

An LCA Data Package Manager (LDPM)
from FLCAC Data Packages to “Commons Merged” DB

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ERG

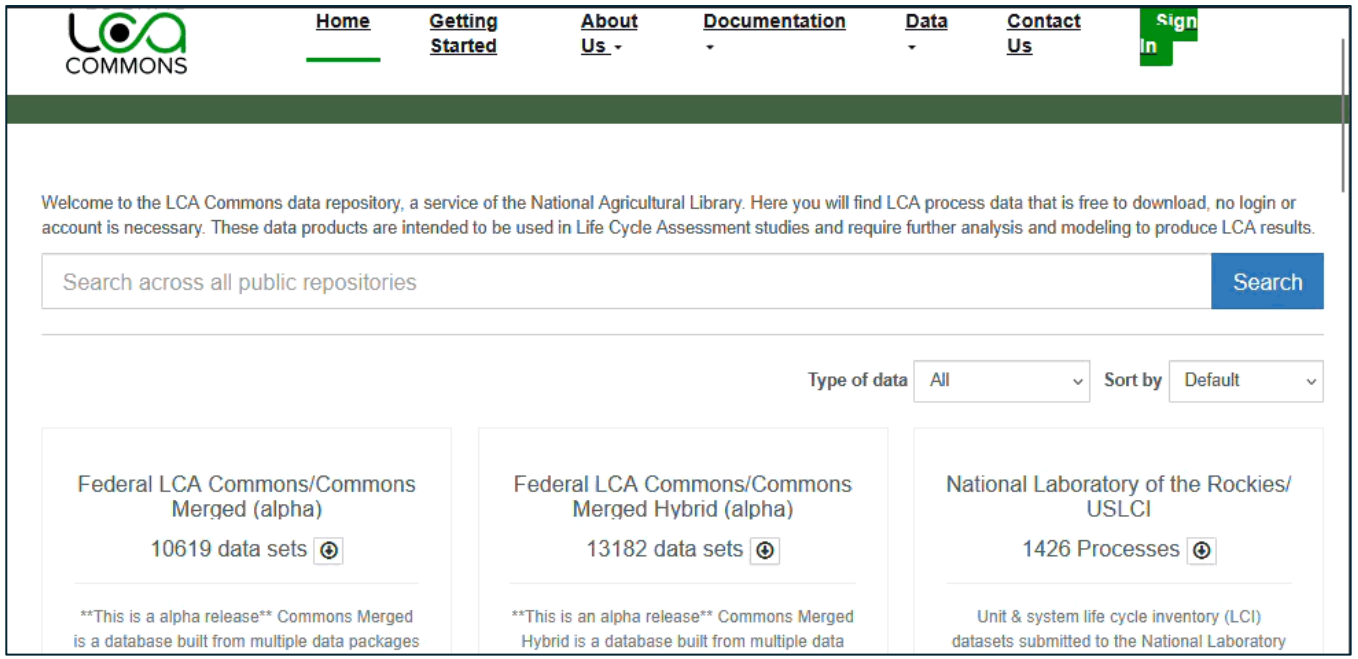
Federal LCA Commons (FLCAC)

- Interagency community of practice working to advance LCA data, methods, research, and information systems

- ERG has curated and maintained USLCI on behalf of NLR (fmr. NREL) since 2022 and served as central curator of FLCAC since 2024

- lcacommons.gov hosts a federation of data packages developed and maintained by agency staff

