Sustainability Analysis of Zn-Ni Plating and Alternatives at Fleet Readiness Center Southeast

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Agenda

I. Description of need/problem

II. Sustainability Analysis Overview

III. System Boundary

IV. Inventory

V. Results - Cost

VI. Results - Impacts

VII. Sensitivity

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Statement of problem and need

- Need to understand cost over life cycle and ESOH impacts of switch to Zn-Ni from Cd electroplating
- OSD benefit:
  - Test SA method and avoid burden-shifting throughout portfolio
- FRCSE benefit:
  - high level picture of benefits and drawbacks (cost, quantitative, and qualitative) for new line.
  - Can communicate results up the command chain (e.g., build business case)

LHE Zn-Ni Plating at Hill AFB.
Source Final Report ESTCP Project WP-201107

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Method of analysis

Sustainability Analysis = LCC + LCA

Internal costs
Total cost for use (and disposition)
Compatible with DoD cost structures

External costs
Environmental impacts
Indicators of potential future liabilities

Department of Defense Guidance

Sustainability Analysis Guidance:

Integrating Sustainability into Acquisition Using Life Cycle Assessment

Version 5.0 – Current Version

December 2016

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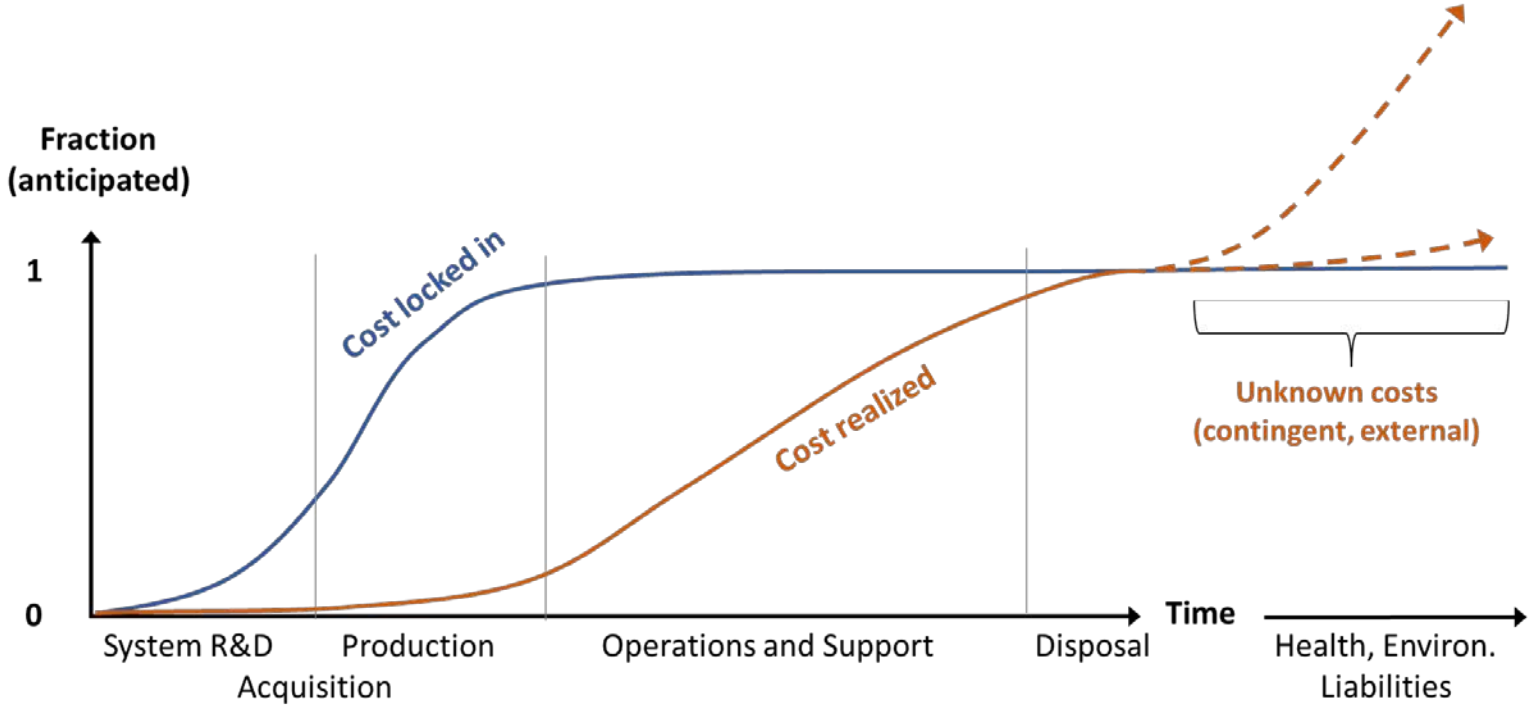
Costs are locked in early



