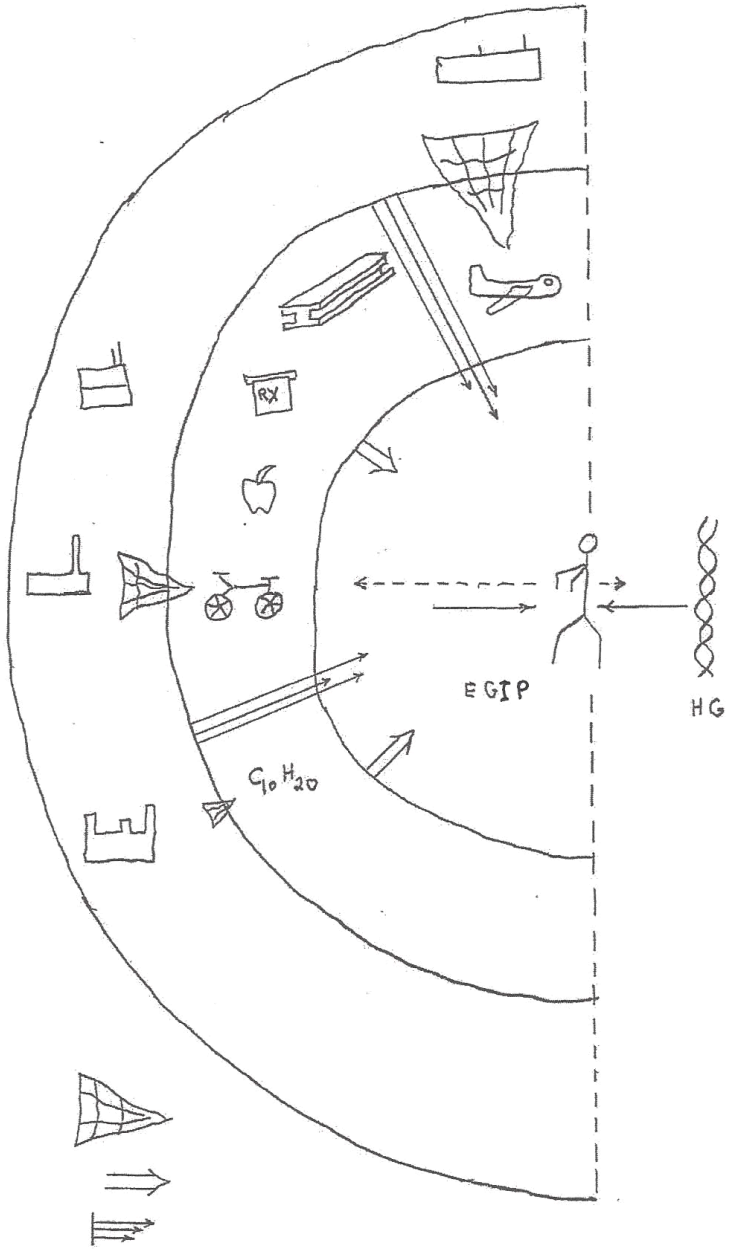
Mapping the Genomic Web of Chemicals and Materials