- {MyST} Markdown docs site: https://flcac-admin.github.io/FLCAC-docs/

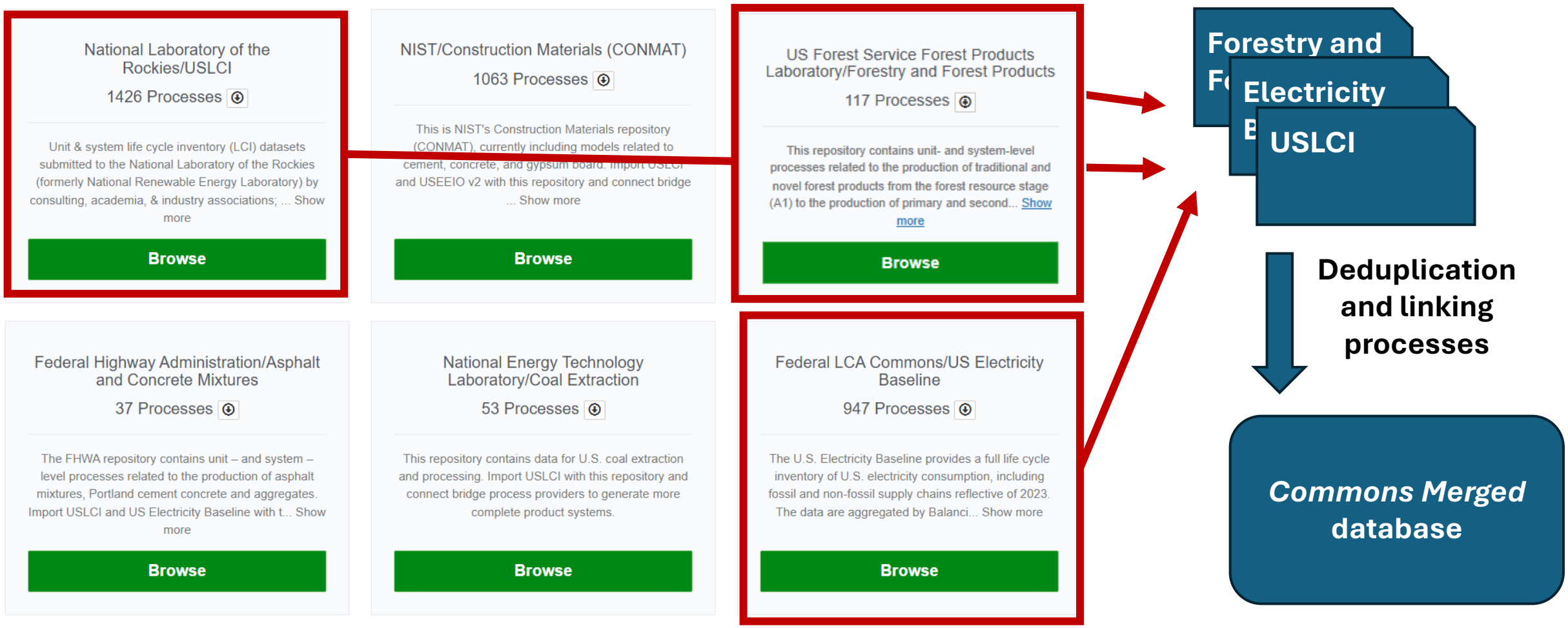


Some Quick Nomenclature

- **build**: a database assembled from a ***manifest***, minted into an olca-schema .ZIP package
- **data package (dpkg)**: a collection of olca-schema data objects with a release version number—e.g., the contents of an FLCAC repository
  - *Note: not (yet) conformant with Data Package v2 standard*
- **dependency**: a data package integrated into a ***build***, as specified by name and version (e.g., (<name> = "<version>")
- **duplicate**: an olca-schema object with multiple instances across ***dpkgs***, as identified by UUID
- **manifest**: a TOML recipe (e.g., the default Commons_Merged manifest) for a ***build***, containing metadata and ***dependencies***

