THE CENTER FOR
CLIMATE STRATEGIES

Economic Benefits
Planning and Analysis for Low Emissions Development Strategies

Center for Climate Strategies, Inc.

LEDS LAC

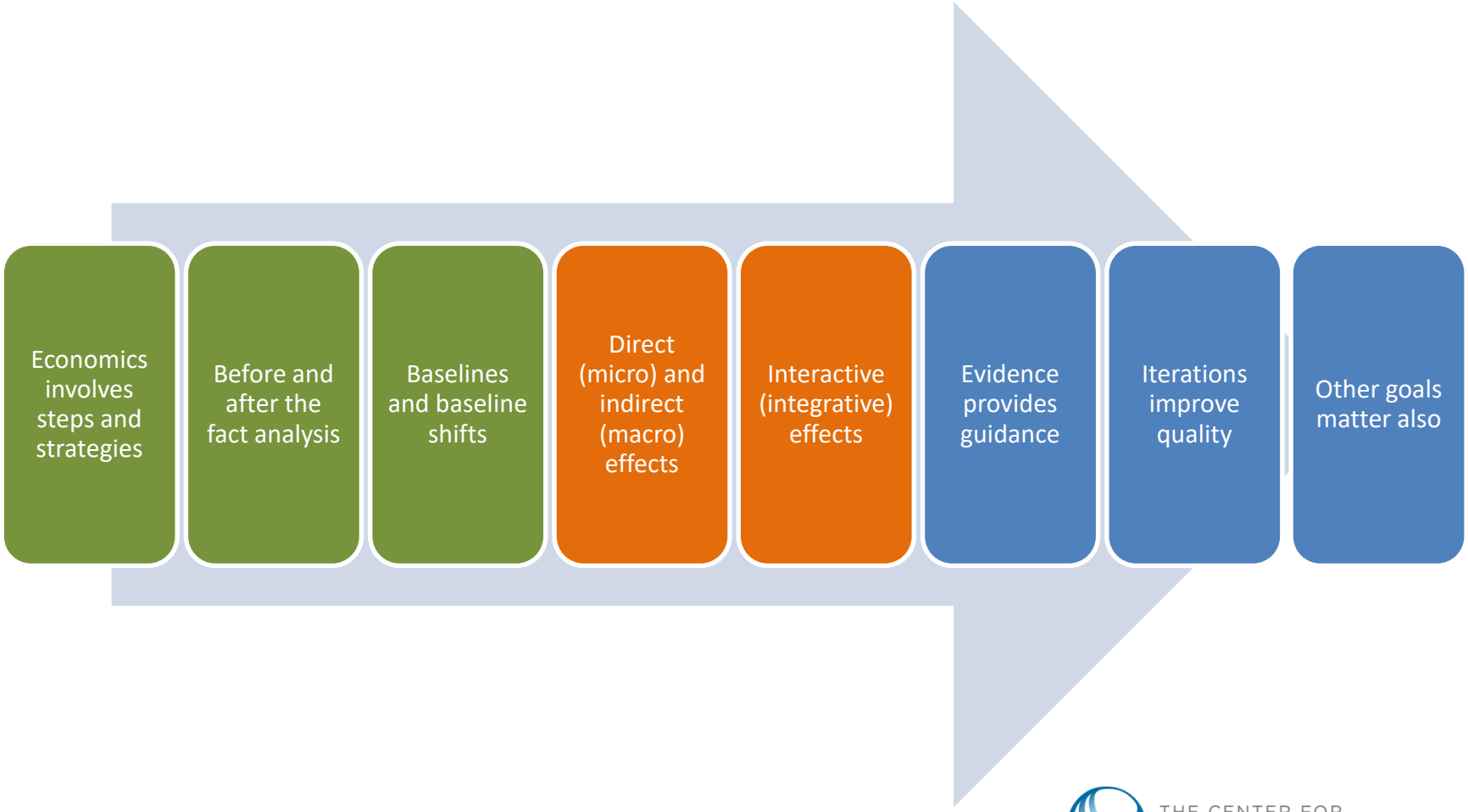
October 12, 2015

Context:
LEDS Competes for Focus

Needs

- National vision
- Agency priority
- Popular support
- Demonstrable success
- Paradigm shift

Concepts


Economics involves steps and strategies
Before and after the fact analysis
Baselines and baseline shifts
Direct (micro) and indirect (macro) effects
Interactive (integrative) effects
Evidence provides guidance
Iterations improve quality
Other goals matter also

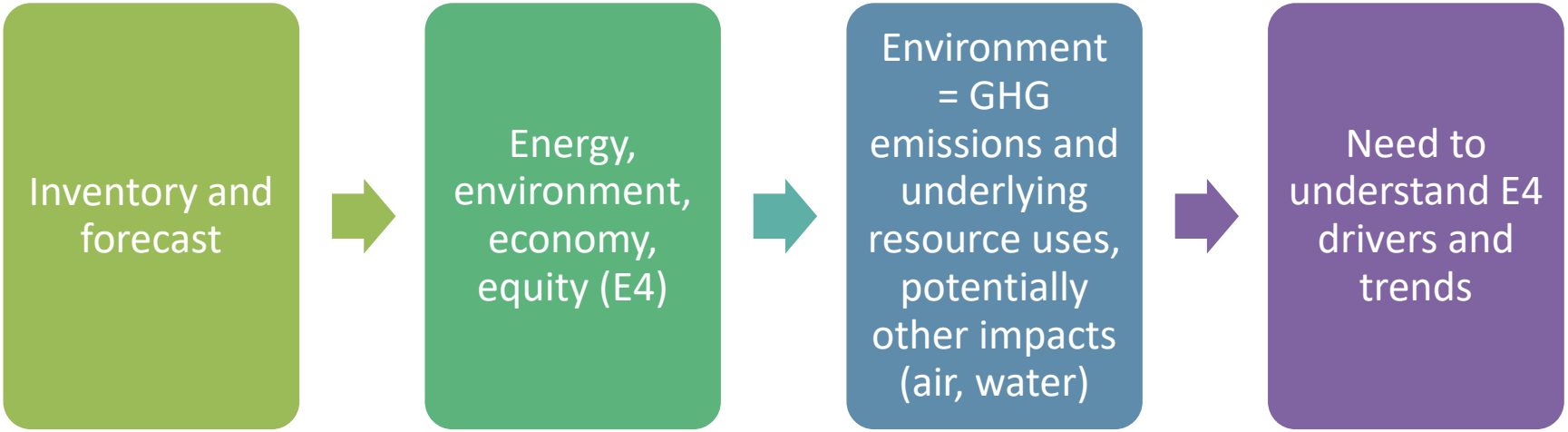
Steps

Step 1	Organization and Goals
Step 2	Baseline Development
Step 3	Policy Options Identification
Step 4	Policy Screening & Prioritization
Step 5	Initial Policy Design Specifications
Step 6	Direct (Micro) Impacts Assessment
Step 7	Policy Options Integration and Overlap
Step 8	Indirect (Macro) Impacts Assessment
Step 9	Final Recommendations & Report Transmittal
Step 10	Monitoring, Reporting, Evaluation, & Updating