There is a need to capture LCC comprehensively during system R&D

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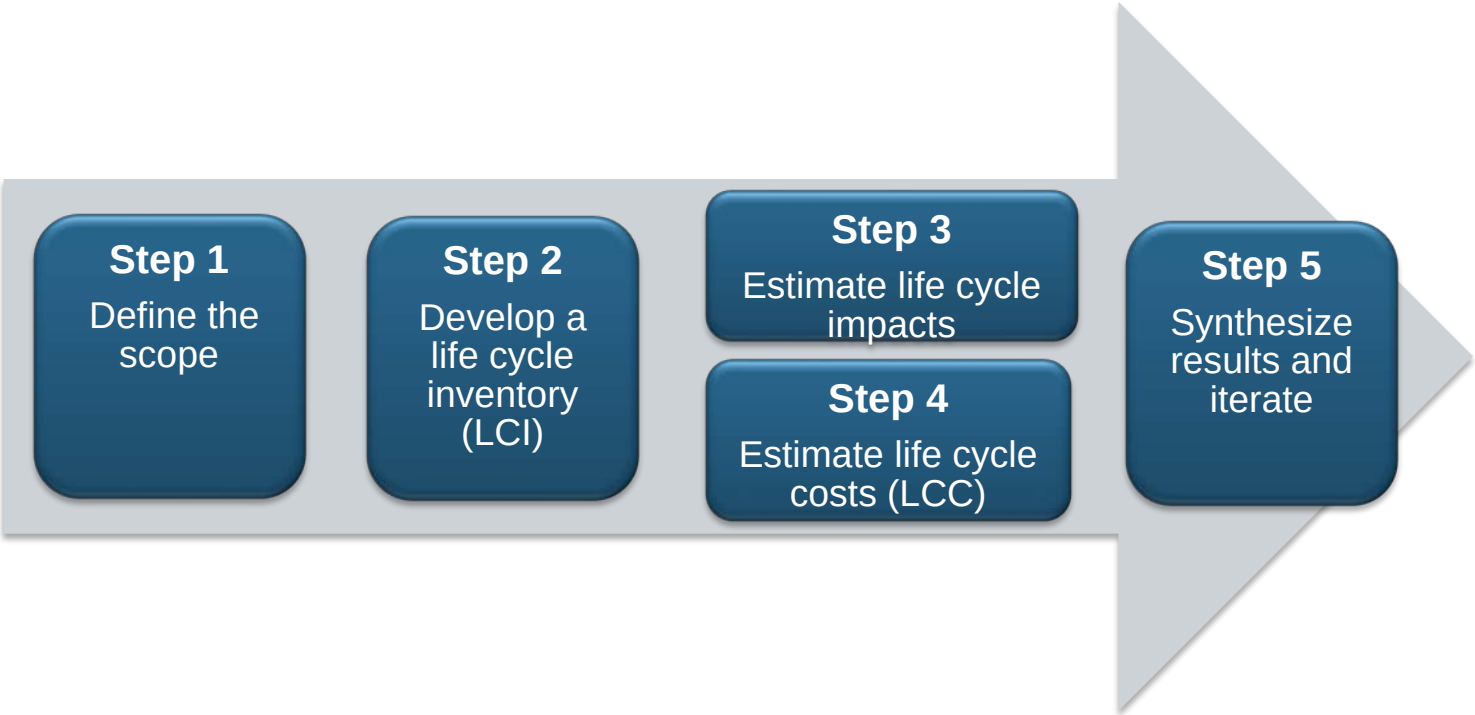
Steps for analysis



