WASHINGTON DEPARTMENT OF NATURAL RESOURCES

Forest Roads

Weikko S. Jaross

June 4th, 2018

CAT

If you build it…

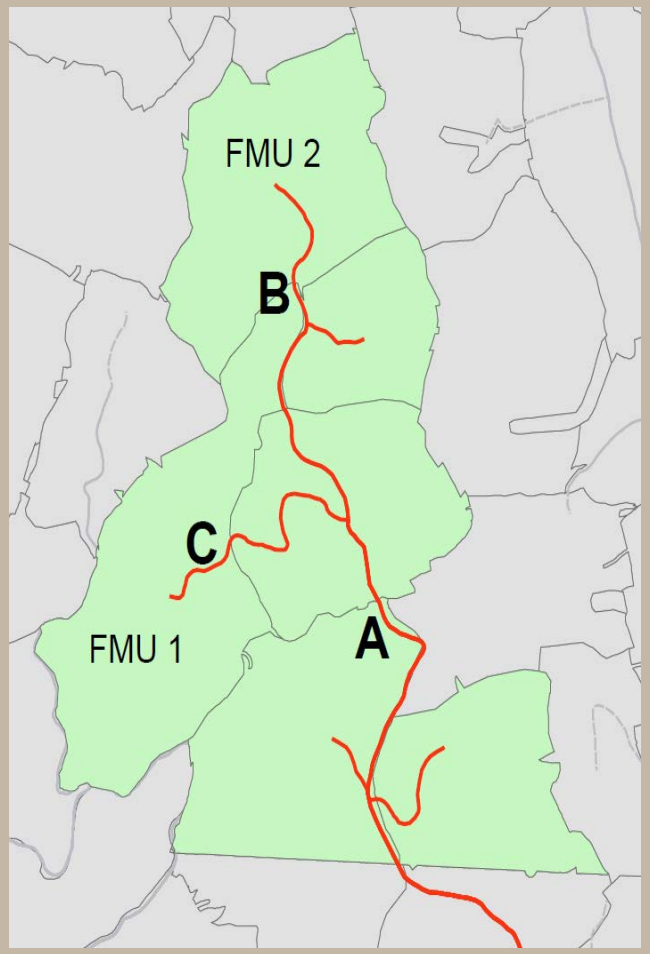
- You have to pay for it.

And…

- multiple FMUs will access it.

Therefore road construction is a …

“shared fixed cost”



Dig deeper…

- The harvest schedule determines need for access.
- The longer between repairs, the more costly the repair.
- Therefore road *reconstruction* is an…

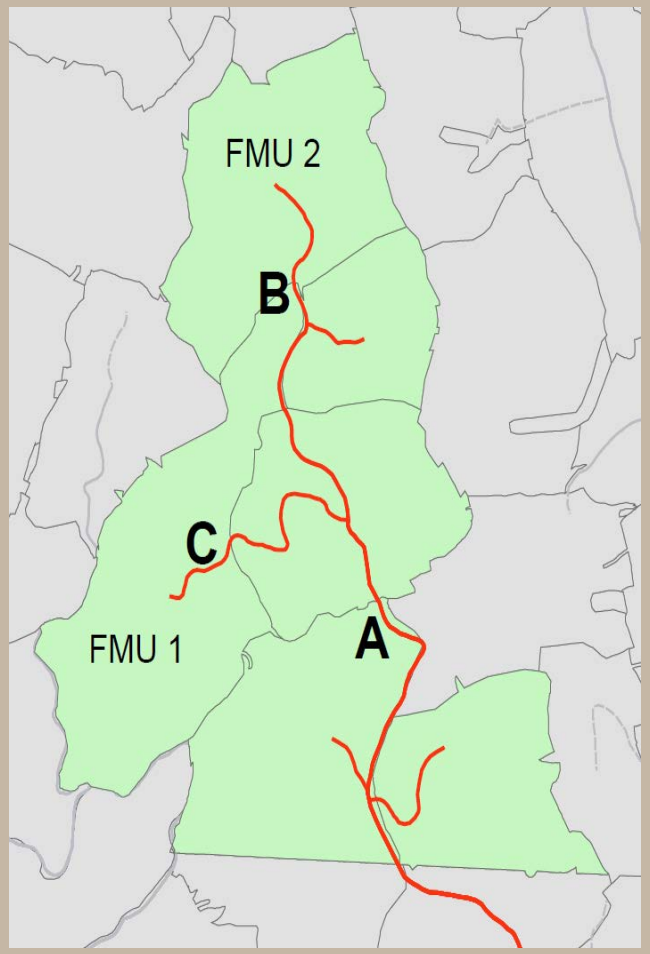
“endogenous fixed-cost”

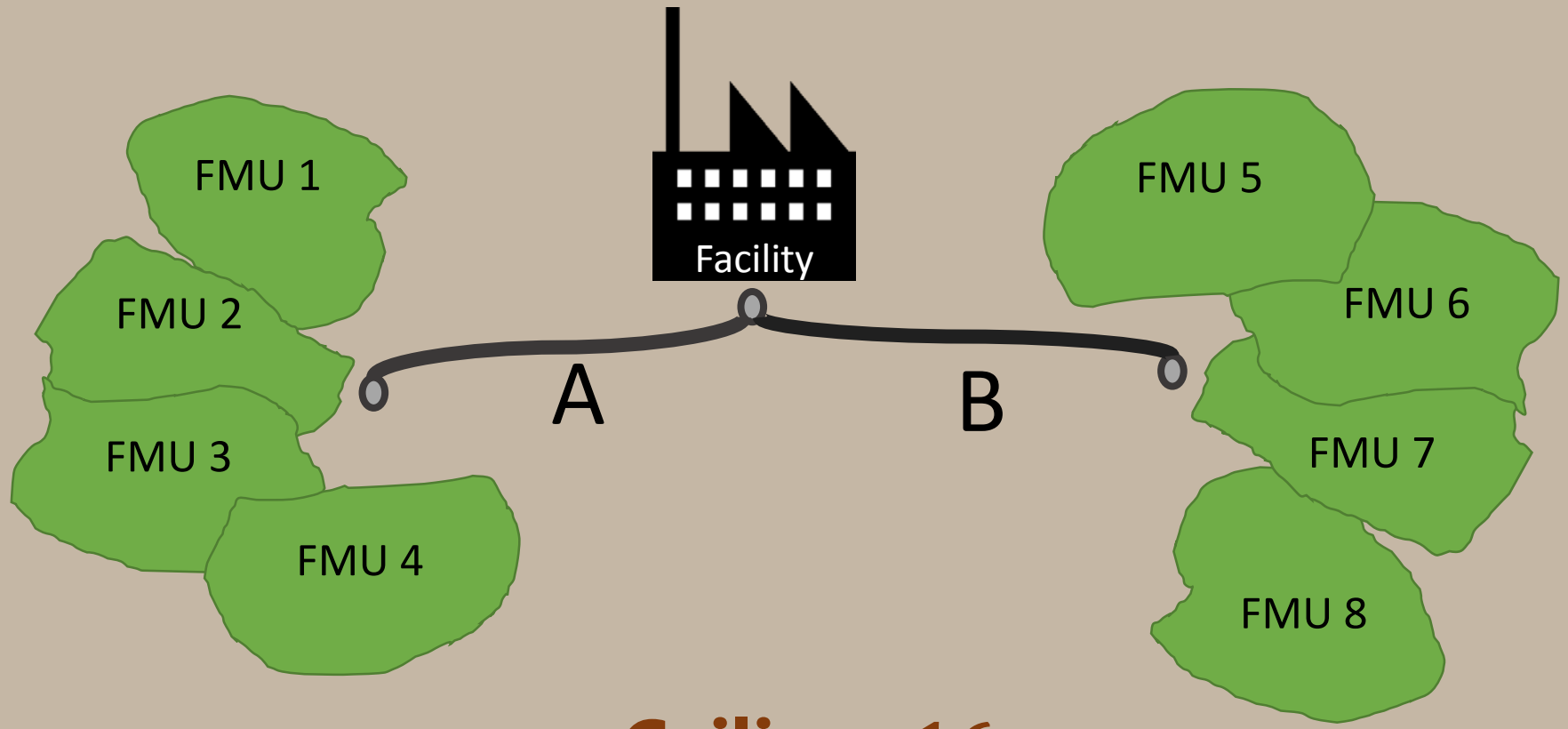
Extra Credit

What is the solution to the time and space continuum problem?

