

I. INTRODUCTION

The primary objective of this work is to develop a mechanism to enable chemists to compare and evaluate chemical reactions in terms of their pollution prevention (P2) potential. The secondary goal is to demonstrate the importance of incorporating pollution prevention (P2) and life cycle design (LCD) principles into the underlying teaching methodology of chemical science educators.

This document is divided into four major sections. The first contains an extensive discussion of the historical role of chemistry in societal development, traditional evaluatory criteria for chemical reaction feasibility, and the applicable P2 and LCD theory.

The second section provides a summary of the concepts related to “green chemistry” and highlights examples of relevant chemical science research from academia and industry. A related resource list and annotated bibliography, published by the National Pollution Prevention Center for Higher Education (NPPC), provide a comprehensive listing of references covering the chemical science topics discussed in Section III.

The third section presents a multi-disciplinary framework that describes the life cycle data necessary to perform a comprehensive P2 analysis of chemicals and chemical reactions.

In the fourth section, this framework is applied to a case study comparing antifreeze solutions based on ethylene glycol (EG) and propylene glycol (PG). The case study is designed to illustrate the usefulness of the proposed framework in identifying the inherent “trade-offs” associated with alternative chemicals and reaction pathways.

The materials in this document provide chemical science educators with the knowledge necessary to initiate a more comprehensive study of the subjects of chemical life cycle analysis, pollution prevention, green chemistry. In addition, this material may also serve as introductory reading for university-level chemistry students interested in research in the field.