Your Footprint: Water, Energy & GHG

Lon W. House, Ph.D.
www.waterandenergyconsulting.com
530.676.8956

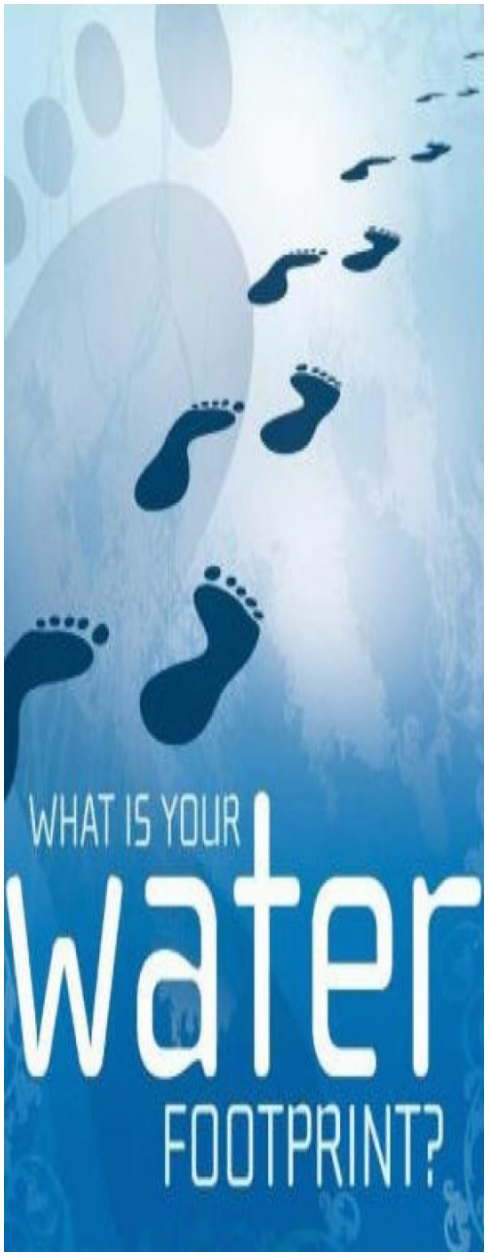
U.S. DEPARTMENT OF ENERGY

INDUSTRIAL TECHNOLOGY PROGRAM

Presentation Outline

- Water footprint
  - Definition
  - Resources
  - Example
- Energy footprint
  - Definition
  - Resources
  - Example
- GHG footprint
  - Definition
  - Resources
  - Example
- Things to watch out for
  - Embedded energy in water
  - Conclusions/recommendations