Sustainability Analysis is a 5-step process

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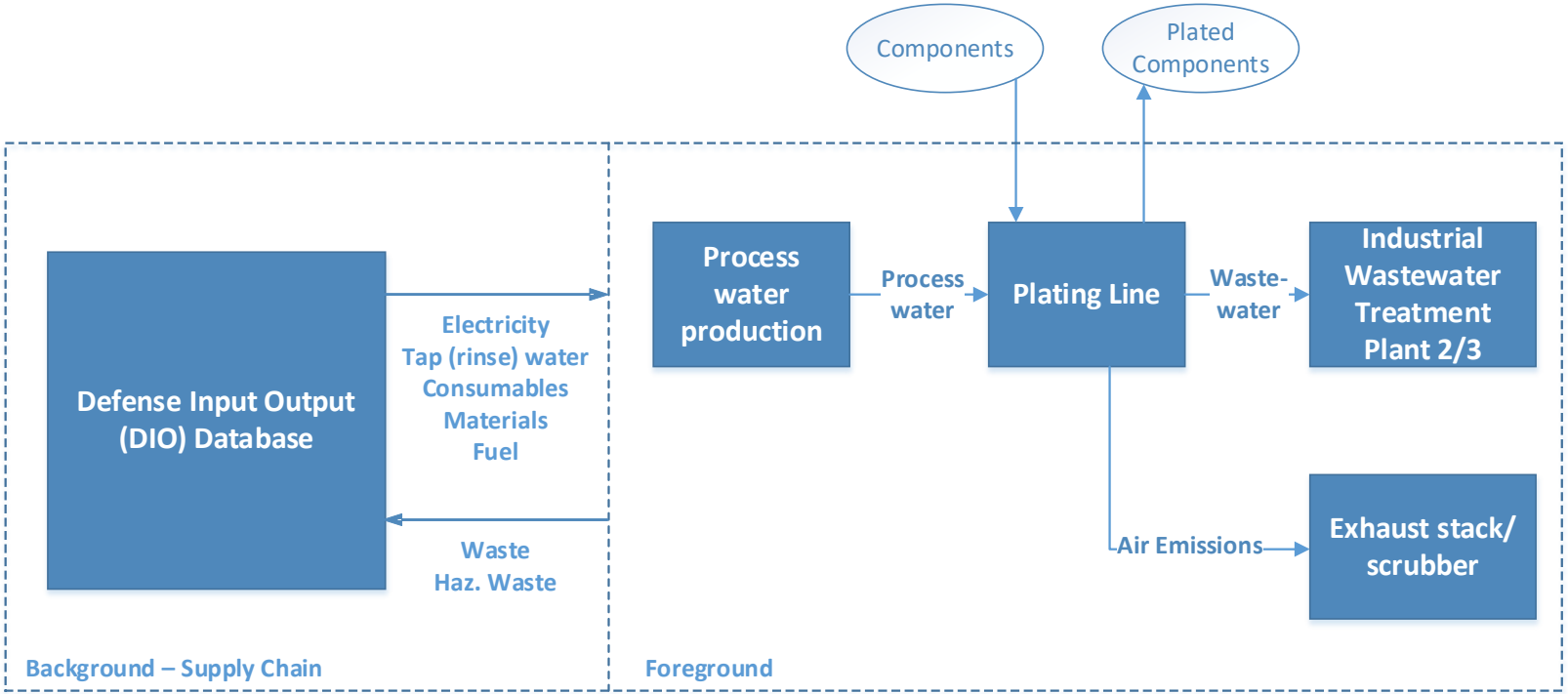
Scope and basis of comparison



Costs and environmental impacts are compared per ft^2 of plating over a 15-year line life span. The analysis system boundary includes the plating line, support infrastructure, and the DoD supply chain.