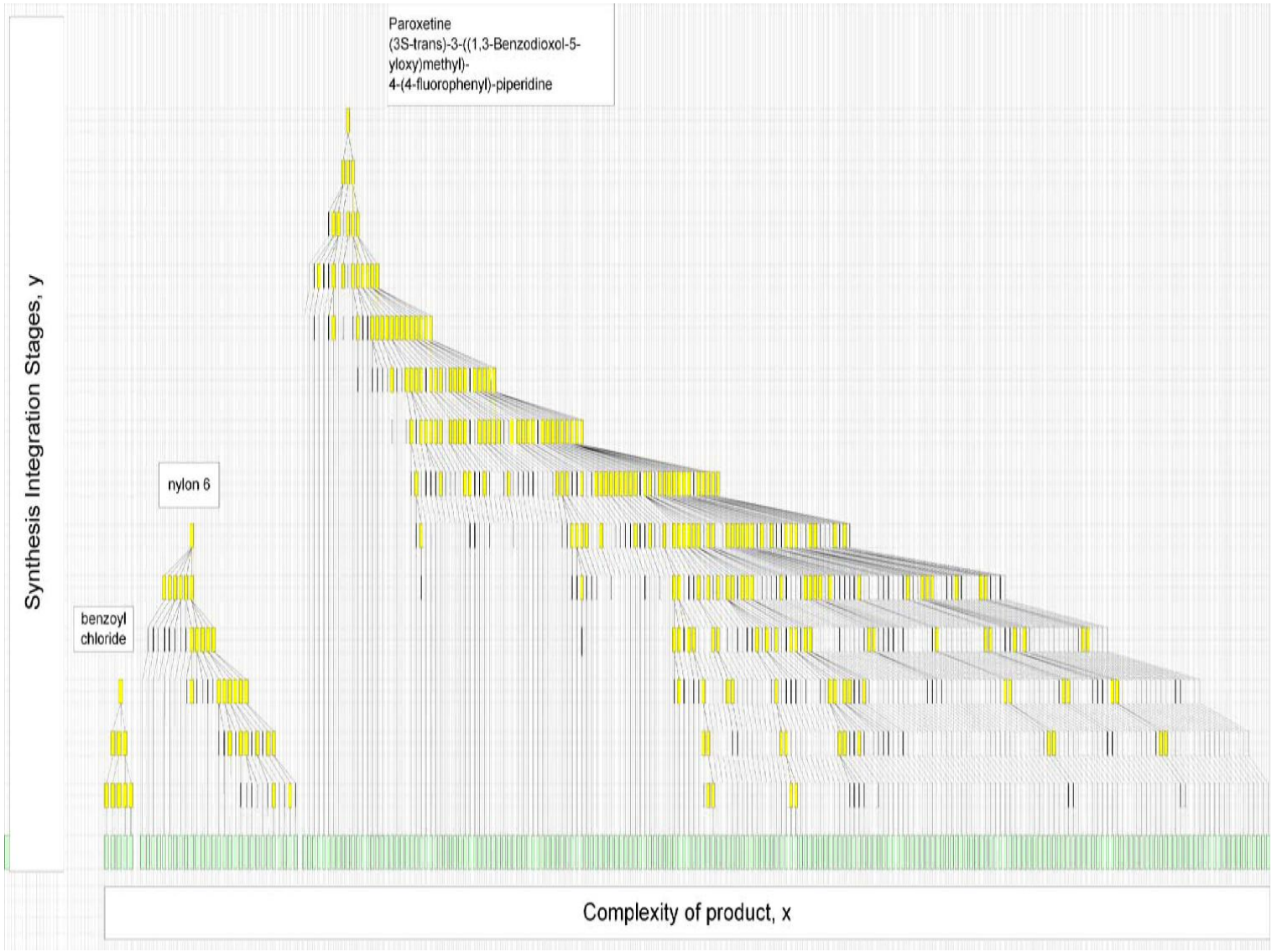
The essential building blocks of human creativity

The project leads the exploration of the environmental genome and is envisioned as a joint, respectful effort of product manufacturers for our global society's needs, public health organizations, and the philanthropic community.

The goal is to create an open-source database and map of origin and development, in both time and place, of molecular building processes for the approximately 100,000 chemicals and materials used commercially to build every nearly product in current use by global society.