Water Footprint

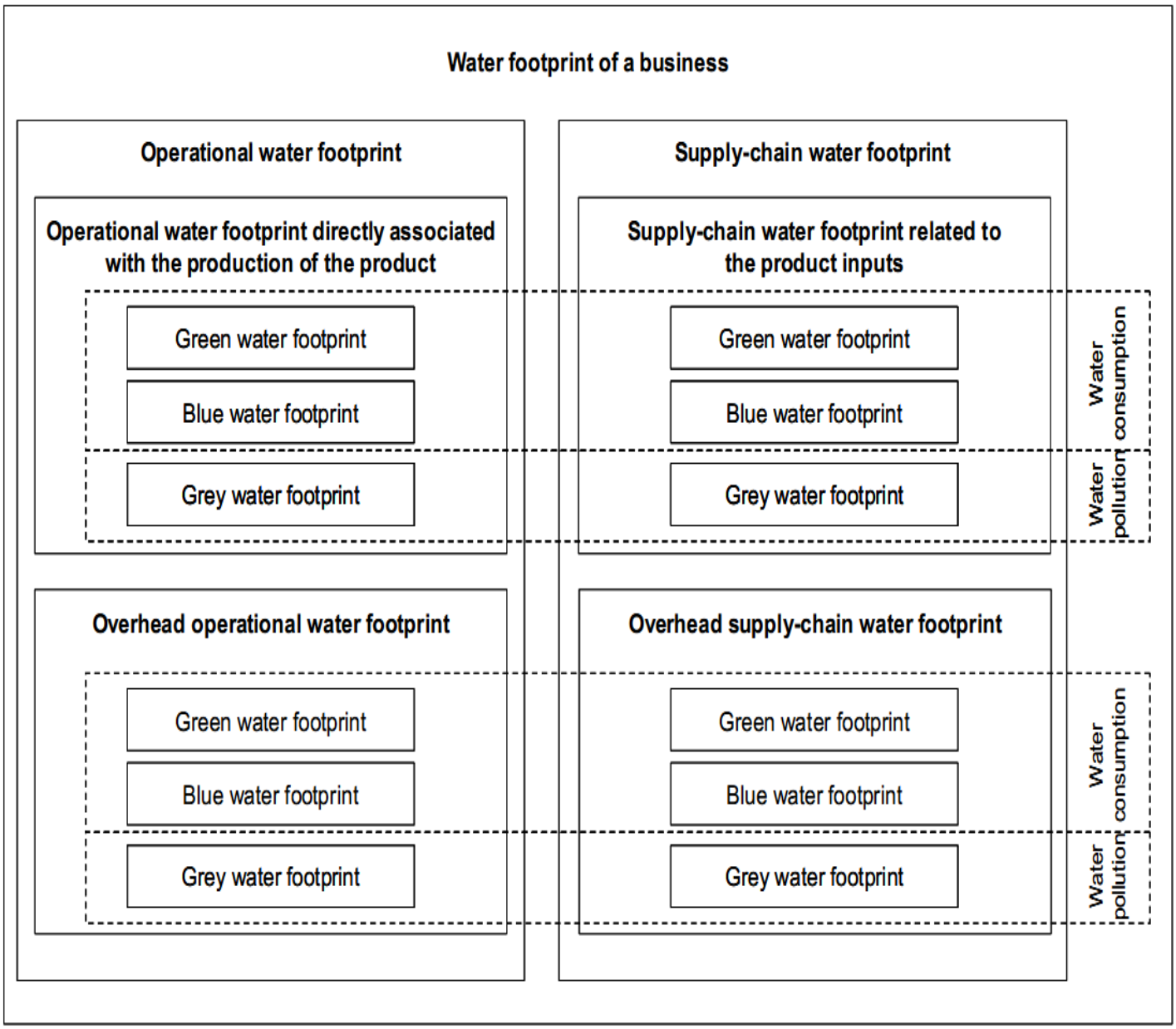


The water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business.
The water footprint of a business, the 'corporate water footprint', is defined as the total volume of freshwater that is used directly or indirectly to run and support a business. It is the total volume of water use to be associated with the use of the business outputs. The water footprint of a business consists of two components: the direct water use by the producer (for producing/manufacturing or for supporting activities) and the indirect water use (in the producer's supply chain).

