Printing Papers and Recycling: Using A Life Cycle Perspective

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GAA 2007 Environmental Workshop
Grand Rapids, MN
June 21, 2007

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Presentation Overview

- U.S. Paper Recovery
- Uses of Recovered Paper
  - Domestic and Exports
  - Domestic Use by Grade
- Environmental Perspective on Paper Recycling
- The Role of Life Cycle Analysis
- Public Environmental Assessment Models
- Take Away Thoughts

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U.S. Paper Recovery

- Paper Recovery Now Above 50%
- Paper Recycling Continues to Increase
- Where Does Recovered Paper Go?

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Recovery of Paper – The Big Picture

Most Recovered Paper Goes to Paper Mills

Net Exports are Growing Faster Than Domestic Mill Use

Recovered Paper Use 2006
(In 1,000 Short Tons)

	Tons	Percent
Consumed at U.S. Mills	34,726	64.8
Other Uses - Insulation, etc.	1,880	3.5
Net Exports	16,986	31.7
Total Recovered	53,592	100.0

Source: AF&PA

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Paperboard Production and Recovered Paper Input (thou tons)

Paperboard Production	Use of Recovered Paper*	Production	Percent Input	Principal Technology
Kraft Linerboard	4,340	21,689	20.0%	Repulp
Other Kraft Bleached/Unbleached	365	7,407	4.9%	Repulp
Semichemical	3108	6,224	49.9%	Repulp
Recycled Containerboard	8,965	7,917	113.2%	Repulp
Other Recycled Paperboard (e.g. Boxboard)	7,020	7,164	98.0%	Repulp
Total Paperboard	23,798	50,401	47.2%	

* = Before yield loss

Source: AF&PA

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Paperboard Grades Using Recovered Paper

- Paperboard a Big User of Recovered Paper
- Average 47% on Input Overall Compared to Production
- Paperboard Uses All Grade Categories of Recovered Paper Including Mixed, Magazines, Catalogs, Office Paper

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Paper Production and Recovered Paper Input (thou tons)

Paper Production	Use of Recovered Paper*	Production	Percent Input	Principal Technology
Newsprint	3,515	5,225	67.3%	Deink
Printing Writing	1,607	24,536	6.5%	Deink
Packaging & Ind. Converting	542	4,117	13.2%	Repulp
Tissue	4,234	7,471	56.7%	Deink
Total Paper	9,898	41,349	23.9%	

* = Before yield loss

Source: AF&PA

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Paper Grades Using Recovered Paper

- Newsprint a Big User
- Tissue a Big User
- Printing Papers Not a Big User
- All Three Require Deinking – Purchased Fuels, Sludge
- Recycling into Paper Products Only 24% Overall

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Grades Based Over 90% on Virgin Fiber

- Printing & Writing Papers
- “At Home” Tissue Products
- Bleached Kraft Paperboard
- Unbleached Kraft Paperboard

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U.S. Production of Printing & Writing Papers 2006

(In 1,000 tons)

Uncoated Mechanical		1,910
Coated Paper		9,268
Free Sheet	4,634	
Mechanical	4,634	
Uncoated Free Sheet		12,069
Other		1,288
Total		24,536

Source: AF&PA

Excludes imports from Canada.

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Recovered Paper Utilization in Printing, Writing and Related Paper

(In Percent of Production)

Period	Range - Percent
1980 to 1990	5.5 to 6.5
1991 to 1999	8.5 to 10.5
2000 to 2006	6.5 to 7.0

Note: 2006 was 6.5%

Source AF&PA Statistics/Franklin Associates

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An Environmental Perspective

- Printed products are highly visible to consumers
- Printed products are targets for recycled content
- Environmental activists make the recycling case for magazines and catalogs via retailers
- Pressure on publishers to specify recycled paper content
- Pressure on paper producers to use recycled fiber
- The benefits: Recycled paper saves trees; reduces landfill disposal; is good environmental stewardship
- Conventional wisdom: Recycling is Always Good
- Reality: Not Necessarily!