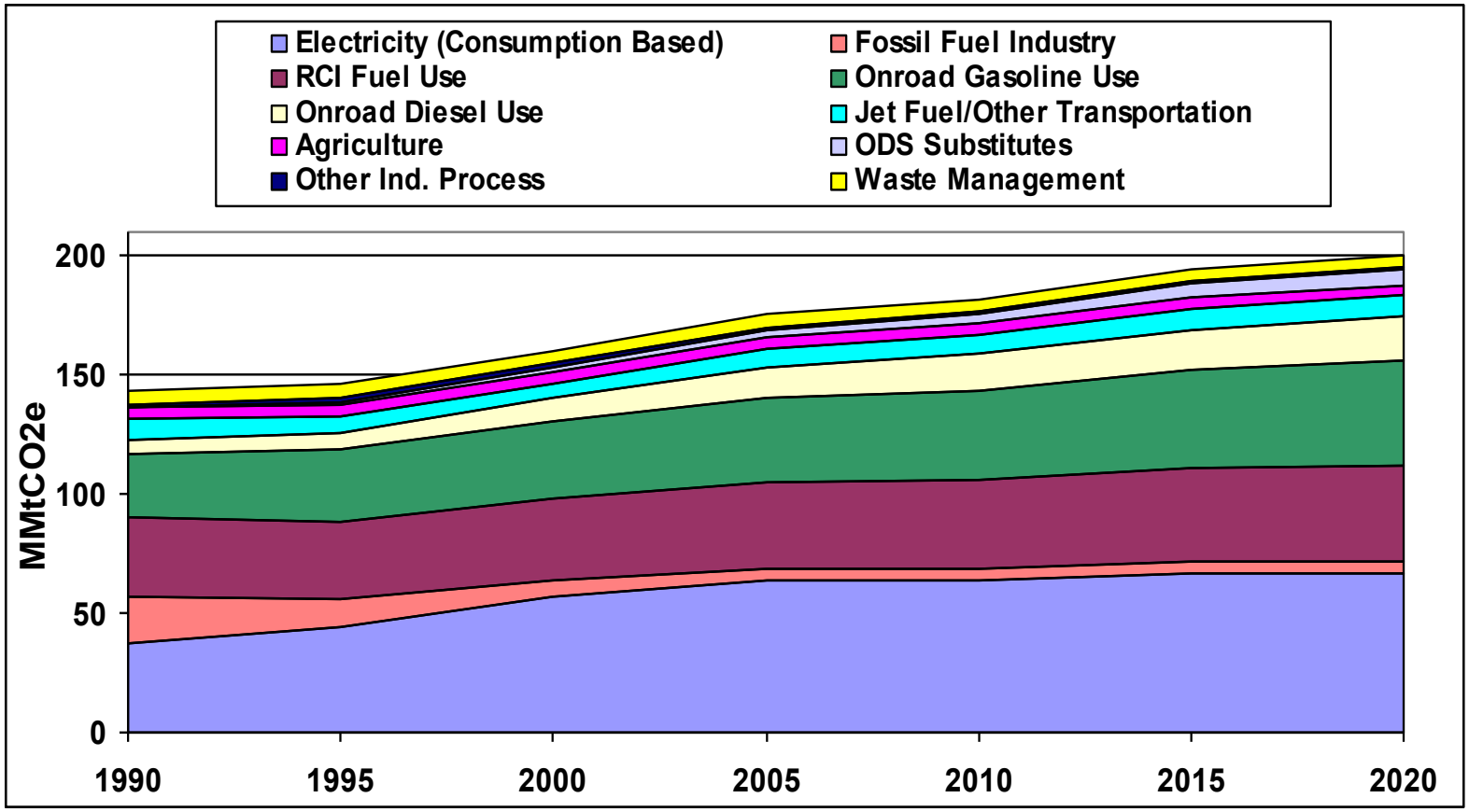
Organization

- Goals and objectives
- Leadership from the top
- Agency capacity
- Work plan
- Technical and facilitative support
- Representative stakeholders
- Expert work group(s)

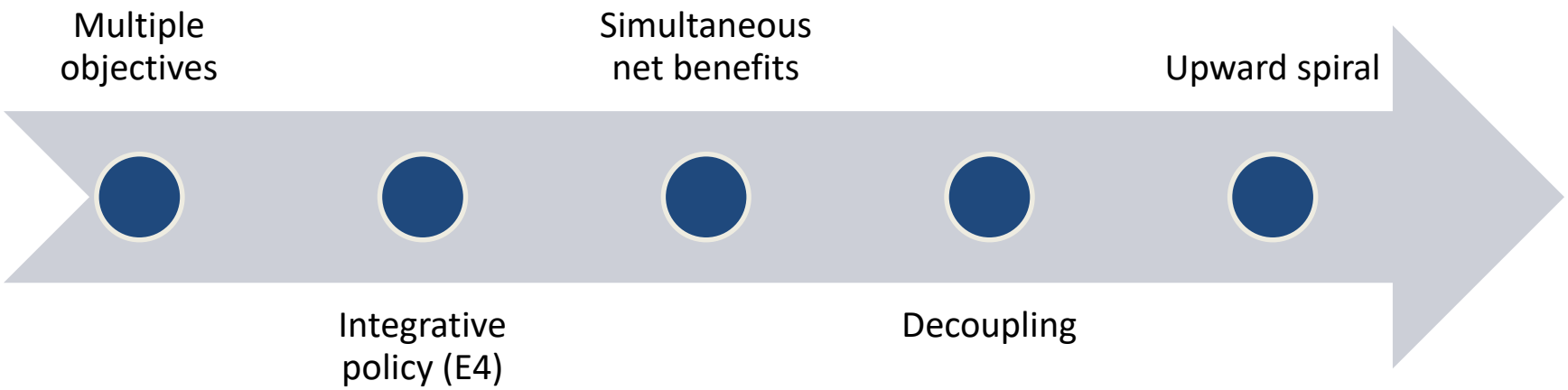
Baselines


Inventory and forecast
Energy, environment, economy, equity (E4)
Environment = GHG emissions and underlying resource uses, potentially other impacts (air, water)
Need to understand E4 drivers and trends

Baselines


Electricity (Consumption Based)
Fossil Fuel Industry
RCI Fuel Use
Onroad Gasoline Use
Onroad Diesel Use
Jet Fuel/Other Transportation
Agriculture
ODS Substitutes
Other Ind. Process
Waste Management
MMtCO2e
200
150
100
50
0
1990
1995
2000
2005
2010
2015
2020

Goals


Multiple objectives
Integrative policy (E4)
Simultaneous net benefits
Decoupling
Upward spiral