Resources

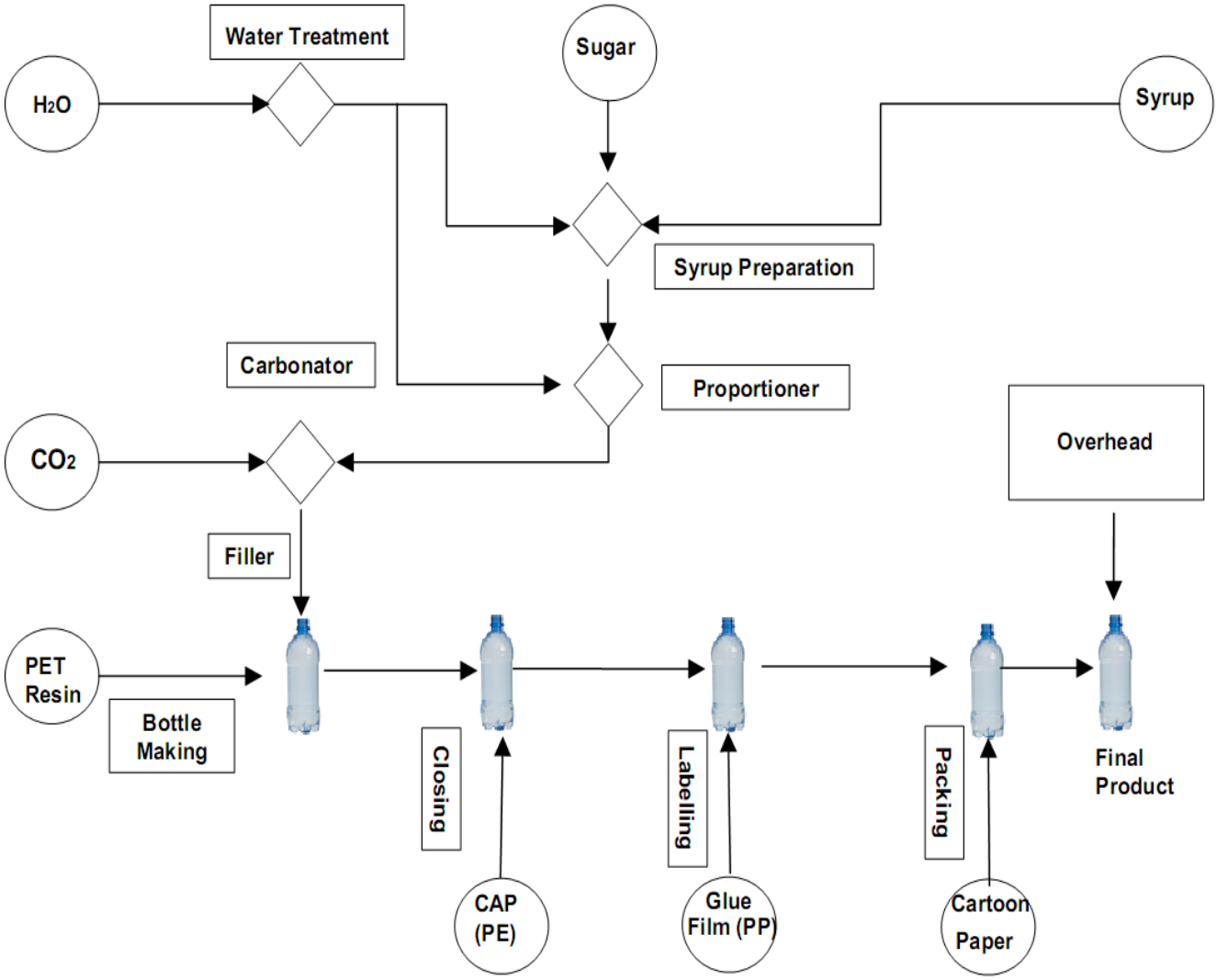
www.waterfootprint.org

- **Water Footprint Manual**
- Practical guide on water footprint assessment



Green=rainwater, blue=surface/groundwater, gray=polluted water

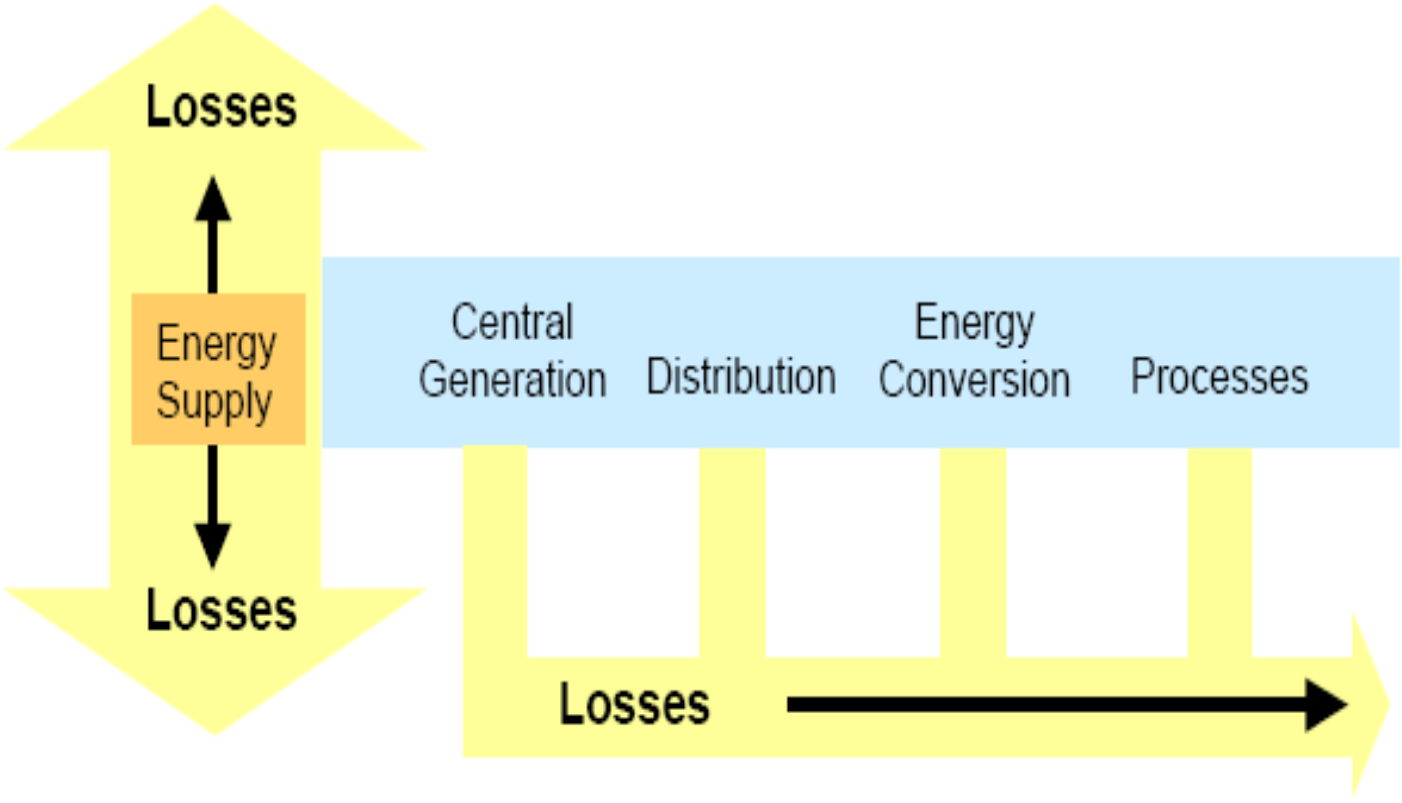
Example –
0.5L PET-bottle sugar containing carbonated beverage