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Material Sources for Papermaking in North America

- Abundant forest resources
- Pulp from virgin fiber dominates in U.S. & Canada
- Greater than 65% of U.S. production is based on virgin fiber
- Sustainable forestry is a growing emphasis
- Recovery is also growing as a percent of total fiber
- Export of recovered paper is growing most rapidly

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Life Cycle Approach

- Life cycle analysis reveals relative environmental burdens and benefits of recycling and virgin fiber use
- Systems analysis is very important to identify resource use, energy use, and wastes to air, water, and land for each stage
- Pulp and paper making are the dominant processes
- Life cycle approach quantifies effects specific to individual producers and mills:
  - Mix of virgin and/or recycled fiber
  - Pulping and bleaching technologies and efficiencies
  - Self-generated and purchased energy
  - Profile of purchased energy
  - Utilization of sludge

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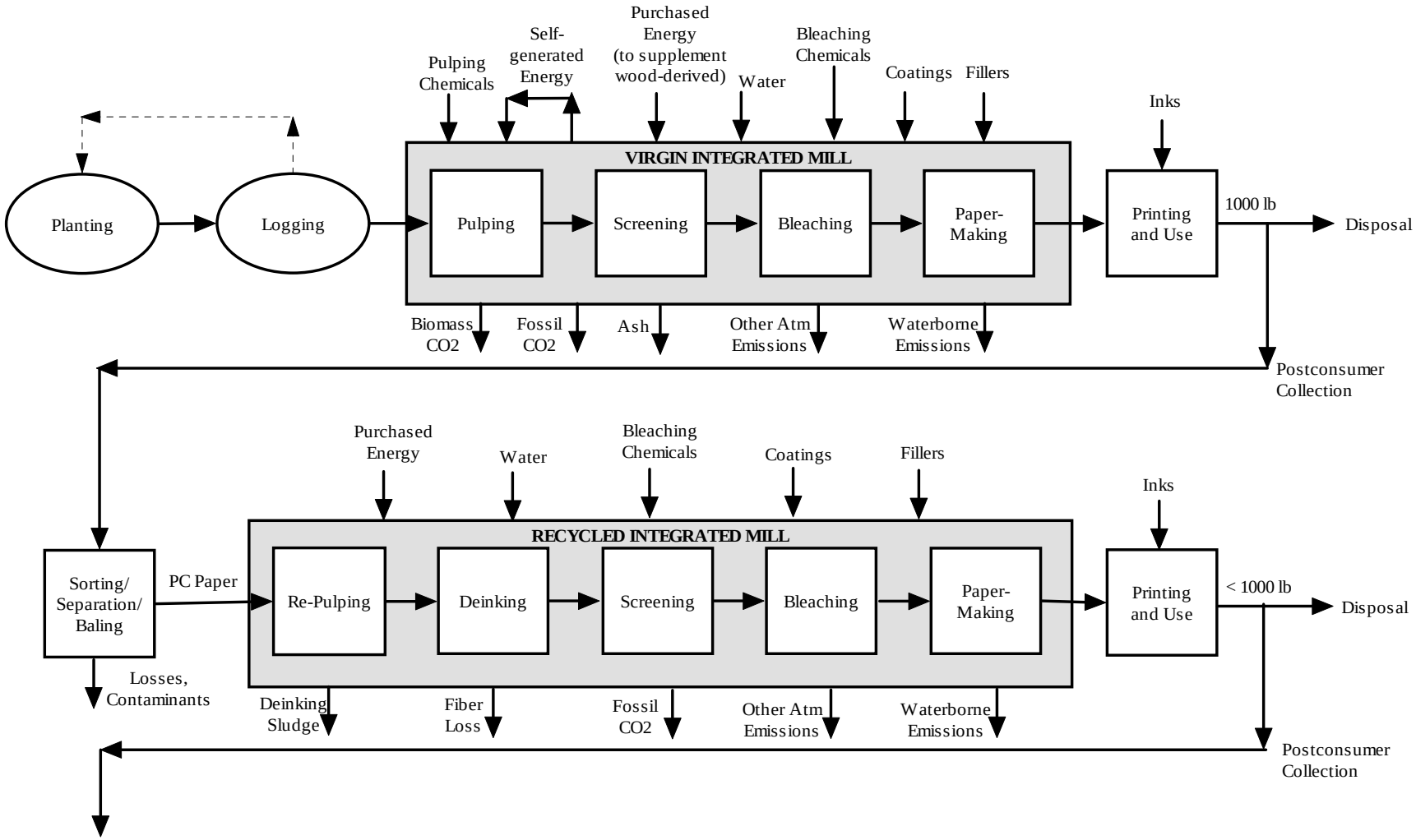
Pulping Chemicals
Self-generated Energy
Purchased Energy (to supplement wood-derived)
Water
Bleaching Chemicals
Coatings
Fillers
Inks
VIRGIN INTEGRATED MILL
Planting
Logging
Pulping
Screening
Bleaching
Paper-Making
Printing and Use
1000 lb
Disposal
Biomass CO2
Fossil CO2
Ash
Other Atm Emissions
Waterborne Emissions
Postconsumer Collection
Purchased Energy
Water
Bleaching Chemicals
Coatings
Fillers
Inks
RECYCLED INTEGRATED MILL
Sorting/ Separation/ Baling
PC Paper
Re-Pulping
Deinking
Screening
Bleaching
Paper-Making
Printing and Use
< 1000 lb
Disposal
Losses, Contaminants
Deinking Sludge
Fiber Loss
Fossil CO2
Other Atm Emissions
Waterborne Emissions
Postconsumer Collection
Repeat recycling sequence with additional fiber loss each cycle...