Three scenarios…

- Hierarchical Planning
- Fixed Cost
- Endogenous Fixed Cost



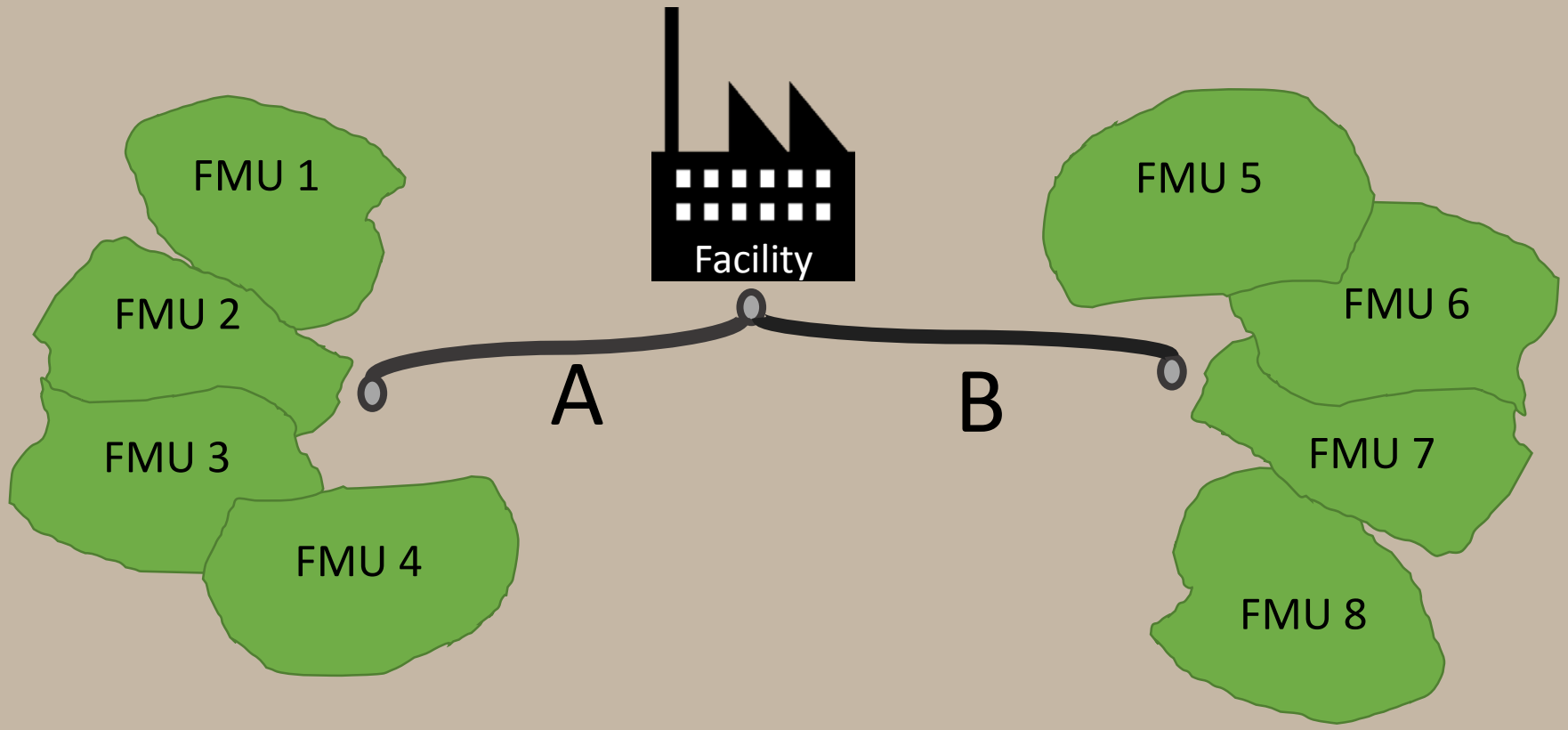


Ceiling: 16α

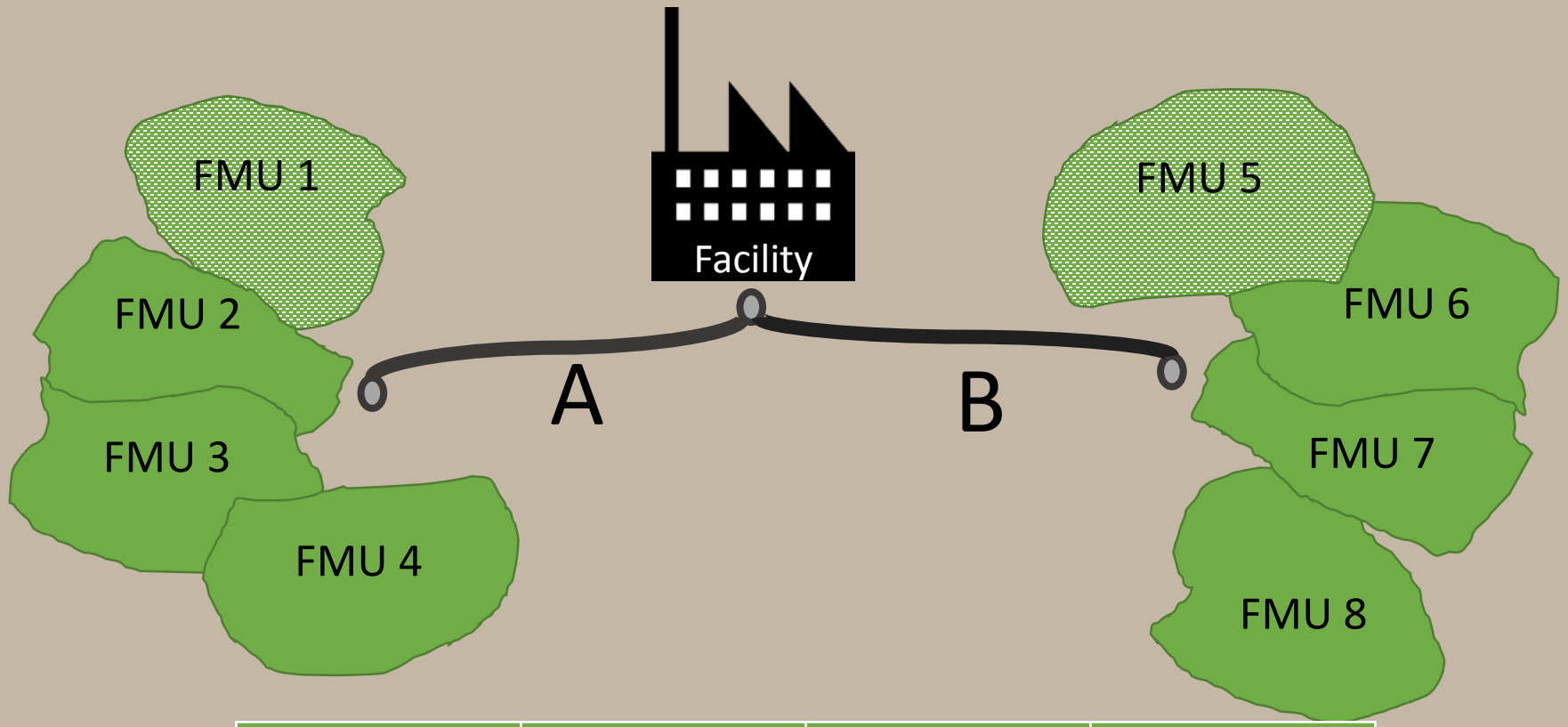
- Can only harvest two units in each period (four periods total)
- All FMUs are identical
- Cost to rebuild segment A = B = 2α
- But only α if the segment was rebuilt in the previous period

Hierarchical Planning

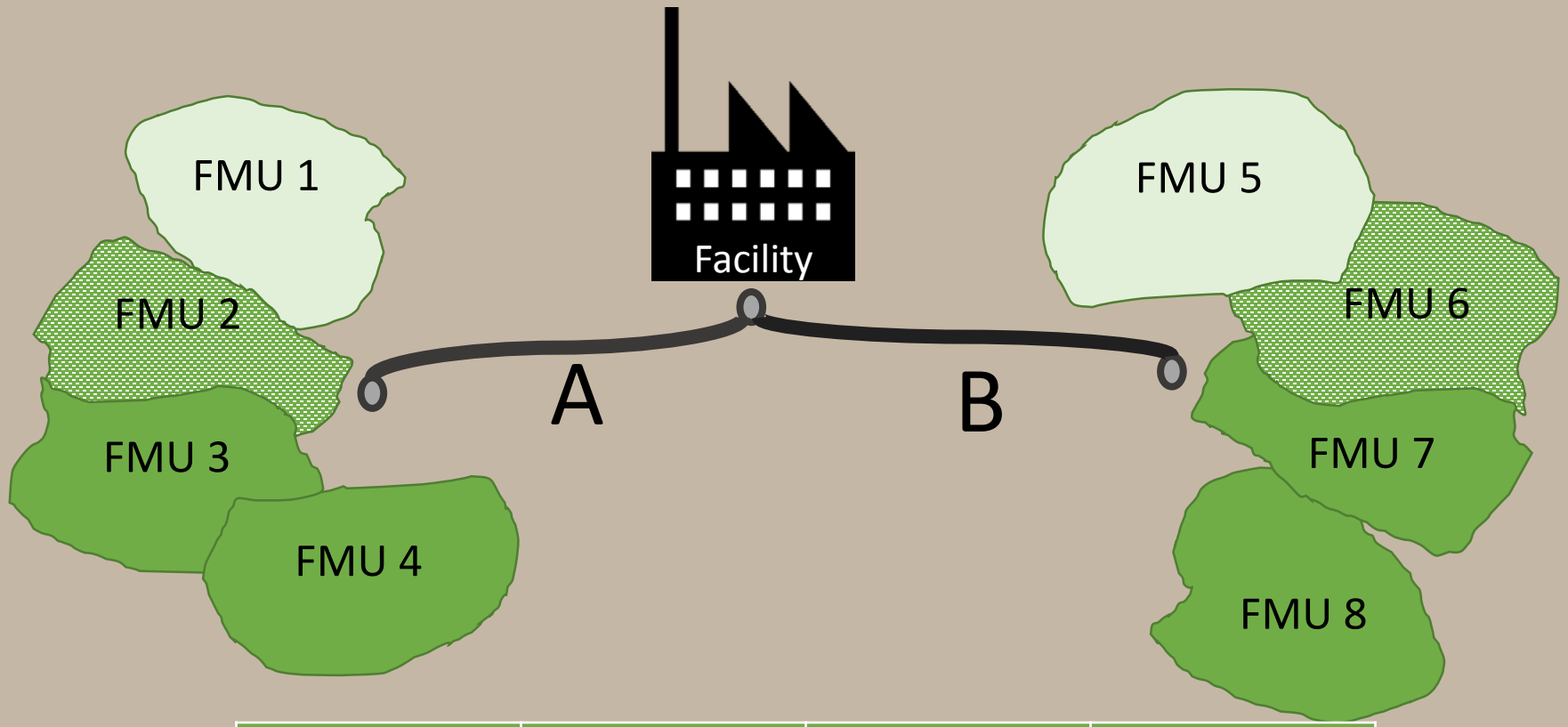
"status quo"