Yes! Climate policy CAN Improve Economy

1. Cost effective actions increase economic efficiency and expansion

2. Energy savings actions cut energy costs, stimulate labor investment

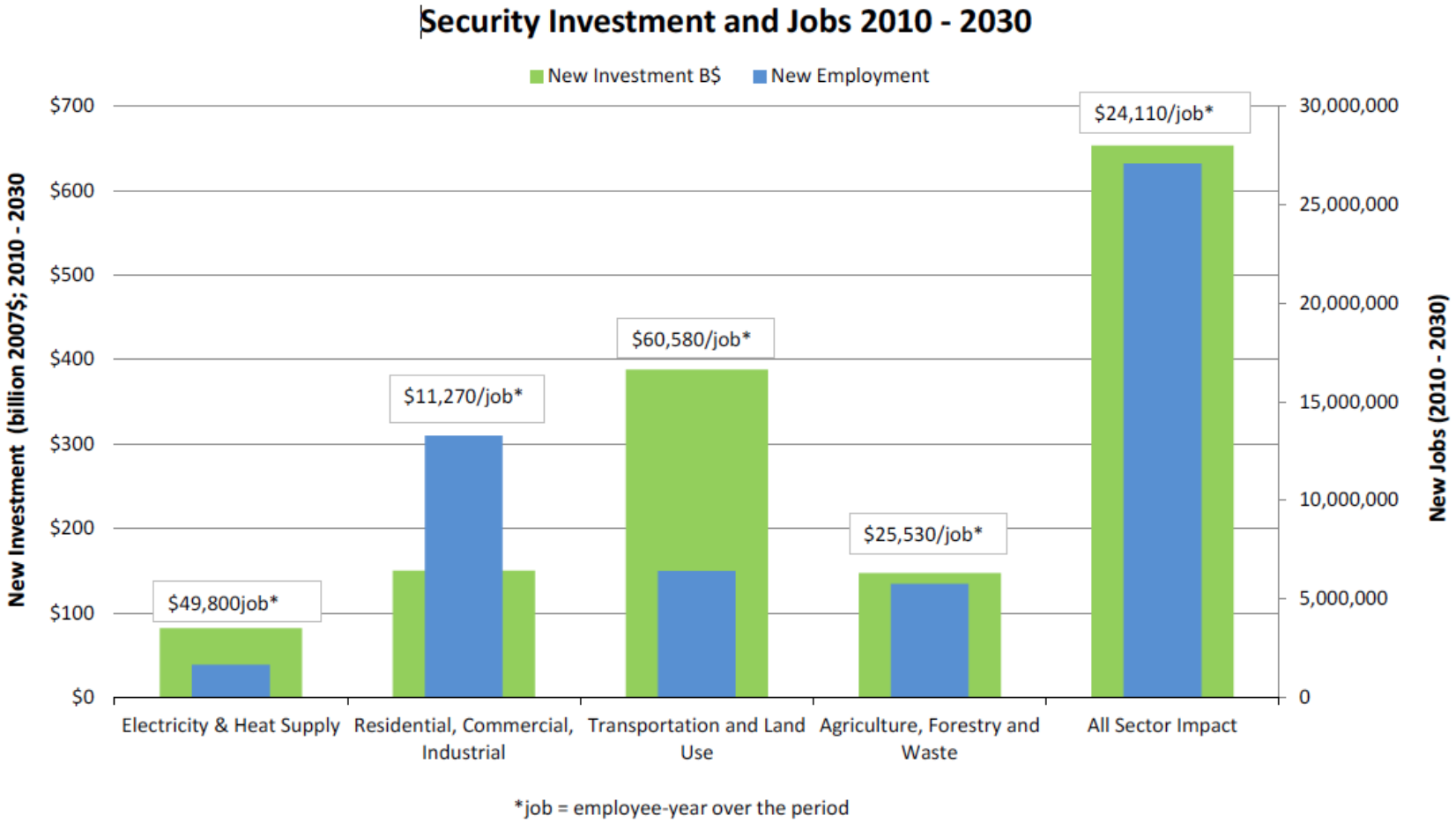
3. Shifts to indigenous vs. imported energy and resources cut capital outflows

6. Labor intensive activities create more jobs, even if at higher cost (up to a point)

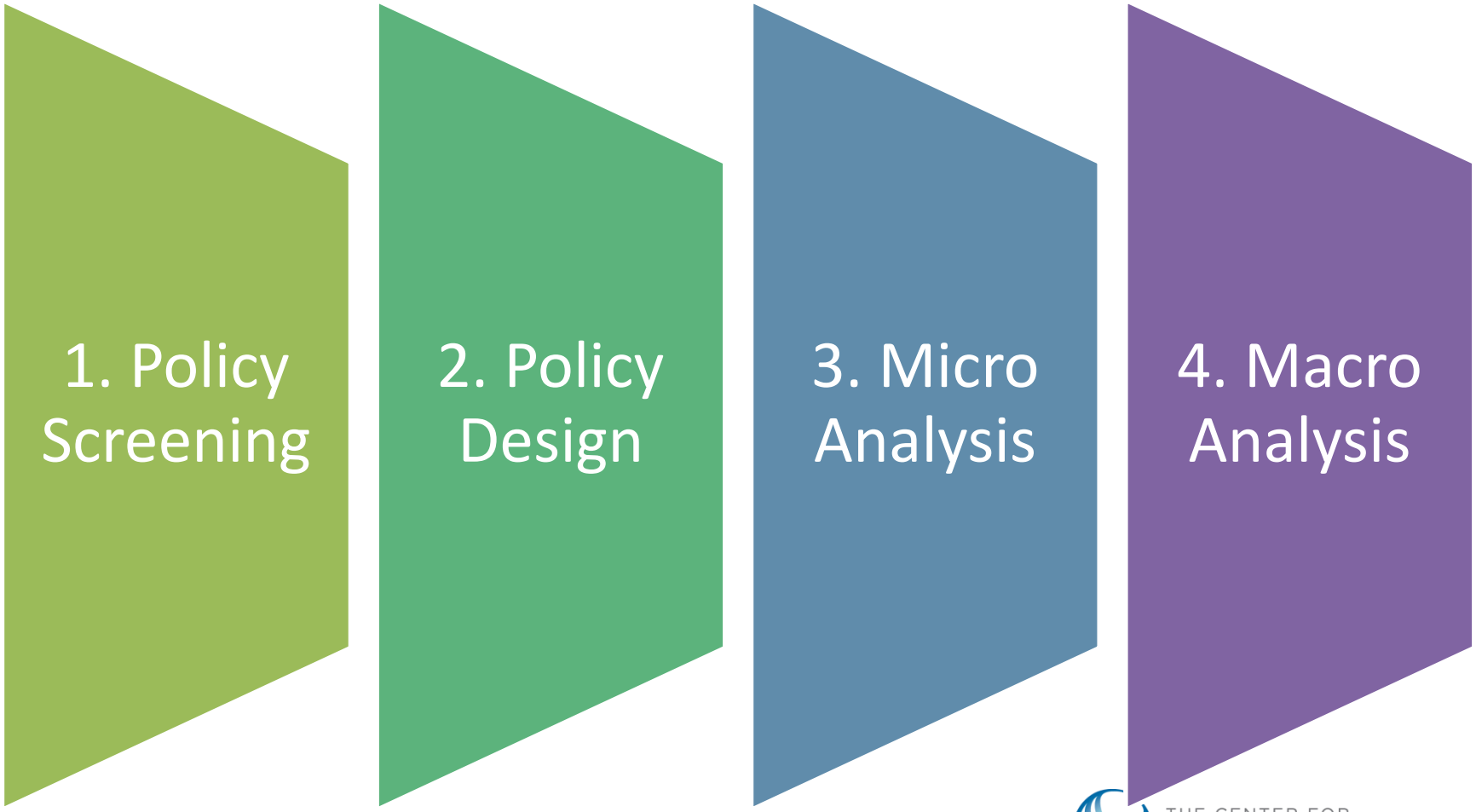
5. New investment from outside sources stimulates labor investment at home