Observations on Pulping Processes

Virgin Bleached Kraft

- Wood-derived energy, carbon neutral
- Supplemental purchased energy

Virgin Newsprint

- Groundwood, TMP pulping uses mostly purchased energy

Deinking

- Purchased energy
- Management of sludge important
  - 30% or greater losses (coatings, short fiber, etc.)
  - Landfill? Energy production? Other use?
- Transportation can be significant

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Observations on Pulping Processes

For All Pulping Processes

- Quantity and profile of purchased energy important
- Utility fuel sources very region-dependent (e.g. hydro vs. coal)

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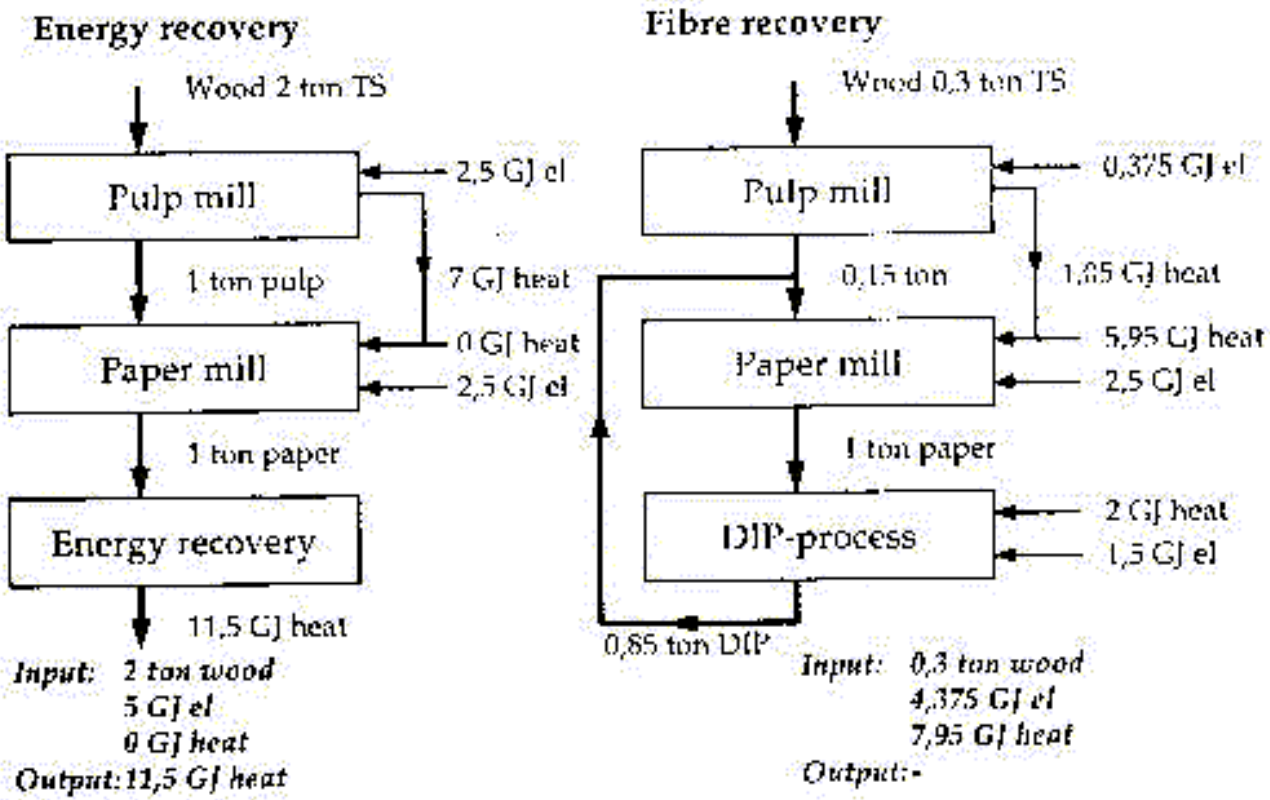