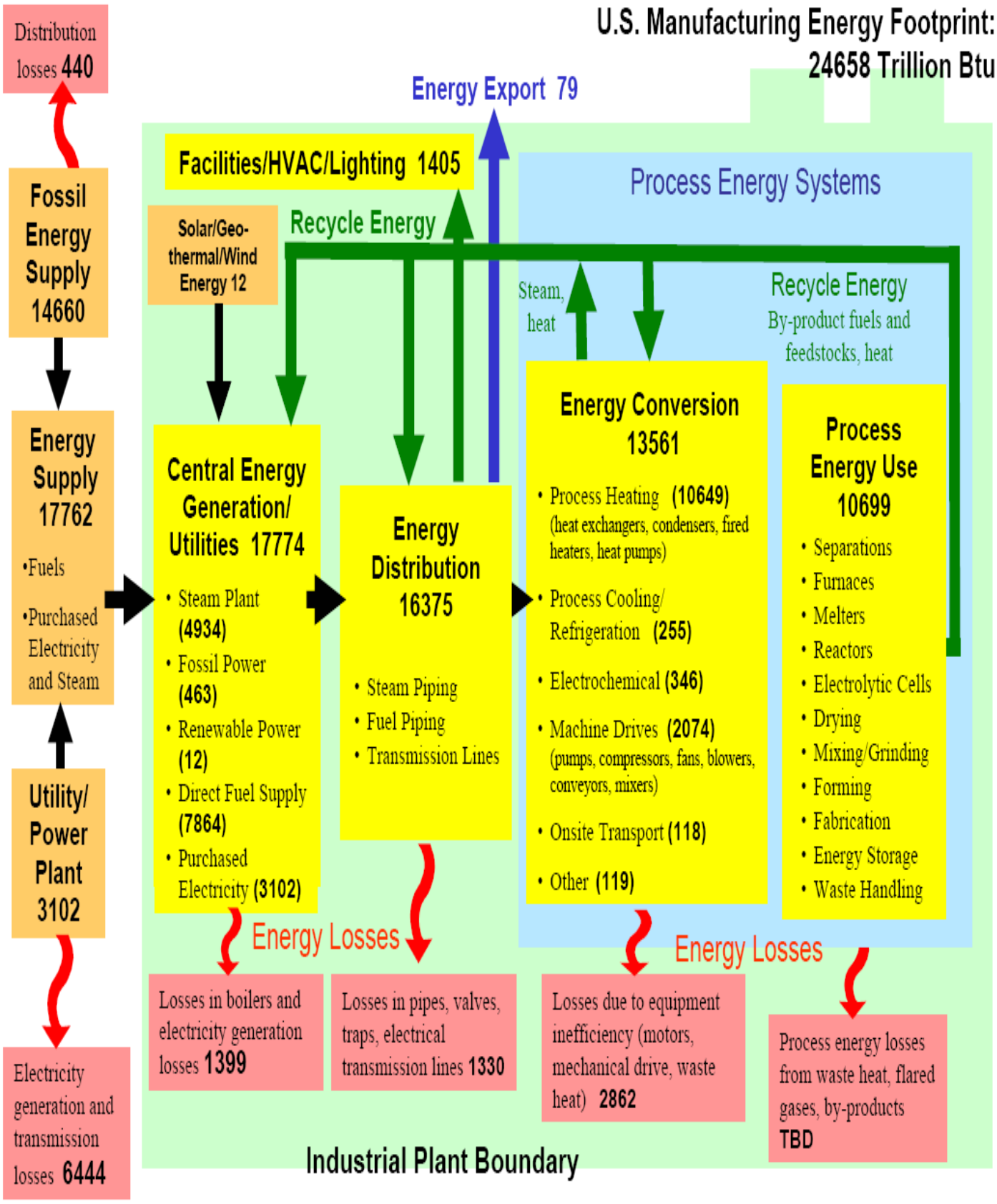


The total water footprint of 0.5 liter PET-bottle sugar-containing carbonated beverage is calculated as being between 169 liters (with sugar beet from the Netherlands) and 309 liters (with sugar cane from Cuba). The operational water footprint of the product is 0.5 liters, which forms 0.2-0.3% of the total water footprint. The supply-chain water footprint constitutes 99.7-99.8% of the total water footprint of the product.