4. Actions supported by local vs. distant supply chains cut job outflows

Evidence


Security Investment and Jobs 2010 - 2030
New Investment B$
New Employment
New Investment (billion 2007$; 2010 - 2030)
New Jobs (2010 - 2030)
$700
$600
$500
$400
$300
$200
$100
$0
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
$49,800job*
$11,270/job*
$60,580/job*
$25,530/job*
$24,110/job*
Electricity & Heat Supply
Residential, Commercial, Industrial
Transportation and Land Use
Agriculture, Forestry and Waste
All Sector Impact
*job = employee-year over the period

Today's Exercises



Options

- Full range of potential options
- Relevant to action and place
- Examples from existing programs
- Also enhancements and innovations
- Inside and outside jurisdiction
- Winning strategies

Success Strategies

HEAT AND POWER

- Renewable and low emitting sources

RESIDENTIAL, COMMERCIAL, INDUSTRIAL, INSTITUTIONAL

- Efficiency, process improvements

TRANSPORTATION AND LAND USE

- Low carbon fuels, vehicle efficiency, community design

AGRICULTURE

- Bio energy, carbon storage, low input farming, feed efficiency

FORESTRY

- Bio energy, carbon storage, land restoration

WASTE

- Source reduction, recycling, energy recovery

Options

Policy Number	Low Carbon Development Policy	Upper Limit (%) of 2035 BAU GHG 7,210 Tg CO2e BAU GHG	Realistic Screening Potential (%) of 2035 BAU GHG	Micro-economic Costs/ Savings Indicator	Potential Macroeconomic Impact by 2035		Potential Impacts on Local Health and Environment	2035 Carbon Intensity Screening 336 g CO2e/ ¥2010	Potential Impacts on Clean Energy Goals
					Gross State Product	Employ-ment			
Group 1: RENEWABLE ENERGY									
ES-1a	Renewable Portfolio Standard	3.8%	1.2%	500	+	+	+	4.2	+
ES-1b	Green Power Purchases and Marketing	3.8%	1.9%	400	U	U	+	6.3	+
ES-1c	Grid Based Renewable Incentives or Barrier Removal	0.001%	0.001%	350	U	U	+	0.004	+
ES-1d	Offshore Wind Development Issues	0	0	300	-	-	+	-	+
Group 2: ADVANCED FOSSIL ENERGY									
ES-2a	Advanced Fossil Fuel Technology Incentives, Support, or Requirements	1.1%	0.35%	250	-	-	+	1.2	+
ES-2b	Support Efficiency Improvements at Existing Fossil Fuel Power Plants	0.35%	0.17%	50	+	+	+	0.58	+
ES-2c	Support Repowering of Existing Plants (incentives/barrier removal)	1.7%	0.56%	300	+	+	+	1.9	+

Screening

- List for each sector
- Selection criteria for draft priorities
- Benchmarking or expert judgements
- List revision
- Group balloting
- Top tier, second and third tiers

Minnesota MCA

Minnesota Climate Solutions and Economic Opportunities (CSEO) Project	Decision Criteria ➤	Complexity, Ease of Technical Analysis	GHG Cuts Now and or Later	$ Total Costs	Cost Effectiveness -- $/GHGs Cut	Jobs, Income, and or Growth	New Markets and or Investments	Energy Diversity and or Independence	Energy Reliability Now and or Later	Energy Acces and or Affordability	Health -- AQ, WQ, or Other	Land, Water, and or Wildlife Conservation	Equity -- Income, Age, Place, and or Ethnicity	Feasibility -- Technical, Market, Program, Legal	Feasibilty -- Social/Political	# Ballots	Priority Ranking
2008 Options	Ranking Scheme ➤	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	H, M, L, U, or a range/combination	10 Ballots/Voter, 1 For Each Preference	Tiers 1, 2, 3
Option #, Sector	Ranking Scale ➤ Policy Option Description ↴	H = x... to y... (+/-) M = x... to y... (+/-) L = x... to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)	H = x to y... (+/-) M = x to y... (+/-) L = x to y... (+/-)		
ES 3	Efficiency Improvements, Repowering and Up Grades to Existing Plants																
ES	Increase RES																
ES	Increase Solar Standard																
ES/RCII	111(d) Scenario (Including Price and Non-Price Mechanisms)																

Minnesota Ballot MCA Results

Policy Number	Decision Criteria ➤	Ease of Technical Analysis	Total GHG Cuts by 2025	$ Total Annual (Levelized) Costs	2020 Cost Effectiveness $/GHGs Cut	2020 Jobs, Income, and or Growth (Compared to Base)	Co-benefits 2025	Does the technology exist?	2020 Feasibility -- Social/ Political	Agency experts committed?	# Ballots
16	Efficiency Improvements, Repowering and Up Grades to Existing Plants	L	L to H	High		U	U	U	low	PCA	7
29	Renewable chemicals or bio-products that displace fossil fuels	low					h	A range		DEED	5
30	Increase RES	high	high	low	high	high	high - fuel	high	medium	PCA	9
31	Water use/management and energy efficiency integration	M					H	M to H		MDH and DNR	6
32	Electric Vehicles/Zero Emission Vehicle Standard									DOT, PCA	3
33	Water Freight/Transportation										
34	Water Use and Treatment									MDH and Met Council	1
35	Increase Solar Standard	M	U	M-H	U	Medium	H	Yes		DEED	2
36	111(d) Scenario (Including Price and Non-Price Mechanisms)	unkown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	PCA	2
37	Increase EE Requirement	medium	medium	medium	high	high	high	medium	medium	PCA	3
38	Thermal Renewable Standard	H	H	medium	H	H	M	high	medium	PCA, DEED	2
39	Incentives and Resources to Promote Thermal Renewables	M	High	medium	H	H	M	high	High	DEED, DNR	5
40	Demand/response	M					H	H	H		3
41	Distributed Generation										
42	R&D on clean energy technology										
43	Carbon Tax like British Columbia									MPCA	2
44	Building Benchmarking										1
45	100% LED streetlights									DOT	3
46	Rural Propane Alternatives (ex. Rooftop solar thermal heaters, biomass to dry grains, TBD)									DEED, PCA, DNR	2

Exercise 1

- Economic decision criteria
  - Measurable & Manageable
- Benchmark sources
- Expert ranking/rating
  - http://www.surveygizmo.com/s3/2361505/LEDS-LAC-Survey-for-Exercise-1
  - http://goo.gl/H1PQYK

Policy Design

- Timing
- Level of effort
- Coverage of parties
- Eligibility and definitions
- Type of mechanism(s)
- Sources and uses of funds

Example

Energy Supply Matrix, Baja, California (MLEDS)

"The current mix power generation relies largely on fossil fuels that generate GHG emissions and significantly deplete air quality. Due to high dependency on oil and the emissions which result from energy production in Baja California, there is a need for a policy that will diversify the energy matrix of the State to include a larger percent of renewable energy sources that do not affect the environment.