Challenge: Linking Across Repositories

Using and linking across multiple repositories is cumbersome



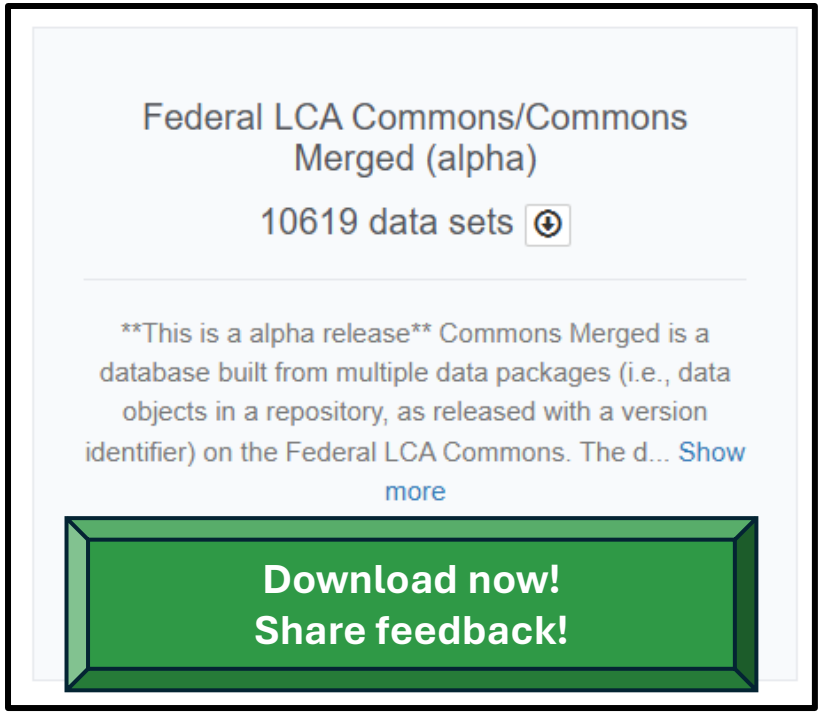
Manifest TOML

- Acts like a Makefile for LCA data (i.e., both LCI and LCIA data packages)
- Use cases:
  - Rebuild a background DB on new dependency release