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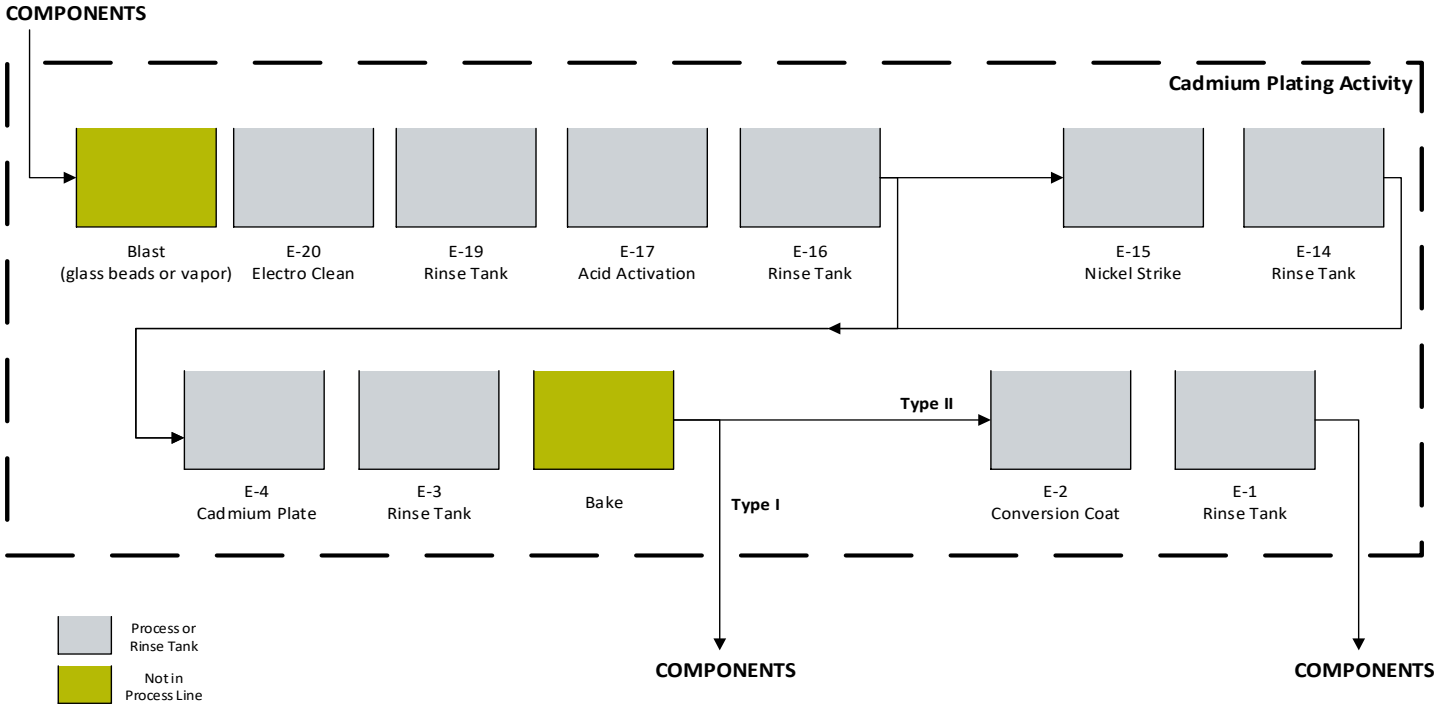
Plating line: Cd baseline



The baseline includes a 15-year lifespan; capital costs associated with line installation are sunk. Inputs and outputs for components with and without post-treatment are included.

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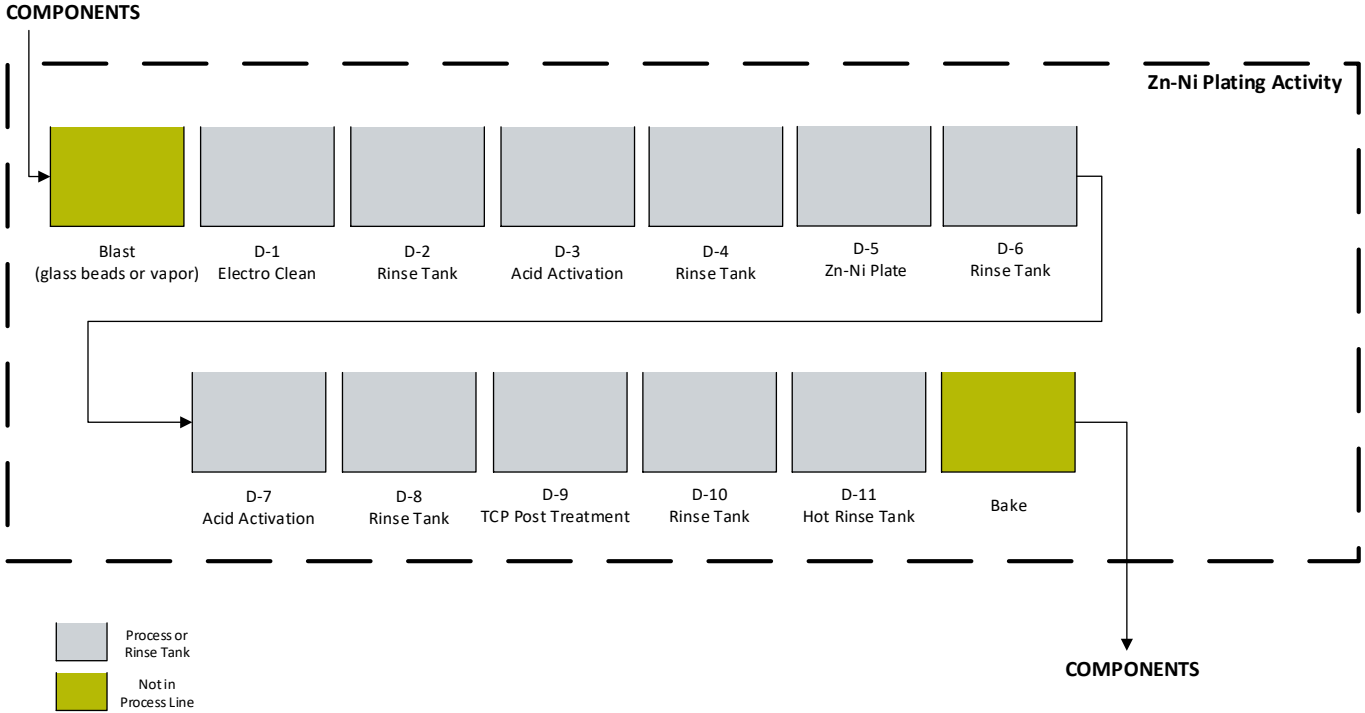
Plating line: Zn-Ni alternative



