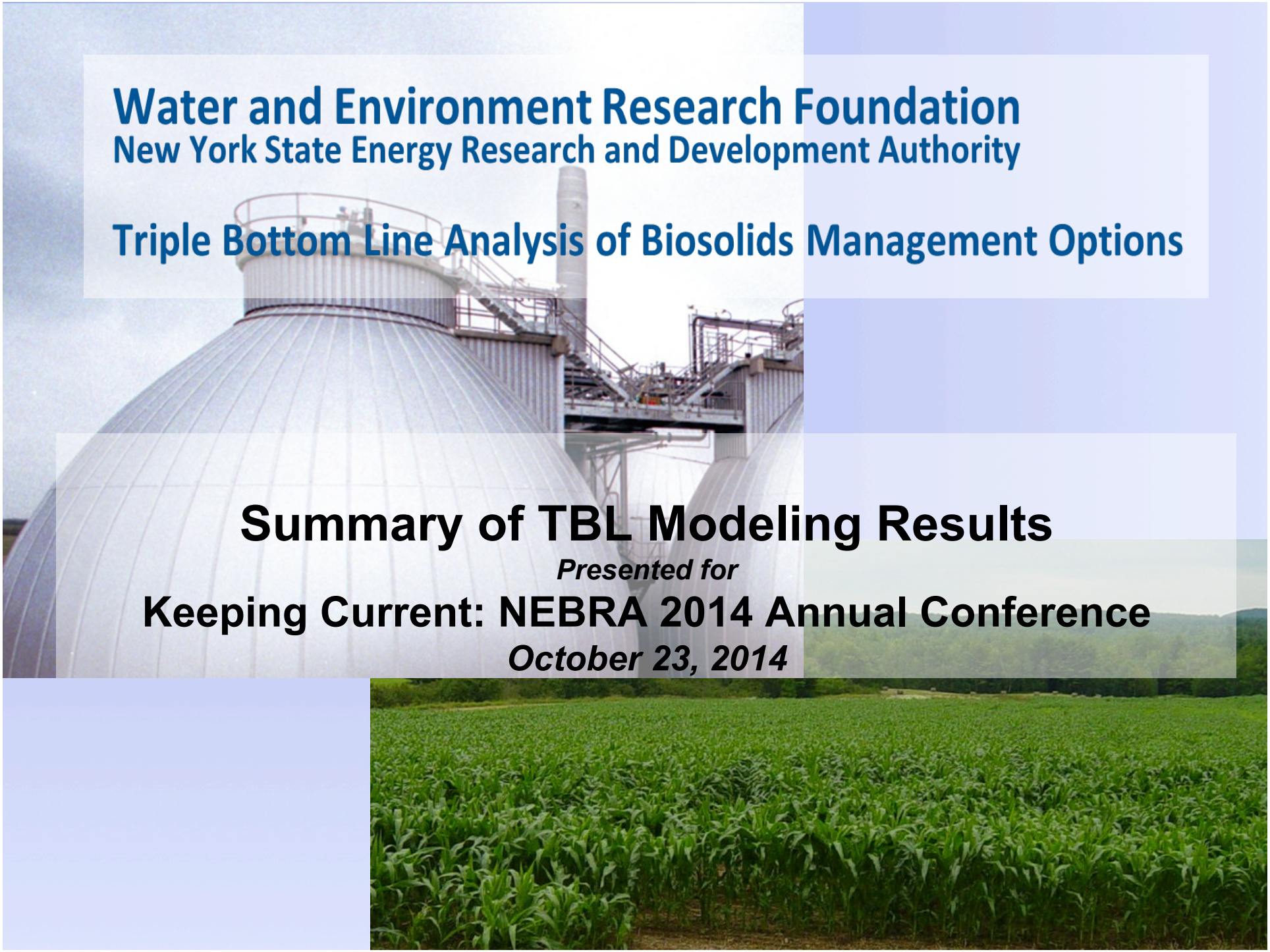


Water and Environment Research Foundation
New York State Energy Research and Development Authority

Triple Bottom Line Analysis of Biosolids Management Options

Summary of TBL Modeling Results

Presented for

Keeping Current: NEBRA 2014 Annual Conference

October 23, 2014

TBL Project Overview

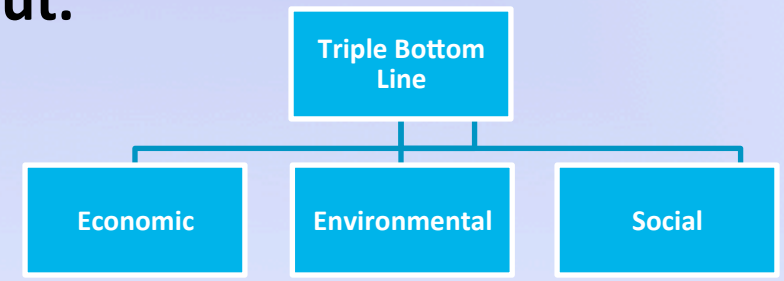
1. **Created a TBL Model**
    1. Literature review
    2. Spreadsheet model (to be delivered to WERF/NYSERDA)
    3. TBL process can be followed by others, using the new spreadsheet model as a starting point.
2. **Applied the TBL model – 2 example uses each comparing 6 biosolids management scenarios**
    1. for guiding research
    2. for utility decision-making
3. **Submitted Final Report earlier this week**

Why TBL?

- **Traditional focus is on *economic* bottom line**
- **Increasing industry focus on sustainable operations requires multi-criteria decision making**
- **TBL is a widely-understood approach for incorporating economic, environmental, and social criteria in an evaluation of the sustainability of an activity.**
  - Most often used for reporting on sustainability.
  - Also used for multi-criteria decision making.
- **TBL provides a structured, methodical evaluation of the social, environmental, & economic impacts of decisions.**
- **Focuses stakeholders on tangible, measurable differences**
- **Helps stakeholders evolve understanding and appreciation of different factors or criteria**

The new TBL for Analysis of Biosolids Options

- **Built from literature review (included in report appendix)**
- **Includes concepts & experiences of several TBL analyses in wastewater & biosolids management**
- **To be effective,**
  - Must be understood, adjusted, and applied by engaged, diverse stakeholders
  - Adapted to local situation
    - For the purposes of this model, we needed to use some generic, nation-wide assumptions
- **A TBL process is only as good as the inputs (assumptions and data), which must be determined with diverse stakeholder input.**



Criteria

- **The TBL model for analyzing biosolids management options includes recommended criteria**
  - Fewer is better
  - Use only criteria clearly useful in distinguishing between options being considered.
  - Our criteria selections are discussed in the report

