TRIPLE BOTTOM LINE CALCULATOR

URBAN SUSTAINABILITY DIRECTORS NETWORK

PRESENTED BY:

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City of Boston

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BRA Director of Research

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TBL Calculator Project Team

- This project is a partnership between the cities of Boston, Calgary, and Atlanta, with consulting from HDR Decision Economics

Overview of Presentation

- Background and rationale of the project
- The development of the current *Triple Bottom Line Calculator*
- How the *Triple Bottom Line Calculator* works

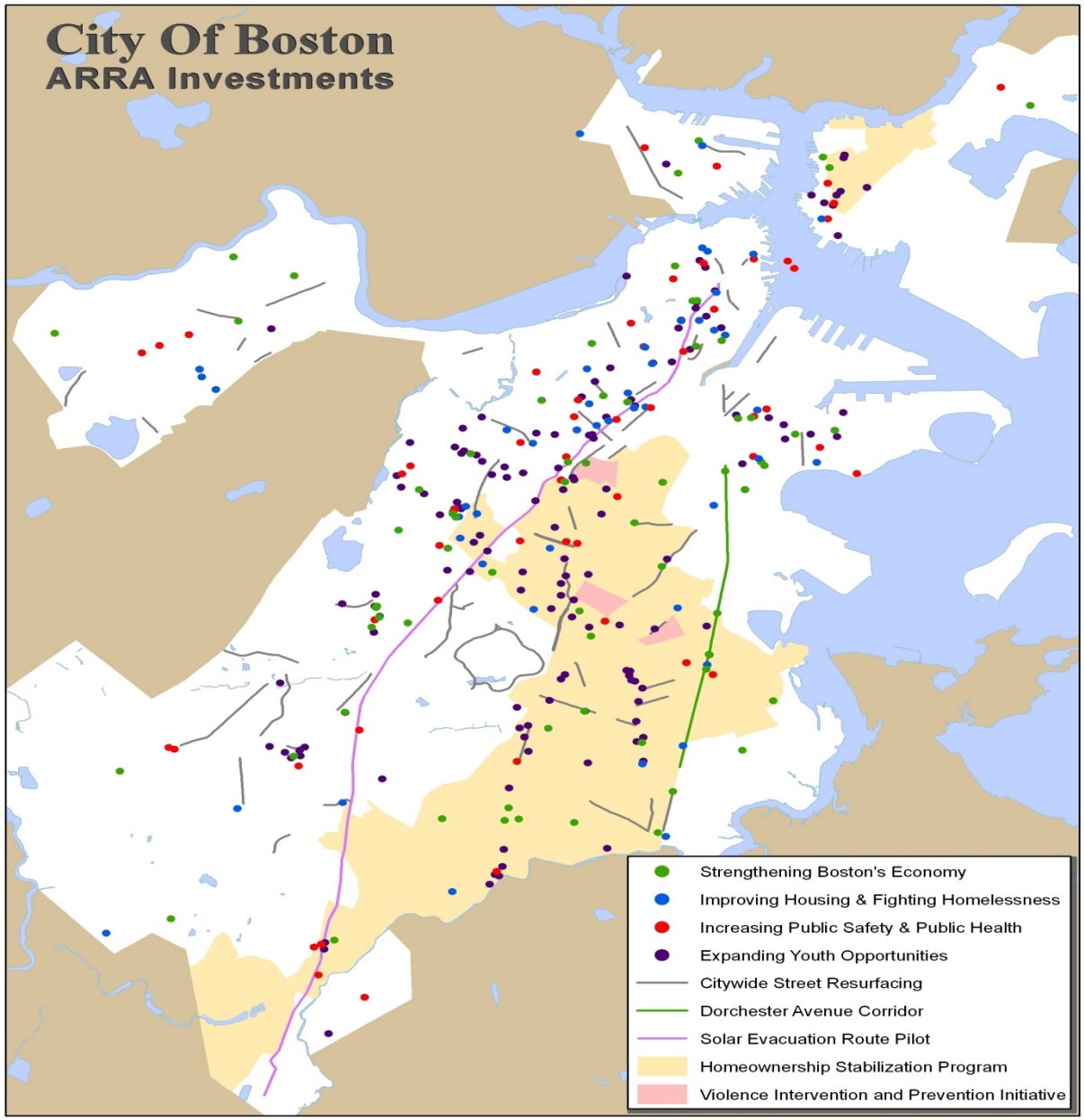
Background-City of Boston's SROI Project

- A commitment from the city to fully track ARRA projects
  - Money in, money out
  - Job creation
  - Economic impact
- Current modeling effort limitations
  - The benefits on some projects were not fully captured
- Provide model for how to assess ARRA projects and augment the city's efforts for transparency in the federal stimulus process.

ARRA in Boston Overview

Objective	Examples
Strengthening Boston's Economy (Creating New Jobs)	•Transportation Infrastructure Investments •Broadband Technologies Opportunities Program •Job Training Disadvantaged and Dislocated Adults
Improving Housing and Fighting Homelessness	•Public Housing Modernization •Stabilizing Neighborhood Community •Homelessness Prevention and Rapid Re-Housing
Expanding Youth Opportunities	•Title1 •IDEA •Summer and Year-Round Jobs
Greening the City	•Renew Boston •Solar Market Transformation Pilot
Increasing Public Safety and Public Health	•Community Orienting Policing Services •Boston Senior Health and Nutrition