Figure 3. Use and production of energy in office paper production.

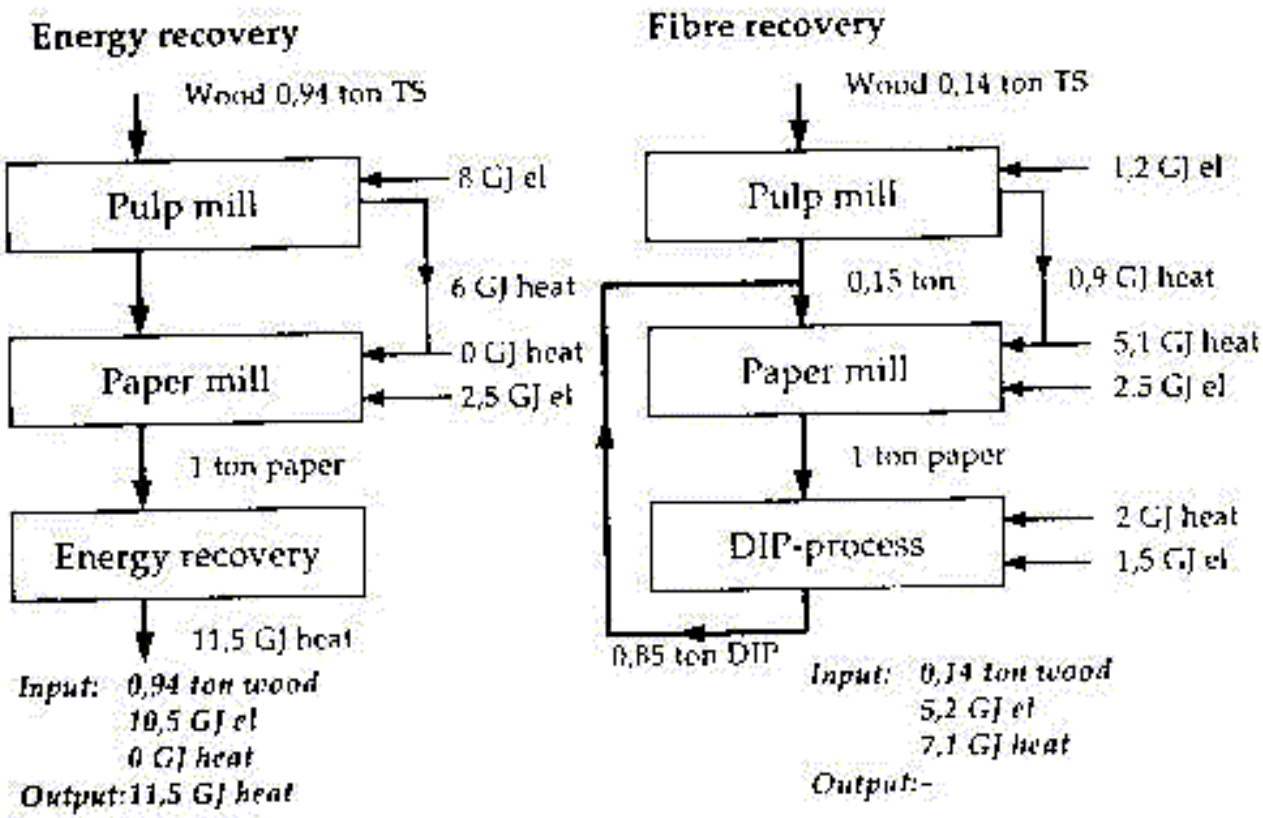

Figure 4. Use and production of energy in newsprint production.