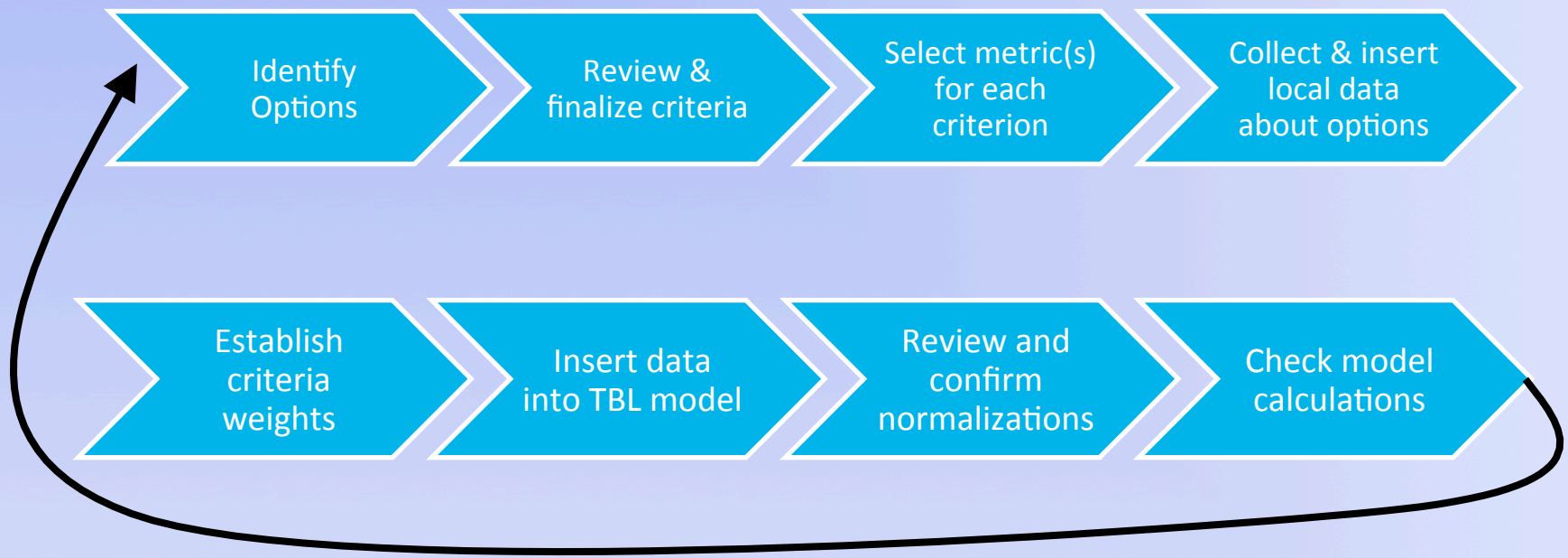
Metrics

- **Has to be measurable for each option**
- **Examples:**
  - **Qualitative vs. Quantitative**
    - **Qualitative: plan does comply with objectives**
    - **Quantitative: NPV = $ 1,000,000**
  - **Scale**
    - **Binary: Yes/No**
    - **Ordinal: Scale of 0-5**
  - **Objective vs. Subjective**
    - **Objective: big, bigger, biggest**
    - **Subjective: good, better, best**

The TBL Process

conducted with engaged, diverse stakeholders

Preparations (using the new TBL model)…



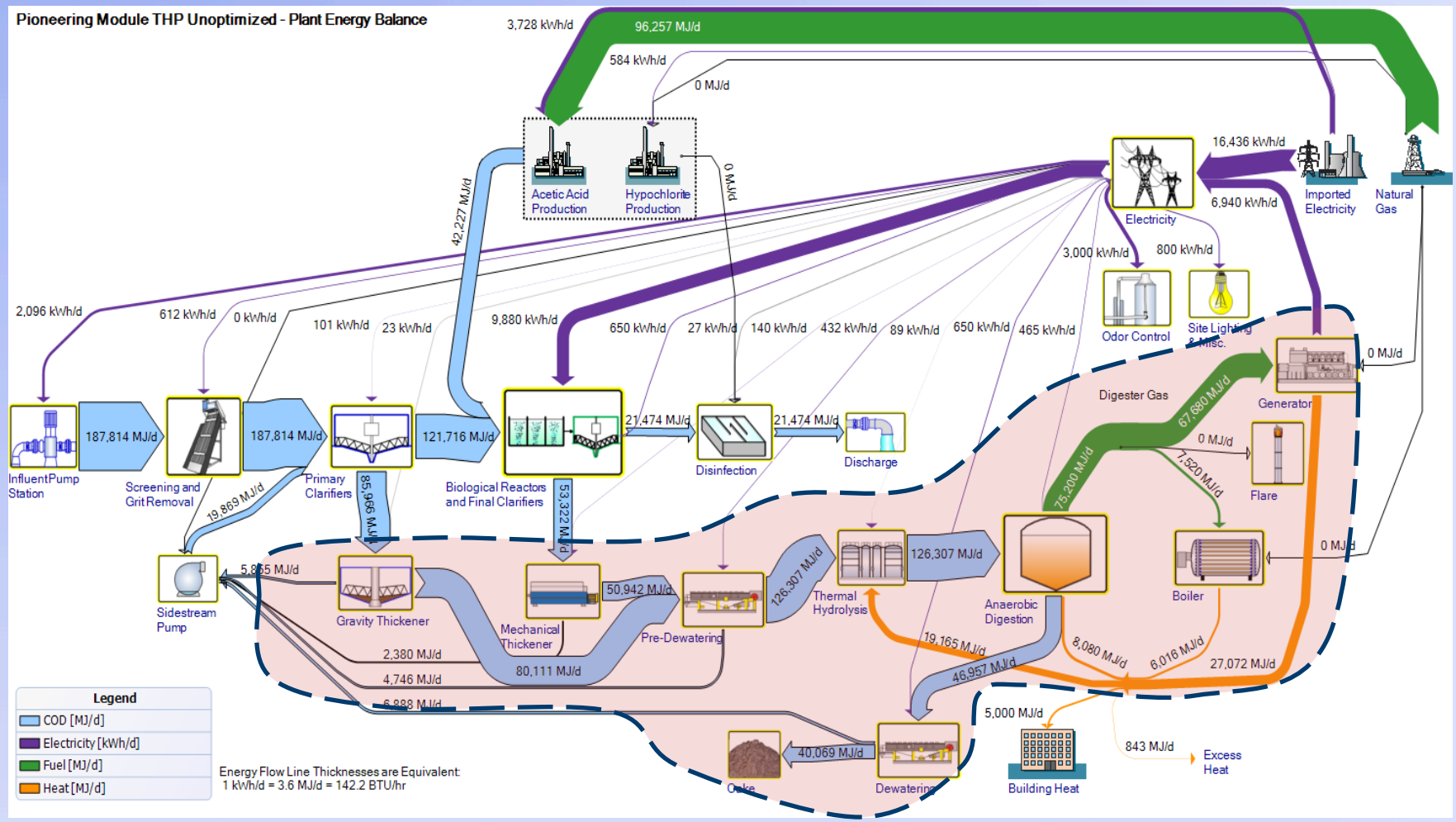
Now the scoring of options can begin!

Options

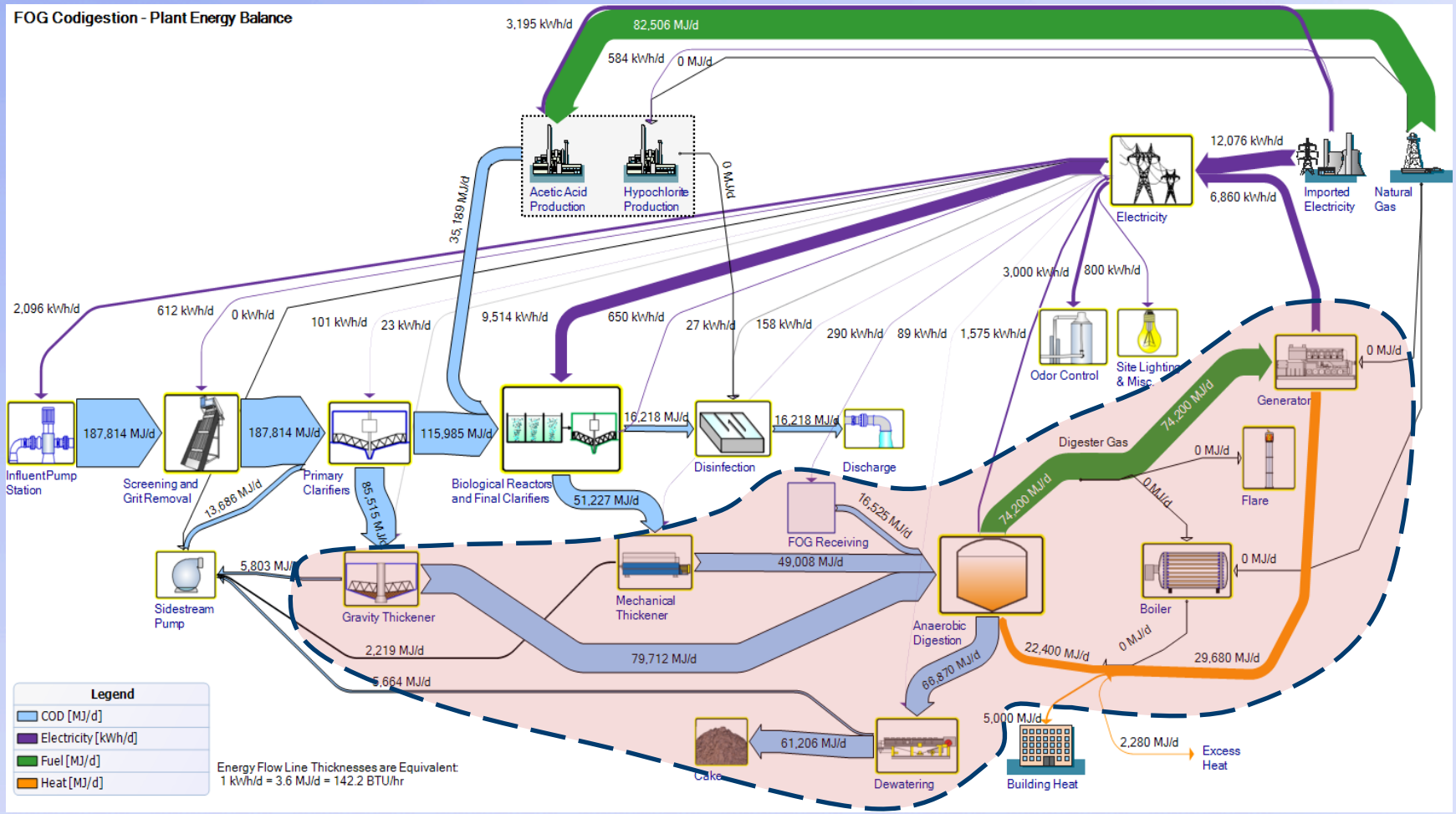
- **Six Options were identified for TBL Analysis**

