      | 0.004950198      | 0.004499528      | 0.004306188      | 0.004613401      | 0.004230219      | 0.004080666      |
| TEP             | kg 1,4-DCB              | 109.37606        | 77.781667        | 63.180406        | 102.755417       | 71.242311        | 57.666849        | 91.195779        | 64.374058        | 53.453203        |
| FETP            | kg 1,4-DCB              | 1.1566233        | 0.94018231       | 0.84121354       | 1.10397347       | 0.88903473       | 0.79687286       | 1.02076333       | 0.83803519       | 0.76708748       |
| METP            | kg 1,4-DCB              | 1.6631354        | 1.36521986       | 1.22896866       | 1.58540856       | 1.28953596       | 1.16265977       | 1.46747903       | 1.21594013       | 1.11818117       |
| HCTP            | kg 1,4-DCB              | 1.8297255        | 1.55855798       | 1.43495771       | 1.76343274       | 1.4944977        | 1.37934392       | 1.65936424       | 1.43081068       | 1.34332081       |
| HNCTP           | kg 1,4-DCB              | 32.723088        | 26.842045        | 24.147578        | 31.021897        | 25.176915        | 22.668511        | 28.587242        | 23.617112        | 21.669981        |

**Table S10.** Absolute values of the impact categories for different LFR and FGFR at the 80 % of solvent composition and 100 cm<sup>3</sup>/min of SHFR.

| Impact category | Unit                    | LFR18.90-FGFR300 | LFR18.90-FGFR200 | LFR18.90-FGFR100 | LFR16.60-FGFR300 | LFR16.60-FGFR200 | LFR16.60-FGFR100 | LFR15.10-FGFR300 | LFR15.10-FGFR200 | LFR15.10-FGFR100 |
|-----------------|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| GWP             | kg CO <sub>2</sub> eq   | 81.174702        | 76.974429        | 72.482465        | 78.761638        | 75.429009        | 69.921406        | 75.613389        | 72.717194        | 68.382226        |
| SODP            | kg CFC11 eq             | 5.451E-05        | 5.313E-05        | 5.164E-05        | 5.209E-05        | 5.101E-05        | 4.917E-05        | 4.999E-05        | 4.906E-05        | 4.762E-05        |
| IRP             | kBq Co-60 eq            | 7.1366615        | 6.0468732        | 4.8677431        | 6.8505583        | 5.9867413        | 4.5362105        | 6.2256009        | 5.4814702        | 4.3422263        |
| OFHHP           | kg NO <sub>x</sub> eq   | 0.1887359        | 0.183356201      | 0.17751187       | 0.180270927      | 0.176011022      | 0.168816278      | 0.172719719      | 0.16905487       | 0.163403483      |
| FPMFP           | kg PM <sub>2.5</sub> eq | 0.1326199        | 0.128338262      | 0.123688057      | 0.128128385      | 0.124737769      | 0.11901332       | 0.12354532       | 0.120628074      | 0.116131625      |
| OFTEP           | kg NO <sub>x</sub> eq   | 0.2125123        | 0.207060605      | 0.201137584      | 0.202253174      | 0.197936275      | 0.190644572      | 0.193529136      | 0.189815343      | 0.184087787      |
| TAP             | kg SO <sub>2</sub> eq   | 0.2989845        | 0.28777466       | 0.275600684      | 0.28672712       | 0.277849934      | 0.262863829      | 0.2743967        | 0.266758702      | 0.254987414      |
| FEP             | kg P eq                 | 0.0262299        | 0.023775241      | 0.021113318      | 0.025368811      | 0.02342416       | 0.020148216      | 0.023823698      | 0.0221497        | 0.019576621      |

|       |            |           |             |             |             |             |             |             |             |            |
|-------|------------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| MEP   | kg N eq    | 0.0060681 | 0.005794704 | 0.005496386 | 0.005515718 | 0.005299382 | 0.004931864 | 0.005153164 | 0.004967294 | 0.00467858 |
| TEP   | kg 1,4-DCB | 134.95616 | 116.006289  | 95.161987   | 126.239217  | 111.281276  | 85.563269   | 112.81263   | 99.996734   | 79.788626  |
| FETP  | kg 1,4-DCB | 1.6095682 | 1.47898578  | 1.33669574  | 1.54323008  | 1.43990853  | 1.26464408  | 1.44779165  | 1.35899028  | 1.22131082 |
| METP  | kg 1,4-DCB | 2.3157363 | 2.13601889  | 1.94015355  | 2.2191508   | 2.07695836  | 1.83569527  | 2.08437519  | 1.96217277  | 1.77264704 |
| HCTP  | kg 1,4-DCB | 2.7436870 | 2.57980388  | 2.40172389  | 2.66049421  | 2.53073273  | 2.31149434  | 2.54131384  | 2.42968691  | 2.25747687 |
| HNCTP | kg 1,4-DCB | 44.319084 | 40.774801   | 36.906009   | 42.242573   | 39.439447   | 34.672606   | 39.472829   | 37.065015   | 33.320229  |