ARRA In Boston Overview

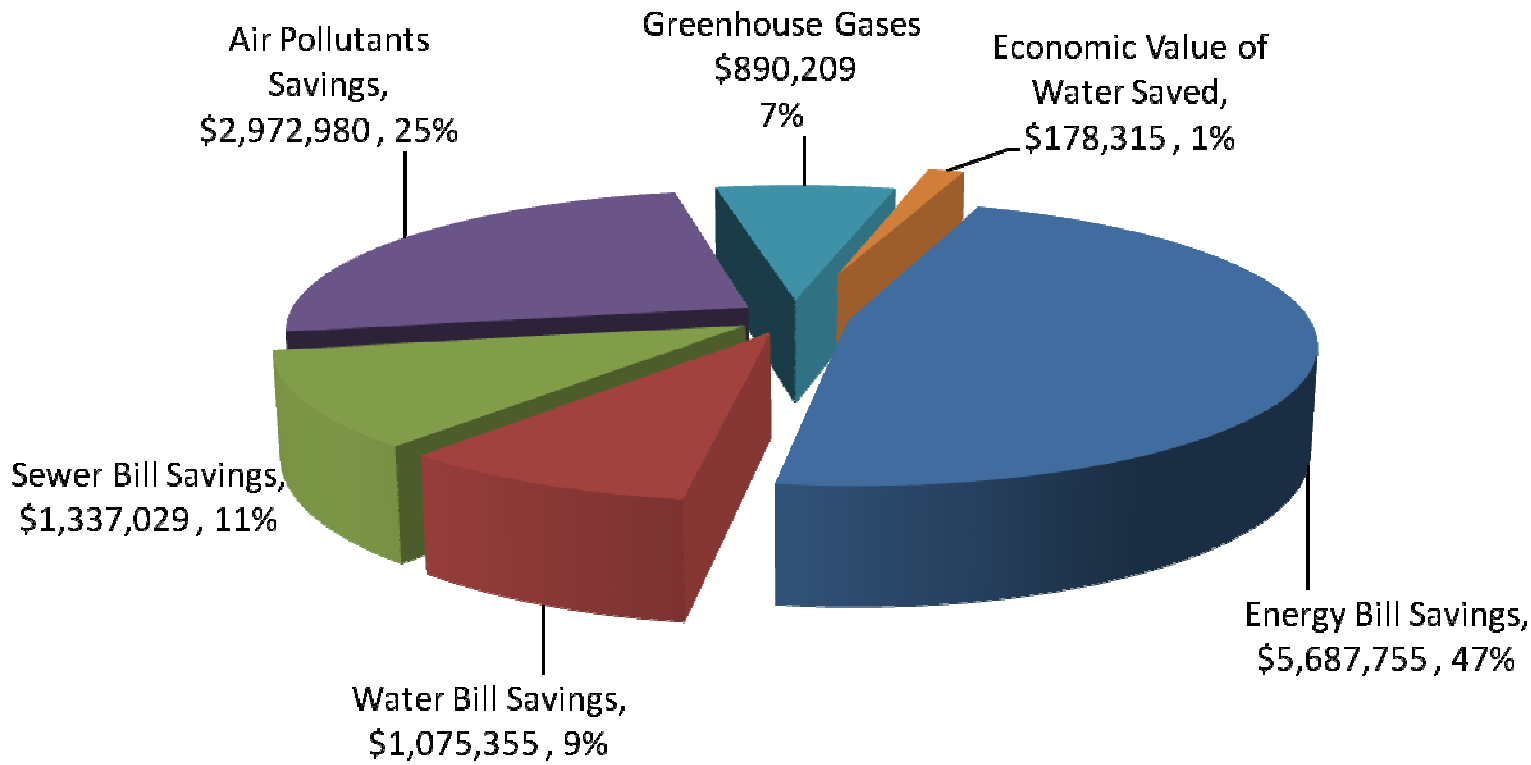


Sustainable Return on Investment (SROI)

Direct sustainability benefits are estimated to be substantial over time, with annual benefits in 2015 of:

- 34.4 million fewer kWh of electricity consumed
- 277,000 reduction of therms of gas used
- 23,750 HCF (hundreds of cubic feet) of water preserved
- 25,150 fewer tons of greenhouse gas emissions (CO2)

Annual Energy and Environmental Benefits and Cost Savings in 2015



Sustainable Return on Investment Results

Department	Net Present Value	Discounted Payback Period (Years)	Internal Rate of Return	Benefit-Cost Ratio
EE	$ 52,394,089	4	35%	3.0
BTD & PW	$ 111,398,447	4	38%	6.8
DND	$ 1,114,915	13	10%	1.6
BHA	$ 43,746,959	2	63%	9.2
TOTAL	**$ 208,654,409**	**5**	**38%**	**4.5**

- The aggregate Net Present Value (NPV) is over $208 million with a 4.5 discounted payback period of about 5 years
- Benefit-cost ratios are estimated to be greater than 1.0 for all departments evaluated, ranging from 1.6 to 9.2
- The total Internal Rate of Return (IRR) is estimated to be 38%

USDN Opportunity Grant-TBL Calculator Project

- The purpose of the model is to provide USDN members a tool to:
  - Help understand and be strategic about capital investments in their respective cities
  - Calculate the impact of strategic investment
  - Monetize the environmental and social benefits of capital investments

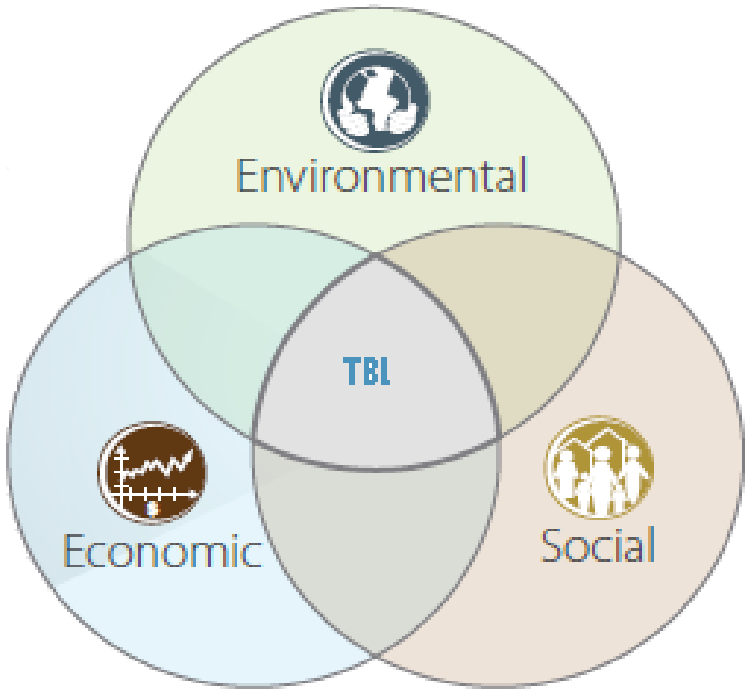
Overview-Development of TBL Calculator

Estimate the TBL --- economic, environmental, and social benefits of capital investments in the following categories:

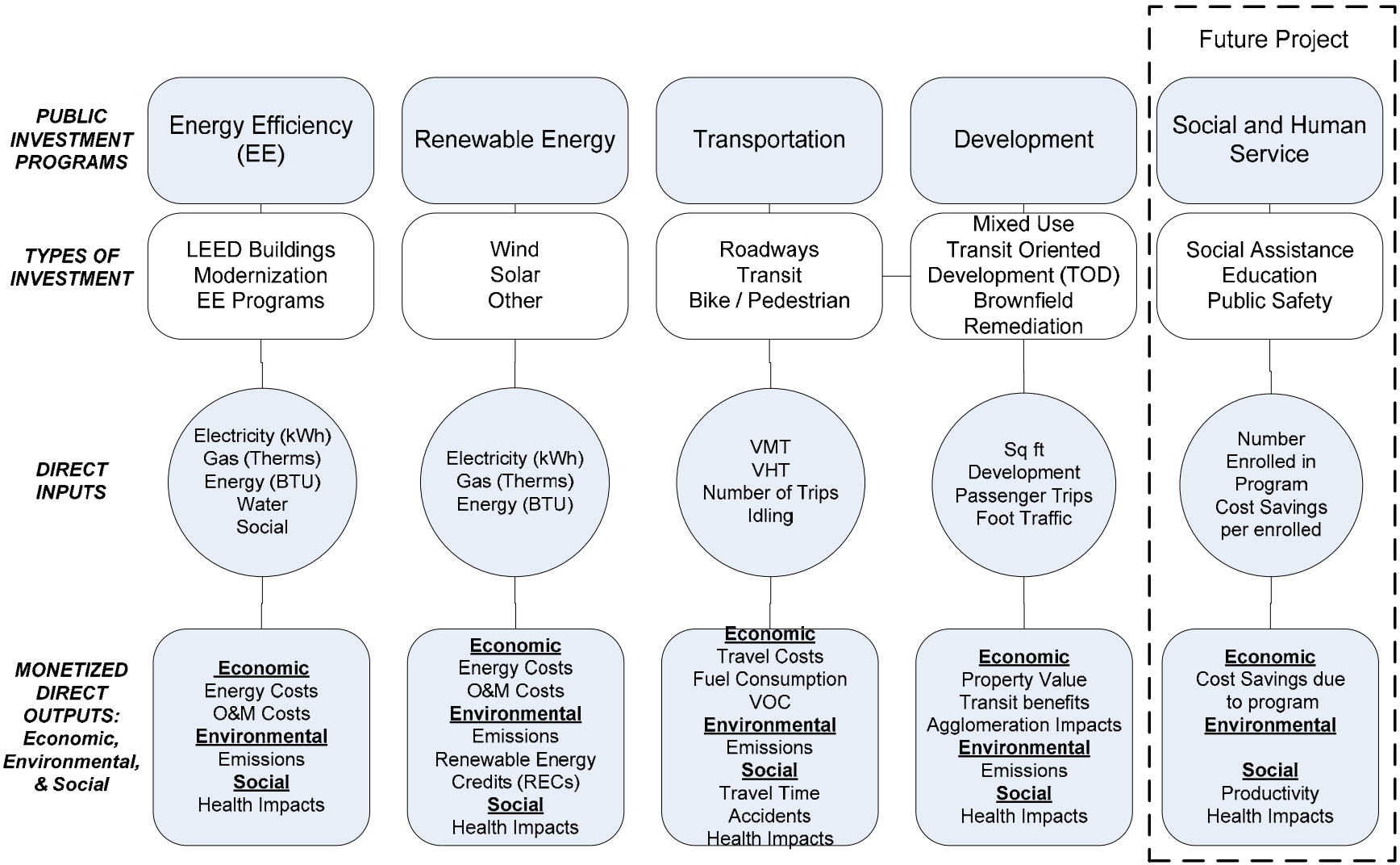
- **Energy Efficiency** - Investments and energy retrofit programs that reduce energy usage for infrastructure, municipal, commercial, and residential buildings.
- **Renewable Energy** - New renewable energy infrastructure including solar, wind, hydroelectric, and others.
- **Transportation** - Investments in roadways, public transit, bike/pedestrian infrastructure, and operations.
- **Development** - Mixed use and transit oriented development (TOD) projects will create more centralized development, reduce auto trips and travel, and increase foot traffic.

Analytical Framework

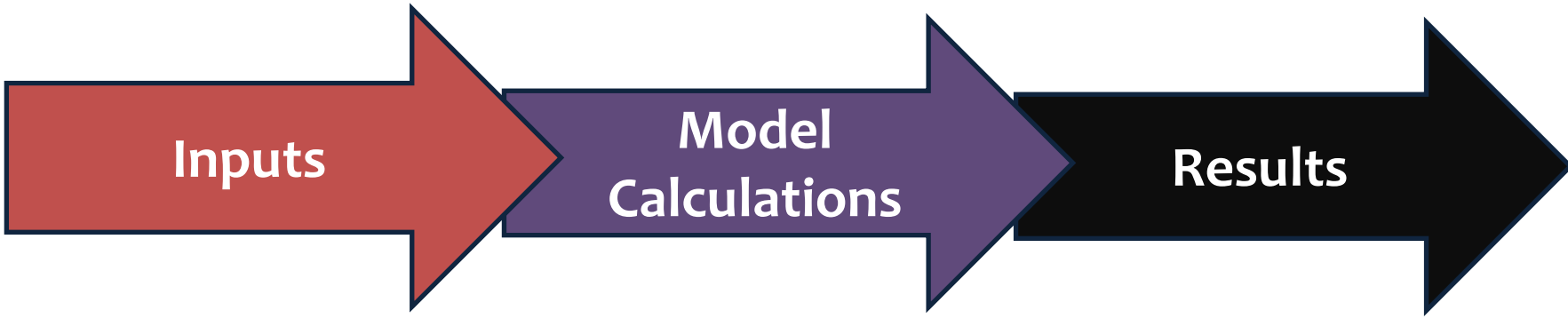
- Capital investments can have a combination of economic, environmental, and social impacts
- In some cases the impacts may be concentrated in only two of the three categories.



USDN Triple Bottom Line Model

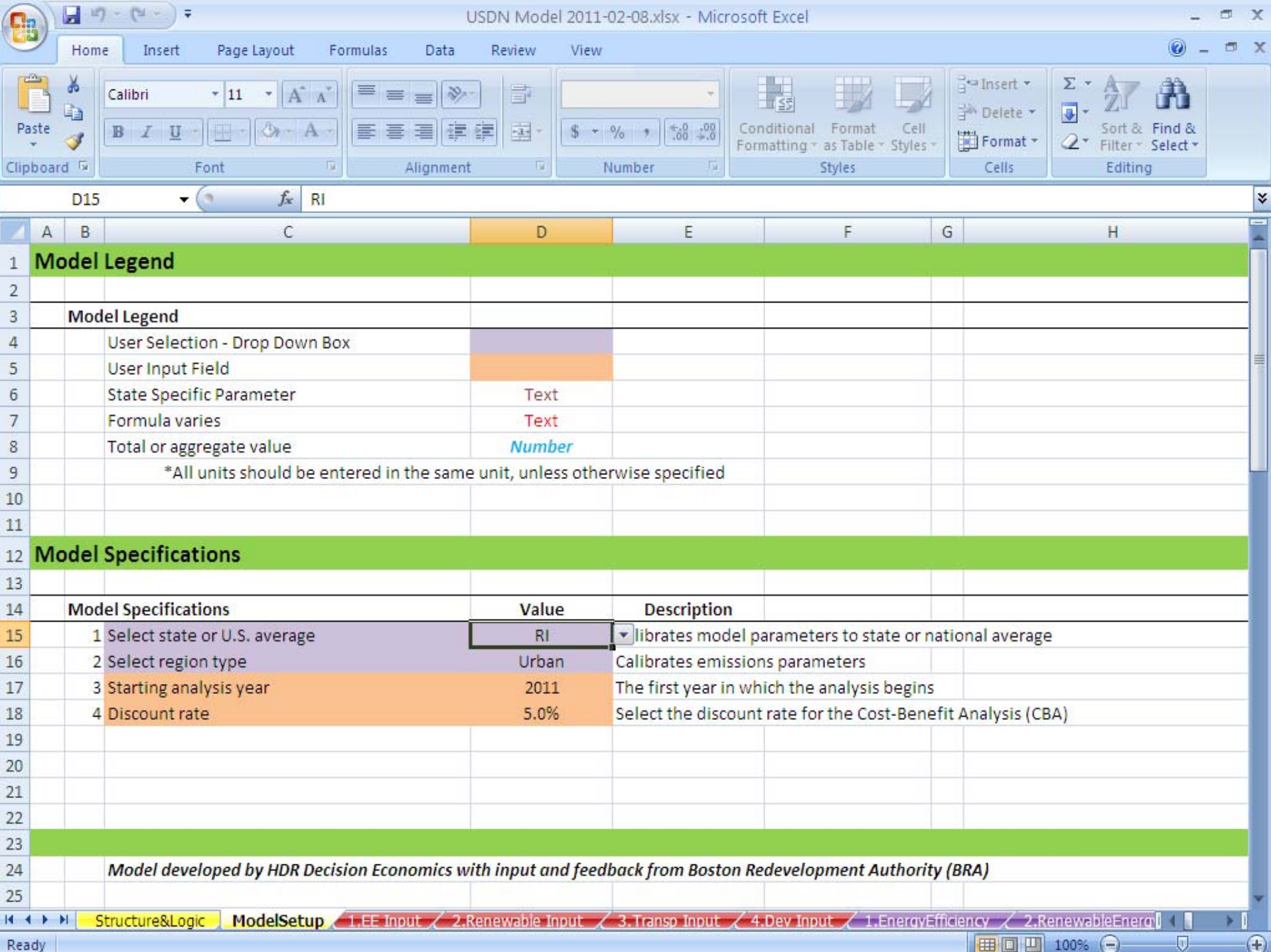


Triple Bottom Line Calculator



Examples:

- Total investments
- Investment period
- Electricity consumer
- Electricity cost differential
- Average vehicle occupancy
- Average office wage
- Annual value of benefits
- Return on investment
- Benefit to cost ratio



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Model Legend

Model Legend	
User Selection - Drop Down Box	
User Input Field	
State Specific Parameter	Text
Formula varies	Text
Total or aggregate value	*Number*

*All units should be entered in the same unit, unless otherwise specified

Model Specifications

	Model Specifications	Value	Description
1	Select state or U.S. average	RI	librates model parameters to state or national average
2	Select region type	Urban	Calibrates emissions parameters
3	Starting analysis year	2011	The first year in which the analysis begins
4	Discount rate	5.0%	Select the discount rate for the Cost-Benefit Analysis (CBA)

Model developed by HDR Decision Economics with input and feedback from Boston Redevelopment Authority (BRA)

Structure&Logic ModelSetup 1.EE Input 2.Renewable Input 3.Transp Input 4.Dev Input 1.EnergyEfficiency 2.RenewableEnerg

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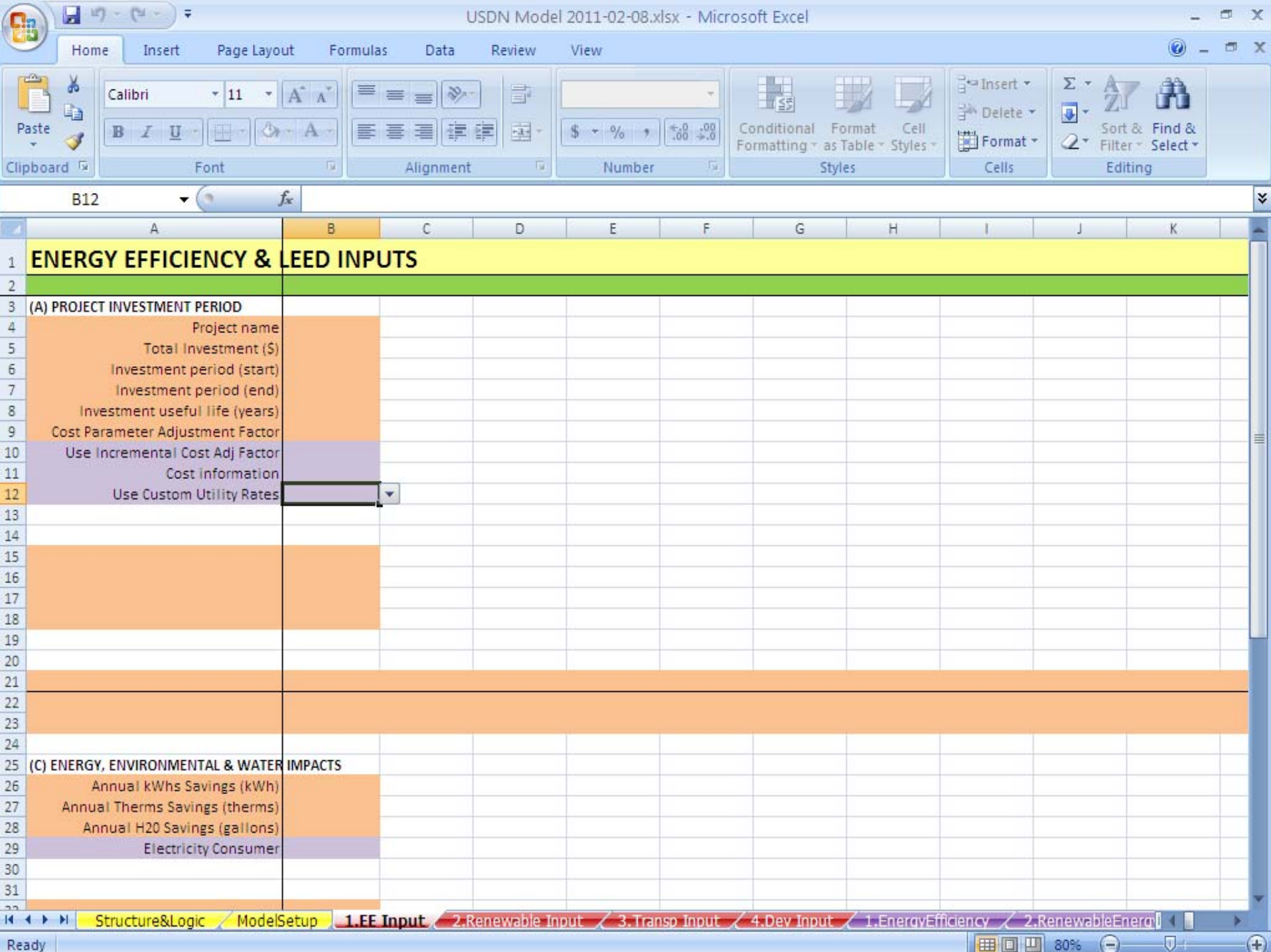
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ENERGY EFFICIENCY & LEED INPUTS
(A) PROJECT INVESTMENT PERIOD
Project name
Total Investment ($)
Investment period (start)
Investment period (end)
Investment useful life (years)
Cost Parameter Adjustment Factor
Use Incremental Cost Adj Factor
Cost information
Use Custom Utility Rates