1X = AD, solids pretreatment, CHP, land application
1Y = AD, solids pretreatment, CHP, landfill disposal
2X = AD, co-digestion, CHP, land application
2Y = AD, co-digestion, CHP, landfill disposal
3Y = Incineration with ash landfill disposal
4Y = Gasification with ash landfill disposal

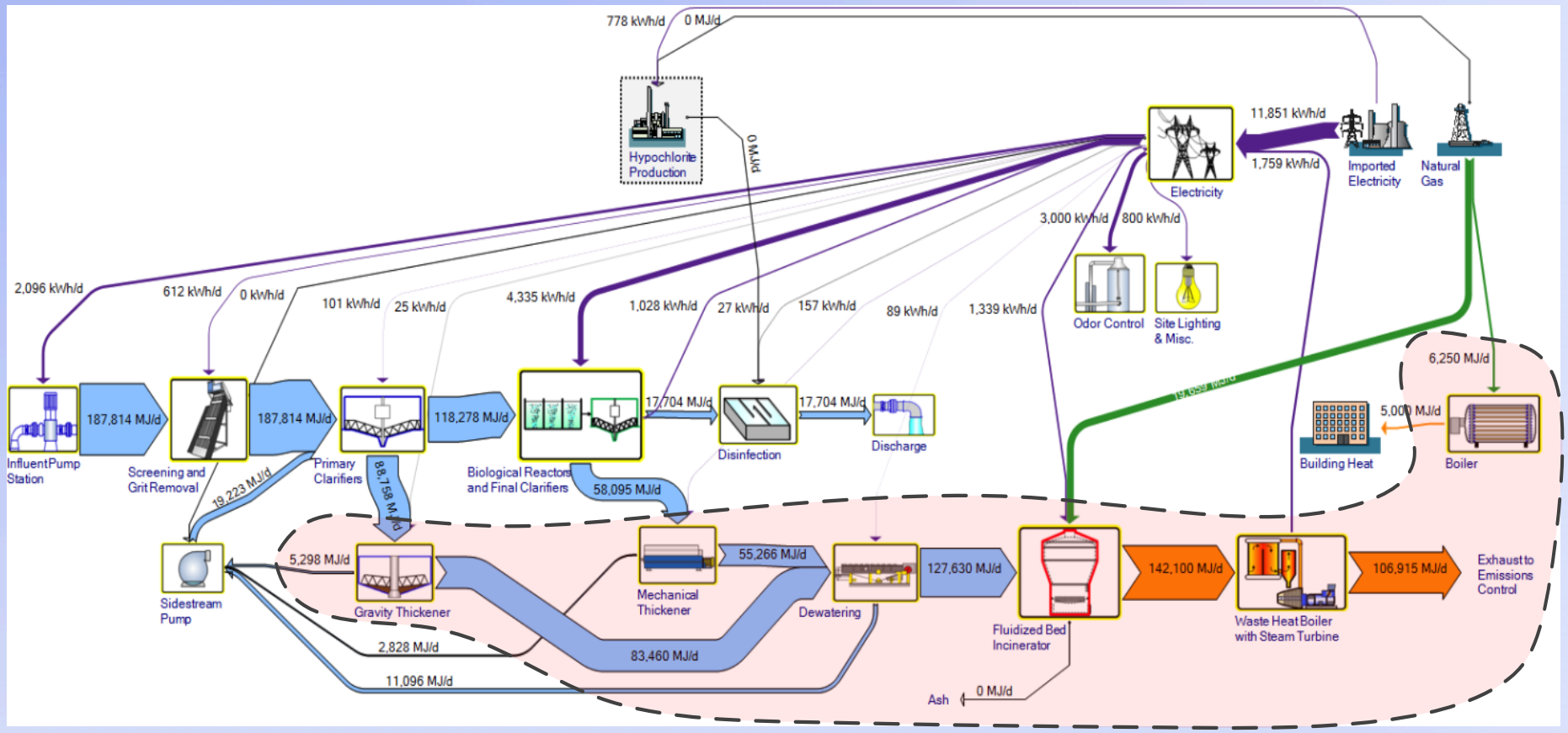
1X/1Y Anaerobic Digestion with Solids Pretreatment/Hydrolysis & CHP