  - Compose a frozen/pinned build as foundation of EPD or PEF template
  - Attach as Supplementary File to a journal article
  - Faster reproducibility
- Recycled basic syntax and logic from Rust Cargo dependency specifiers



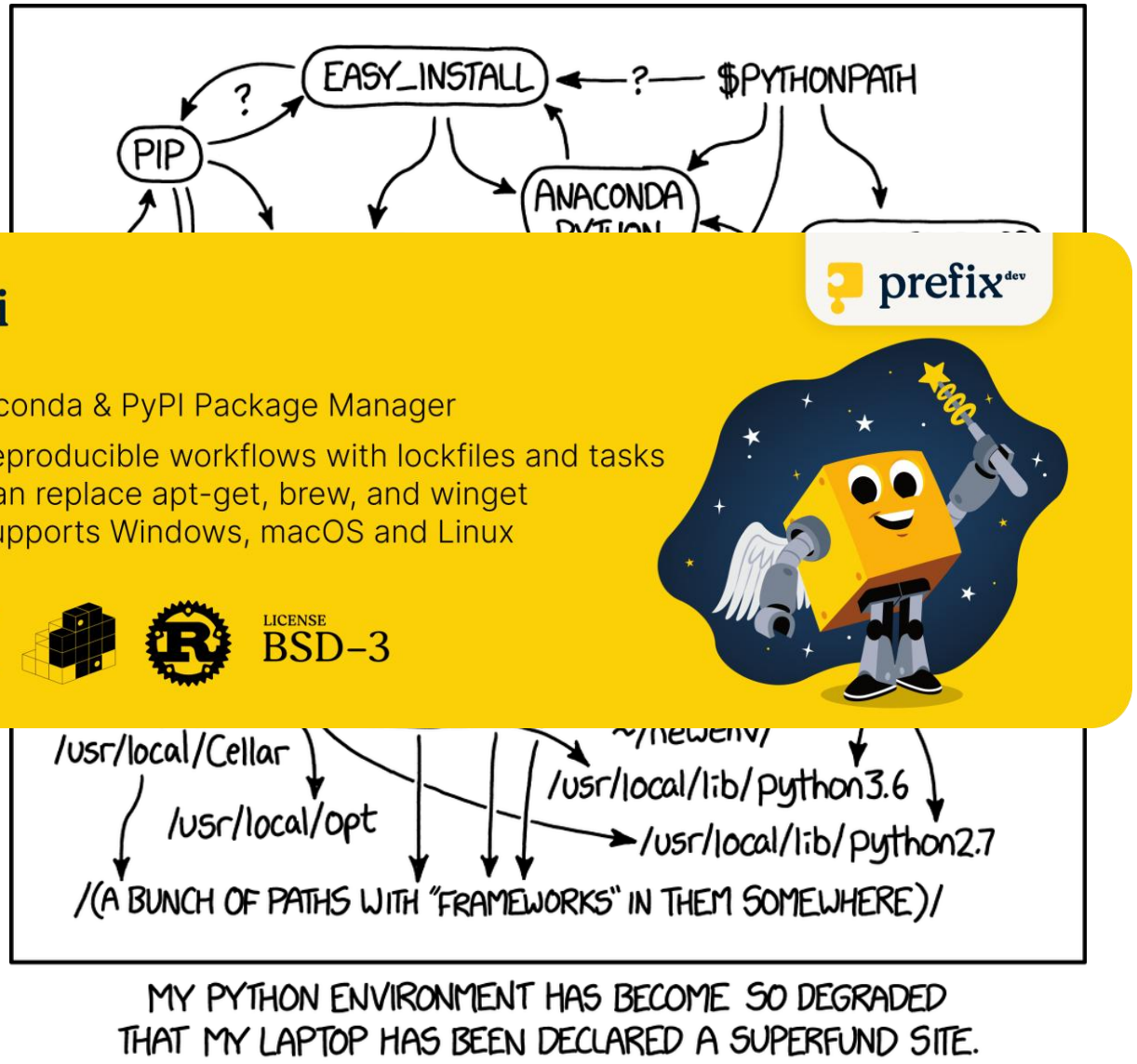
Outcome: LDPM + Commons Merged databases