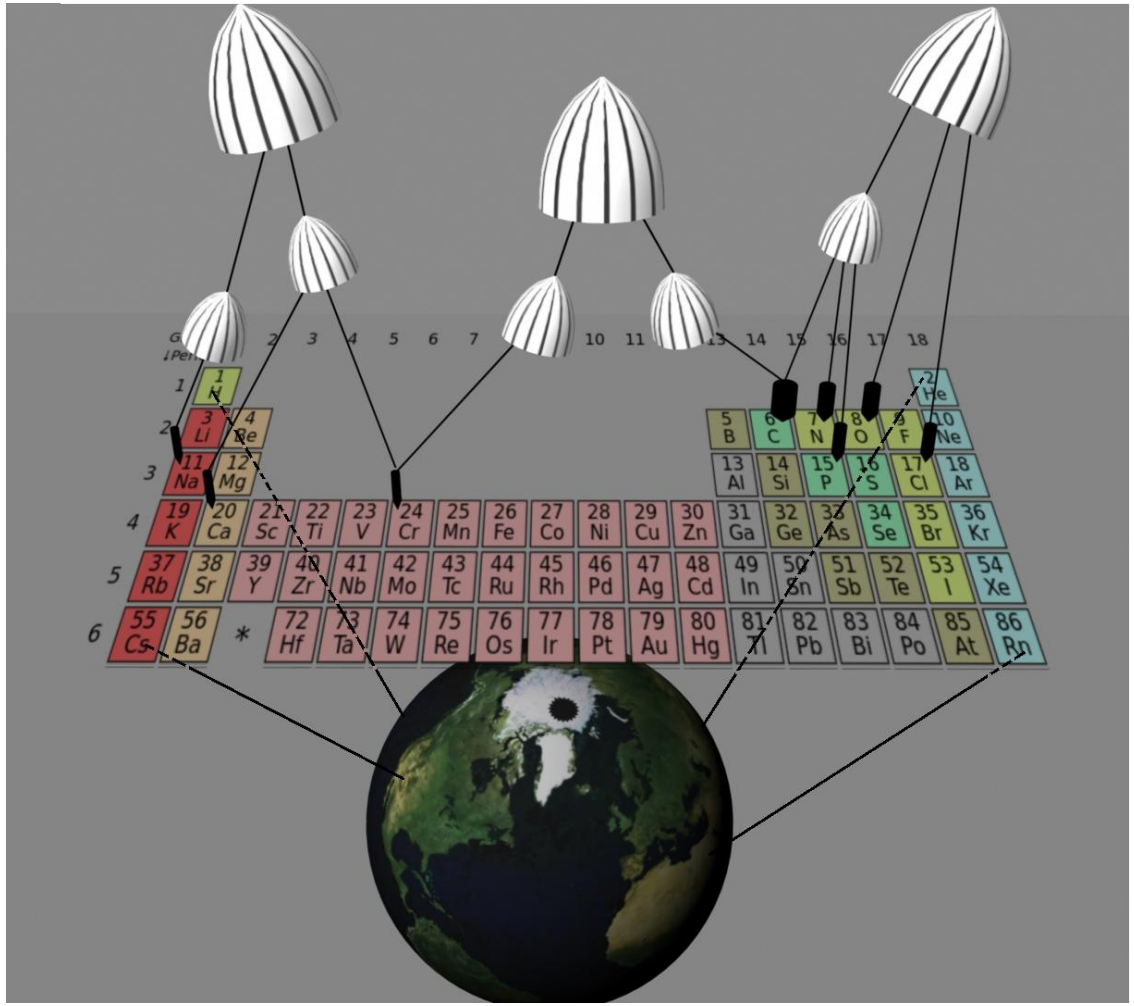


Discovery sketch (2001) of the existence of an environmental genome of industrial products to mirror human genome as effects to human health