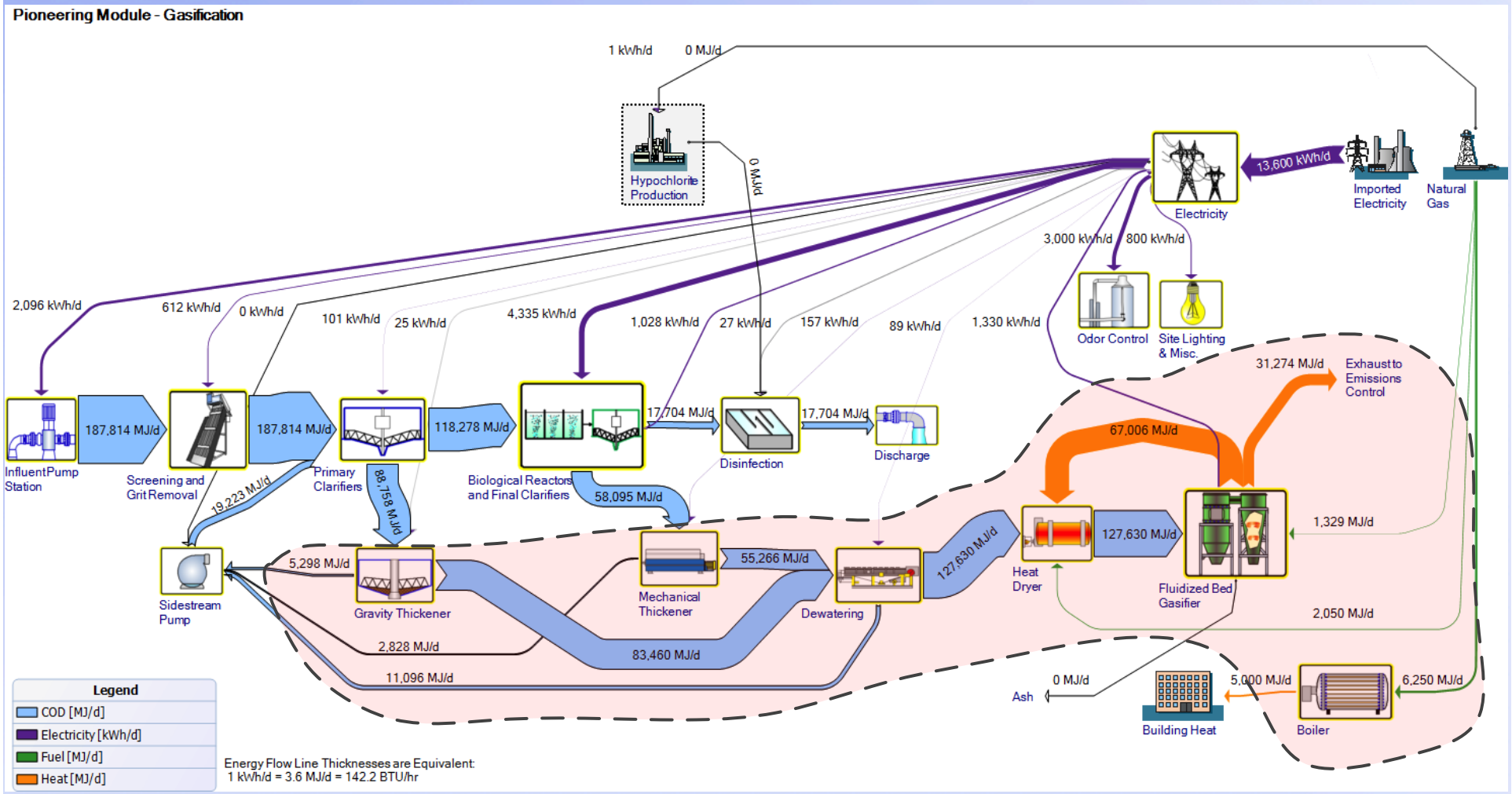
2X/2Y - Anaerobic Digestion, CHP with Codigestion



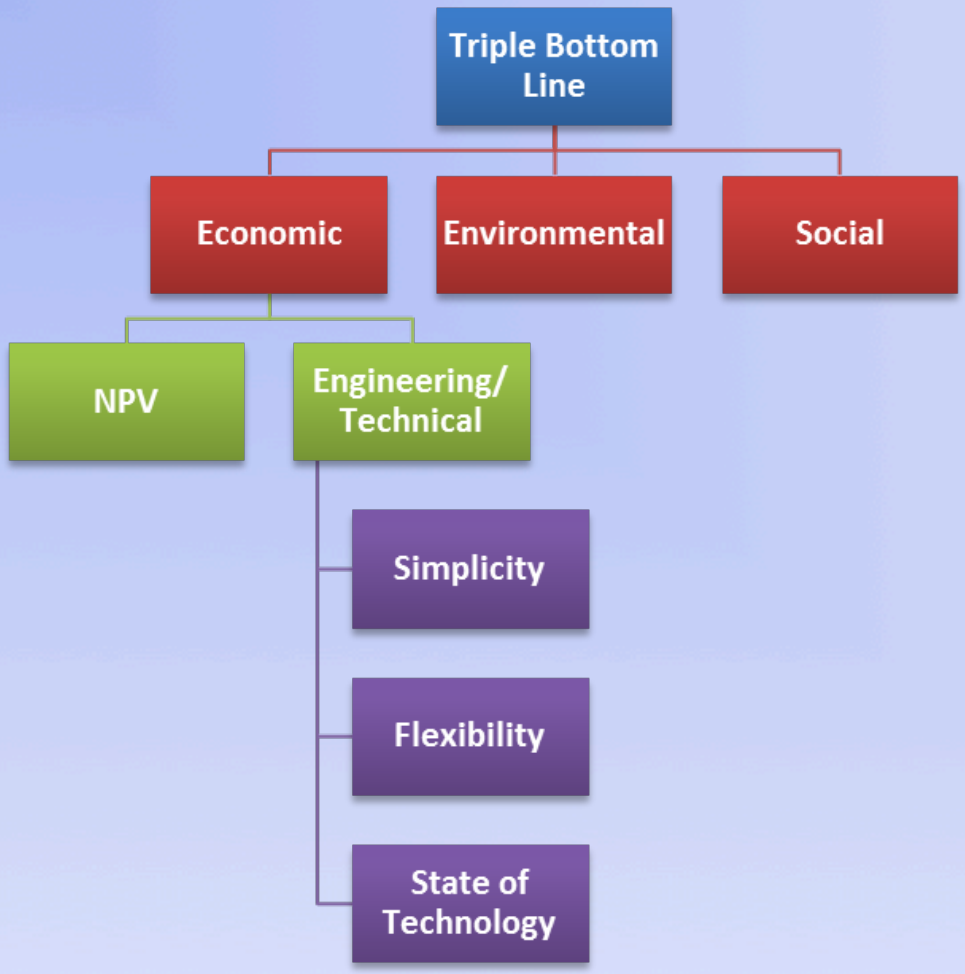
3Y – Incineration with landfill disposal



4Y – Gasification with Landfill Disposal



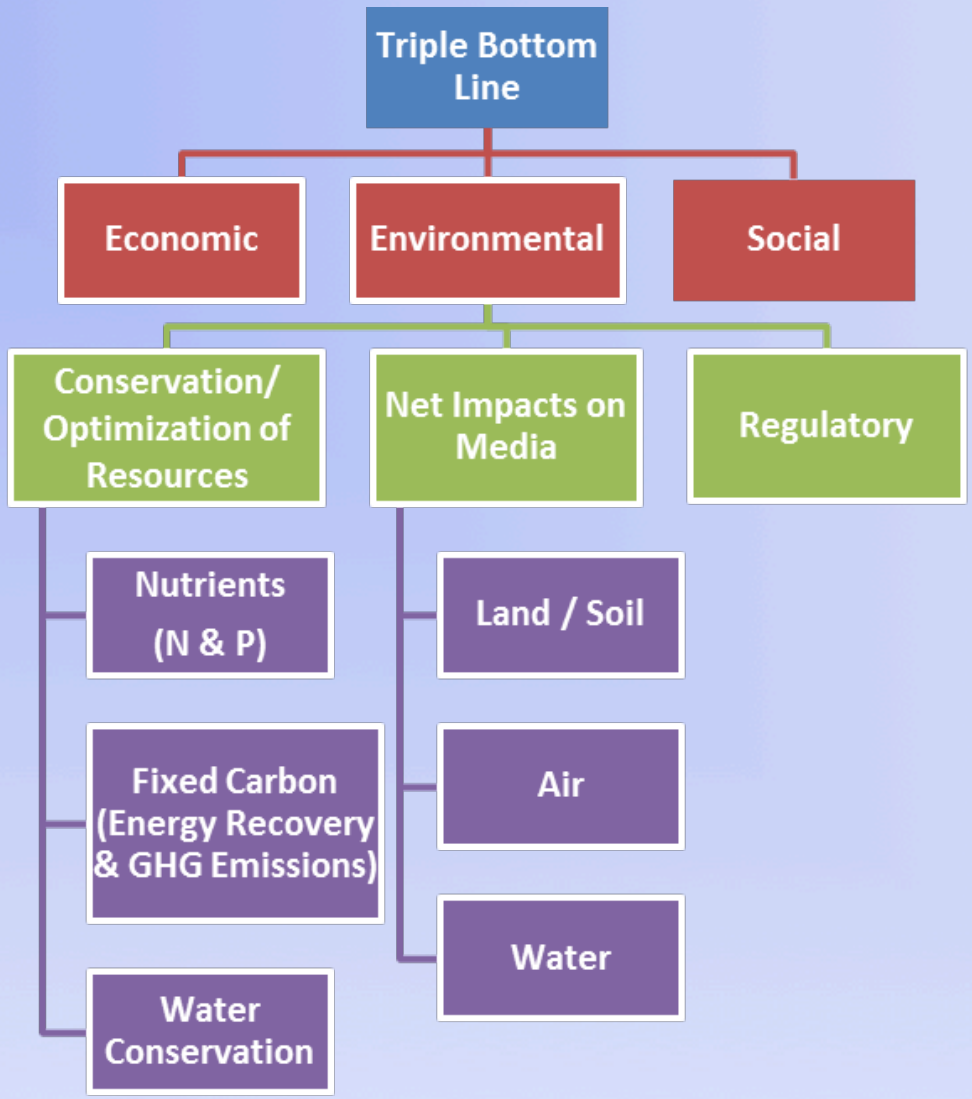
Economic Criteria & Metrics



Lifecycle Cost Data

Category	Inputs
Costs	
Capital Costs	Bottom-up estimates
O&M costs	Comparable projects, vendor data
Labor	Comparable projects, team estimates
Maintenance	Comparable projects, team estimates
Chemicals	GPS-X
Reuse and disposal costs	GPS-X
Natural gas	GPS-X
Electricity consumption	GPS-X
Extraordinary maintenance costs	Comparable projects, team estimates
Benefits	
Electricity production	GPS-X
Tipping fees	GPS-X