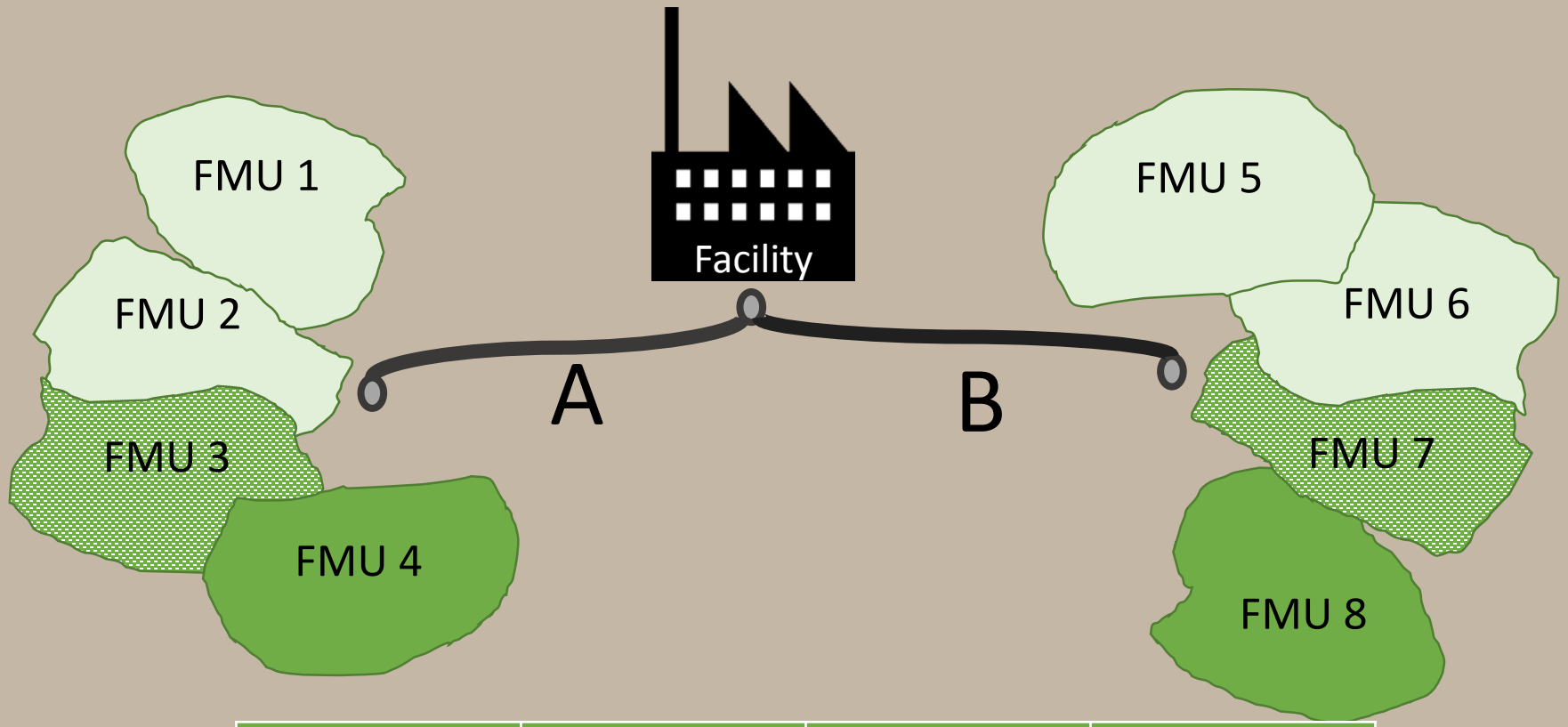
Hierarchical Model	Harvest	Build	Cost
Period 1			
Period 2			
Period 3			
Period 4			



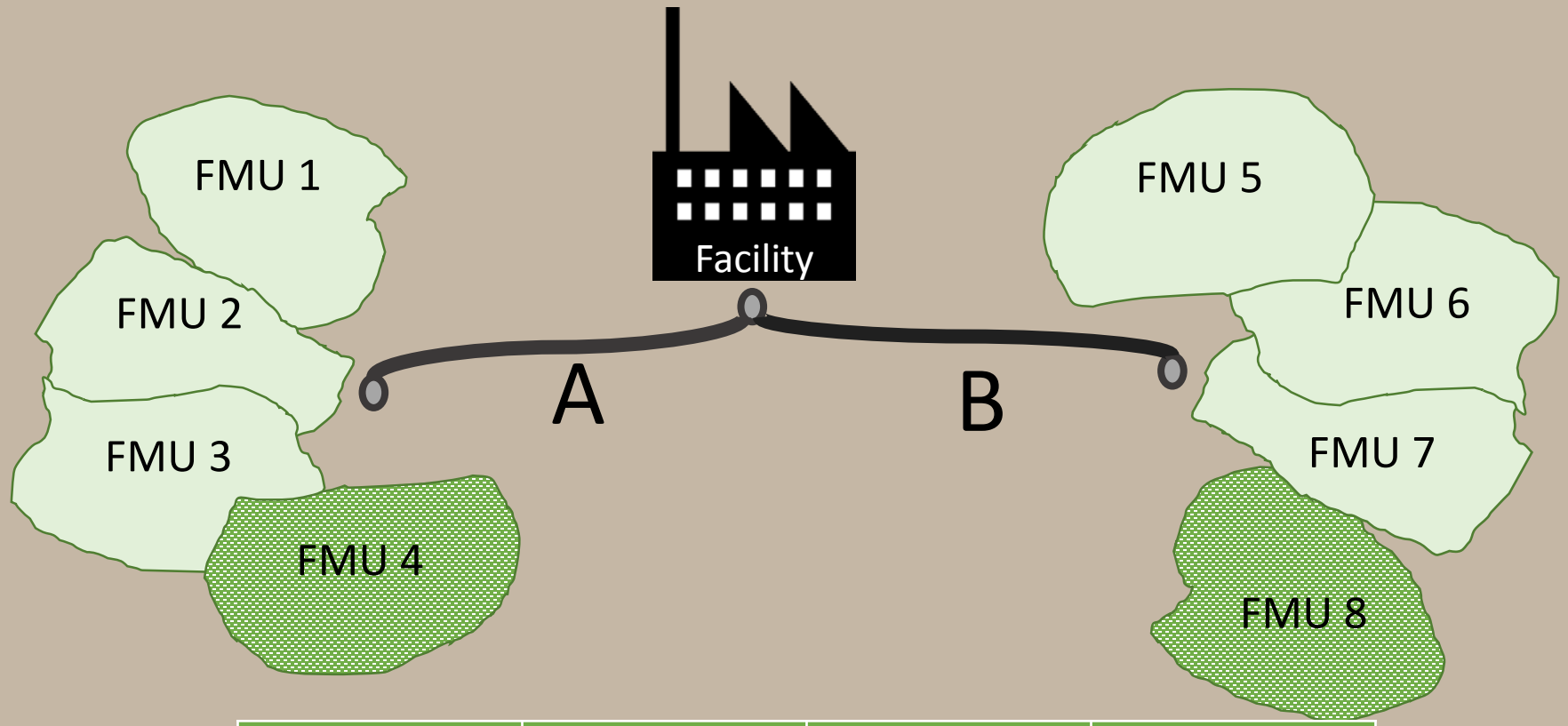
Hierarchical Model	Harvest	Build	Cost
Period 1	1,5	A,B	$2\alpha + 2\alpha = 4\alpha$
Period 2			
Period 3			
Period 4			



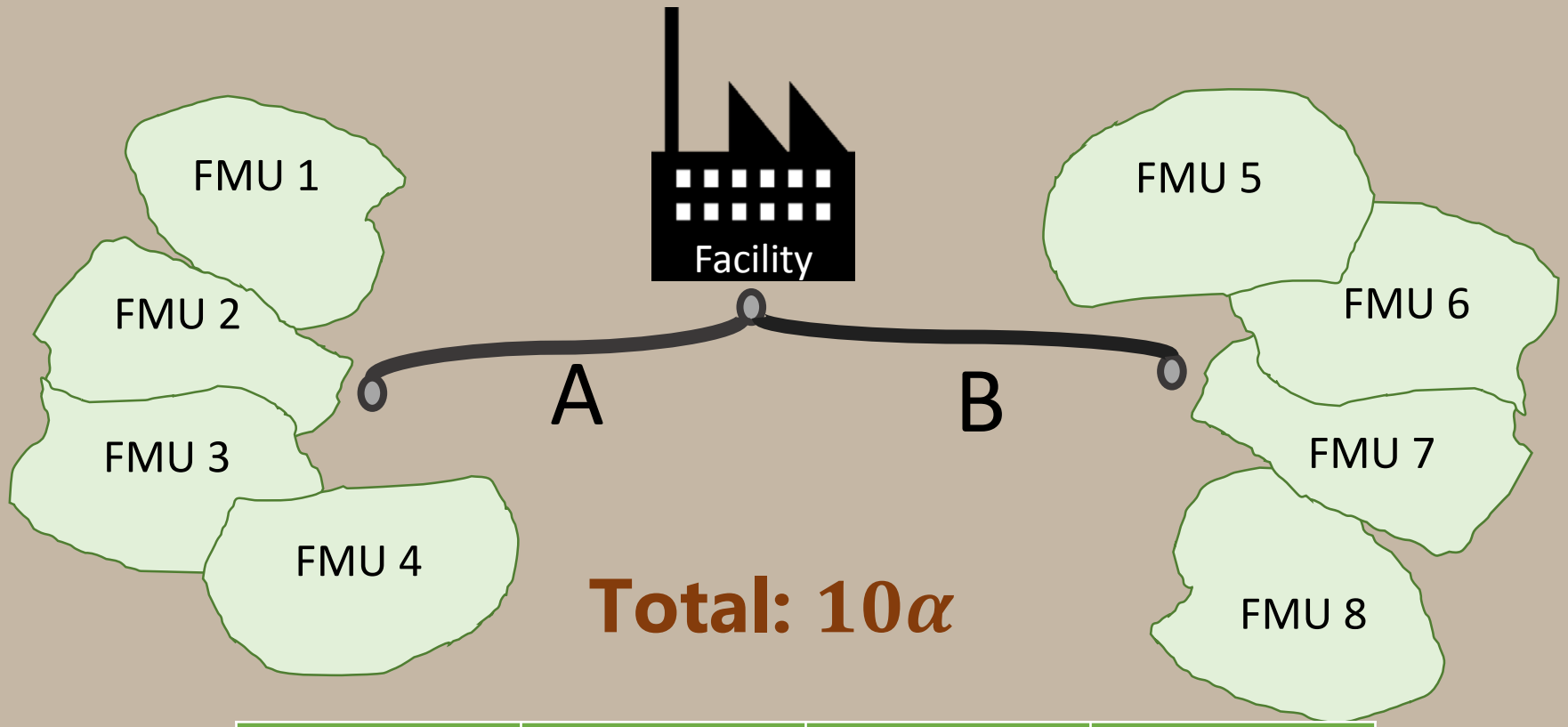
Hierarchical Model	Harvest	Build	Cost
Period 1	1,5	A,B	$2\alpha + 2\alpha = 4\alpha$
Period 2	2,6	A,B	$\alpha + \alpha = 2\alpha$
Period 3			
Period 4			



Hierarchical Model	Harvest	Build	Cost
Period 1	1,5	A,B	$2\alpha + 2\alpha = 4\alpha$
Period 2	2,6	A,B	$\alpha + \alpha = 2\alpha$
Period 3	3,7	A,B	$\alpha + \alpha = 2\alpha$
Period 4			



Hierarchical Model	Harvest	Build	Cost
Period 1	1,5	A,B	$2\alpha + 2\alpha = 4\alpha$
Period 2	2,6	A,B	$\alpha + \alpha = 2\alpha$
Period 3	3,7	A,B	$\alpha + \alpha = 2\alpha$
Period 4	4,8	A,B	$\alpha + \alpha = 2\alpha$