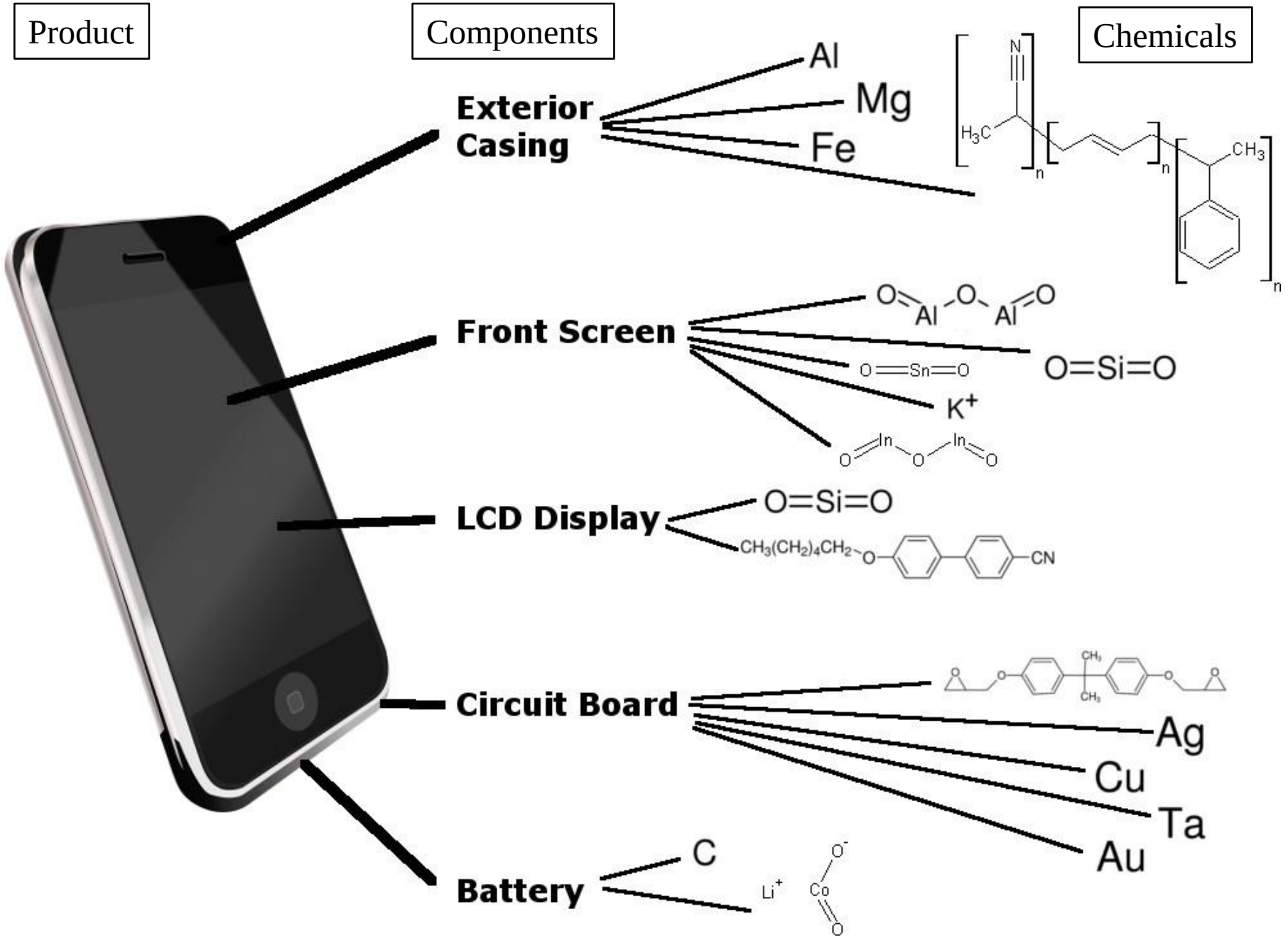


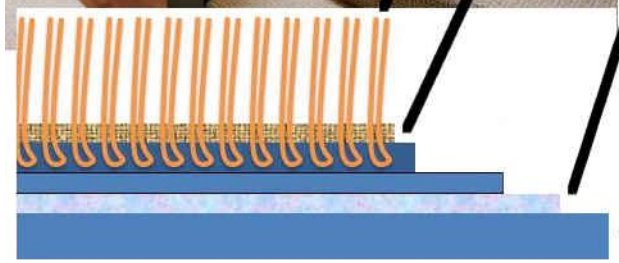
Repeating environmental genome structures for three chemicals manufactured from natural resources to completed chemical structure.