**Table S11.** Absolute values of the damage categories for different solvent composition, LFR, FGFR at 50 cm<sup>3</sup>/min of SHFR.

| Conditions                           | Damage Category |            |           |
|--------------------------------------|-----------------|------------|-----------|
|                                      | Human Health    | Ecosystems | Resources |
| Solv-80-LFR-15.10-FGFR-100-SHFR-50   | 1.60E-02        | 1.28E-03   | 6.61E-04  |
| Solv-80-LFR-15.10-FGFR-200-SHFR-50   | 1.67E-02        | 1.33E-03   | 6.65E-04  |
| Solv-80-LFR-15.10-FGFR-300-SHFR-50   | 1.84E-02        | 1.46E-03   | 6.75E-04  |
| Solv-90-LFR-15.10-FGFR-100-SHFR-50   | 1.60E-02        | 1.28E-03   | 6.88E-04  |
| Solv-90-LFR-15.10-FGFR-200-SHFR-50   | 1.61E-02        | 1.29E-03   | 6.89E-04  |
| Solv-90-LFR-15.10-FGFR-300-SHFR-50   | 1.62E-02        | 1.30E-03   | 6.90E-04  |
| Solv-Pure-LFR-15.10-FGFR-100-SHFR-50 | 1.61E-02        | 1.29E-03   | 7.17E-04  |
| Solv-Pure-LFR-15.10-FGFR-200-SHFR-50 | 1.63E-02        | 1.30E-03   | 7.18E-04  |
| Solv-Pure-LFR-15.10-FGFR-300-SHFR-50 | 1.63E-02        | 1.30E-03   | 7.18E-04  |
| Solv-80-LFR-16.60-FGFR-100-SHFR-50   | 1.61E-02        | 1.29E-03   | 6.84E-04  |
| Solv-80-LFR-16.60-FGFR-200-SHFR-50   | 1.70E-02        | 1.36E-03   | 6.89E-04  |
| Solv-80-LFR-16.60-FGFR-300-SHFR-50   | 1.91E-02        | 1.50E-03   | 7.00E-04  |
| Solv-90-LFR-16.60-FGFR-100-SHFR-50   | 1.61E-02        | 1.29E-03   | 7.14E-04  |
| Solv-90-LFR-16.60-FGFR-200-SHFR-50   | 1.62E-02        | 1.30E-03   | 7.15E-04  |
| Solv-90-LFR-16.60-FGFR-300-SHFR-50   | 1.64E-02        | 1.31E-03   | 7.16E-04  |
| Solv-Pure-LFR-16.60-FGFR-100-SHFR-50 | 1.63E-02        | 1.31E-03   | 7.48E-04  |
| Solv-Pure-LFR-16.60-FGFR-200-SHFR-50 | 1.63E-02        | 1.31E-03   | 7.49E-04  |
| Solv-Pure-LFR-16.60-FGFR-300-SHFR-50 | 1.64E-02        | 1.32E-03   | 7.49E-04  |
| Solv-80-LFR-18.90-FGFR-100-SHFR-50   | 1.63E-02        | 1.30E-03   | 7.19E-04  |
| Solv-80-LFR-18.90-FGFR-200-SHFR-50   | 1.73E-02        | 1.37E-03   | 7.24E-04  |
| Solv-80-LFR-18.90-FGFR-300-SHFR-50   | 1.93E-02        | 1.52E-03   | 7.35E-04  |
| Solv-90-LFR-18.90-FGFR-100-SHFR-50   | 1.64E-02        | 1.31E-03   | 7.55E-04  |
| Solv-90-LFR-18.90-FGFR-200-SHFR-50   | 1.65E-02        | 1.32E-03   | 7.56E-04  |
| Solv-90-LFR-18.90-FGFR-300-SHFR-50   | 1.66E-02        | 1.33E-03   | 7.57E-04  |
| Solv-Pure-LFR-18.90-FGFR-100-SHFR-50 | 1.66E-02        | 1.32E-03   | 7.92E-04  |
| Solv-Pure-LFR-18.90-FGFR-200-SHFR-50 | 1.66E-02        | 1.33E-03   | 7.92E-04  |
| Solv-Pure-LFR-18.90-FGFR-300-SHFR-50 | 1.67E-02        | 1.33E-03   | 7.93E-04  |