Mass and Energy Inputs per Ton of Paper Output*

	Office Paper (Bleached Kraft)		Newsprint (TMP)	
Mass	Virgin	Recovered	Virgin	Recovered
Wood inputs (ton)	2.00	0.30	0.94	0.14
Recovered paper input		1.00		1.00
Total mass of inputs				
Energy (GJ)				
Virgin pulping				
Heat generated	7.00	1.05	6.00	0.90
Purchased electricity	2.50	0.38	8.00	1.20
Deinking				
Purchased electricity		1.50		1.50
Other purchased energy		2.00		2.00
Papermaking				
Purchased electricity	2.50	2.50	2.50	2.50
Other purchased energy		5.95		5.10
Total self-generated energy	7.00	1.05	6.00	0.90
Total purchased energy	5.00	12.33	10.50	12.30
Total	**12.00**	**13.38**	**16.50**	**13.20**

Note: At end of life, if not recycled, paper could be incinerated with energy recovery. For virgin paper scenario, incineration of 1 ton of paper would generate 11.5 GJ/ton.

*Figures and data from "Waste Paper Recycling: Economic and Environmental Impacts" by S. Byström and L. Lönnsted, published in the proceedings of an international workshop organized by the European Forest Institute and Federal Centre for Forestry and Forest Products, May 3-5, 1995.

Assessing Environmental Performance of Paper

- The Paper Calculator (Environmental Defense)
- MERGE (packaging model, also from Environmental Defense)
- EPAT (Metafore)
- Paper Profile (largely EU companies)
- Environmental Profile Data Sheet (Canada)

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Paper Calculator - Overview

- Publicly available, endorsed by EPA and other public agencies
- Covers printing papers and other grades (coated and uncoated free sheet and groundwood, also paperboard and corrugated)
- Life cycle approach, but underlying data needs to be updated (white paper from 1995, individual data sources older)
- Also, results reflect industry average – in reality, specific mill operations, technologies, efficiencies vary widely

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Using Paper Calculator

- Stand-alone or comparative results
- If differences in basis weights of paper compared, user needs to calculate equivalent tonnages (e.g., if recycled content results in higher basis weight paper than virgin alternative, need to adjust weights)
- User can adjust some details — fiber content, pulp mix, recycled fiber source, bleaching technology—but these are represented using average data
- Cannot specify some mill-specific data that can have significant effects on environmental profile: energy efficiency, purchased fuel mix (e.g., electricity grid), transportation distance for recycled fiber inputs, management of sludge

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Paper Calculator Cautions

- Based on average data, not mill-specific
- Individual mill operations, technologies, efficiencies vary widely
- Also regional issues associated with mill locations (fuels used to generate purchased electricity, transportation of incoming materials and outgoing product)
- Thus, not appropriate tool to use for communicating environmental information for products of specific mills
- BUT this approach is a good starting point
- LCA modeling can be structured to incorporate mill-specific data (transportation of input materials, total energy, purchased energy profile, sludge management, etc.) to give life cycle results specific to individual mills and their products

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Takeaway Thoughts (1)

Recycled content may not improve the environmental profile. Cases include:

- Uses where appearance and quality are critical (example: at-home tissue)
- Virgin mills using best-available-technology and self-derived (carbon-neutral) energy can outperform recycled fiber mills with older technology and fossil-derived purchased energy
- Long-haul transport of post-consumer paper, esp. with low fiber content (coatings)
- Heavier basis weight to meet specs for use (recycled fibers shorter, weaker than virgin)

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Takeaway Thoughts (2)

Recycled content can improve environmental profile in cases where:

- Deinking is not required (boxboard, corrugated)
- PC paper transportation is not excessive or is done using more energy-efficient/C-efficient modes
- PC fiber displaces virgin pulp produced with significant quantities of purchased electricity (groundwood, TMP, CTMP)
- De-inked sludge is not landfilled and mills are using B-A-T
- Purchased energy profile is key! (e.g., electricity derived from hydro versus coal)

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Takeaway Thoughts (3)

Consumers should be encouraged to recover paper, magazines, etc. for recycling into products where recycled content has clear benefits.

- 2006 U.S. paper recycling rate 53.4 percent overall, but mixed paper recovery (catalogs and direct mail) lagging at 30 percent.
- Direct Marketing Association member companies adding “Recycle Please” logos to catalogs and other direct mail pieces.

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