The State of Baja California has potential resources that can be utilized as for diversification of energy sources, such as: bioenergy, solar energy, geothermal energy, hydropower, wind power and various forms of ocean energy (tidal, waves and marine currents). The objective of this policy is to diversify the energy matrix, give greater stability, sustainability and increase supply current of energy, reduce hydrocarbons consumption and reduce Greenhouse Gas emissions."

Exercise 2

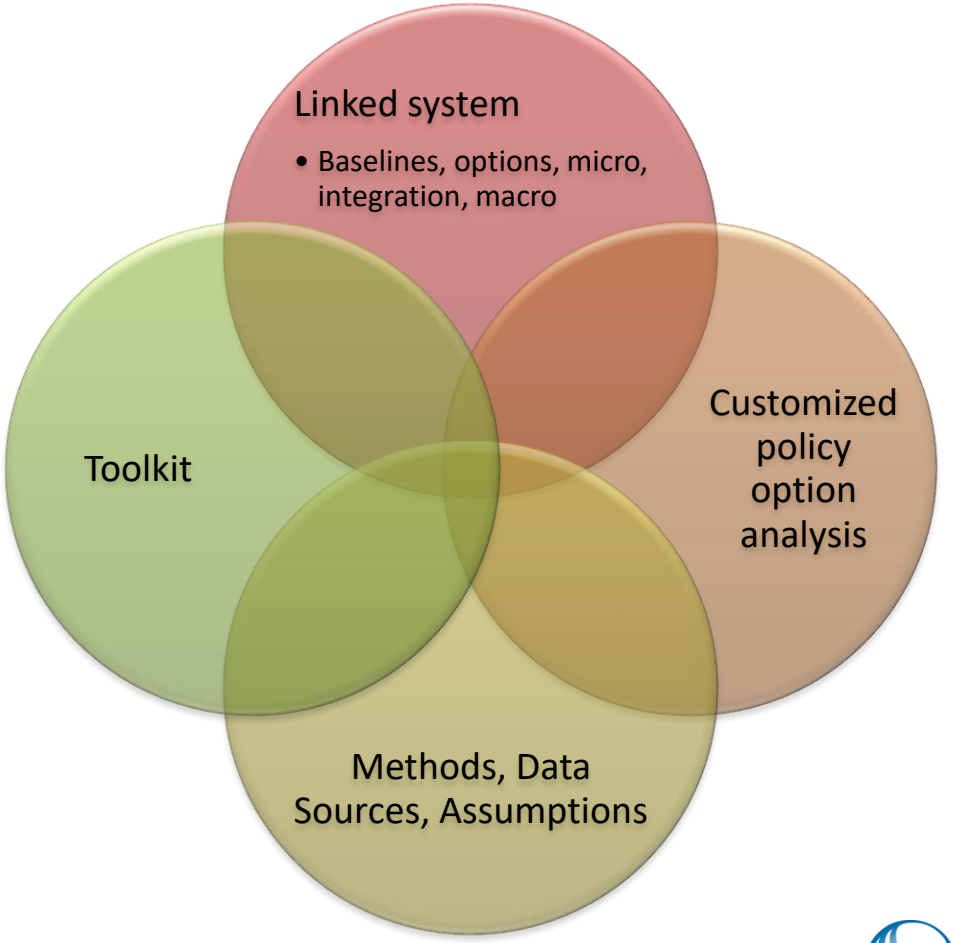
- RPS
  - Timing: Start, ramp up, stop
  - Level of effort: Metrics and targets
  - Coverage of parties: Implementing parties
  - Eligibility and definitions: Entity type and RE type
  - Policy mechanisms
  - http://www.surveygizmo.com/s3/2361722/LEDS-LAC-Survey-for-Exercise-2
  - http://goo.gl/OBIfEr

Analysis

Principles and guidelines

- Common assumptions for all sectors
- Common assumptions for each sector
- End user needs
- Capacity constraints
- Templates and tools

Templates


Linked system
• Baselines, options, micro, integration, macro
Toolkit
Customized policy option analysis
Methods, Data Sources, Assumptions