- LDPM links exchange providers across data packages, as intended by original consuming-process authors at each agency
  - Deterministic build w/ linking and deduplication YAML config files
- Pre-release *alpha* version contains subset of FLCAC data packages:
  - **USLCI** – Industry data
  - **Electricity Baseline**
  - USFS **Forest and Forestry Products**
  - Without **USEEIO**: Commons Merged
    With **USEEIO**: Commons Merged Hybrid
  - **LCIA** methods:
    TRACI 2.2, IPCC, FEDEFL Inventory



Background – Dev Tips & Tricks

- Formerly served as de facto Chief Conda YAML Troubleshooter for everyone at ERG
- Migrated to Pixi late last year and never looked back
  - Easy migration from conda
  - ***Fast*** – no more 5 min. builds
  - TOML can store user & dev envs; no more hosting 2+ YAMLs
- Python Dataclasses:
  I plan to use these much more moving forward

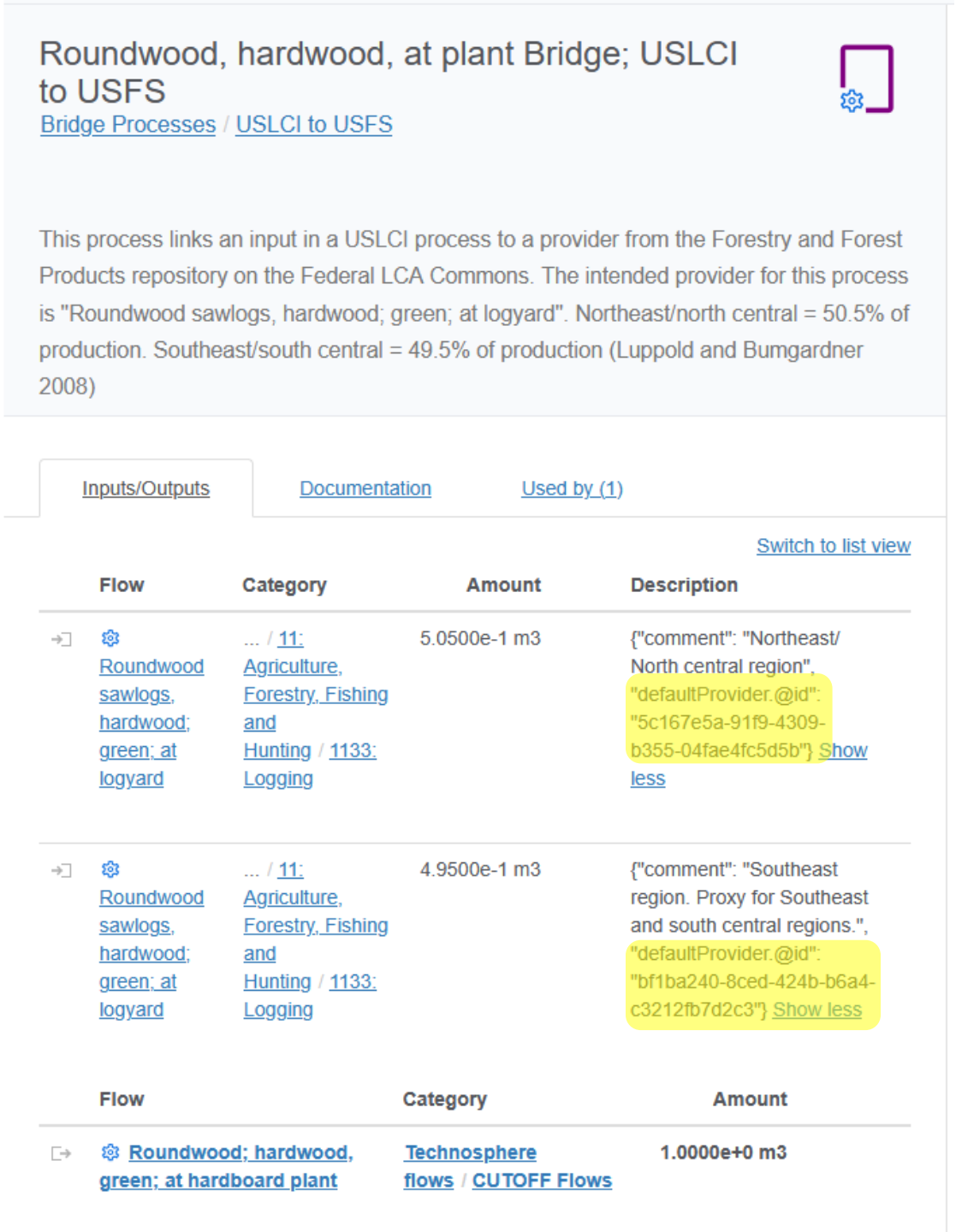


Quick Demo

https://github.com/FLCAC-admin/commons_merged

Bridge Processes

- Keeping bridge processes intact for now
  - Used to consider these duct-tape-y; now more like Python `import` statements
  - Simple, readable, and explicitly declares of other-dpkg provider
- Certain sub-types of bridges store data we don't want to lose:
  - "...; *X* to USEEIO" contain currency-to-physical-unit conversion factors



Roundwood, hardwood, at plant Bridge; USLCI to USFS

Bridge Processes / USLCI to USFS

This process links an input in a USLCI process to a provider from the Forestry and Forest Products repository on the Federal LCA Commons. The intended provider for this process is "Roundwood sawlogs, hardwood; green; at logyard". Northeast/north central = 50.5% of production. Southeast/south central = 49.5% of production (Luppold and Bumgardner 2008)

Inputs/Outputs | Documentation | Used by (1)