The Zn-Ni alternative includes a 15-year lifespan and capital costs associated with line installation. Additionally, high and low labor estimate scenarios were included.

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Inventory example

Annual cost

Annual amount used

Link to DIO (supply chain)

Description	Annual Use	Units	Cost	Cost - per amount	Cost - per units	Cost per year	NAICS activity, process activity, elementary flow	Data Source(s)	Notes
Cadmium ball anodes (Tank E-4)	1.0	kg/yr	$ 650.00	1	kg	$ 650	332812 Metal Coating, Engraving (except Jewelry and Silverware), and	OO ALC Zn-Ni line	Data from estimate for line at OO-ALC. Per Alibaba, `$650 per kilogram. Standard = 1 Kg
Sodium dichromate (Tank E-2)	1.7	lb/yr	$ 326.74	100	lb	$	325188 All Other Basic Inorganic Chemical Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018. Cost given by FRCSE.
Sulfuric acid (Tank E-2)	6.0	gal/yr	$ 210.00	6.5	gal	$ 194	325188 All Other Basic Inorganic Chemical Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Assumed same amount used as in tank E-17. Cost given by FRCSE.
Cadmium oxide (Tank E-4)	48.6	lb/yr	$ 225.16	1	lb	$ 10,936	325188 All Other Basic Inorganic Chemical Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018. Cost provided by OO-ALC.
Sodium cyanide (Tank E-4)	552.0	lb/yr	$ 3.00	1	lb	$ 1,656	325188 All Other Basic Inorganic Chemical Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018. Cost provided by OO-ALC.
Sodium carbonate (Tank E-4)	11.4	lb/yr	$ 15.00	1	lb	$ 171	325188 All Other Basic Inorganic Chemical Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018. Cost based on professional judgement
Sodium Hydroxide (Tank E-4	64.6	lb/yr	$ 2.30	1	lb	$ 149	325188 All Other Basic Inorganic Chemical Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018. Cost provided by OO-ALC.
SNR-24 (Tank E-15)	0.5	gal/yr	$ 40.00	1	gal	$ 20	325188 All Other Basic Inorganic Chemical Manufacturing	Noblis estimate, FRCSE; Plating shop chemical forecast data (12	Noblis estimate. Chemicals added to tanks between January 2015 and June 2018. Cost based on professional judgement
Barret SNAC (Tank E-15)	3.7	lb/yr	$ 15.00	1	lb	$ 56	325188 All Other Basic Inorganic Chemical Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018. Cost based on professional judgement
Hydrochloric Acid (Tank E-15)	1.1	gal/yr	$ 30.00	1	gal	$ 34	325181 Alkalies and Chlorine Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018. Cost based on professional judgement
Boric Acid (Tank E-15)	0.5	gal/yr	$ 298.11	25	lb	$	325188 All Other Basic Inorganic Chemical Manufacturing	Noblis estimate. FRCSE; Plating shop chemical forecast data (12	Noblis estimate. Chemicals added to tanks between January 2015 and June 2018. Cost given by FRCSE.
Sulfuric acid (Tank E-17)	24.1	gal/yr	$ 210.00	6.5	gal	$ 780	325188 All Other Basic Inorganic Chemical Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018. Cost given by FRCSE.
Sodium Hydroxide (Tank E-20)	300.0	lb/yr	$ 2.30	1	lb	$ 690	325181 Alkalies and Chlorine Manufacturing	FRCSE; Plating shop chemical forecast data (12 Month).xlsx	Chemicals added to tanks between January 2015 and June 2018
Rinse water influent	4.38E+06	gal/yr						ZnNi Cd Baseline Information v1b.xlsx	Preliminary calculation to update