(C) ENERGY, ENVIRONMENTAL & WATER IMPACTS
Annual kWhs Savings (kWh)
Annual Therms Savings (therms)
Annual H20 Savings (gallons)
Electricity Consumer
Structure&Logic
ModelSetup
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2.Renewable Input
3.Transp Input
4.Dev Input
1.EnergyEfficiency
2.RenewableEnerg
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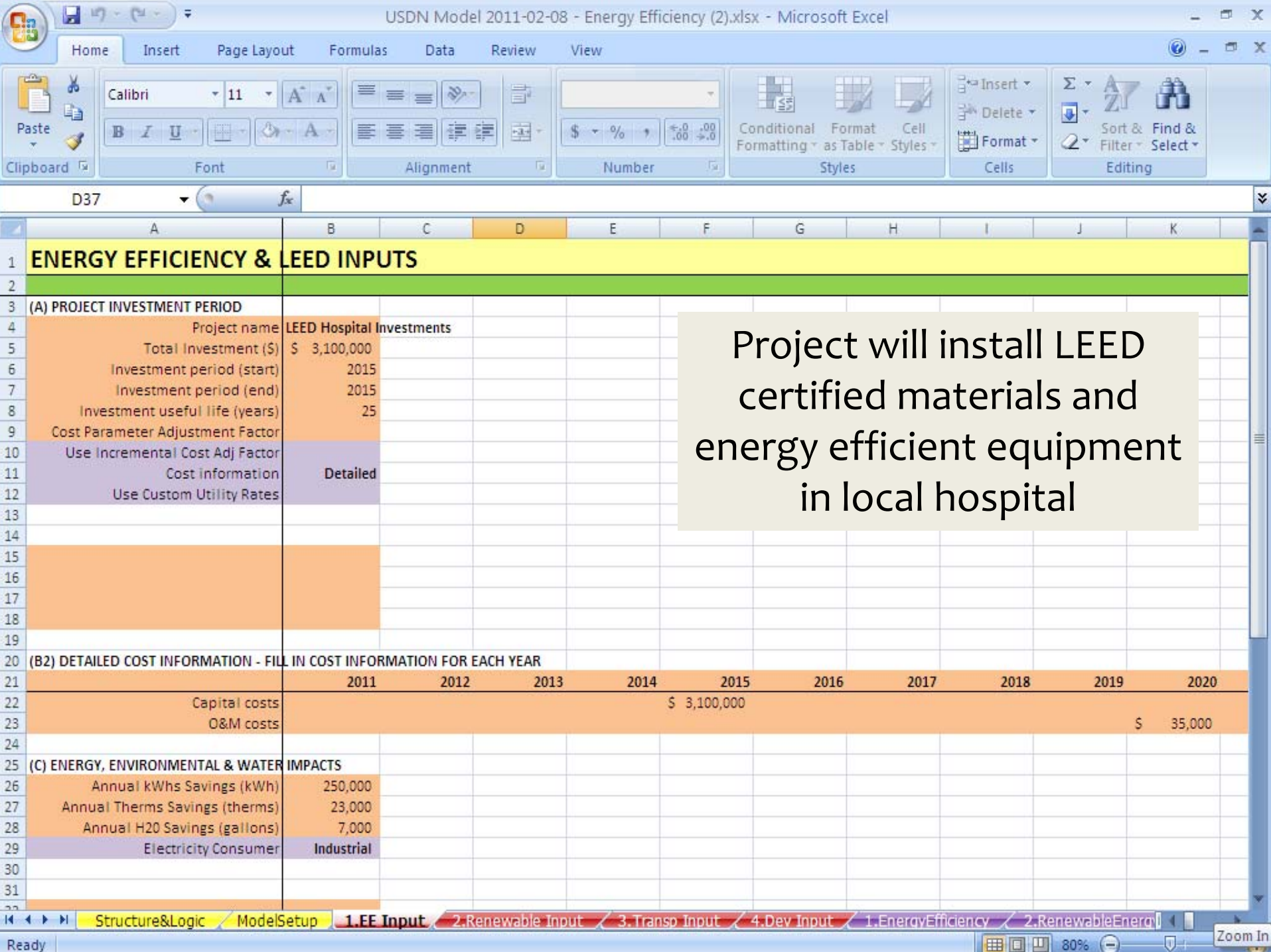
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ENERGY EFFICIENCY & LEED INPUTS
(A) PROJECT INVESTMENT PERIOD
Project name LEED Hospital Investments
Total Investment ($) $ 3,100,000
Investment period (start) 2015
Investment period (end) 2015
Investment useful life (years) 25
Cost Parameter Adjustment Factor
Use Incremental Cost Adj Factor
Cost information Detailed
Use Custom Utility Rates
Project will install LEED certified materials and energy efficient equipment in local hospital
(B2) DETAILED COST INFORMATION - FILL IN COST INFORMATION FOR EACH YEAR
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
Capital costs $ 3,100,000
O&M costs $ 35,000
(C) ENERGY, ENVIRONMENTAL & WATER IMPACTS
Annual kWhs Savings (kWh) 250,000
Annual Therms Savings (therms) 23,000
Annual H20 Savings (gallons) 7,000
Electricity Consumer Industrial
Structure&Logic
ModelSetup
1.EE Input
2.Renewable Input
3.Transp Input
4.Dev Input
1.EnergyEfficiency
2.RenewableEnerg
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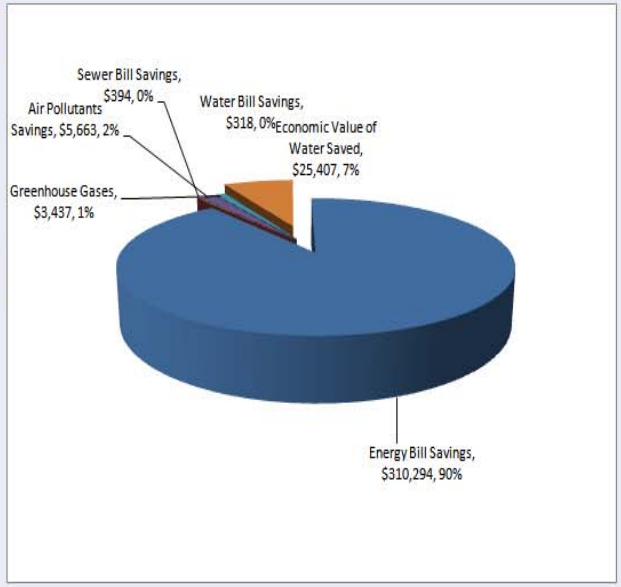
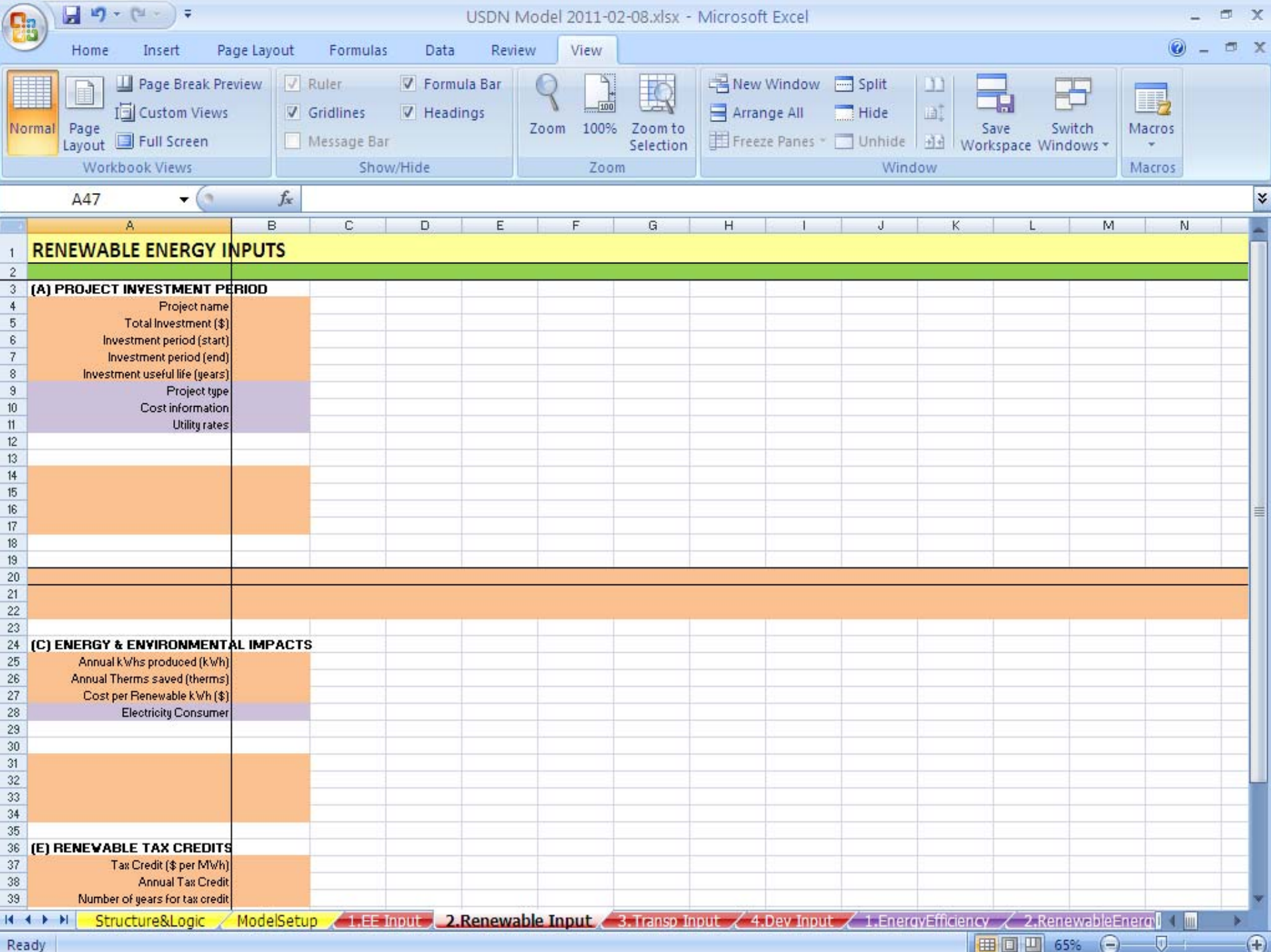
Energy Efficiency & LEED

