

Path2Green: Introducing 12 Green Extraction Principles and a Novel Metric for Assessing Sustainability in Biomass Valorization

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1. Introduction

The *Path2Green* app was designed as a calculator to assess the environmental impact of biomass extraction processes, adhering to the 12 principles of Green Extraction developed in this referred article. The calculator's results are converted into an easy-to-interpret pictogram, serving as an indicator to identify the strengths and weaknesses of the extraction process. This tool can compare different processes and pinpoint potential improvements for developing new methods using biomass as a source of compounds. This calculator was developed in Java and is compatible with Android operating system smartphones.

2. Disclaimer

Path2Green is provided "as is," without any express or implied warranties, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. The authors shall not be liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including but not limited to the procurement of substitute goods or services, loss of use, data, or profits, or business interruption) regardless of the cause and theory of liability, whether in contract, strict liability, or tort (including negligence or otherwise), arising in any way from the use of this software, even if advised of the possibility of such damages. This software is made available under the UNICAMP license.

3. Installation and how to use the *Path2Green* app

Download the ZIP file from the Green Chemistry Journal to your personal computer (PC). After extracting the file on your PC, transfer the Path2Green.apk file to your Android smartphone (suggested methods: via WhatsApp or USB connection).

After downloading the app on your compatible Android smartphone, you can run it by following the tabs shown in Figure 1 (tabs: *biomass, transport, pre-treatment, solvent, scaling, purification, yield, post-treatment, energy, application, repurposing, and waste*). After assessing each principle, a score is generated and color-coded like traffic lights: (i) red, indicating a poor score; (ii) yellow, indicating a need for attention; and (iii) green, indicating a good score. In Figure 2, a colored pictogram displays the final score at its center. The final score ranges from -1.00, the lowest score, indicating a non-environmentally friendly approach, to +1.00, indicating that the developed process adheres to the 12 principles of green extraction. Each principle is detailed in the manuscript associated with this file, assisting the users in a more accurate score. This user-friendly app allows users to evaluate

each principle according to the developed process and consider their own expertise. Besides, as well as exposed in the manuscript, each principle has an associated weight, which is suggested considering the influence each principle has in the sustainability pillars (environmental, social, and economic). However, the user can switch the weights if desired or if necessary. In the end, after evaluating each principle in the tabs, you can view the final score and its corresponding pictogram in the "Score" tab. Print this pictogram and share it in your work.

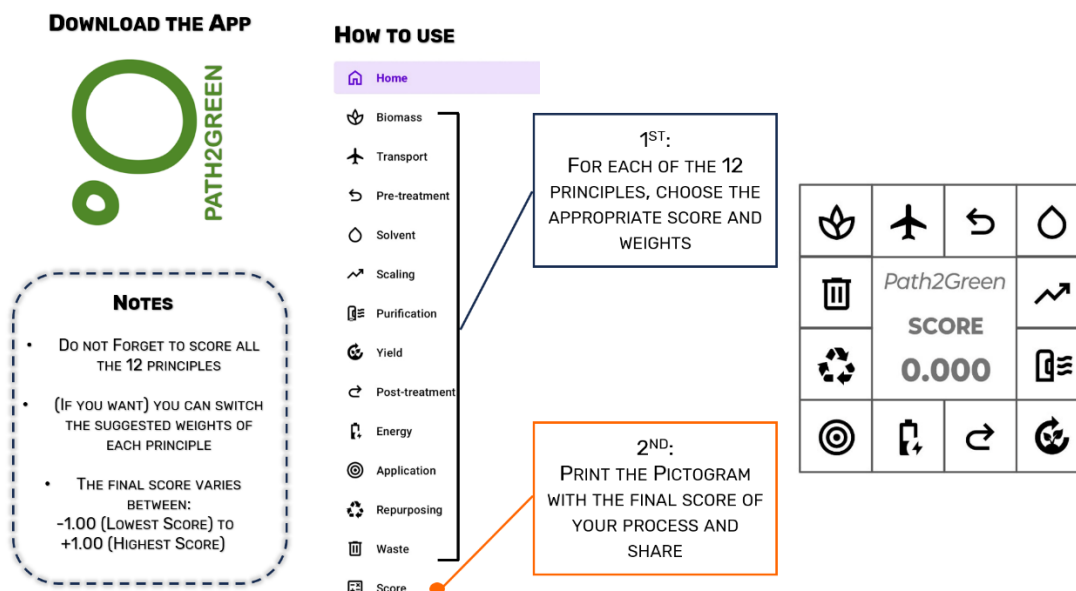


Figure 1. Recommended suggestions for using the *Path2Green* app.



Figure 2. The colored pictogram highlights how each principle was scored (red, yellow, or green), with the final score displayed at its center. In this example, the hypothetical principle receives a final score of 0.082, indicating that it falls within the neutral (yellow) zone. By examining the colors of each principle, users can identify possible improvements for the extraction process.