**Table S12.** Absolute values of the damage categories for different solvent composition, LFR, FGFR at 100 cm<sup>3</sup>/min of SHFR.

| Conditions                            | Damage Category |            |           |
|---------------------------------------|-----------------|------------|-----------|
|                                       | Human Health    | Ecosystems | Resources |
| Solv-80-LFR-15.10-FGFR-100-SHFR-100   | 6.42E-03        | 4.14E-04   | 1.08E-03  |
| Solv-80-LFR-15.10-FGFR-200-SHFR-100   | 6.77E-03        | 4.41E-04   | 1.09E-03  |
| Solv-80-LFR-15.10-FGFR-300-SHFR-100   | 7.01E-03        | 4.59E-04   | 1.09E-03  |
| Solv-90-LFR-15.10-FGFR-100-SHFR-100   | 6.46E-03        | 4.16E-04   | 1.11E-03  |
| Solv-90-LFR-15.10-FGFR-200-SHFR-100   | 6.49E-03        | 4.19E-04   | 1.11E-03  |
| Solv-90-LFR-15.10-FGFR-300-SHFR-100   | 6.53E-03        | 4.22E-04   | 1.11E-03  |
| Solv-Pure-LFR-15.10-FGFR-100-SHFR-100 | 6.61E-03        | 4.26E-04   | 1.14E-03  |
| Solv-Pure-LFR-15.10-FGFR-200-SHFR-100 | 6.63E-03        | 4.28E-04   | 1.14E-03  |
| Solv-Pure-LFR-15.10-FGFR-300-SHFR-100 | 6.65E-03        | 4.29E-04   | 1.14E-03  |
| Solv-80-LFR-16.60-FGFR-100-SHFR-100   | 6.58E-03        | 4.25E-04   | 1.11E-03  |
| Solv-80-LFR-16.60-FGFR-200-SHFR-100   | 7.03E-03        | 4.60E-04   | 1.11E-03  |
| Solv-80-LFR-16.60-FGFR-300-SHFR-100   | 7.30E-03        | 4.81E-04   | 1.12E-03  |
| Solv-90-LFR-16.60-FGFR-100-SHFR-100   | 6.61E-03        | 4.26E-04   | 1.14E-03  |
| Solv-90-LFR-16.60-FGFR-200-SHFR-100   | 6.65E-03        | 4.29E-04   | 1.14E-03  |
| Solv-90-LFR-16.60-FGFR-300-SHFR-100   | 6.68E-03        | 4.32E-04   | 1.17E-03  |
| Solv-Pure-LFR-16.60-FGFR-100-SHFR-100 | 6.77E-03        | 4.32E-04   | 1.14E-03  |
| Solv-Pure-LFR-16.60-FGFR-200-SHFR-100 | 6.79E-03        | 4.37E-04   | 1.17E-03  |
| Solv-Pure-LFR-16.60-FGFR-300-SHFR-100 | 6.81E-03        | 4.39E-04   | 1.17E-03  |
| Solv-80-LFR-18.90-FGFR-100-SHFR-100   | 6.84E-03        | 4.44E-04   | 1.14E-03  |
| Solv-80-LFR-18.90-FGFR-200-SHFR-100   | 7.21E-03        | 4.72E-04   | 1.15E-03  |
| Solv-80-LFR-18.90-FGFR-300-SHFR-100   | 7.55E-03        | 4.98E-04   | 1.16E-03  |

|                                       |          |          |          |
|---------------------------------------|----------|----------|----------|
| Solv-90-LFR-18.90-FGFR-100-SHFR-100   | 7.83E-03 | 4.41E-04 | 1.18E-03 |
| Solv-90-LFR-18.90-FGFR-200-SHFR-100   | 7.87E-03 | 4.44E-04 | 1.18E-03 |
| Solv-90-LFR-18.90-FGFR-300-SHFR-100   | 7.90E-03 | 4.47E-04 | 1.18E-03 |
| Solv-Pure-LFR-18.90-FGFR-100-SHFR-100 | 7.02E-03 | 4.54E-04 | 1.21E-03 |
| Solv-Pure-LFR-18.90-FGFR-200-SHFR-100 | 7.05E-03 | 4.56E-04 | 1.21E-03 |
| Solv-Pure-LFR-18.90-FGFR-300-SHFR-100 | 7.06E-03 | 4.57E-04 | 1.21E-03 |