TBL Results 2020	Expected	Notes
Annual Value of Benefits	$345,986	The total value of the benefits in the 10th year
Electric Utility Savings	$16,900	Direct
Gas Utility Savings	$293,394	Direct
Water Utility Savings	$318	Direct
Sewer Utility Savings	$394	Direct
Total Green House Gas Savings	$8,151	Externality
Total Criteria Air Contaminant Savings	$9,574	Externality
Net Present Value	$1,673,451	PV Benefits - PV All Costs
Return on Investment	6%	Arithmetic Average Rate of Return on Capital Investment
Discounted Payback Period	2026	Time in years till positive discounted cash flow
Internal Rate of Return (%)	12%	Discount rate which would make NPV = 0
Benefit to Cost Ratio	1.66	PV Benefits / PV Costs

Utility Benefits 2020	
Energy Bill Savings	$310,294
Water Bill Savings	$318
Sewer Bill Savings	$394
Air Pollutants Savings	$5,663
Greenhouse Gases	$3,437
Economic Value of Water Saved	$25,407



Resource Savings 2020	
Water (gallons)	7,000
Electricity (kWh)	250,000
Energy (Therms)	23,000
NOx (Tons)	0.24
SO2 (Tons)	0.66
PM (Tons)	-
VOC (Tons)	-
CO2 (Tons)	301
CH4 (Tons)	0.02
N20 (Tons)	0.00
Hg (Tons)	0.00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RENEWABLE ENERGY INPUTS
(A) PROJECT INVESTMENT PERIOD
Project name
Total Investment ($)
Investment period (start)
Investment period (end)
Investment useful life (years)
Project type
Cost information
Utility rates
(C) ENERGY & ENVIRONMENTAL IMPACTS
Annual kWhs produced (kWh)
Annual Therms saved (therms)
Cost per Renewable kWh ($)
Electricity Consumer
(E) RENEWABLE TAX CREDITS
Tax Credit ($ per MWh)
Annual Tax Credit
Number of years for tax credit
Structure&Logic
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1.EE Input
2.Renewable Input
3.Transp Input
4.Dev Input
1.EnergyEfficiency
2.RenewableEnerg
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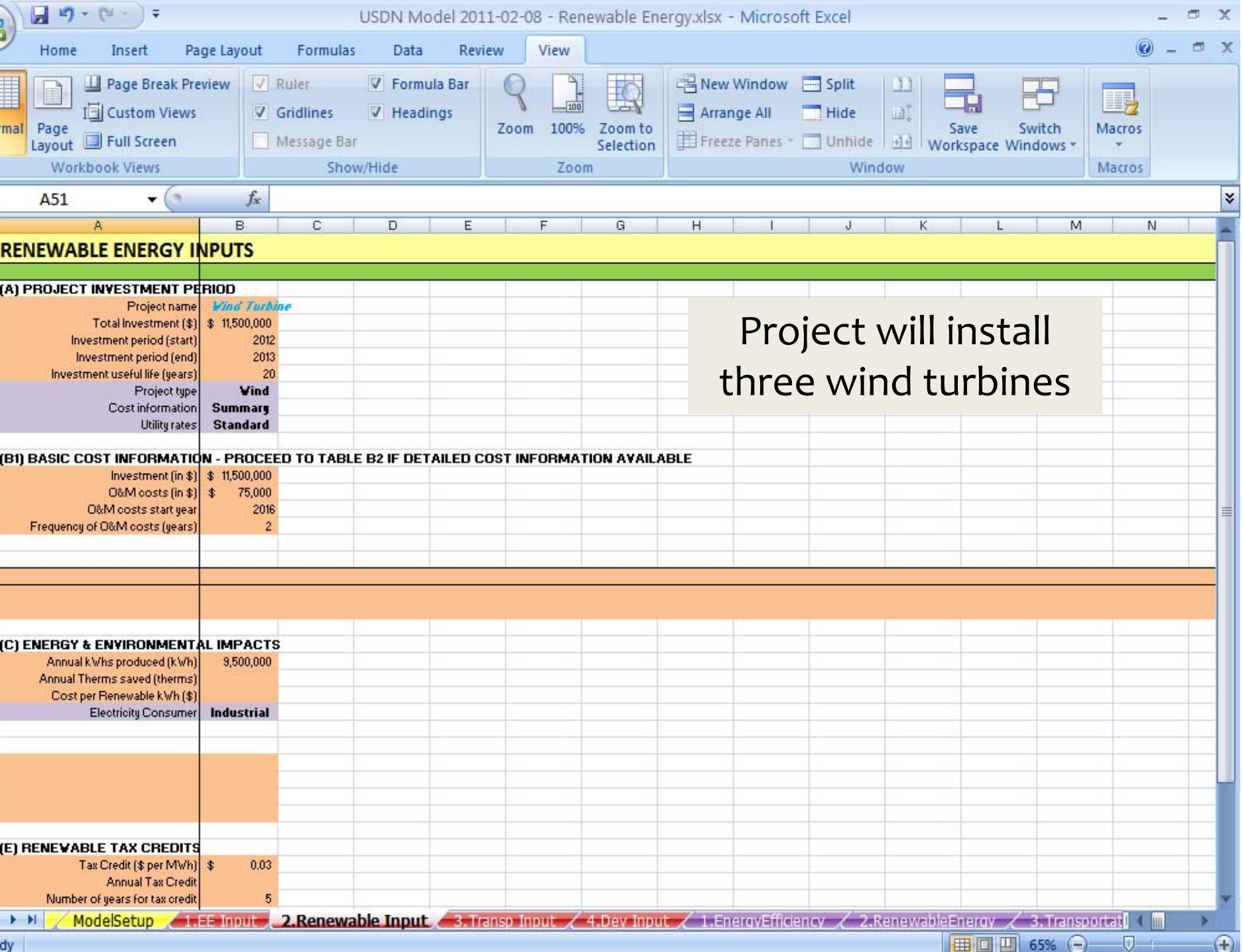
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RENEWABLE ENERGY INPUTS
(A) PROJECT INVESTMENT PERIOD
Project name Wind Turbine
Total Investment ($) $ 11,500,000
Investment period (start) 2012
Investment period (end) 2013
Investment useful life (years) 20
Project type Wind
Cost information Summary
Utility rates Standard
(B1) BASIC COST INFORMATION - PROCEED TO TABLE B2 IF DETAILED COST INFORMATION AVAILABLE
Investment (in $) $ 11,500,000
O&M costs (in $) $ 75,000
O&M costs start year 2016
Frequency of O&M costs (years) 2
(C) ENERGY & ENVIRONMENTAL IMPACTS
Annual kWhs produced (kWh) 9,500,000
Annual Therms saved (therms)
Cost per Renewable kWh ($)
Electricity Consumer Industrial
(E) RENEWABLE TAX CREDITS
Tax Credit ($ per MWh) $ 0.03
Annual Tax Credit
Number of years for tax credit 5
Project will install three wind turbines
ModelSetup
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2.Renewable Input
3.Transp Input
4.Dev Input
1.EnergyEfficiency
2.RenewableEnergy
3.Transportati
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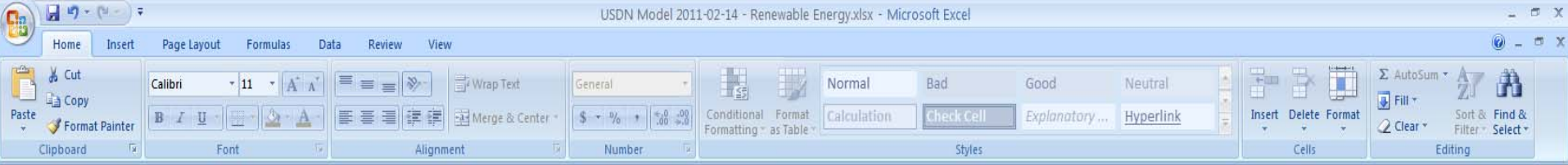