Illustration of a portion of the environmental genome of industrial products

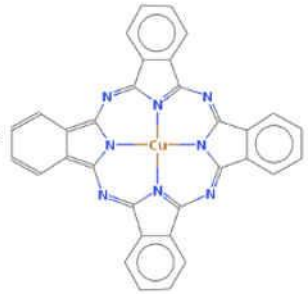


All Products in Society Are Made From About 100,000 Chemicals In Commerce

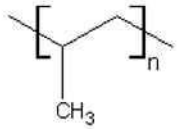




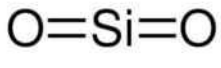
Dyed nylon 6 face yarn

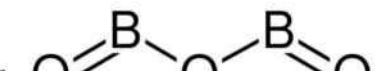


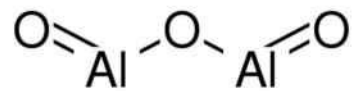
Primary backing

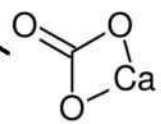


Fiberglass scrim

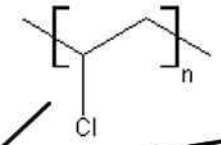


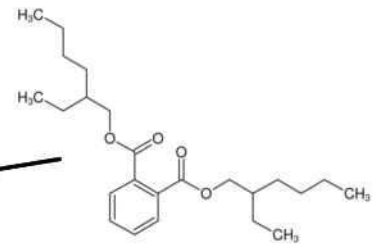


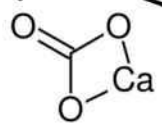


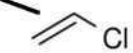


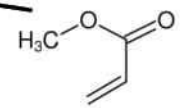
Mid-coat and back-coat









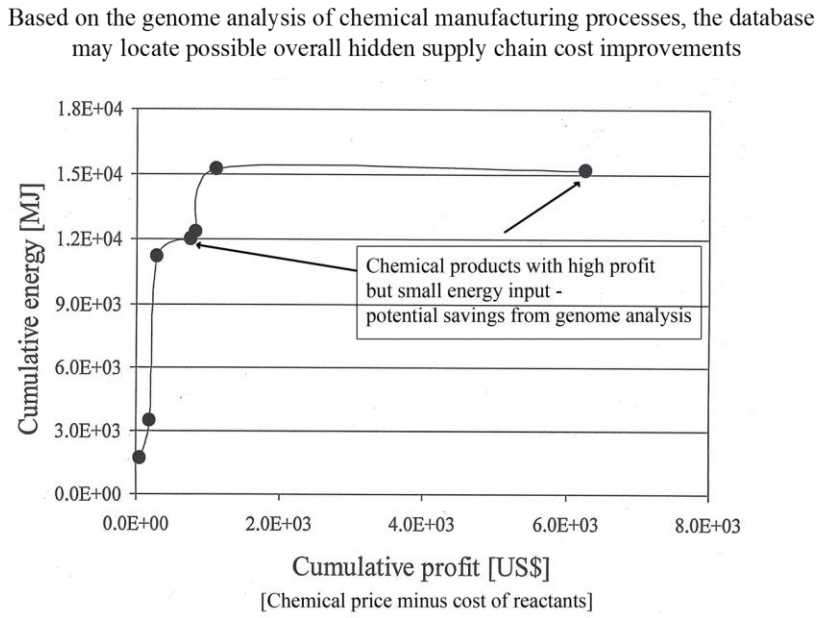


Comparison of human and environmental genomes

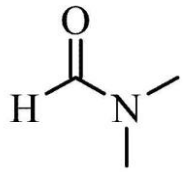
Requirements	Human Genome	Genome Map for Web of Chemicals and Materials
Informational size	About 3 billion	Range of 0.5 – 8 billion
General shape	Helix with 23 chromosomes	Pyramidal (100,000 chemicals in commerce)
Time to map	13 years	6 years (estimated)
Mechanism in mapping	Polymerase Chain Reactions (PCR) machines	Streamline process design and engineering analysis
Rate of genome change	Very slow	Less slow