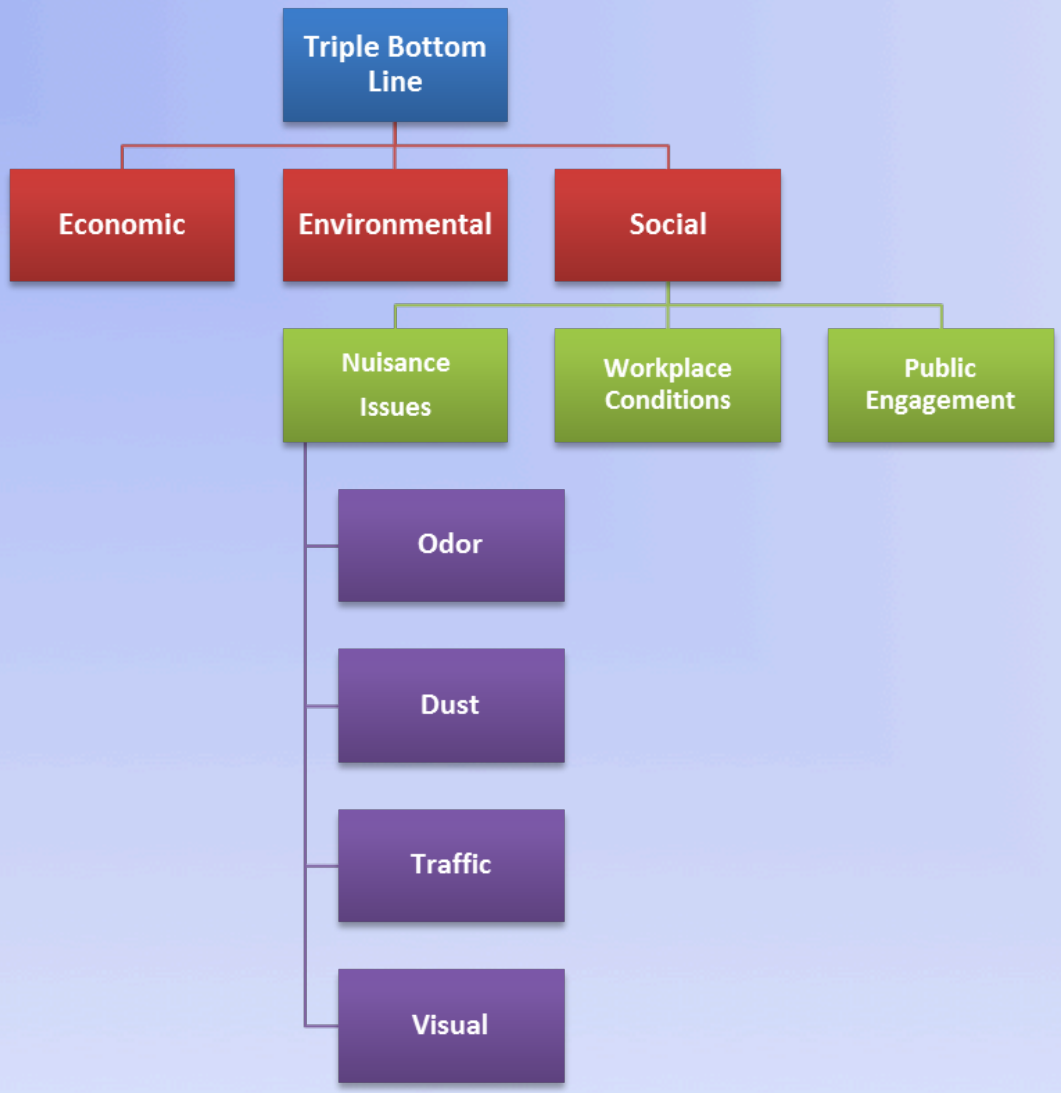
Environmental Criteria & Metrics

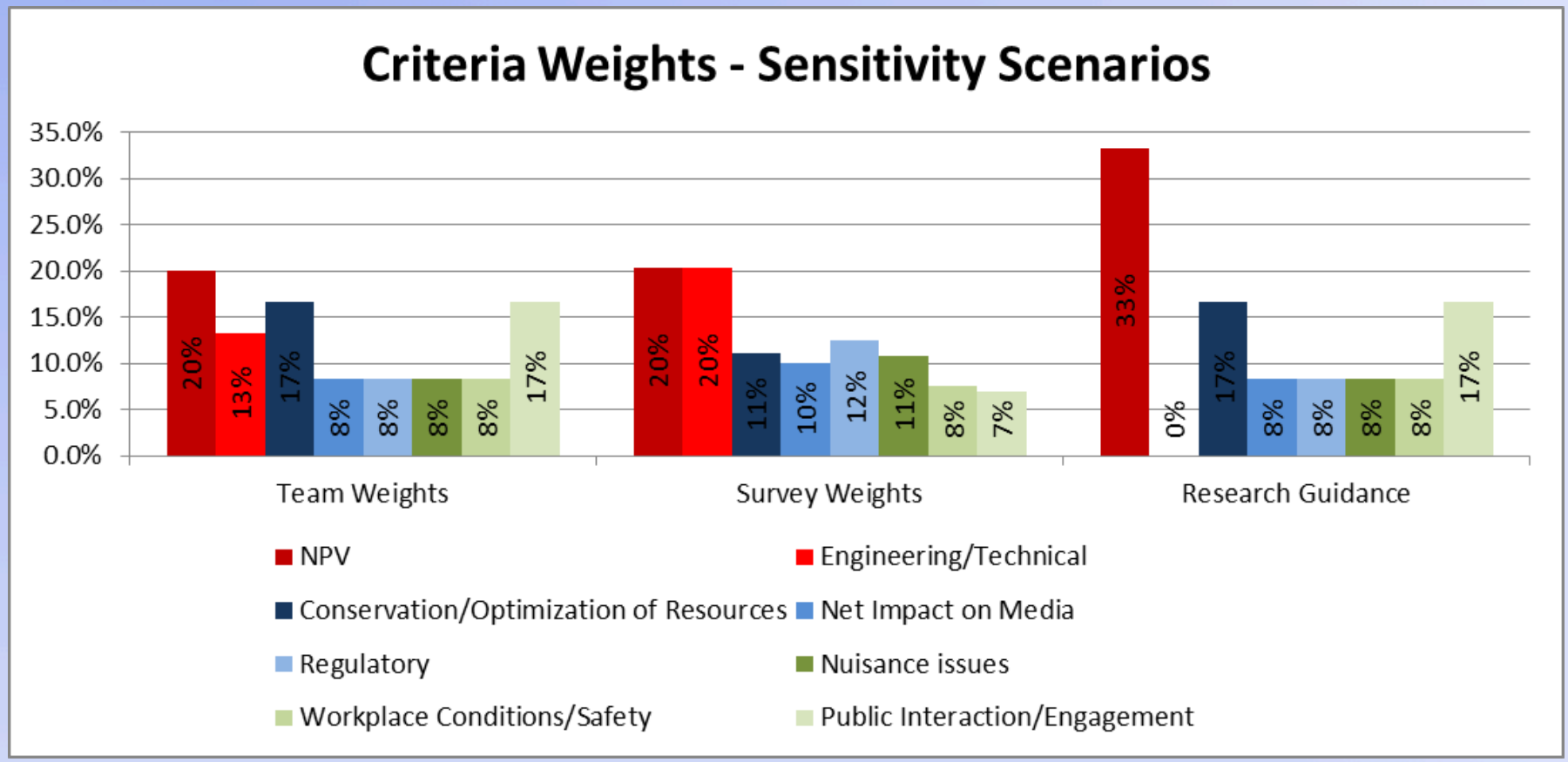


Environmental Data

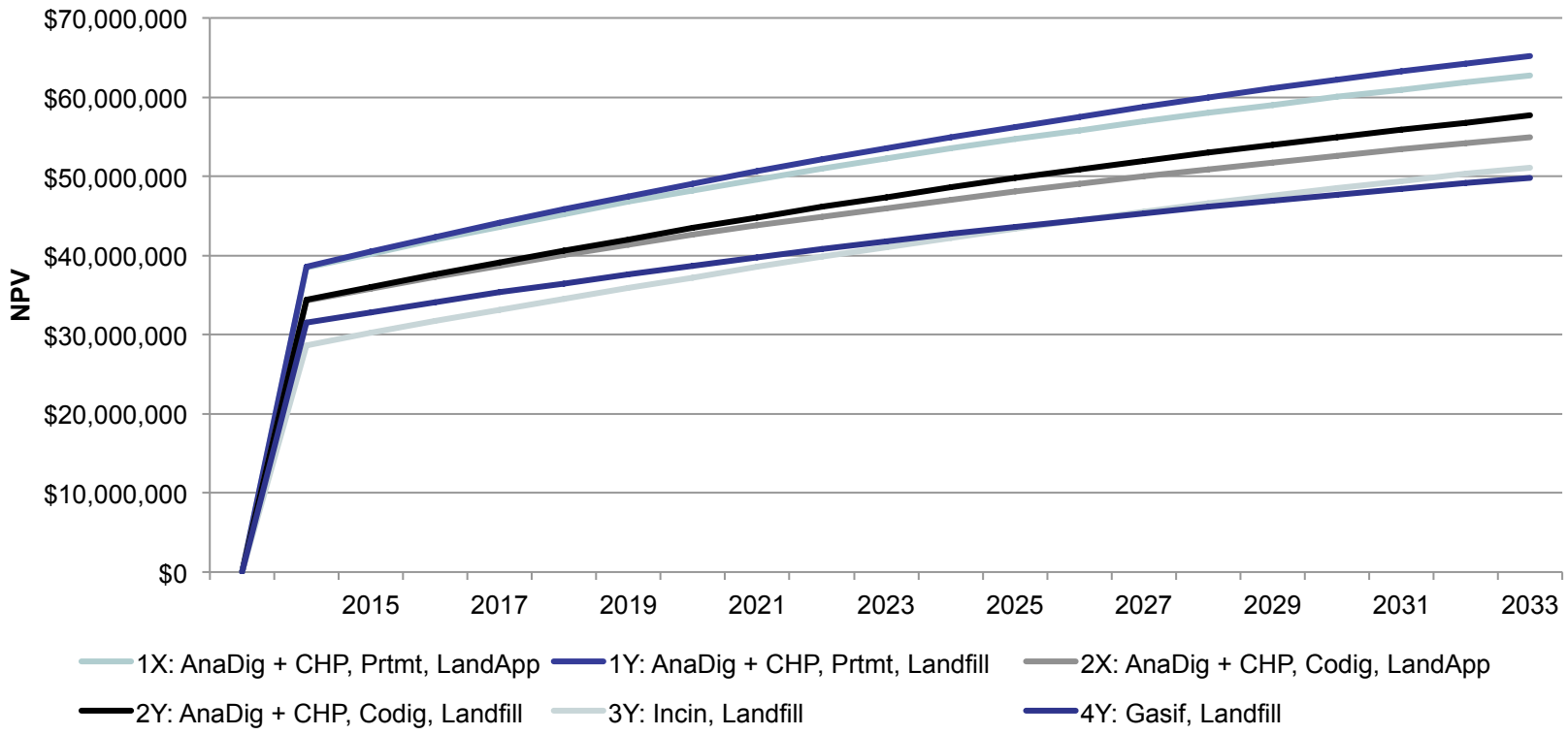
Category	Inputs
Conservation of Resources	
Nutrients	Mass balance from GPS-X
Fixed Carbon/GHG	BEAModel
Fixed Carbon/Energy	GPS-X
Water Conservation	Irrigation eliminated based on lit. review
Net Impact on Media	
Land/Soil Quality	Improved land v. disturbed land
Air Quality	NO_x, SO_2 and PM emissions (EPA data)
Water Quality	Turbidity, nutrients, leaching
Meeting Future Regulations	Judgment based on current trends

Social Criteria & Metrics




Criteria Weights - Sensitivity Scenarios