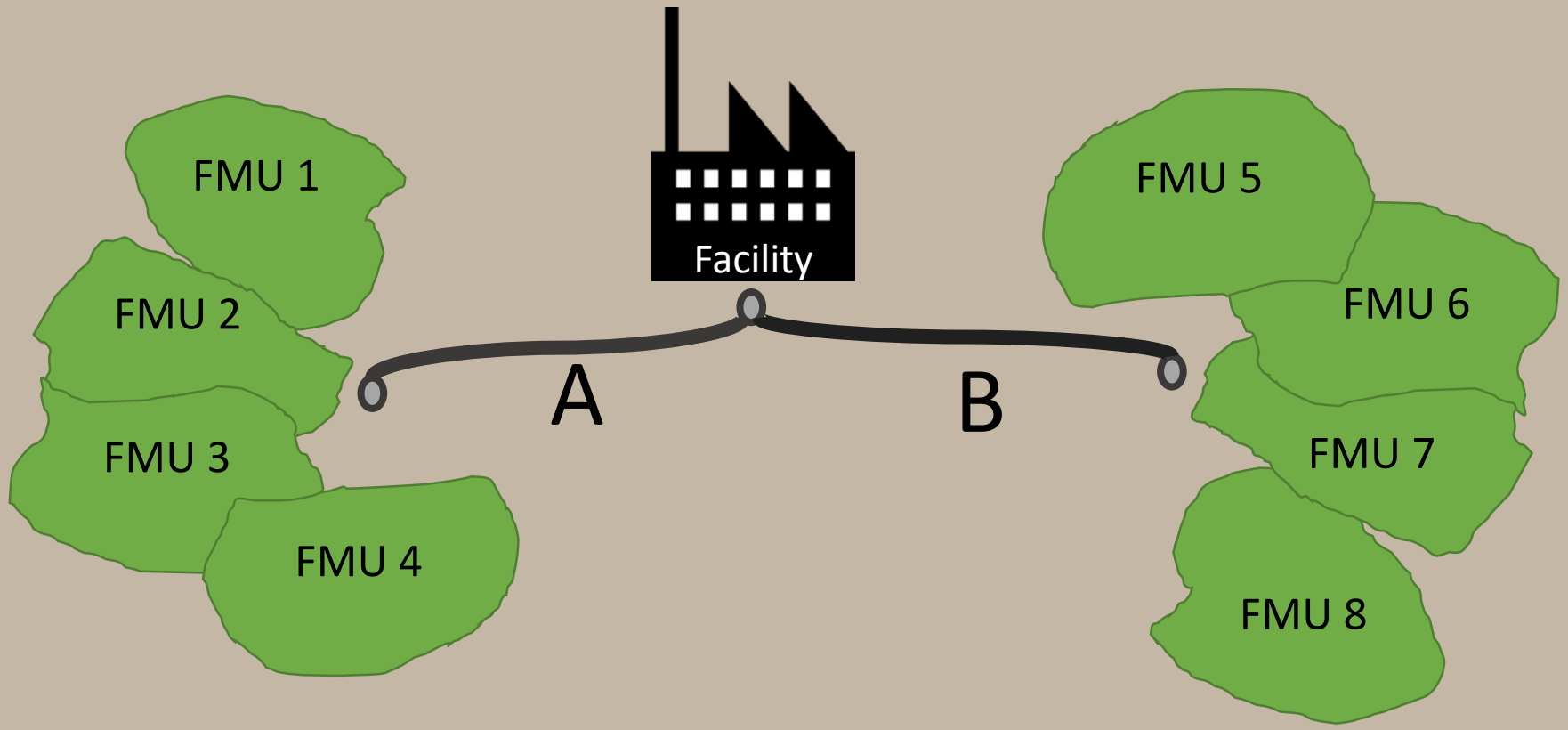


Total: 10α

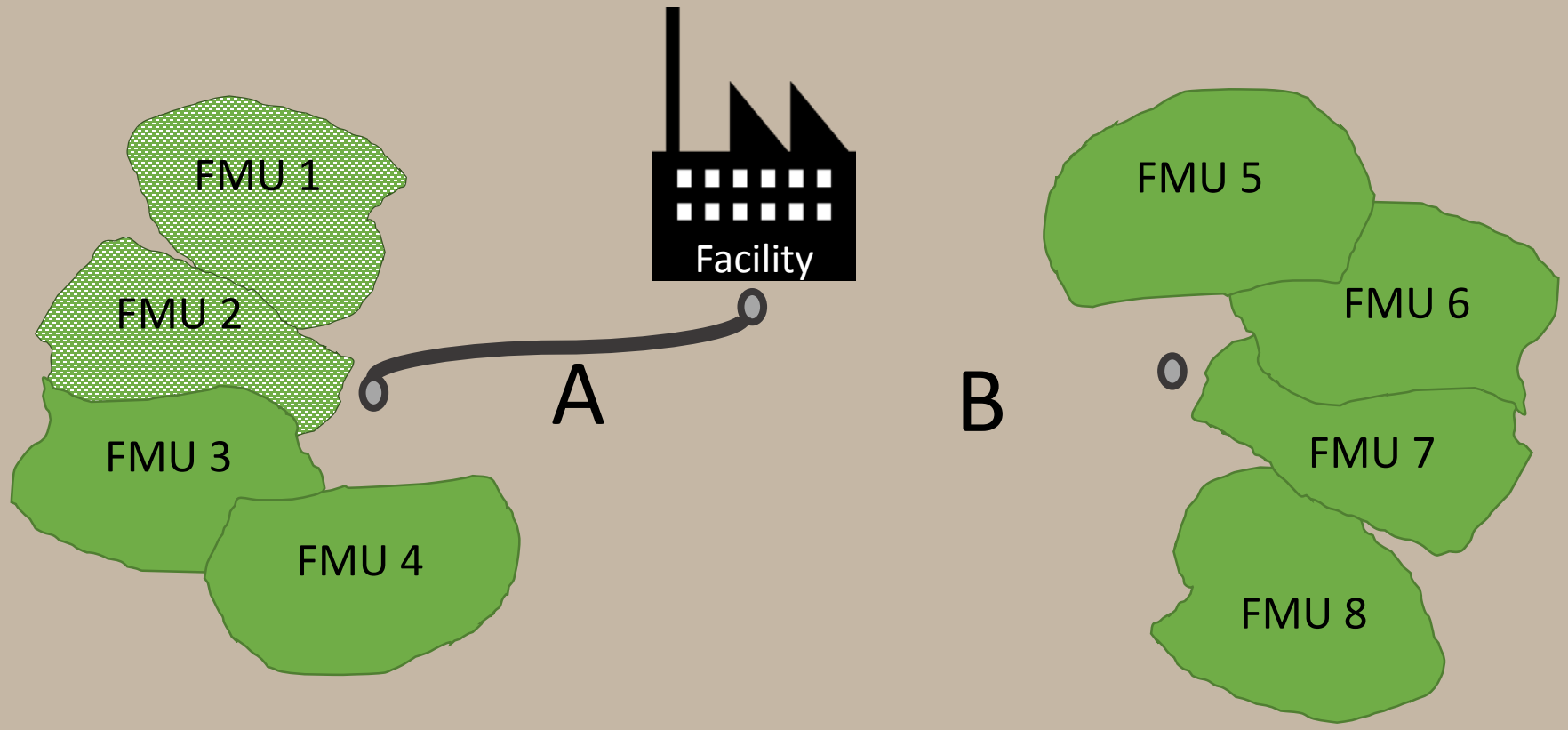
Hierarchical Model	Harvest	Build	Cost
Period 1	1,5	A,B	$2\alpha + 2\alpha = 4\alpha$
Period 2	2,6	A,B	$\alpha + \alpha = 2\alpha$
Period 3	3,7	A,B	$\alpha + \alpha = 2\alpha$
Period 4	4,8	A,B	$\alpha + \alpha = 2\alpha$

Fixed Cost Scenario

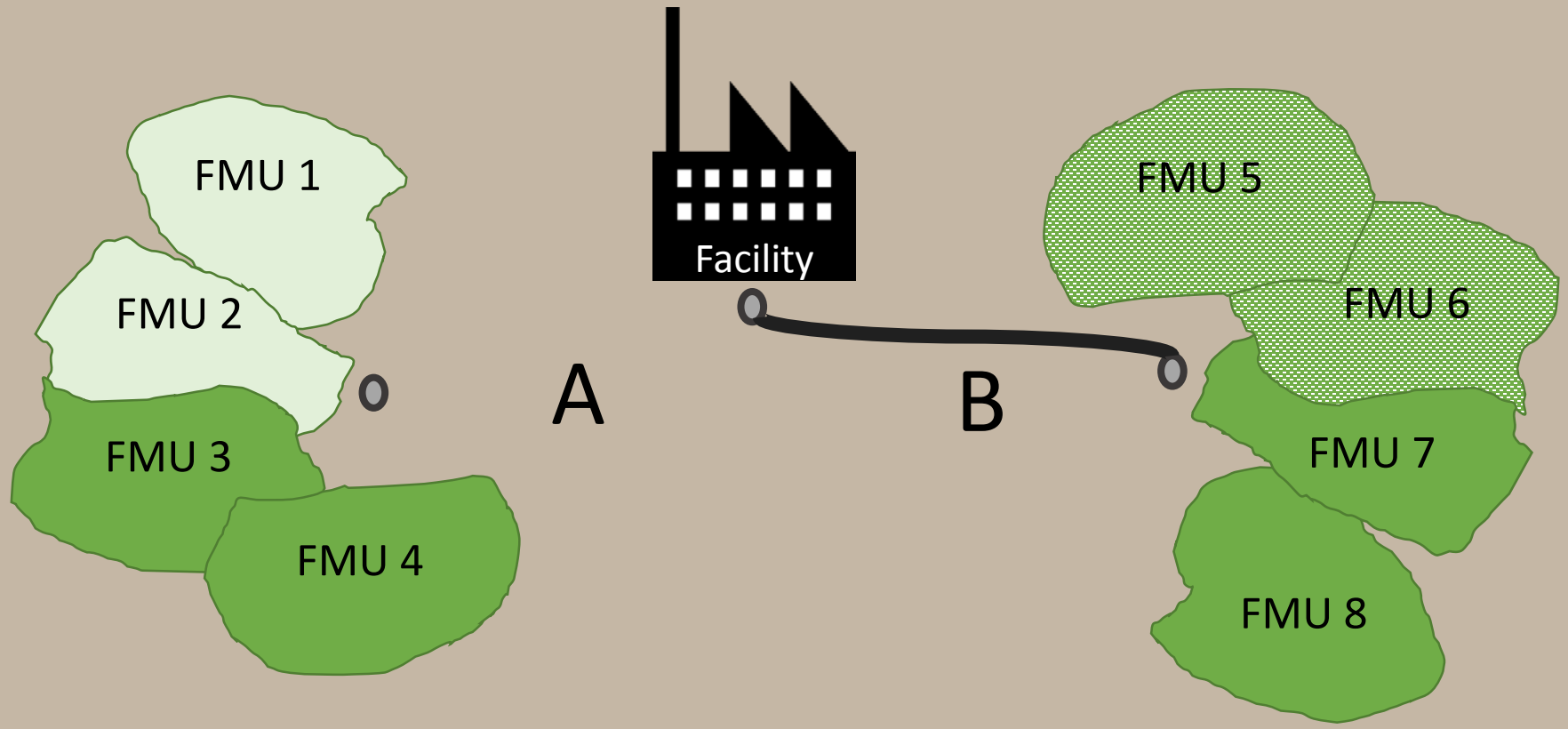
“text book”