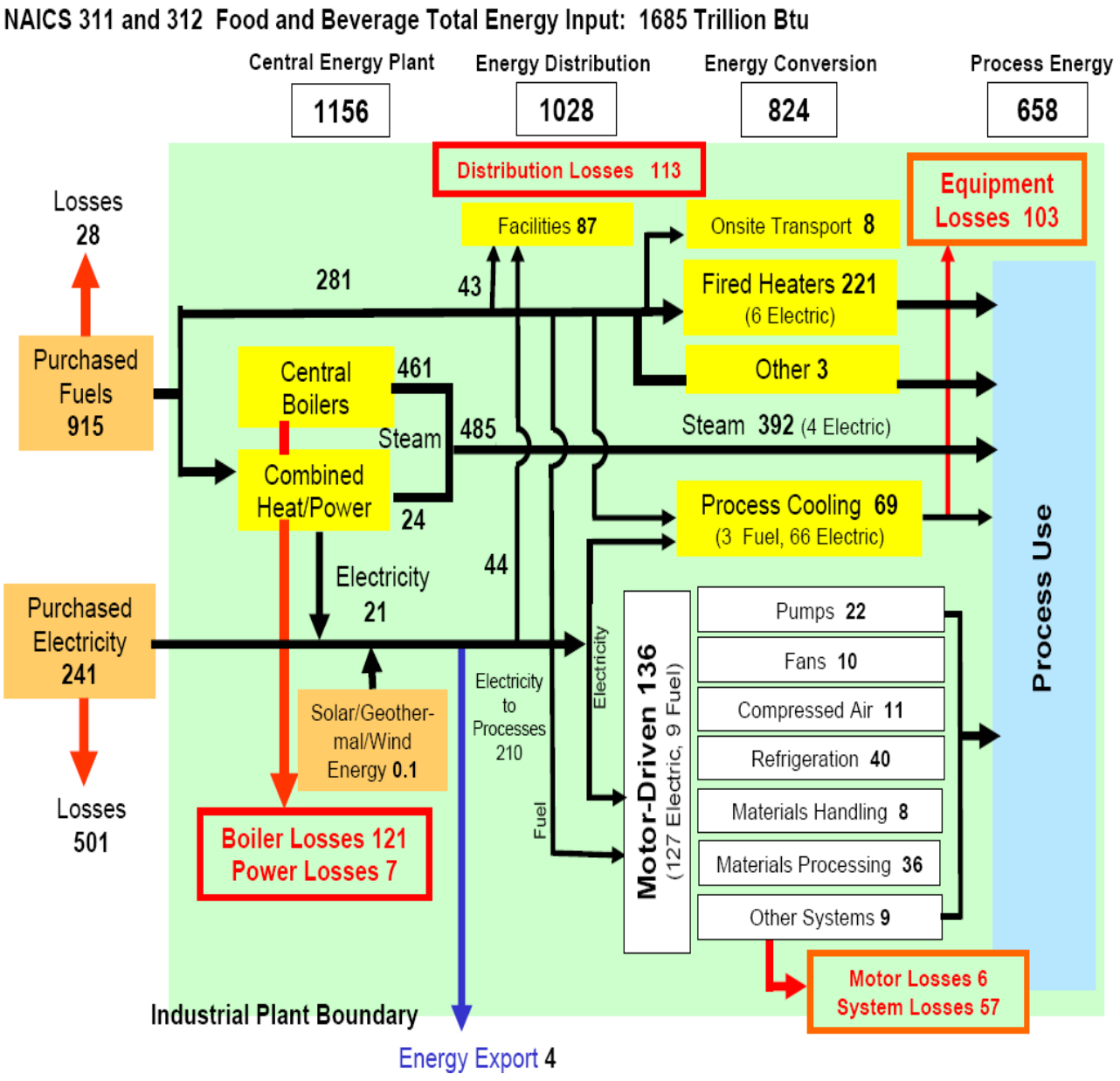
Energy Footprint

- Energy footprints map the flow of energy supply, demand, and losses in U.S. manufacturing industries. Each footprint illustrates:
  - What energy is purchased from utilities (electricity, fossil fuels), generated onsite, and transported to the local electric utility grid.
  - Where and how energy is used within a typical plant, from central boilers to electric motors.
  - Where energy is lost due to inefficiencies, both inside and outside the plant boundary.




U.S. Manufacturing Energy Footprint:
24658 Trillion Btu
Distribution losses 440
Energy Export 79
Facilities/HVAC/Lighting 1405
Process Energy Systems
Solar/Geo-thermal/Wind Energy 12
Recycle Energy
Steam, heat
Recycle Energy
By-product fuels and feedstocks, heat
Fossil Energy Supply 14660
Energy Supply 17762
•Fuels
•Purchased Electricity and Steam
Central Energy Generation/ Utilities 17774
• Steam Plant (4934)
• Fossil Power (463)
• Renewable Power (12)
• Direct Fuel Supply (7864)
• Purchased Electricity (3102)
Energy Distribution 16375
• Steam Piping
• Fuel Piping
• Transmission Lines
Energy Conversion 13561
• Process Heating (10649) (heat exchangers, condensers, fired heaters, heat pumps)
• Process Cooling/ Refrigeration (255)
• Electrochemical (346)
• Machine Drives (2074) (pumps, compressors, fans, blowers, conveyors, mixers)
• Onsite Transport (118)
• Other (119)
Process Energy Use 10699
• Separations
• Furnaces
• Melters
• Reactors
• Electrolytic Cells
• Drying
• Mixing/Grinding
• Forming
• Fabrication
• Energy Storage
• Waste Handling
Utility/ Power Plant 3102
Energy Losses
Energy Losses
Losses in boilers and electricity generation losses 1399
Losses in pipes, valves, traps, electrical transmission lines 1330
Losses due to equipment inefficiency (motors, mechanical drive, waste heat) 2862
Process energy losses from waste heat, flared gases, by-products TBD
Electricity generation and transmission losses 6444
Industrial Plant Boundary

Compare Yourself with Rest of Industry



http://www.eoearth.org/article/Energy_footprint_of_the_U.S._manufacturing_sectors

GHG Footprint

- These steps are involved in conducting a GHG inventory
- Determine the scope of your inventory:
  - Scope 1 emissions: all direct emissions, i.e., from sources owned or controlled by your institution
  - Scope 2 emissions: indirect emissions from purchases of electricity, steam, heating, and cooling
  - Scope 3 emissions: all other indirect emissions upstream and downstream
- Determine what input data you will need, and gather that data
- GHG emissions scopes 1, 2, and 3 are defined by international protocols:
  - Direct combustion of fossil fuels by equipment which is owned by and controlled by you such as boilers, furnaces, fleet vehicles, etc. (Scope 1) and So-called “fugitive emissions” from releases of CFCs and HCFCs and on-campus releases of methane (Scope 1)
  - Purchased electricity, steam, heating, and cooling (Scope 2)
  - Transportation (commuting to work) (Scope 3)
  - Business air travel paid for by or through your business (Scope 3)
- Offsets (Renewable Energy Credits purchased, on site generation)