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
20%
13%
17%
8%
8%
8%
8%
17%
20%
20%
11%
10%
12%
11%
8%
7%
33%
0%
17%
8%
8%
8%
8%
17%
Team Weights
Survey Weights
Research Guidance
NPV
Engineering/Technical
Conservation/Optimization of Resources
Net Impact on Media
Regulatory
Nuisance issues
Workplace Conditions/Safety
Public Interaction/Engagement

Lifecycle Cash Flows



1X = AD, solids pretreatment, CHP, land application
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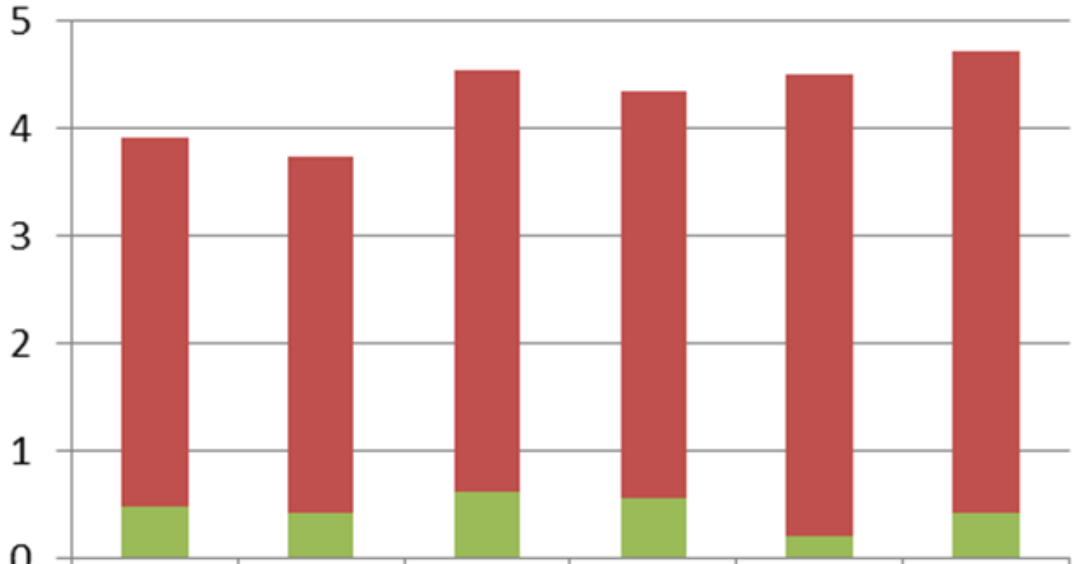
Category Weighted Economic Results



	1X	1Y	2X	2Y	3Y	4Y
NPV	3.42	3.32	3.90	3.78	4.30	4.30
Engineering/Technical	0.49	0.42	0.63	0.56	0.21	0.42