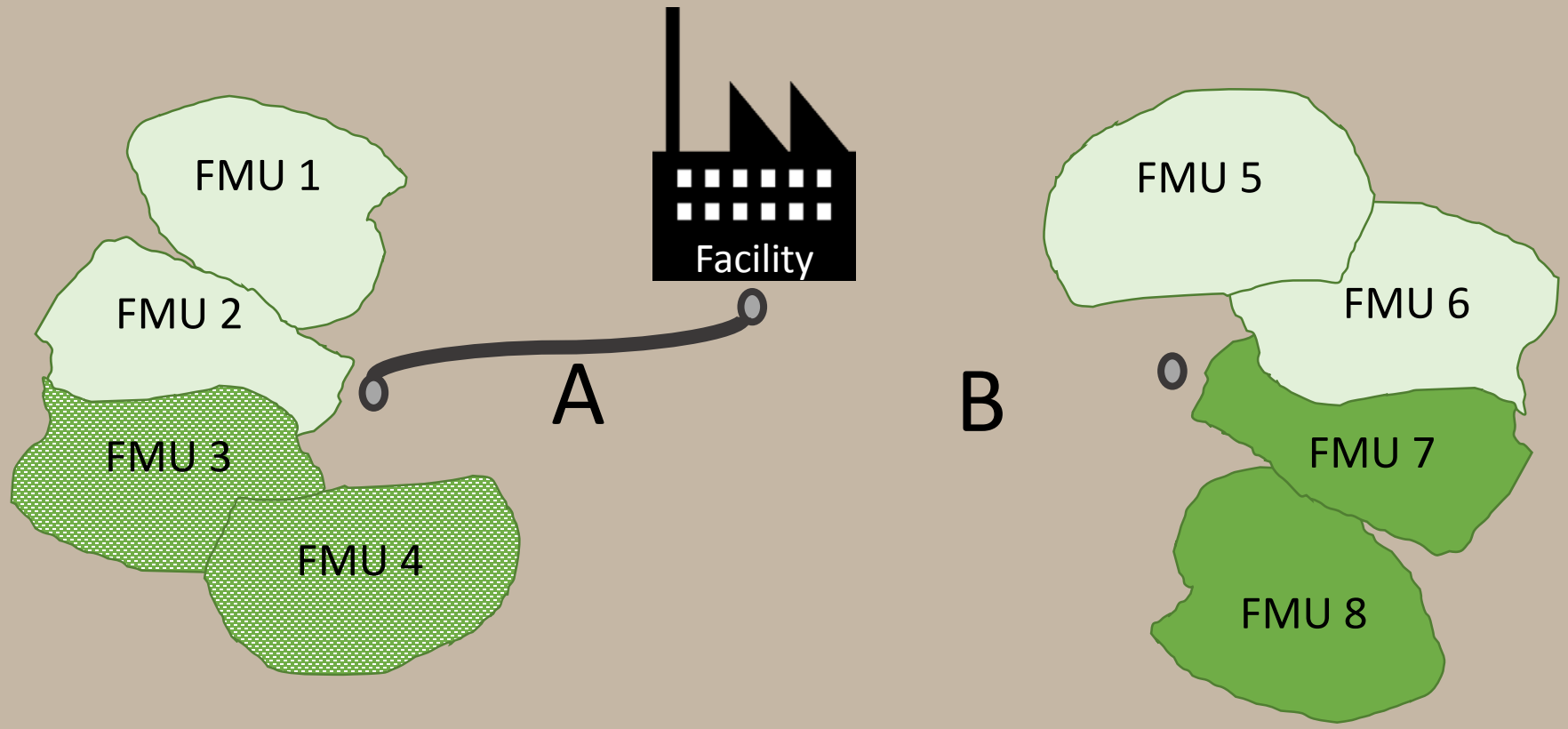
FCP Model	Harvest	Build	Cost
Period 1			
Period 2			
Period 3			
Period 4			



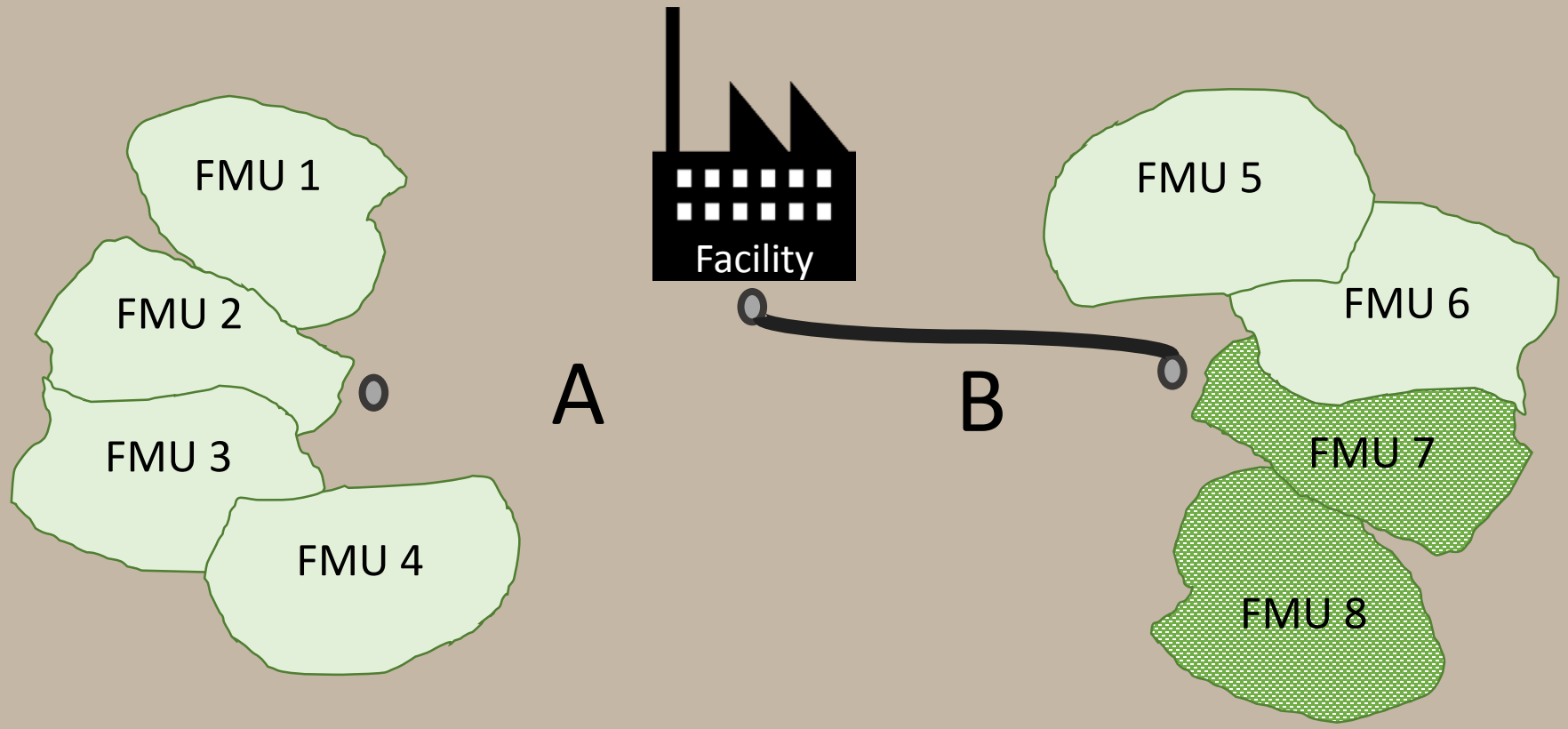
FCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2			
Period 3			
Period 4			



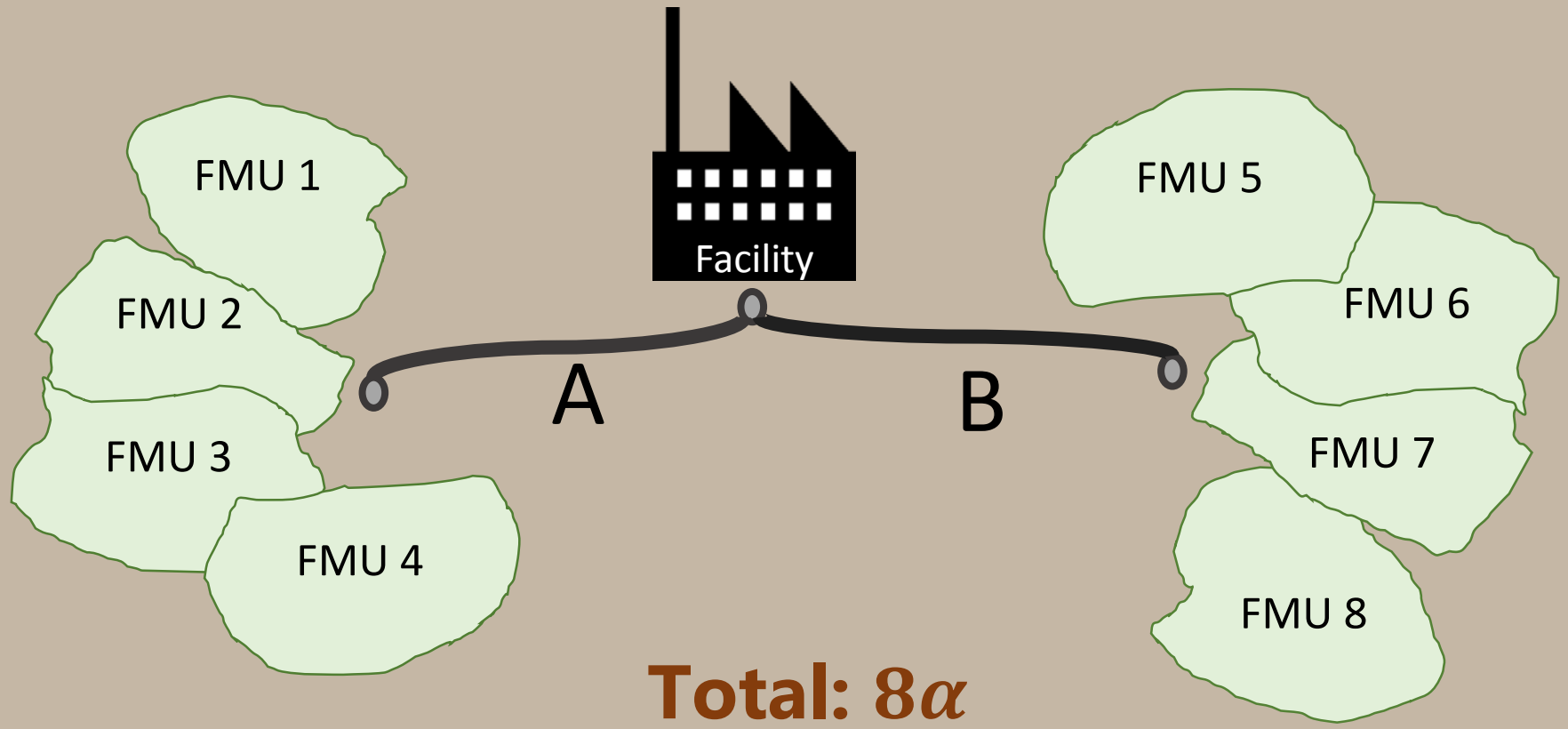
FCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2	5,6	B	2α
Period 3			
Period 4			



FCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2	5,6	B	$2\alpha 5$
Period 3	3,4	A	2α
Period 4			



FCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2	5,6	B	2α
Period 3	3,4	A	2α
Period 4	7,8	B	2α

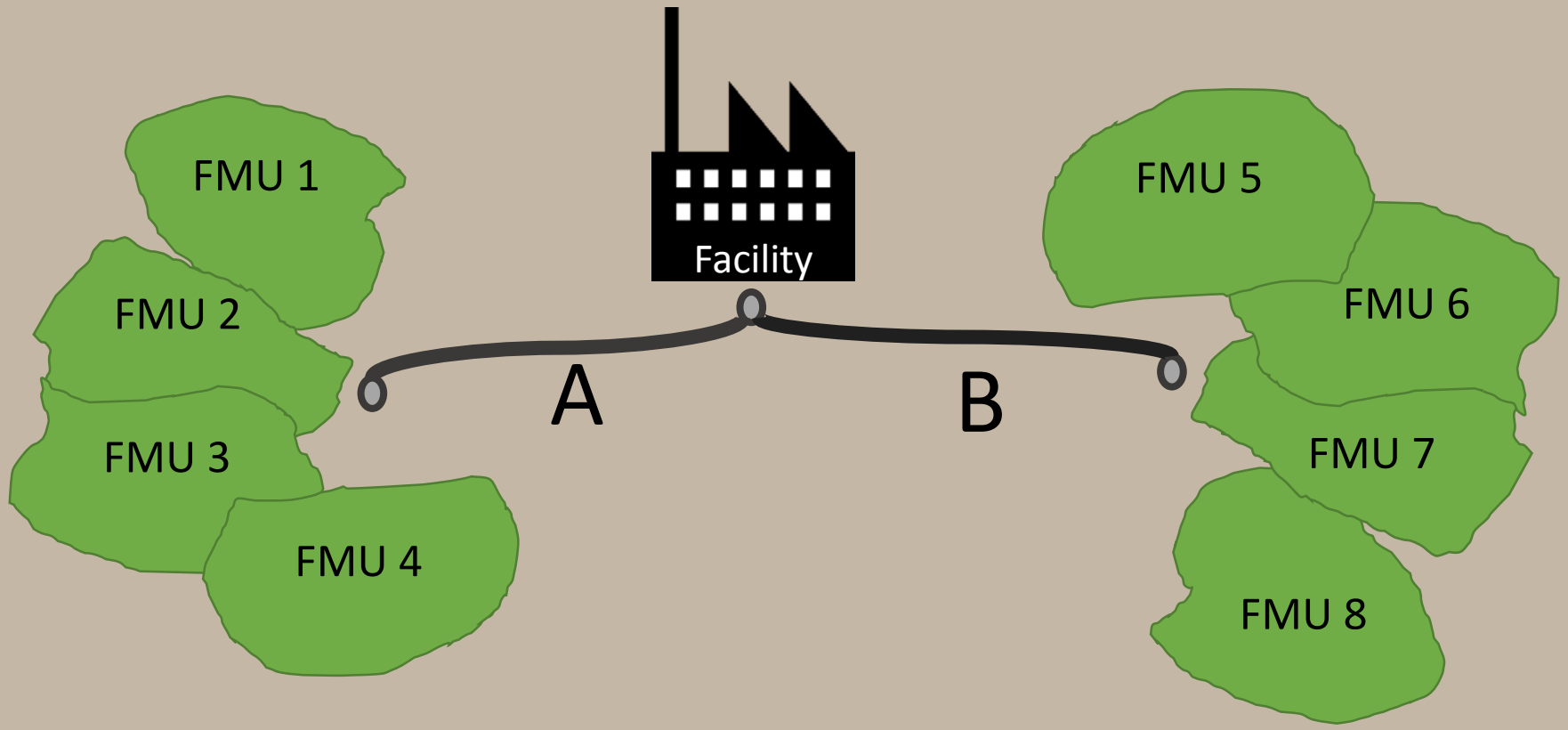


Total: 8α

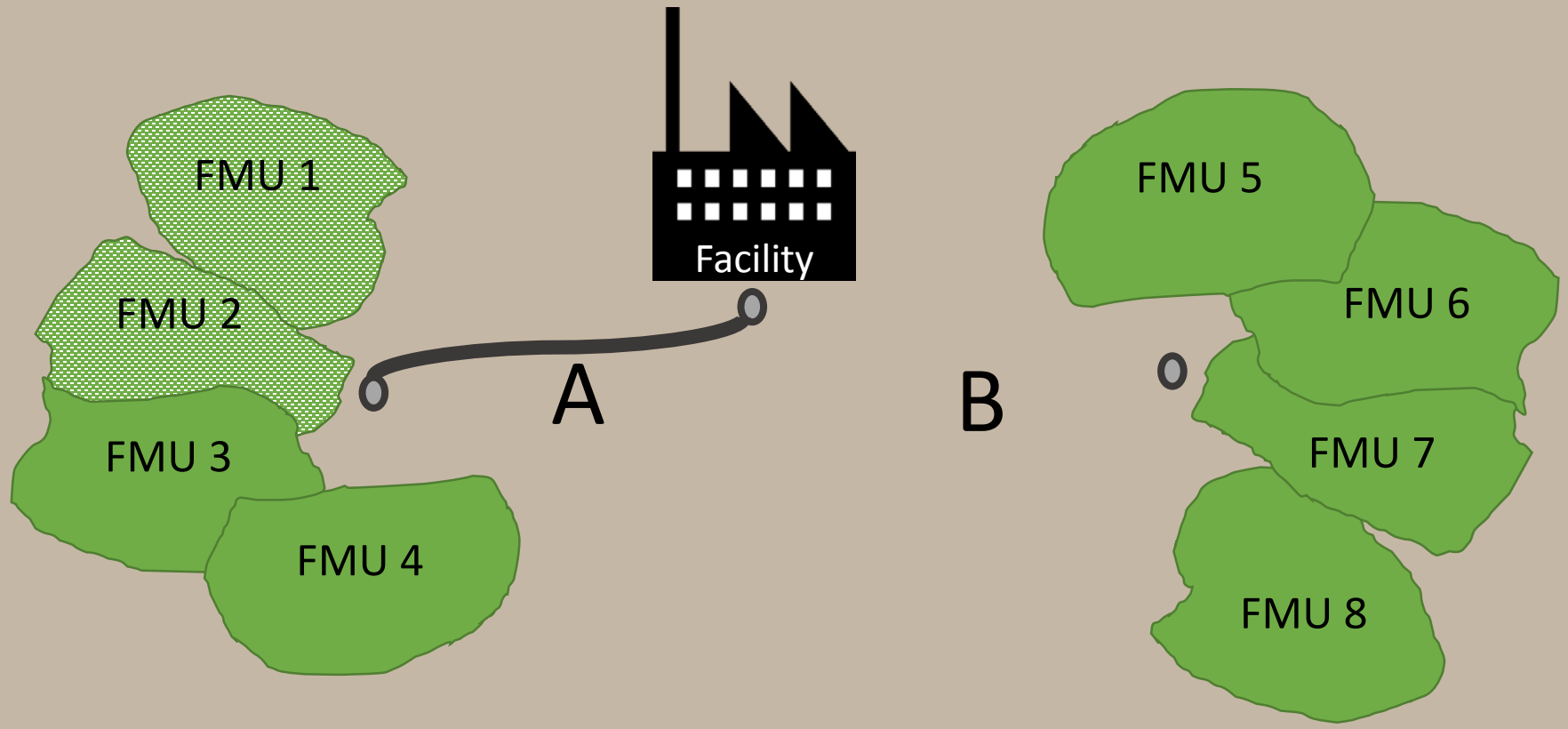
FCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2	5,6	B	2α
Period 3	3,4	A	2α
Period 4	7,8	B	2α