Each modeled activity captures inputs, outputs, cost, and link to supply chain

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Summarized data for comparison and communication

Item (annual, assuming equivalent coating area)	Cd	Zn-Ni
Lbs Cd used at FRCSE	45	0
Process chemicals consumed	$ 9,400	$ 3,400
Labor (man-hours)	830	530 - 830

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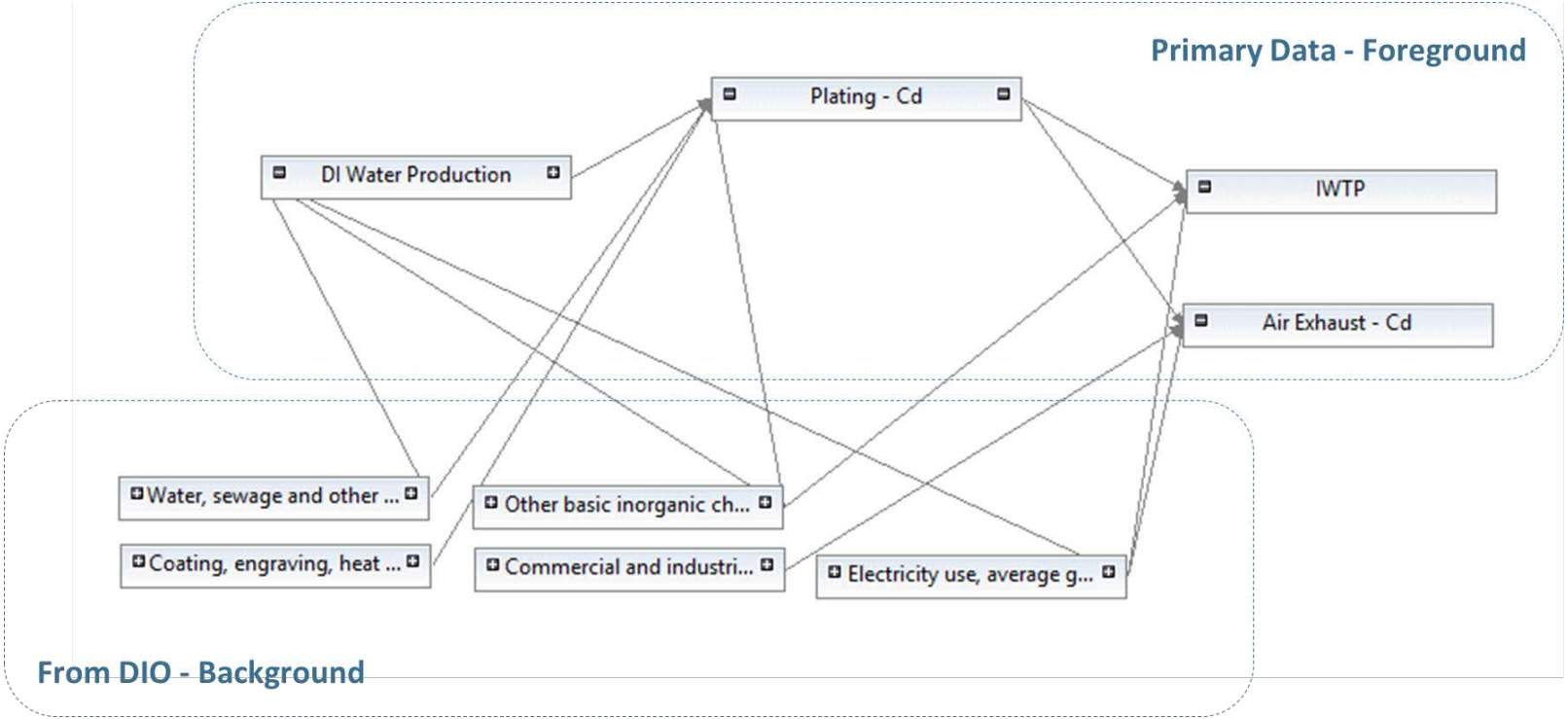
Process flow diagram, structured for LCA



Foreground data were collected from FRCSE, while background data from the Defense Input Output Database (DIO) were used.