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	A	B	C
1	**Renewable Energy**		
2	**TBL Results 2020**	**Expected**	**Notes**
3	**Annual Value of Benefits**	$772,644	The total value of the benefits in the 10th year
4	*Electric Utility Savings*	$642,200	Direct
5	*Gas Utility Savings*	$0	Direct
6	*Total Green House Gas Savings*	$124,228	Externality
7	*Total Criteria Air Contaminant Savings*	$130,159	Externality
8	**Net Present Value**	-$1,115,432	PV Benefits - PV All Costs
9	**Return on Investment**	0%	Arithmetic Average Rate of Return on Capital Investment
10	**Discounted Payback Period**	Doesn't Payback	Time in years till positive discounted cash flow
11	**Internal Rate of Return (%)**	4%	Discount rate which would make NPV = 0
12	**Benefit to Cost Ratio**	0.90	PV Benefits / PV Costs
13			
14			
15	**Benefits 2020**		
16	Electricity (kWh)	9,500,000	
17	Energy (Therms)	-	
18	NOx (Tons)	1.01	
19	SO2 (Tons)	0.26	
20	PM (Tons)	-	
21	VOC (Tons)	-	
22	CO2 (Tons)	4,582	
23	CH4 (Tons)	0.09	
24	N20 (Tons)	0.01	
25	Hg (Tons)	-	
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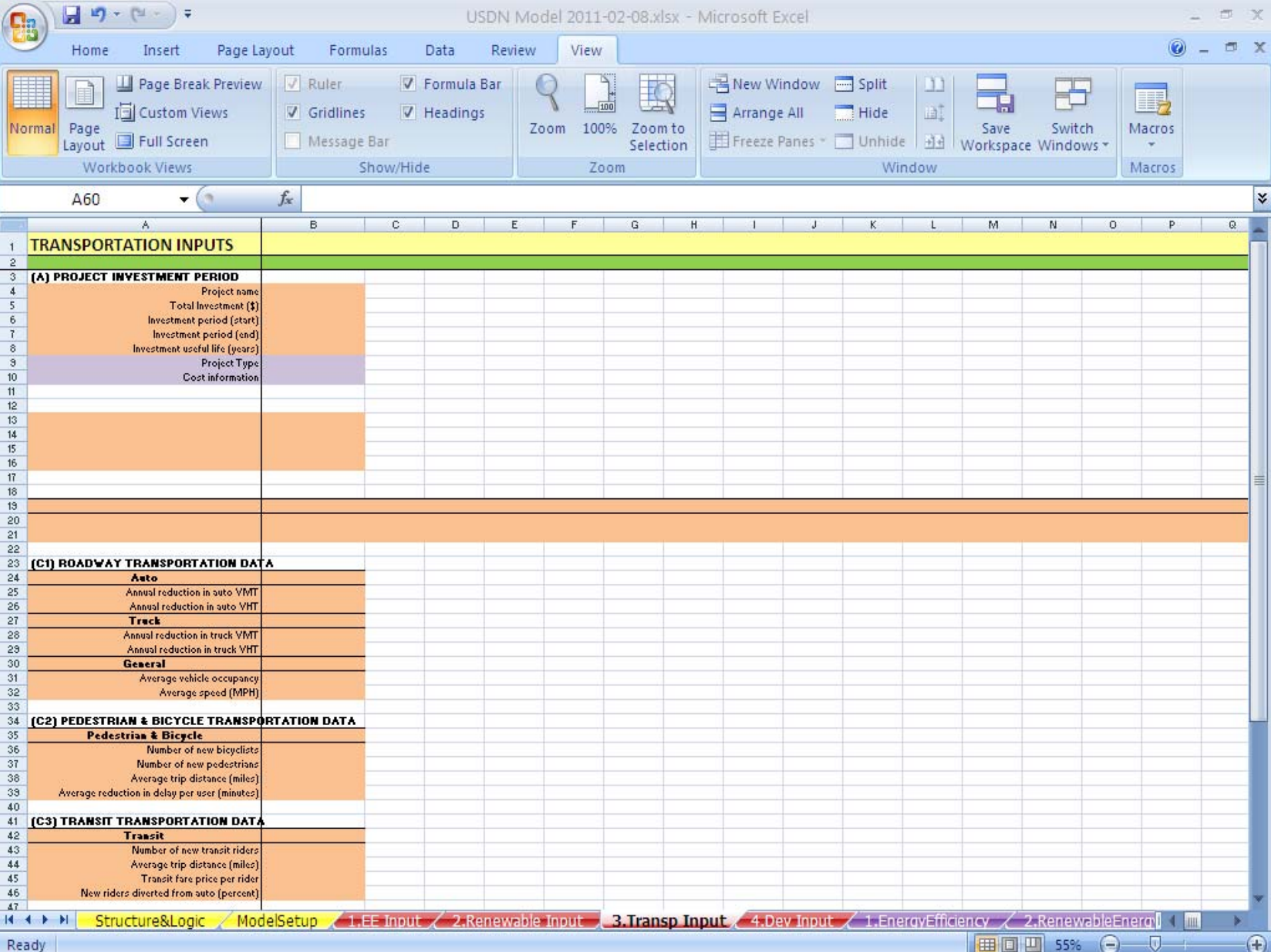