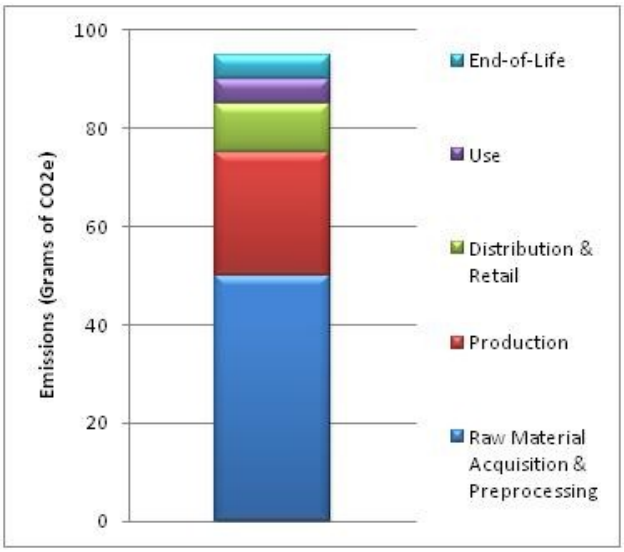
Resources

www.ghgprotocol.org

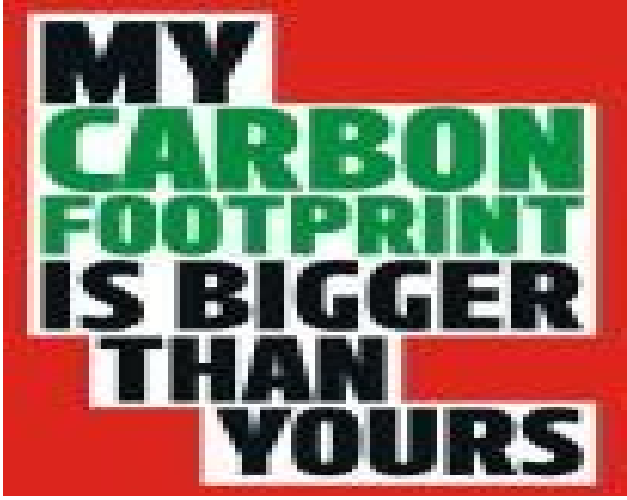
- **Downloads**
- **Direct Emissions (Emission sources owned or controlled by you)**
- These sources are considered Scope 1 for reporting purposes
  - GHG emissions from pulp and paper mills Guidance Document (2 MB)
    Excel Worksheet (367 KB) Version: 1.3
    Release date: December 2008 GHG emissions from stationary combustion Guidance Document (2 MB)
    Excel Worksheet (2 MB) Version: 4.0
    Release date: February 2009 GHG emissions from transport or mobile sources Guidance Document (211 KB)
    Excel Worksheet (1 MB) Version: 2.0
    Release date: June 2009 **Indirect Emissions (Emissions from use of purchased electricity, heat or steam)**
- These sources are considered Scope 2 for reporting purposes
  - GHG emissions from purchased electricity Guidance Document (206 KB)
    Excel Worksheet (1 MB) Version: 2.1
    Release date: June 2009 Allocation of Emissions from a Combined Heat and Power (CHP) Plant Guidance Document (231 KB)
    Excel Worksheet (50 KB) Version: 1.0
    Release date: September 2006 **Other Indirect Emissions (All other emission sources)**
- These sources are considered Scope 3 for reporting purposes
  - Emissions from employee commuting Excel Worksheet (179 KB) Version: 2.0
    Release date: June 2006 GHG emissions from transport or mobile sources Guidance Document (211 KB)
    Excel Worksheet (1 MB) Version: 2.0
    Release date: June 2009 **Additional Guidance Documents**
- These additional documents provide further clarification on quantification and reporting issues
  - A Corporate Accounting and Reporting Standard (Corporate Standard) Guidance Document (4 MB) Base Year Adjustments Guidance Document (143 KB) Categorizing GHG Emissions Associated with Leased Assets Guidance Document (105 KB) Measurement and Estimation Uncertainty of GHG Emissions Guidance Document (227 KB)
    Excel Worksheet (57 KB) Version: 1.0