EFC Model

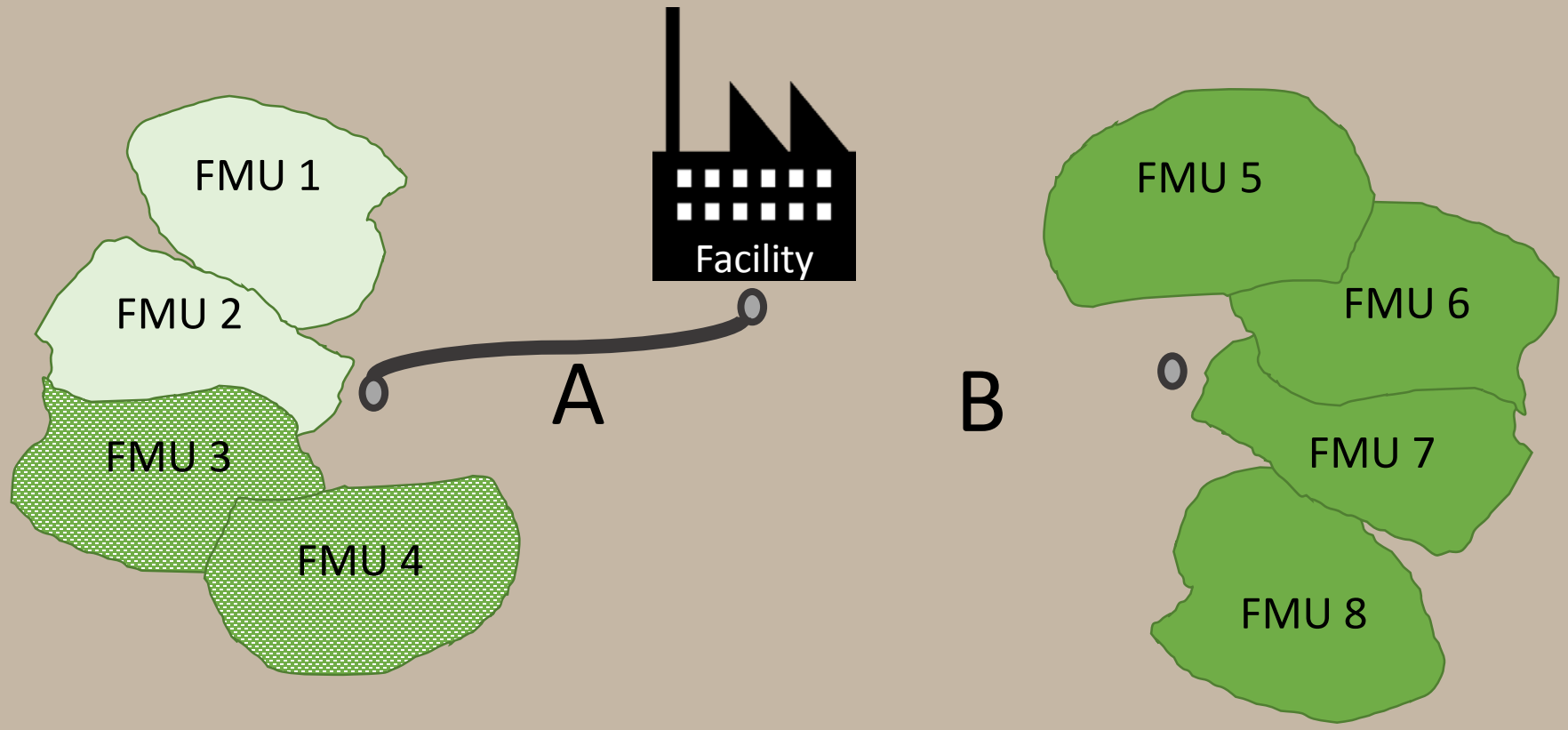
"best avail science"



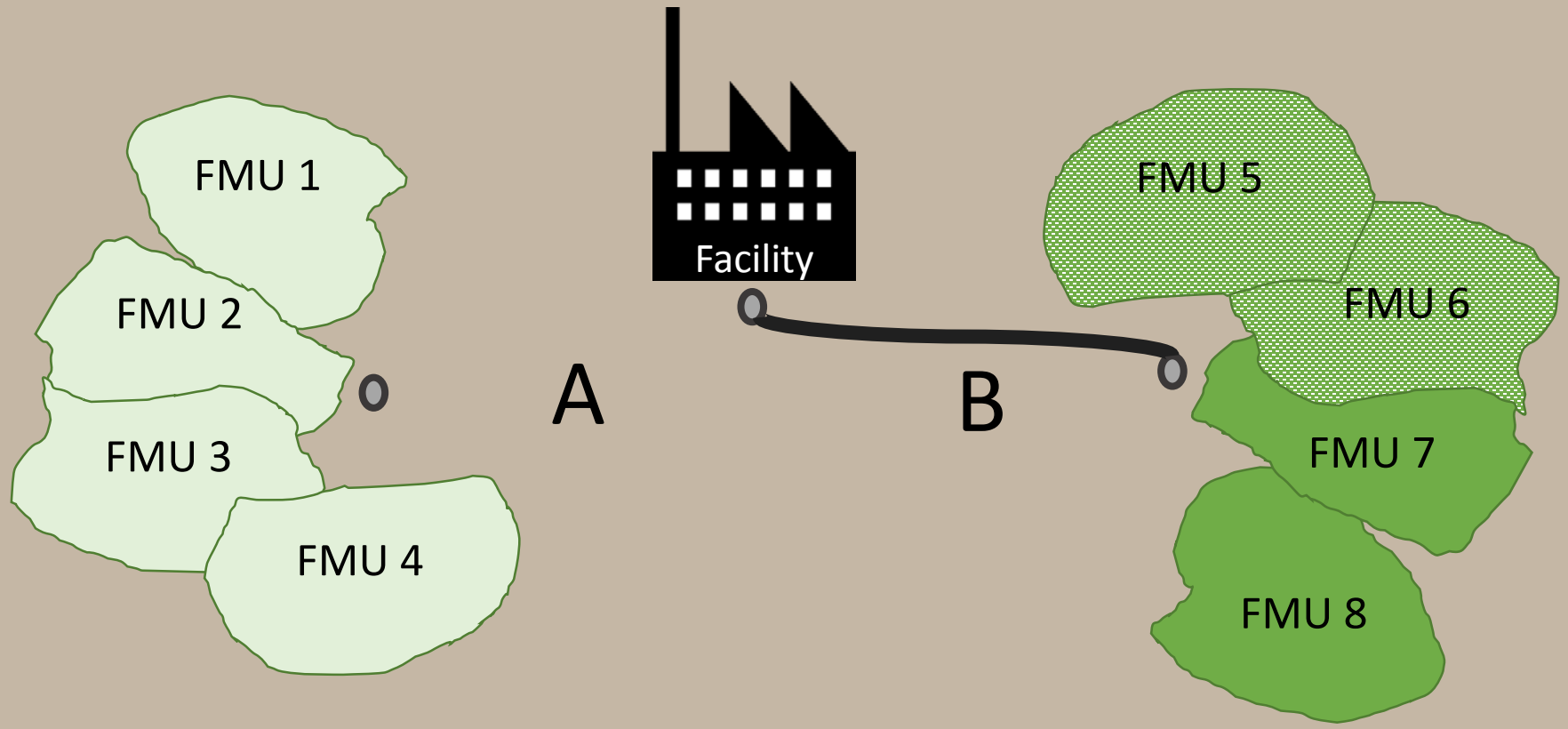
EFCP Model	Harvest	Build	Cost
Period 1			
Period 2			
Period 3			
Period 4			



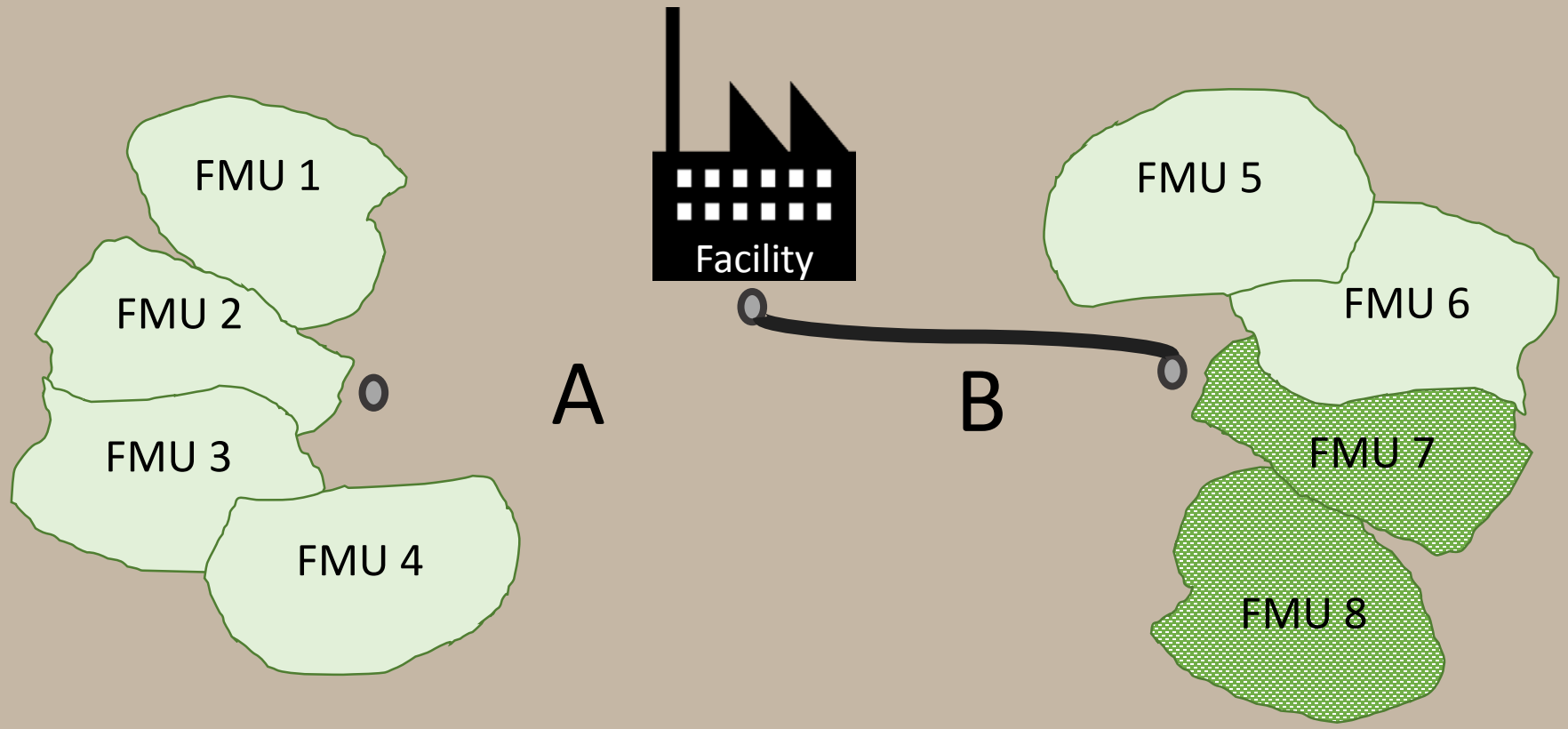
EFCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2			
Period 3			
Period 4			