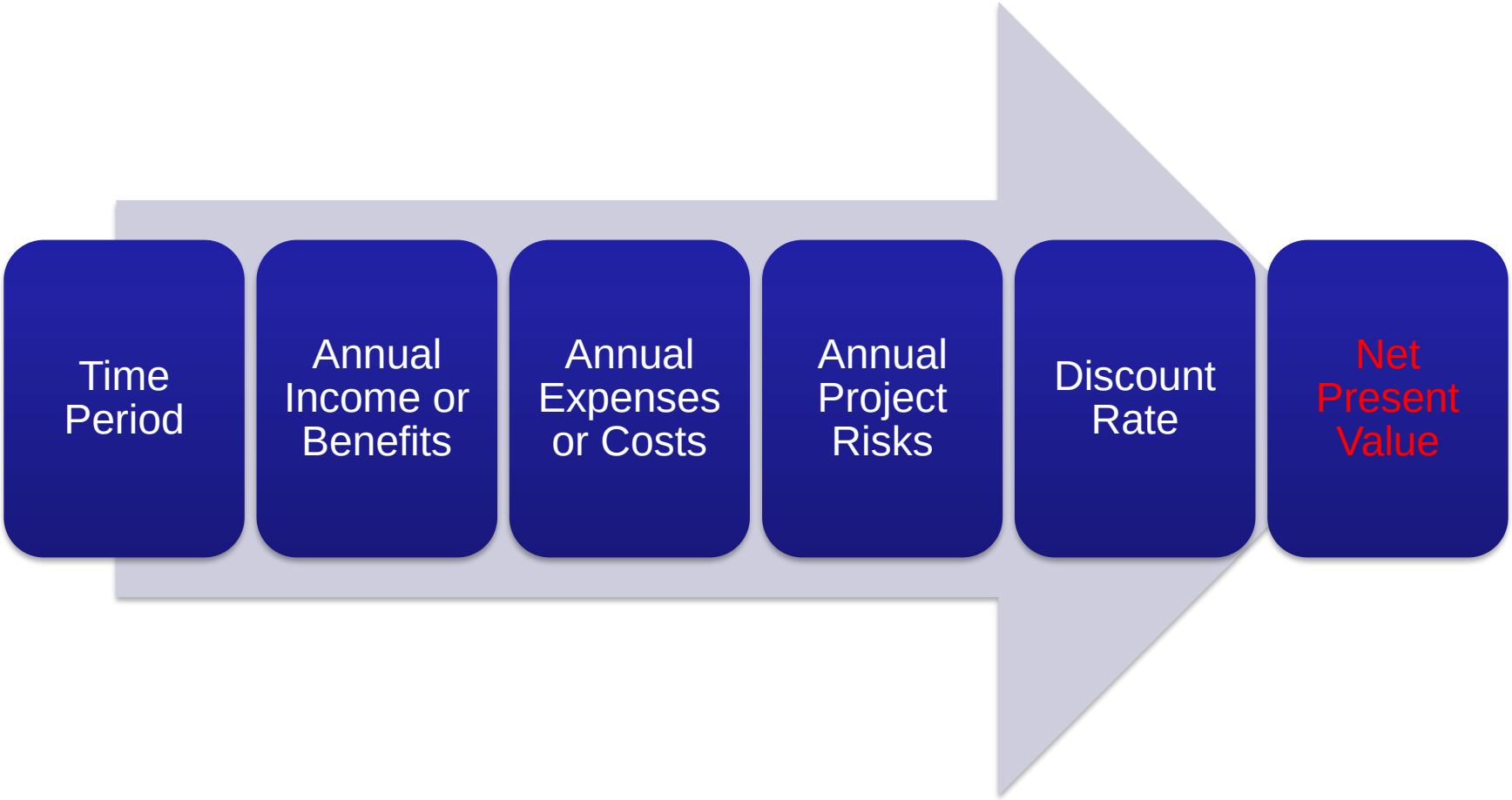
Methods


Before the fact:
Baseline shift
Simulation
Statistical
Optimization
Scenarios

Methods

- Worksheet
- Advanced spreadsheet(s)
- Systems database program
- Statistical formula

Microeconomic Analysis



Micro

Marginal Resource Mix	• All GHG emitting supply sources
Emissions Factors	• GHG loading of each unity of supply
Avoided Emissions	• GHGs of each unit avoided supply
Avoided and Incremental Costs	• Cost/savings of each unit avoided supply
Net Policy Costs/Savings	• Net Policy Option Costs/Savings less Baseline Costs
Net Present Value (NPV)	• Sum, from start to end, of annual income and expenses, adjusted for risk, discounted by time period
Cost Effectiveness (CE)	• Cost/Benefit, or NPV/GHG Removed or Energy Change

Example

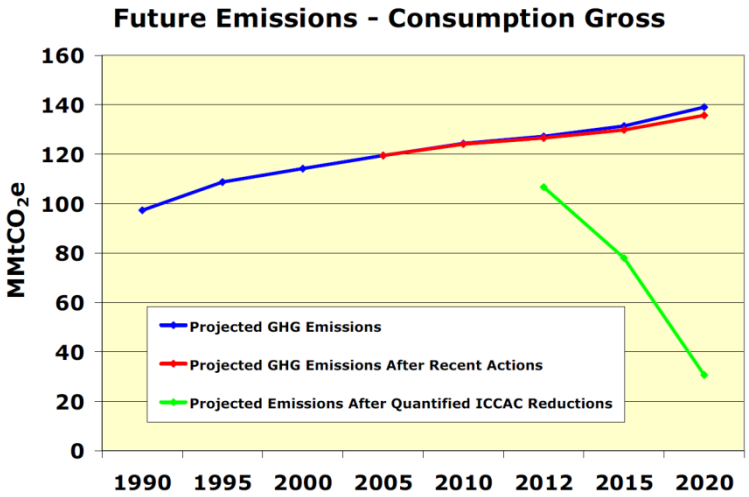
	BAU Costs	Policy Scenario (PS) Costs						Net Policy Costs	
	Avoided Due to the Policy	3a. Initial CapEx	3b. Major OH CapEx	3b. Annualized Initial CapEx	3b. Annualized Major OH	3C. O&M Costs (non-energy)	3d. Electricity Value	4. Net Annual Costs	5. Discounted Net Costs
Year	MM$	MM$	MM$	MM$	MM$	MM$	MM$	MM$	2012 MM$
2016	None Identified	$69	$0.0	$8.9	$0.0	$0.0	$0.0	$8.9	$7.4
2017	None Identified	$69	$0.0	$18	$0.0	$5.8	($6.1)	$18	$14
2018	None Identified	$69	$0.0	$27	$0.0	$13	($13)	$27	$20
2019	None Identified	$69	$0.0	$36	$0.0	$21	($20)	$36	$26
2020	None Identified	$0.0	$0.0	$36	$0.0	$30	($28)	$38	$25
2021	None Identified	$0.0	$0.0	$36	$0.0	$32	($29)	$39	$25
2022	None Identified	$0.0	$0.0	$36	$0.0	$34	($30)	$40	$24
2023	None Identified	$0.0	$0.0	$36	$0.0	$37	($31)	$41	$24
2024	None Identified	$0.0	$0.0	$36	$0.0	$39	($32)	$42	$24
2025	None Identified	$0.0	$0.0	$36	$0.0	$41	($33)	$44	$23
2026	None Identified	$0.0	$22	$27	$2.9	$44	($34)	$39	$20
2027	None Identified	$0.0	$22	$18	$5.8	$46	($35)	$35	$17
2028	None Identified	$0.0	$22	$9	$8.7	$49	($36)	$30	$14
2029	None Identified	$0.0	$22	$0	$12	$51	($37)	$26	$11
2030	None Identified	$0.0	$0.0	$0	$12	$53	($38)	$27	$11
Sum		**$276**	**$89**	**$357**	**$40**	**$496**	**($403)**	**$490**	**$286**

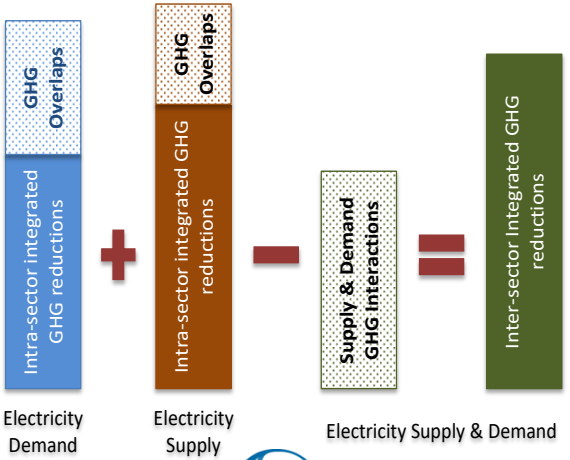
Exercise 3

- RPS
  - Which method(s)
  - Which annual costs and benefits
  - Which data sources for each
  - Key assumptions
  - Current and planned baseline actions
    - http://www.surveygizmo.com/s3/2361419/LEDS-LAC-Survey-for-Exercise-3
    - http://goo.gl/B0x8ZY