GHG Reporting

- On January 20th, 60 corporations have begun measuring GHG.
- The two new GHG Protocol standards – the Product Life Cycle Accounting and Reporting Standard and the Scope 3 (Corporate Value Chain) Accounting and Reporting Standard – provide methods to account for emissions associated with individual products across their life-cycles and of corporations across their value chains.
- The companies include: 3M Company; Acer Inc.; Airbus S.A.S.; AkzoNobel; Alcan Packaging; Alcoa; Anvil Knitwear, Inc; Autodesk, Inc.; Baoshan Iron & Steel Co. Ltd.; BASF SE; Belkin International; Belron International; Bloomberg LP; BT Plc; CA, Inc.; Coca-Cola Erfrishungsgetränke AG; Colors Fruit SA (Pty) Ltd.; Deutsche Post DHL; DuPont; Eclipse Networks (Pty) Ltd.; Ecolab; The Estee Lauder Company; Ford Motor Company; General Electric; U.S. General Services Administration; Gold'n Plump Poultry LLC; Highways Agency (UK); Hydro Tasmania; IBM; IKEA; Italcementi Group; JohnsonDiversey, Inc.; Kraft Foods; Lenovo Corporation; Levi Strauss & Co.; Mitsubishi Chemical Corporation; National Grid; Natura Cosméticos; New Belgium Brewing Co.; Otarian; PepsiCo, Inc.; Pinchin Environmental Ltd.; PricewaterhouseCoopers (Hong Kong); Procter & Gamble Eurocor; Public Service Enterprise Group, Inc.; Rogers Communications, Inc.; SAP AG; SC Johnson; Shanghai Zidan Food Packaging & Printing Co., Ltd.; Shell International Petroleum Company Ltd; Suzano Pulp and Paper; Swire Beverages (Coca-Cola Bottling Partner); TAL Apparel Limited; Tech-Front (Shanghai) Computer Co., Ltd./Quanta Shanghai Manufacturing City; Tennant Company; Veolia Water; Verso Paper Corp.; VT Group Plc; Webcor Builders; Weyerhaeuser Company and WorldAutoSteel.
- More financial institutions are learning to protect investors–and themselves–from investments exposed to risk from climate change, and requiring GHG reporting.
- Citigroup Is requiring emissions reports from projects it is financing.



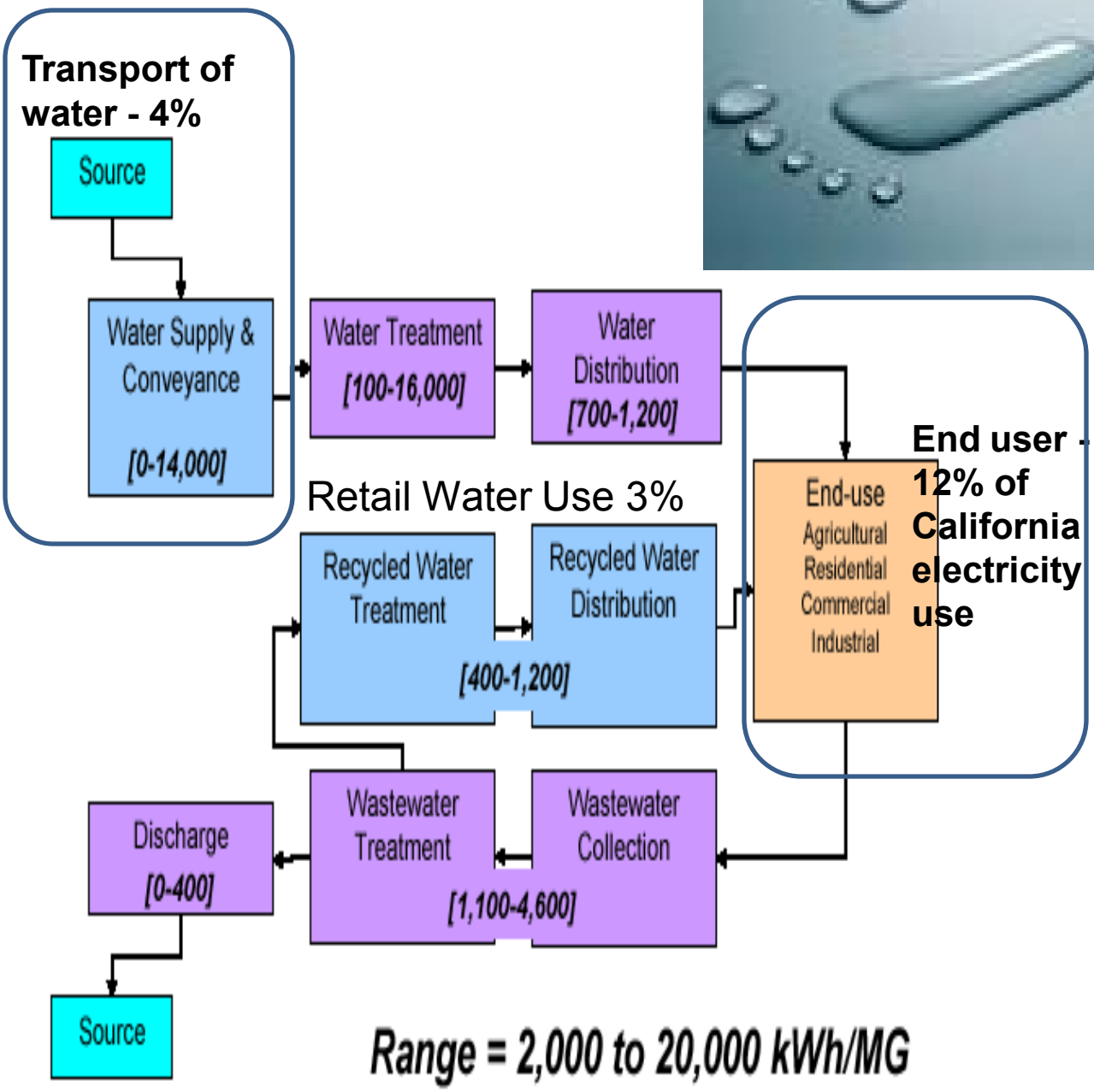
Things To Watch Out For



- **Water footprint ≠ energy footprint ≠ carbon footprint**
  - Footprints are misleading for people familiar with carbon footprint as the water footprint only includes sums of water quantities without considering related impacts (a large fresh water footprint is not nearly the issue in a humid area as it is in an arid area). This is in contrast to carbon footprint where carbon emissions are not simply summarized but normalized by CO2-emissions to account for the environmental impact.