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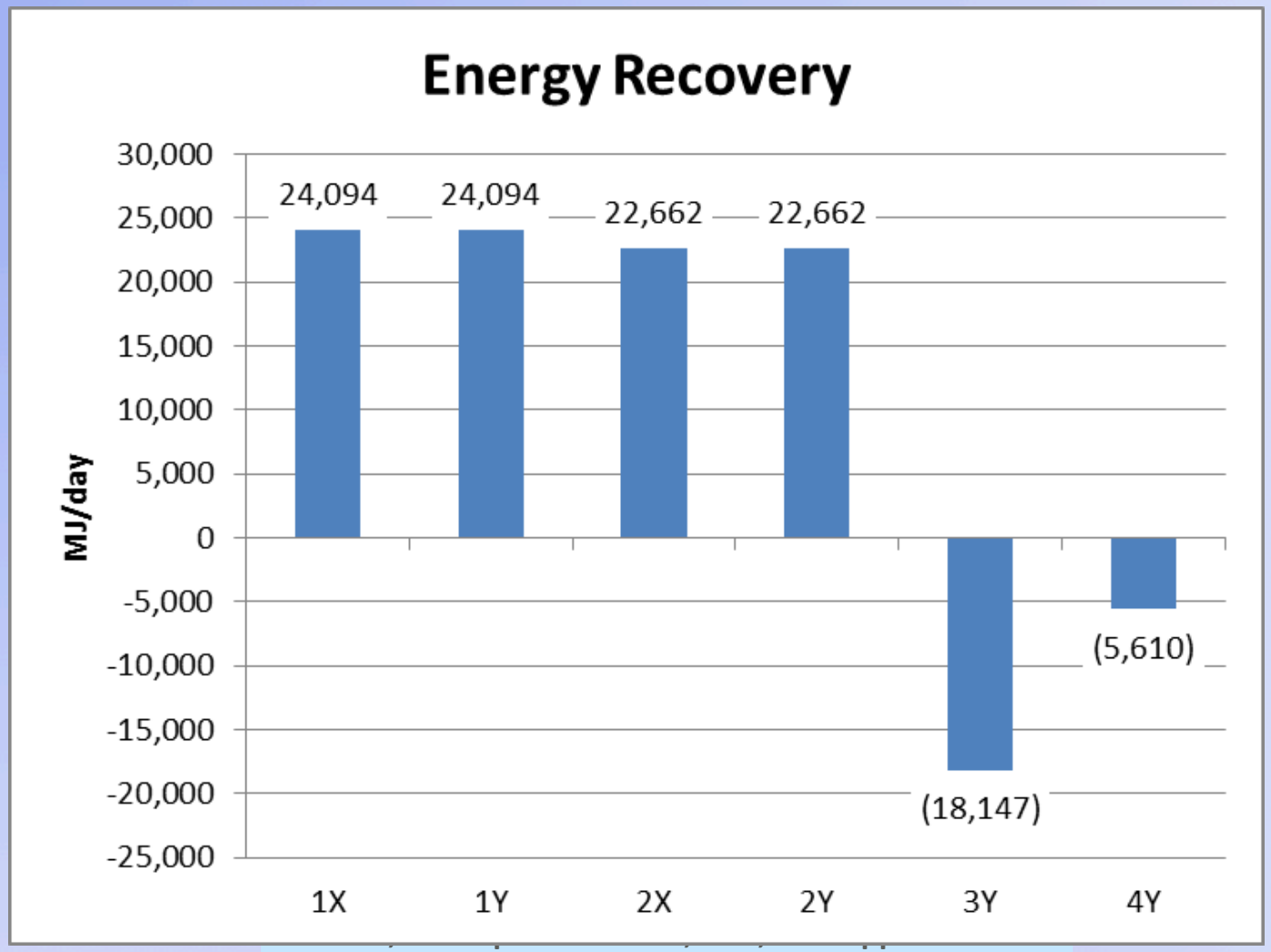

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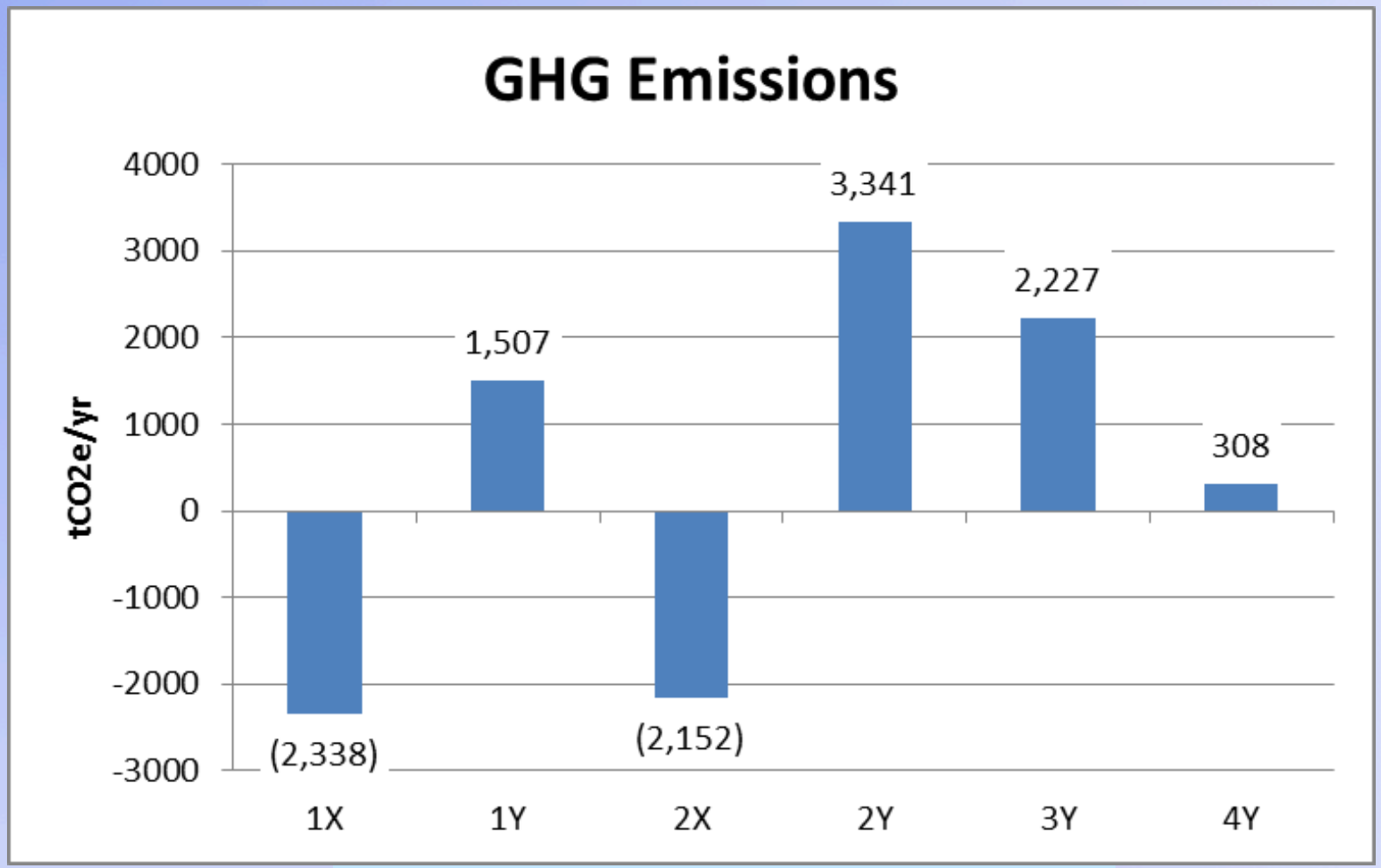