Integration

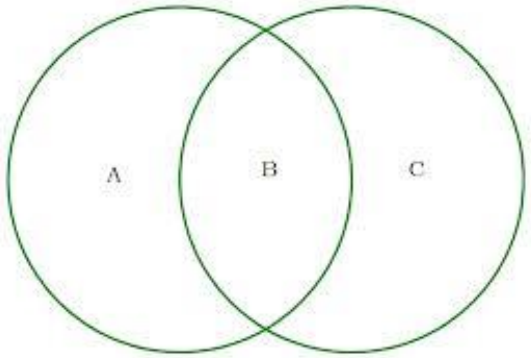
- Initial micro-economic analysis of each policy is done on a "stand-alone" basis.
- This assumes policy implementation all by itself with results calculated against business as usual (BAU) conditions.
- There are both intra-sector and inter-sector overlaps/ interactions to address





Integration

- Reduce the possibility of “double-counting” of GHG reductions and errors in economic impacts
- Double-counting occurs when the two different policies take credit for the “same” GHG reductions
- Double-counting can occur *within* each sector (intra-) as well as *across* sectors (inter-; e.g. AFF/WM/TLU/RCII → ES)
- The *net* GHG effect needs to be calculated and one set of results produced during the inter-sector integration analysis.



E.g. Policy effects A & C have an overlap = Area B

Steps for Overlapping Policy Options

- Review the “Marginal Resource Mix,” such as for the Electricity Supply system
- Aggregate Electricity System Impacts (and other export metrics)
- Compare the size of the plan’s aggregate electricity system impacts to the BAU marginal resource
- Adjust GHG impacts & costs based on the LCD Plan Marginal Resource Mix
- Multiply “Stand-Alone” Results by the ratio of LEDS Plan/Baseline metric

Macroeconomic Analysis

What is Macroeconomics?

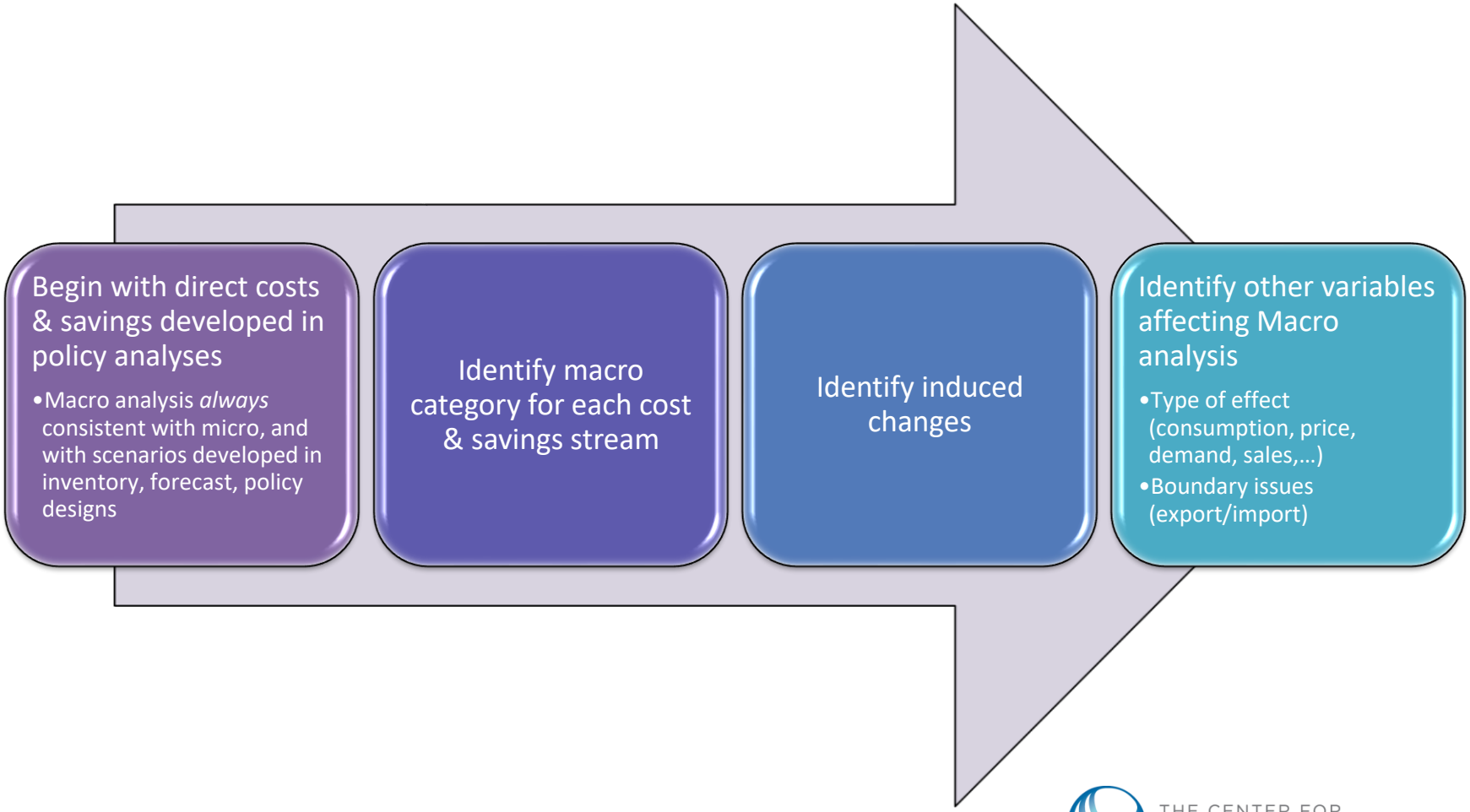
Study of Trends in the Larger Economy

- Changes in total economic activity (GDP), total employment (number of jobs), output – how many goods/services are produced
- Impacts of changes in monetary policy, inflation, interest rates
- Understanding how money spent/saved in one sector flows through to affect other sectors of the economy

Difference from Microeconomics:

- Micro: What types of costs/savings can be attributed to implementing a policy? What are the total direct costs/savings to society?
- Macro: Who pays/receives savings? How will those costs and savings affect the larger economy?

Basic Steps in Macroeconomic Analysis



Identify & Quantify Induced Changes

Key Money Concepts of Macro-analysis:

- If consumers spend more on one good/service, they have less to spend elsewhere
- If businesses invest in a new facility, must account for what is displaced. Savings? Other investment?
- Exception: money can leave (through imports) or enter (through exports)
- Must define and model these reactions in analysis

Macroeconomic Example:
Manure Methane

Problem: Farm-animal manure emits lots of *methane (CH_4)*.

Solution: Install a *digester*, which captures this methane. Once captured, it can be:

- Burned on-site for heat and energy, reducing need to buy fuel
- Sold on the market as a fuel

Step 1 – Identify Direct Costs & Savings

Step 1 – Identify Direct Costs & Savings

Costs!

- Cost to Purchase Digester
- Operations and Maintenance Costs to Run the Digester

Savings!