- **Sum of separate footprints ≠ total water/energy use or GHG production in an area**
  - Only if separate footprint only include primary (direct) use.

Embedded Energy in Water



California Water-Energy Pilot Project (R.06-04-010)

Goal

- See if energy utilities could partner with the water utilities on water conservation programs
- Determine how much water was saved
- Determine how much energy was in the water saved

Objective

If known water and associated (embedded) energy saved, energy utilities can invest in water conservation programs, and get credit for the amount of energy saved with reduced water consumption in their energy conservation programs

1. PG&E Large Commercial
   - **Laundry ozone retrofits, institutional school, detention centers, wineries and creamery**
2. PG&E Emerging Technology
   - **Integrate real-time pump electric data into existing and new SCADA systems to improve operational decisions**
3. PG&E Single Family High Efficiency Toilets Program for low-income customers
4. SDG&E Recycled Water
   - **Reduces potable water usage by replacing it with recycled water**
5. SDG&E Managed Landscape
   - **Program reduces potable water usage by better control of frequency and duration of landscape irrigation and remote control of irrigation system through use of weather data**
6. SDG&E Large Customer Audit
   - **Program for SDG&E commercial and industrial customers. Multiple incentives cover portion of retrofit cost**
7. SCE Leak Detection
   - **Identify apparent water losses**
   - **(metering/data problems, theft) and real losses (leaks), leaks will be identified and repaired or managed**
8. SCE Multifamily High Efficiency Toilets
   - **Multiple incentives cover entire cost of HET. Low-income multifamily properties**
9. SCE pH and ET Controllers
   - **pH controllers for cooling towers & ET controllers for landscapes**
10. SCE/SoCal Gas
   - **Natural gas water pumps efficiency analysis**

Examples of Issue Areas

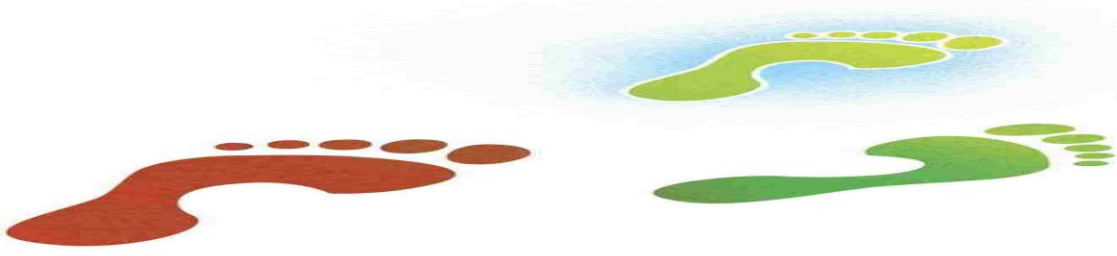
- You change your process to include self-generation

  1) You use natural gas as the fuel to produce electricity
     - Include BTUs of natural gas used? (Did you include the BTUs used to produce the electricity you previously bought?)

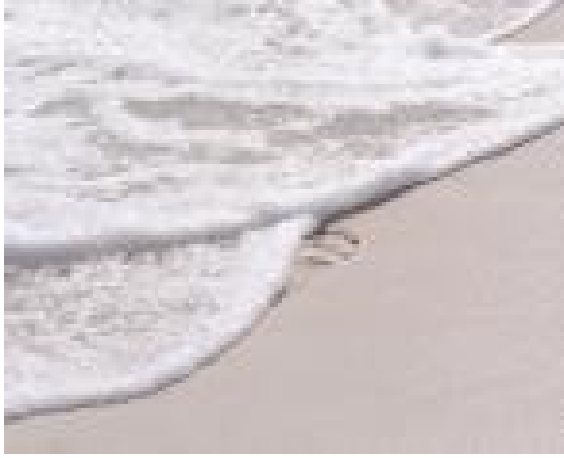
  2) You use biogas to produce the electricity
     - Include the BTUs used? (Did you include the BTUS used to produce the electricity you previously bought?)

  3) You use solar to produce the electricity
     - Do you include the BTUs necessary to produce the solar cells or is this free electricity?

- You improve your process to reduce your water consumption
  - Your water footprint goes down
  - But who gets credit for the reduction in energy and associated GHG with your reduced water use



Conclusions/ Recommendations



- **Footprints can be a valuable reference and marketing tool**
  - Comparison with others in your industry
  - Water/energy/GH in your product
  - Show progress toward environmental goals
- **Clearly define your footprint boundaries**
  - Make sure that it is clear what is included in your footprint, and what is excluded.
  - Make sure you get full credit for anything that you do
- **Use footprints to develop additional relationships**
  - Partner with energy utilities and regulatory agencies to help them meet their goals (and provide you incentives