Mapping the Environmental Genome of Industrial Products Creates Two Major Areas of Benefits

1. Manufacturing Analysis and Improvement
   - Genome segments show energy and mass efficiency for every chemical manufacturing plant in a larger boundary than just one corporation and so it opens scope for more improvement



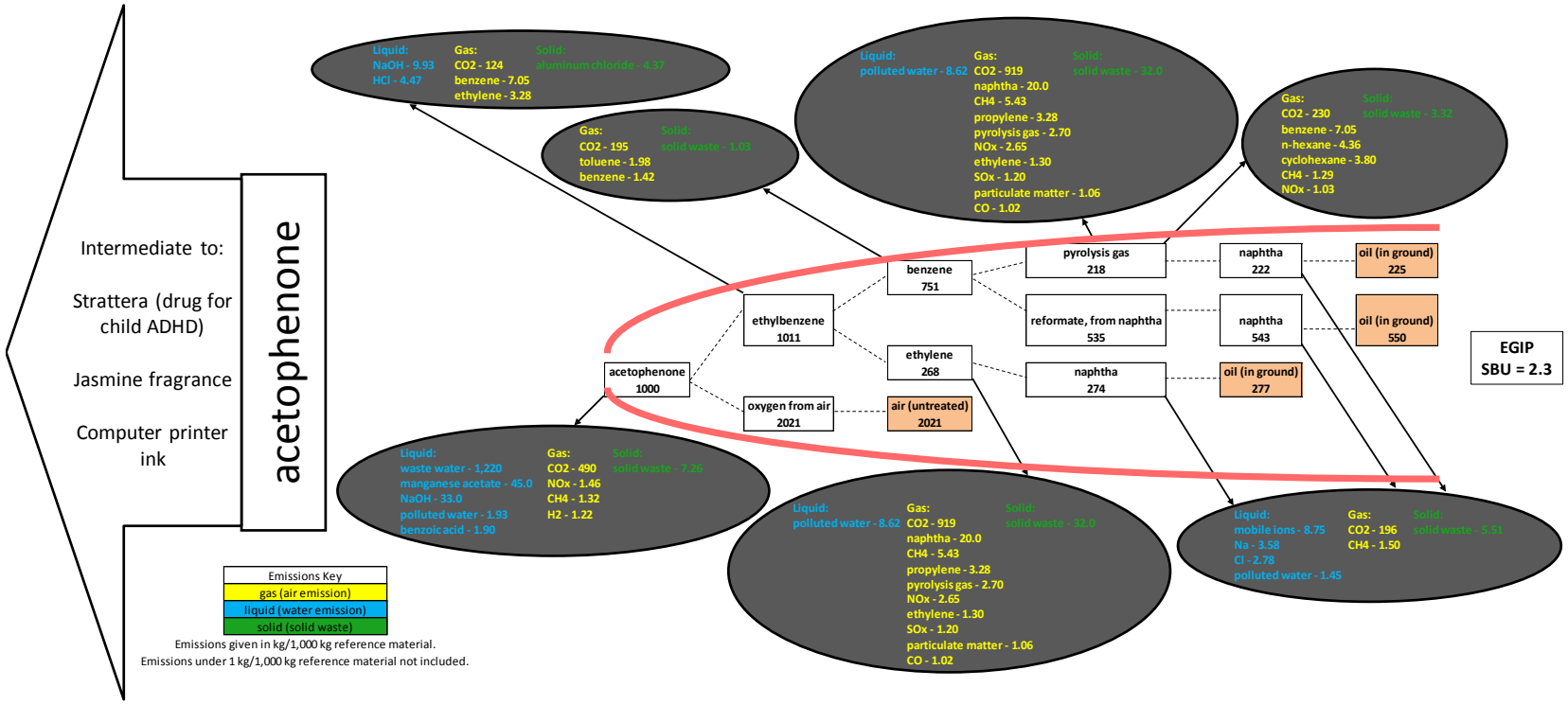
Energy data from entire genome segment for dimethyl formamide