- Less Money Spent to Buy Fuel

New Revenue!

- Sales of Surplus Methane

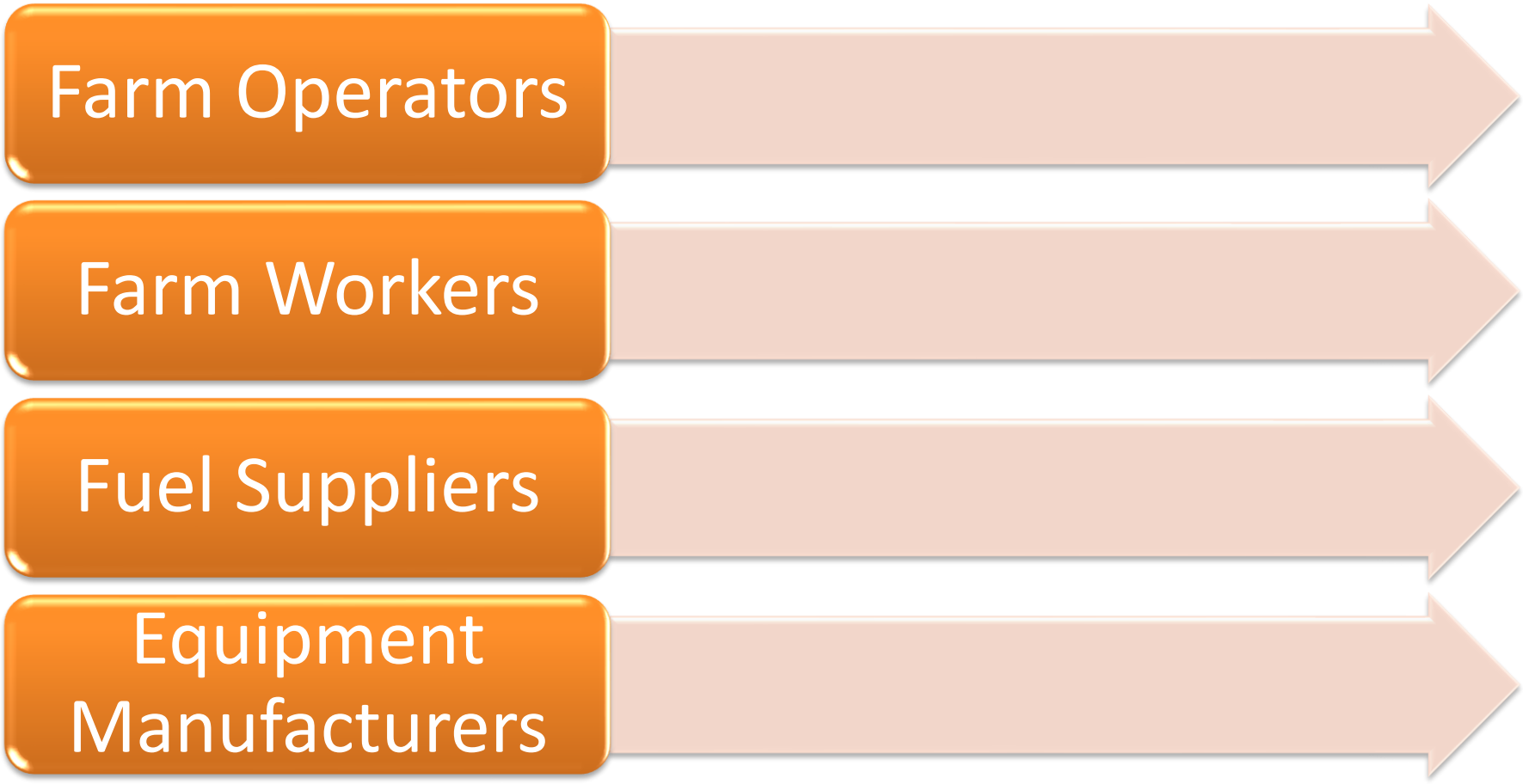
Step 2 – Identify *Both Sides* of Each Cost or Savings

Cost to Purchase Digester?	• Who Spends? • Who earns?
Operations and Maintenance Spending?	• Who Spends? • Who earns?
Less Money Spent to Buy Fuel?	• Who Spends? • Who earns?
Sales of Surplus Methane?	• Who Spends? • Who earns?

Step 2 – Identify *Both Sides* of Each Cost or Savings

Cost to Purchase Digester	• Expense incurred by farms, but also… • Sales and revenue to companies that make digesters
Operations and Maintenance Spending	• Another expense incurred by farms, but also… • Additional jobs, wages and earnings for workers
Less Money Spent to Buy Fuel	• A savings to farms, but also… • A loss of sales for the companies selling fuel (usually natural gas)
Sales of Surplus Methane	• Revenue to farms, but also… • Competes with and reduces sales for companies selling fuel (again, usually natural gas)

Step 3 – Determine the *Response to Change* of Every Affected Party



Step 3 – Determine the *Response to Change* of Every Affected Party

Farm Operators

- Change: Higher capital and labor costs, lower fuel costs, new revenue from methane sales – *net gain*
- Impact: Overall lower costs facilitate competitiveness and growth

Farm Workers

- Change: More hiring by farms to meet labor needs to operate digesters
- Impact: More incomes drive more consumer spending on a range of goods and services

Fuel Suppliers

- Change: Reduced sales of fuel
- Impact: Industry shrinks, demanding less of the resources and labor than before

Equipment Manufacturers

- Change: Increased sales of digesters
- Impact: Industry grows, demanding more labor, resources and capital than before

Step 4 – Quantify Impacts

- Like we said before, this analysis requires…

  LOTS of Data!

- Data needs to be:
  - –Specific to YOUR area – no two economies are alike
  - –Built to model the way sectors interact (I/O, CGE, etc.)
- Steps 1, 2, and 3 help to define inputs, but economic model is still necessary to get results

Exercise 4

Reduce Emissions from Semi-Trucks

- **Problem:** Semi-truck freight emits large amounts of GHGs and is a sector that continues to grow.
- **Solution:** Improve fuel efficiency of semi-trucks by installing trailer fairings or trailer skirts.

  - ❖Identify the costs, savings, and new Revenue
  - ❖Identify who will receive the costs, savings, and new revenue
  - ❖Determine the response change of each affected party

Final Results

Topics

A. Completion of final documentation
B. Alignment to convening order and work plan
C. Transmittal to the Convening Authority
D. Implementation Planning Design
E. Monitor, Report, and Update
F. Linkage to Study Tour and Information Exchange

Learning Objectives

Acquire concepts, techniques, and tools to:

- Finalize the LEDS Action Plan (policy recommendations and impact results aligned with set goals and work plan)
- Transition from a LEDS Action Plan to implementation in short, medium and long term
- Monitor, evaluate, and updated progress and plans

Completion of Final Documentation

Example:

Michigan final report

Table of Contents

Review and Discussion

- Q&A
- Trouble shooting
- Next steps