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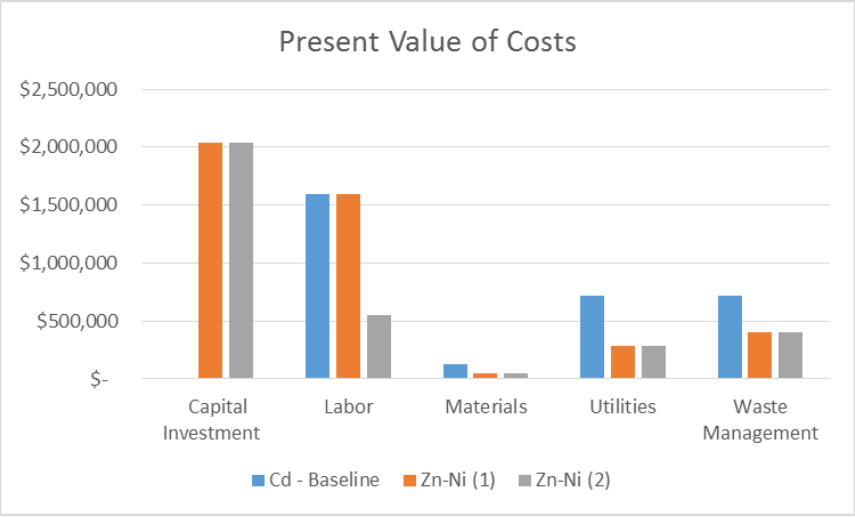
Life cycle costs (LCC)

	Cd - Baseline	Zn-Ni (1)	Zn-Ni (2)
Labor	$ 1,590,000	$ 1,590,000	$ 550,000
Materials	$ 880,000	$ 723,000	$ 723,000
Utilities	$ 717,000	$ 290,000	$ 290,000
Waste Management	$ 722,000	$ 403,000	$ 403,000
Capital Investment	$ -	$ 2,040,000	$ 2,040,000



Labor and capital investment are cost drivers

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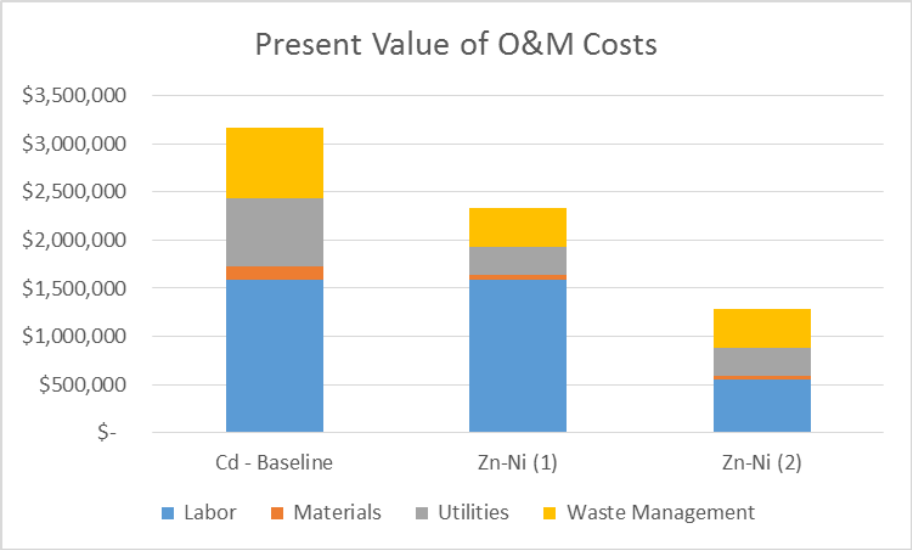
LCCs and O&M costs

Summary of LCCs

	Cd - Baseline	Zn-Ni (1)	Zn-Ni (2)
PV of Investment Costs			
Equipment & Materials	$ -	$ 1,387,000	$ 1,387,000
Labor	$ -	$ 500,000	$ 500,000
Waste Management	$ -	$ 150,000	$ 150,000
Total Investment	$ -	$ 2,037,000	$ 2,037,000
PV of Annual Costs			
Labor	$ 1,592,877	$ 1,592,877	$ 550,335
Materials	$ 129,087	$ 46,342	$ 46,342
Utilities	$ 717,087	$ 290,103	$ 290,103
Waste Management	$ 722,501	$ 403,253	$ 403,253
Total Recurring	$ 3,161,552	$ 2,332,575	$ 1,290,032
NPV	$ 3,161,552	$ 4,369,575	$ 3,327,032