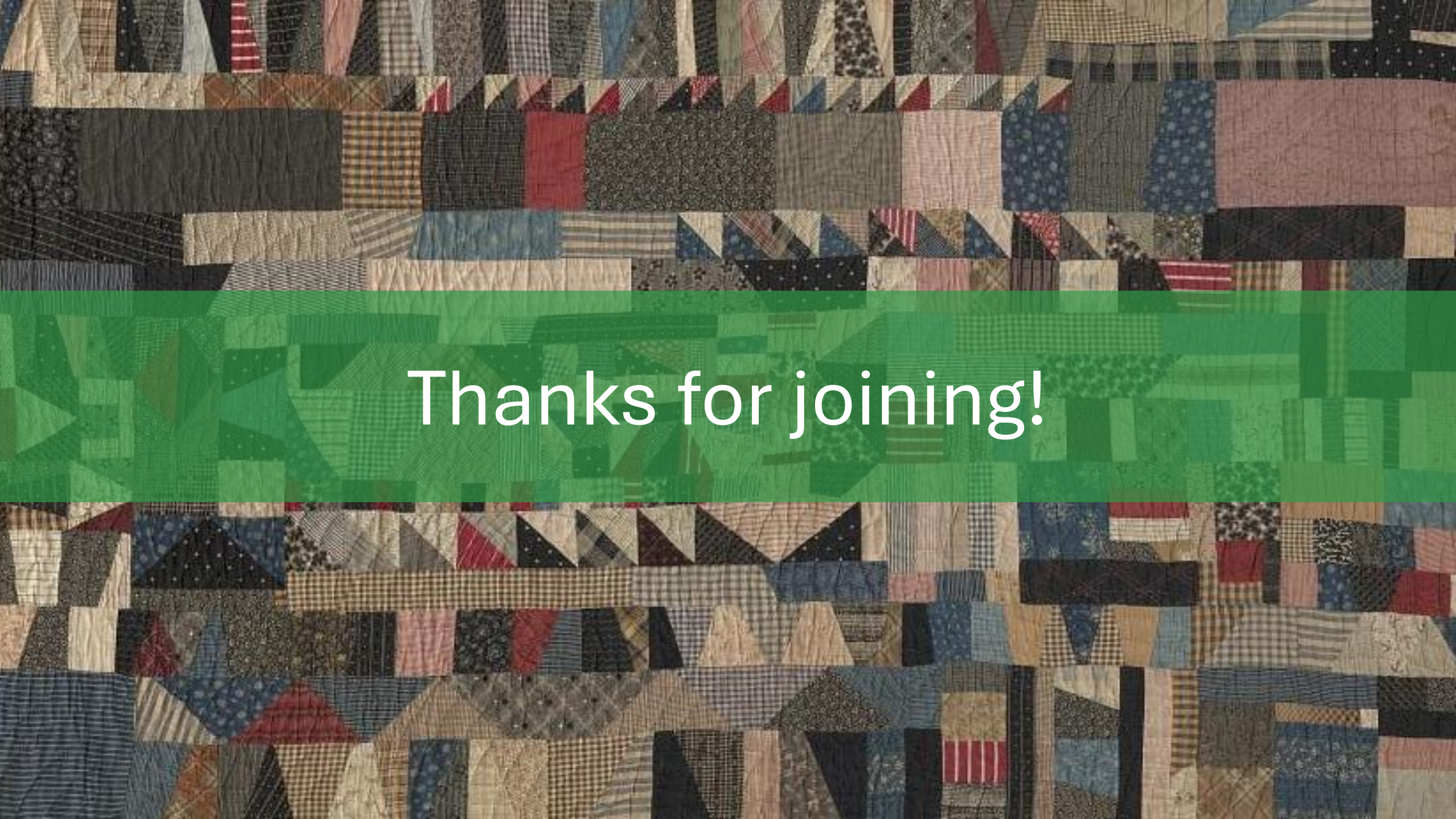
Switch to list view

Flow	Category	Amount	Description
Roundwood sawlogs, hardwood; green; at logyard	... / 11: Agriculture, Forestry, Fishing and Hunting / 1133: Logging	5.0500e-1 m3	{"comment": "Northeast/ North central region", "defaultProvider.@id": "5c167e5a-91f9-4309-b355-04fae4fc5d5b"} Show less
Roundwood sawlogs, hardwood; green; at logyard	... / 11: Agriculture, Forestry, Fishing and Hunting / 1133: Logging	4.9500e-1 m3	{"comment": "Southeast region. Proxy for Southeast and south central regions.", "defaultProvider.@id": "bf1ba240-8ced-424b-b6a4-c3212fb7d2c3"} Show less

Flow	Category	Amount
Roundwood; hardwood, green; at hardboard plant	Technosphere flows / CUTOFF Flows	1.0000e+0 m3

Ongoing & Future Work

- Develop *Commons Merged* pre-release into first stable release by integrating all non-deprecated FLCAC data packages (+USEEIO for *Hybrid*)
- Update docs site to (1) align nomenclature in Glossary, (2) better describe Commons Merged contents and release schedule, and (3) detail how other folks can reuse/extend LDPM builds
- Expand manifest.toml format and related logic to accommodate non-FLCAC data packages
- Host an authoritative collections of Location, UnitGroup, and Actor objects (i.e., as commonly reused across dpkg) in a single peripheral dpkg
- Consider embedding dependency version specifiers on bridge processes and/or manifest.toml on data packages themselves (think: pyproject.toml)


Thanks for joining!

Does a Better Alternative Already Exist?

- Did I ~~reinvent~~ re-fabricate the wheel?
- Setting aside whether dependencies are treated as data packages, which other open-source software packages, libraries, frameworks, tools, etc. have already partially or fully addressed this problem?