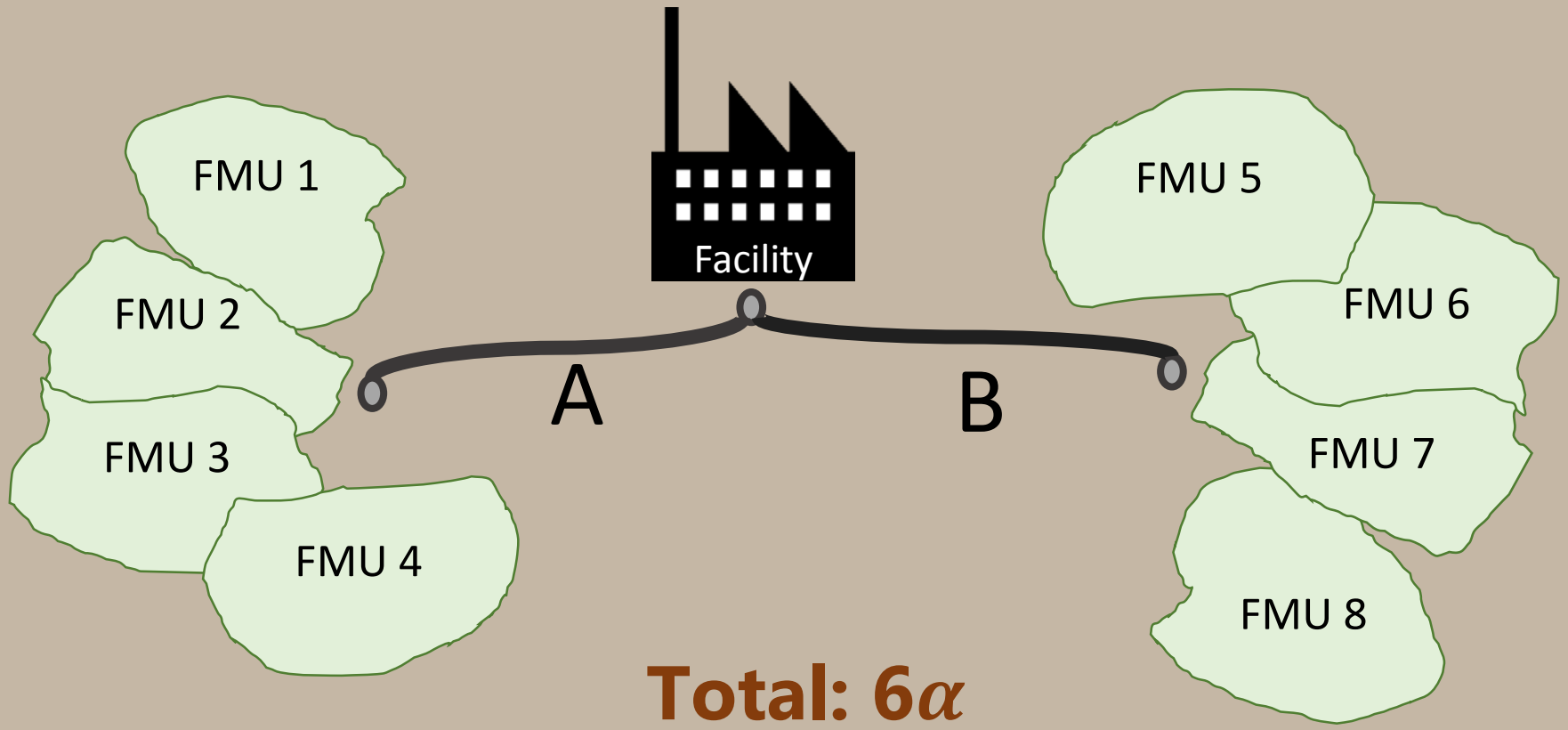
EFCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2	3,4	A	α
Period 3			
Period 4			



EFCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2	3,4	A	α
Period 3	5,6	B	2α
Period 4			



EFCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2	3,4	A	α
Period 3	5,6	B	2α
Period 4	7,8	B	α



Total: 6α

EFCP Model	Harvest	Build	Cost
Period 1	1,2	A	2α
Period 2	3,4	A	α
Period 3	5,6	B	2α
Period 4	7,8	B	α

Case Study

Team Members

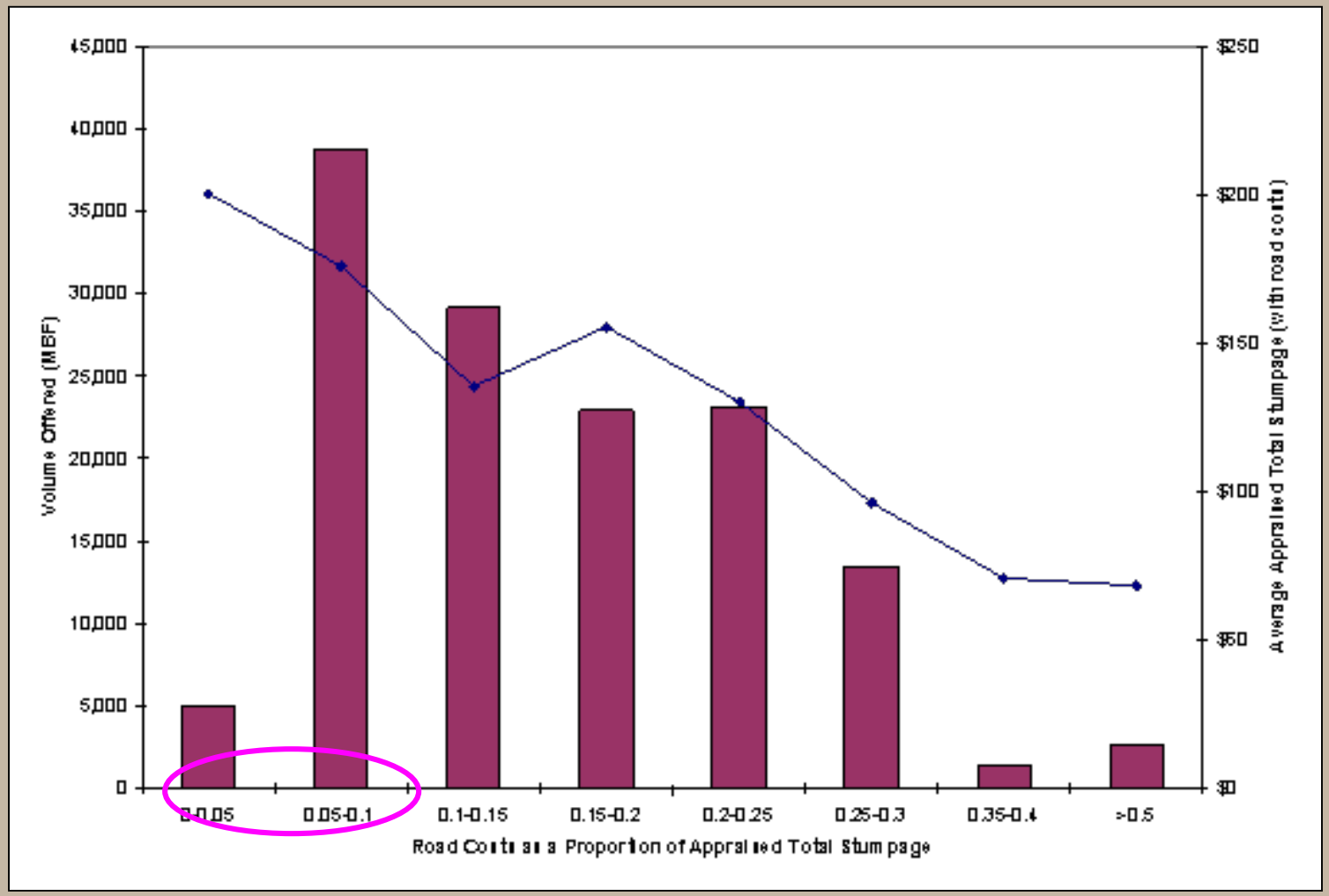
- Project Lead: Weikko Jaross, DNR
- PhD Candidate: Kai Ross, UW now CFS
- Programmer: Kevin Cedar, CFS
- Guru: Sandor Tóth, UW

Improving the Financial Outlook

Several key parameters…

- Stumpage
- Management Costs
- Road reconstruction

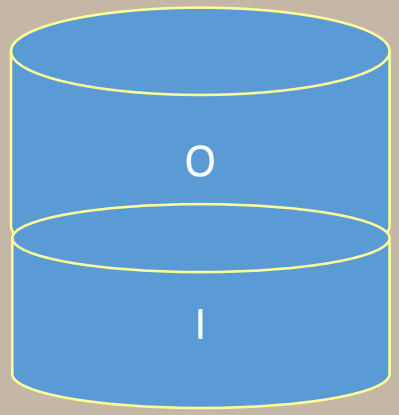
Road Costs vs. Stumpage



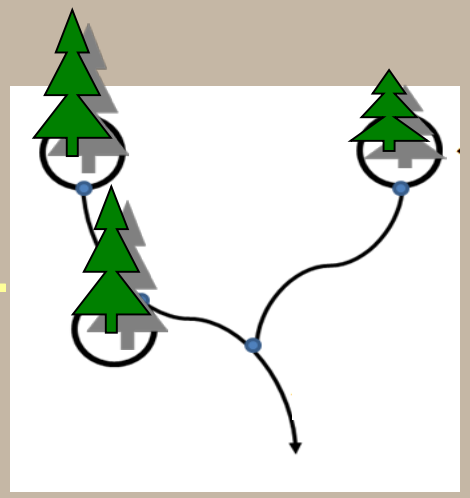
The BUILDER Concept

Woodstock

Solver Domain



Relational Database



Road Network

Findings

- Improved NPV
- 15% reduction in roads

Benefits to DNR

- Effective relations with UW
- Leading role in the industry
- Improved planning information
- Improved financial tools

Happy Ending

INTERFACES

JOURNAL HOME | ABOUT | ISSUES | ARTICLES IN ADVANCE | FOR AUTHORS | CONTACT | Enter Sea

YOU ARE HERE: Home > Interfaces > All Issues > Articles in Advance > Forest Harvest Schedulin...

Prev Next

Article Tools

- Add to Favorites
- Email to a Colleague
- Download Citation
- Track Citations
- Permissions

Article Metrics
(full-text views and PDF downloads over the previous

Forest Harvest Scheduling with Endogenous Road Costs

Kai L. Ross
Cramer Fish Sciences, Issaquah, Washington 98027

Sándor F. Tóth
University of Washington, Seattle, Washington 98195

Weikko S. Jaross
Washington State Department of Natural Resources, Olympia, Washington 98501

Permalink: https://doi.org/10.1287/inte.2017.0926
Received: February 9, 2015
Accepted: May 23, 2017
Published Online: March 26, 2018

WASHINGTON DEPARTMENT OF NATURAL RESOURCES