2. Public health information related to all the products we consume

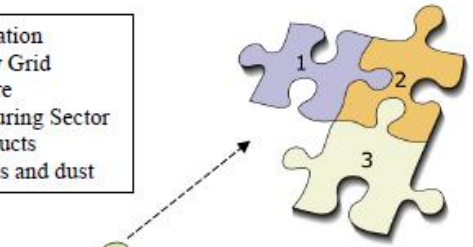
- Genome database informs improvements in social determinants of health (SDOH) with manufacturing plant data on emissions and disability-adjusted life years (DALY)
- Web of chemicals and materials is the fundamental source information for public impacts of emissions to air, water, and land (known as the exposome)

Chemical profile from environmental genome segment of important product, with manufacturing sites unspecified



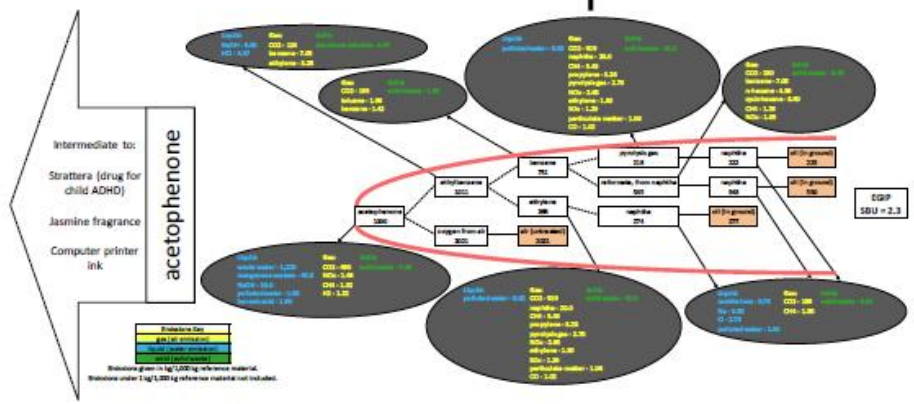
Environment (pollutants*) → Exposome – specific external domain

1 = Transportation
2 = Electricity Grid
3 = Agriculture
4 = Manufacturing Sector and Products
*excludes fires and dust

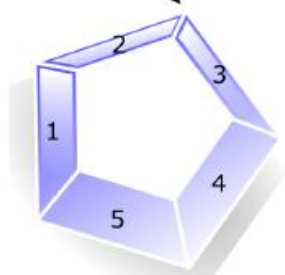


Environmental Genome of Industrial Products

One genomic segment



Building the Foundation for Genome Map by Leveraging Five Core Initial Investments



1. Inaugural Global Workshop
2. Data mining and genome development
3. User interface for environmental genome knowledge
4. Team structure for international mapping
5. Development to lower cost of mapping

Value Propositions

- Public Health Improvement
  - Human exposome and toxicology
  - Social Determinants of Health
  - Policy implications
- Manufacturing
  - Energy and mass efficiency
  - Process design and supply chains
  - Consumer product improvements
  - Chemical fingerprinting
  - National competitiveness and security
- Environmental Impacts
  - Carbon footprints
  - GIS overlays
  - Climate change implications
- Enabling of new research
  - Systems chemistry and Earth System Science
  - Product life cycle technologies

Path Forward

- The mission is to describe, model, and map the Genomic Web of Industrial Chemicals and Materials. This new "genome"— the essential building blocks of everything humans have created and engineered—is defined as the map of origin and development, in both time and place, of molecular building processes for the approximately 100,000 chemicals and materials used commercially to build nearly every product in current use by global society.

- The project is envisioned as a joint, respectful effort of product manufacturers for our global society's needs, public health organizations, and the philanthropic community.

- The completed open-source map promises to yield large, unforeseen health and economic benefits similar to the outcomes and evolution of the Human Genome Project.

- A newly created nonprofit organization will actively support and participate in emerging applications of the resulting genome informational database for a variety of collaborative initiatives and research involving other organizations.