Life cycle operating and maintenance costs are lower for Zn-Ni than Cd plating

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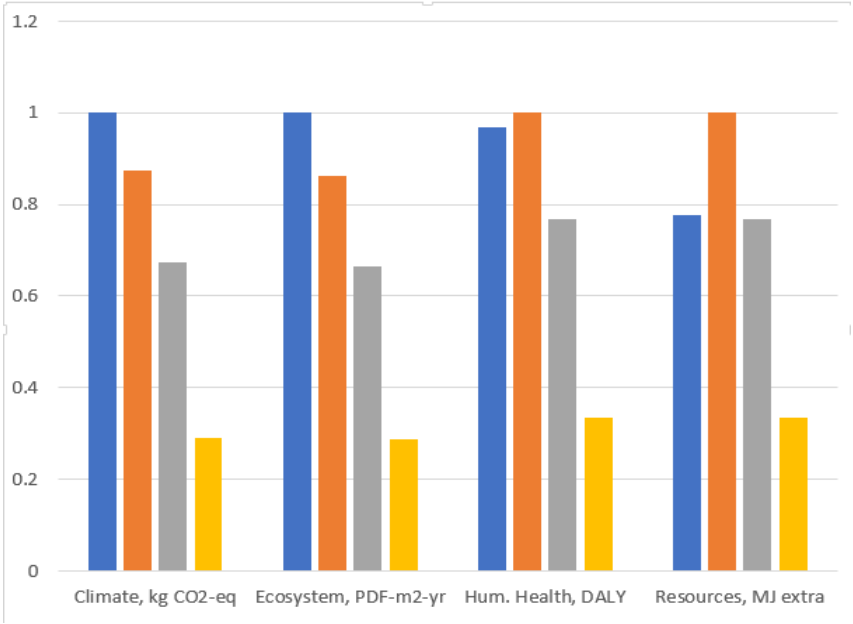
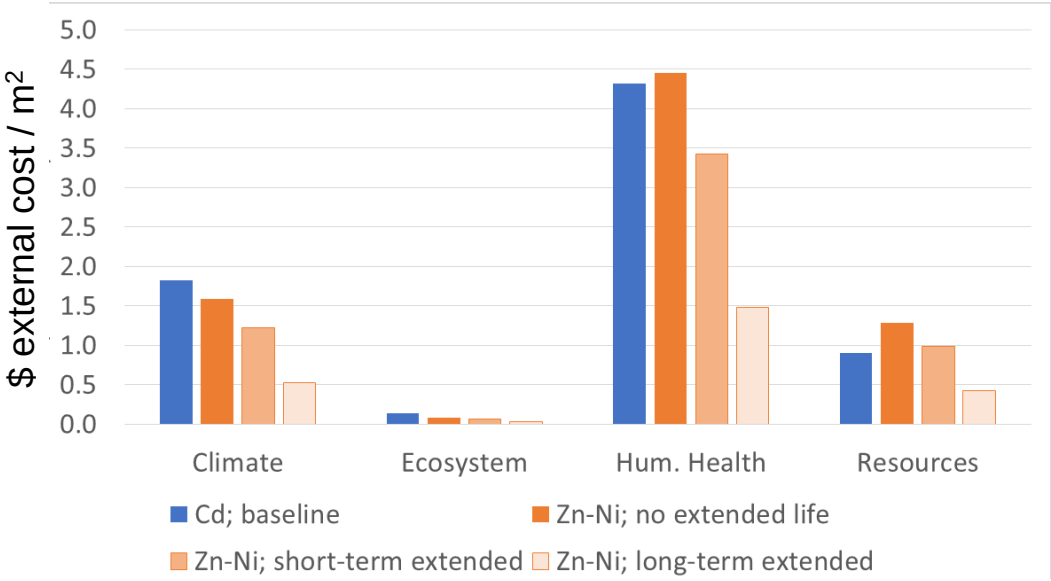
Life cycle impacts and external costs





Life cycle impacts increasingly improve the more corrosion data impact the maintenance cycle

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Conclusions

- Opportunities for improvement
  - Continue gathering data
  - Corrosion testing may indicate longer life of components or less frequent repair plating
  - Continue gathering data related to Cd reduction

- How can results be used?
  - Can communicate results up the command chain (e.g., build business case)
  - high level picture of benefits and drawbacks (cost, quantitative, and qualitative) for new line.

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Questions?

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