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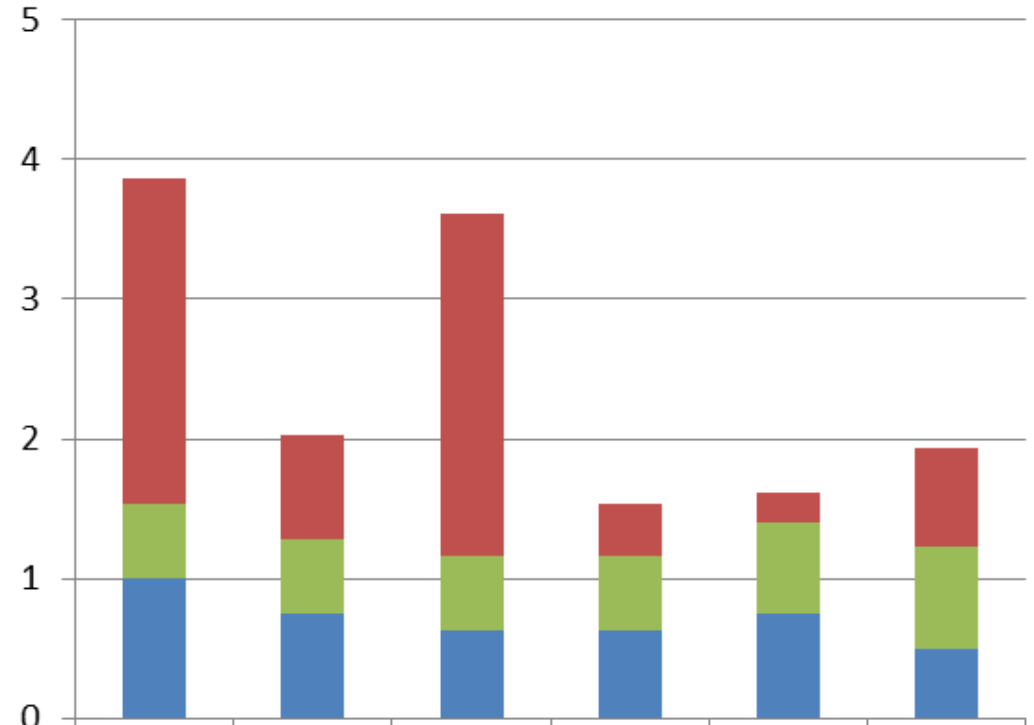
Category Weighted Environmental Results



	1X	1Y	2X	2Y	3Y	4Y
Conservation of Resources	2.33	0.74	2.45	0.36	0.22	0.71
Net Impact on Media	0.54	0.54	0.54	0.54	0.65	0.73
Regulatory	1.00	0.75	0.63	0.63	0.75	0.50

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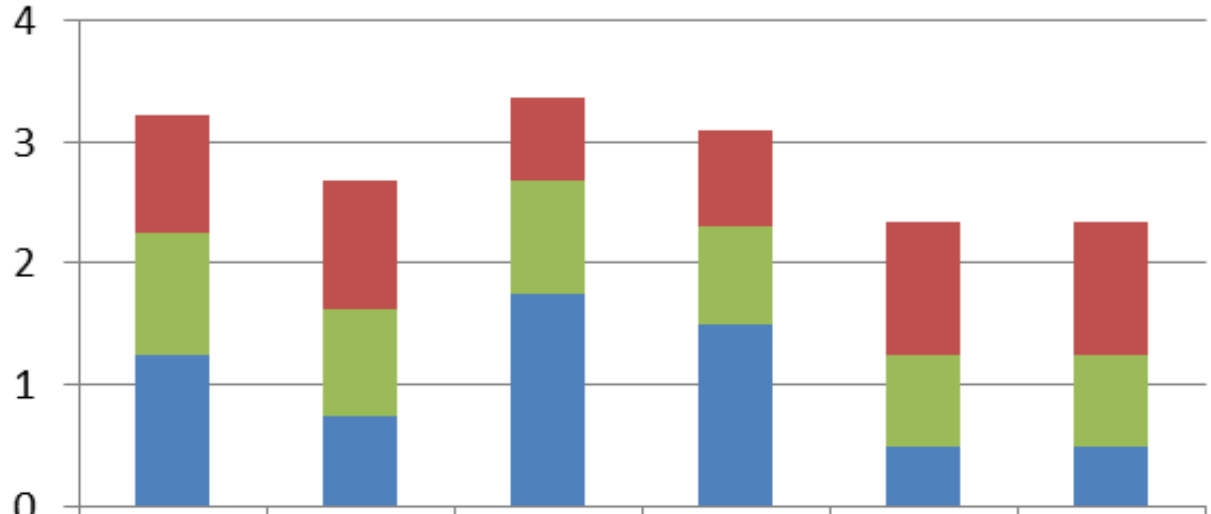
Category Weighted Social Results



	1X	1Y	2X	2Y	3Y	4Y
Nuisance issues	0.96	1.06	0.68	0.78	1.09	1.09
Workplace Safety	1.00	0.88	0.94	0.81	0.75	0.75
Public Engagement	1.25	0.75	1.75	1.50	0.50	0.50

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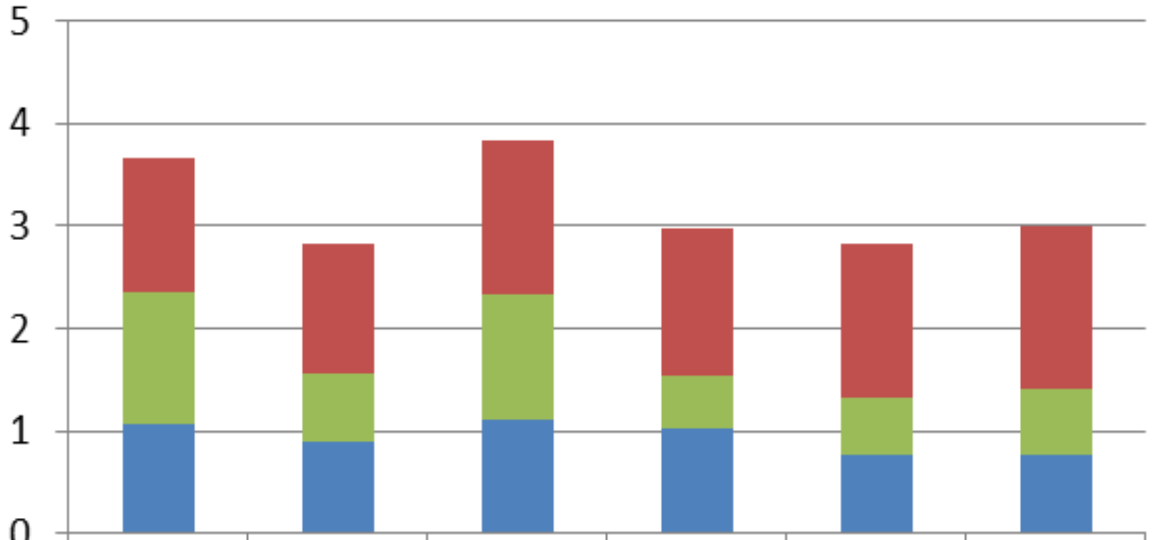
Category-Weighted TBL Results



	1X	1Y	2X	2Y	3Y	4Y
Economic	1.3	1.2	1.5	1.4	1.5	1.6
Environmental	1.3	0.7	1.2	0.5	0.5	0.6
Social	1.1	0.9	1.1	1.0	0.8	0.8

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Some Final Notes

- **Results from this TBL report are not the final say on which biosolids management strategies are the most sustainable**
  - They are based on the assumptions, weightings, etc. used by the team that developed the model
- **Results will vary considerably based on the values considered important by the stakeholders on a particular project and by local conditions**
- **The process provided by this exercise is more important than the final results**

Questions

Mike Elenbaas, Black & Veatch
Alok Patil, Black & Veatch
Ned Beecher, NEBRA
Sally Brown, University of Washington
Patricia Scanlan, Black & Veatch
Valuable input from other members of the WERF Energy Neutrality Study