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	A	B
1	**TRANSPORTATION INPUTS**	
2		
3	**(A) PROJECT INVESTMENT PERIOD**	
4	Project name	
5	Total Investment ($)	
6	Investment period (start)	
7	Investment period (end)	
8	Investment useful life (years)	
9	Project Type	
10	Cost information	
11		
12		
13		
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20		
21		
22		
23	**(C1) ROADWAY TRANSPORTATION DATA**	
24	**Auto**	
25	Annual reduction in auto VMT	
26	Annual reduction in auto VHT	
27	**Truck**	
28	Annual reduction in truck VMT	
29	Annual reduction in truck VHT	
30	**General**	
31	Average vehicle occupancy	
32	Average speed (MPH)	
33		
34	**(C2) PEDESTRIAN & BICYCLE TRANSPORTATION DATA**	
35	**Pedestrian & Bicycle**	
36	Number of new bicyclists	
37	Number of new pedestrians	
38	Average trip distance (miles)	
39	Average reduction in delay per user (minutes)	
40		
41	**(C3) TRANSIT TRANSPORTATION DATA**	
42	**Transit**	
43	Number of new transit riders	
44	Average trip distance (miles)	
45	Transit fare price per rider	
46	New riders diverted from auto (percent)	
47		

Structure&Logic ModelSetup 1.EE Input 2.Renewable Input 3.Transp Input 4.Dev Input 1.EnergyEfficiency 2.RenewableEnerg

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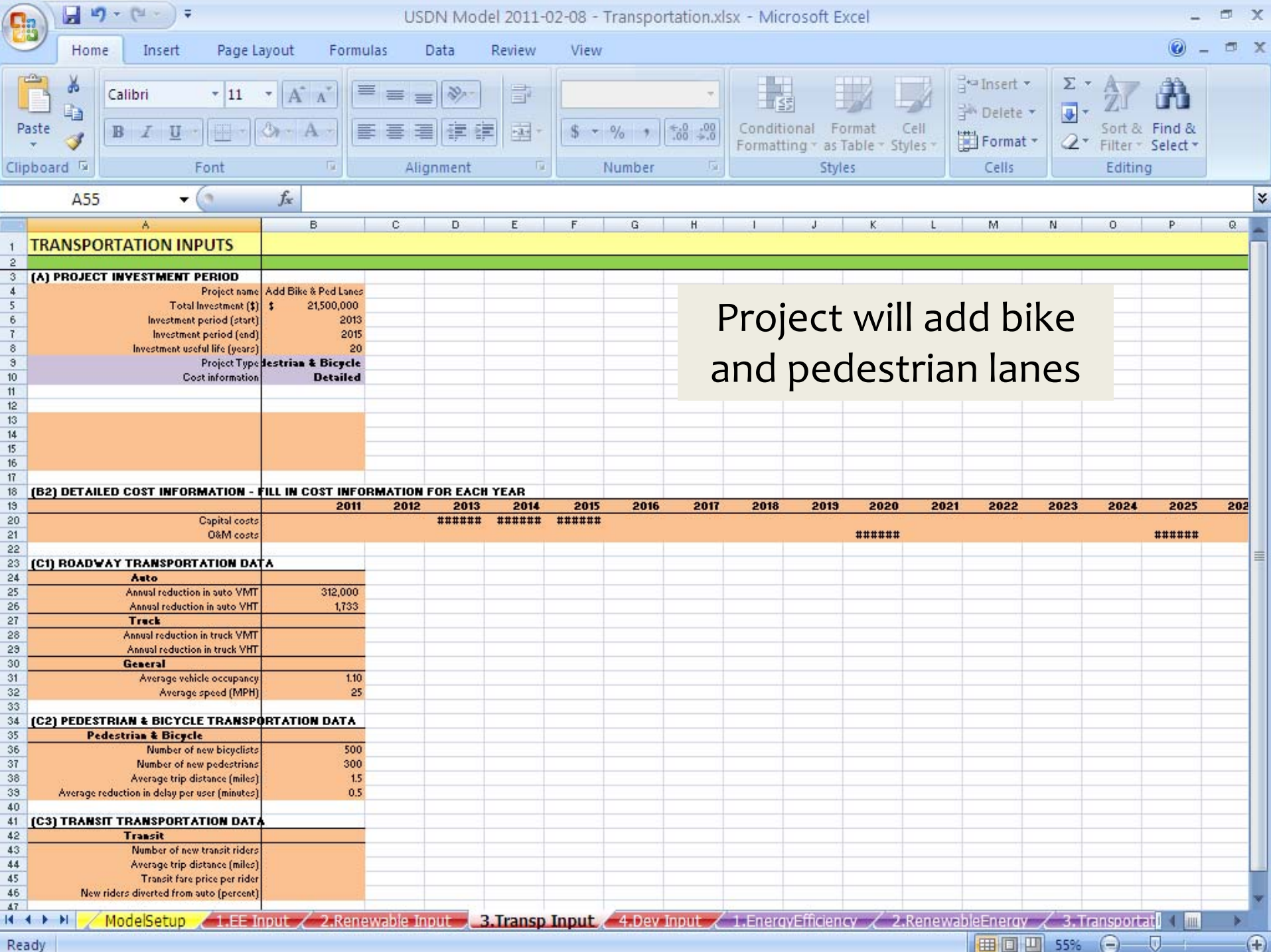
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TRANSPORTATION INPUTS
(A) PROJECT INVESTMENT PERIOD
Project name Add Bike & Ped Lanes
Total Investment ($) $ 21,500,000
Investment period (start) 2013
Investment period (end) 2015
Investment useful life (years) 20
Project Type destrian & Bicycle
Cost information Detailed
Project will add bike and pedestrian lanes
(B2) DETAILED COST INFORMATION - FILL IN COST INFORMATION FOR EACH YEAR
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 202
Capital costs ###### ###### ######
O&M costs ###### ######
(C1) ROADWAY TRANSPORTATION DATA
Auto
Annual reduction in auto VMT 312,000
Annual reduction in auto VHT 1,733
Truck
Annual reduction in truck VMT
Annual reduction in truck VHT
General
Average vehicle occupancy 1.10
Average speed (MPH) 25
(C2) PEDESTRIAN & BICYCLE TRANSPORTATION DATA
Pedestrian & Bicycle
Number of new bicyclists 500
Number of new pedestrians 300
Average trip distance (miles) 1.5
Average reduction in delay per user (minutes) 0.5
(C3) TRANSIT TRANSPORTATION DATA
Transit
Number of new transit riders
Average trip distance (miles)
Transit fare price per rider
New riders diverted from auto (percent)
ModelSetup
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4.Dev Input
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2.RenewableEnergy
3.Transportati
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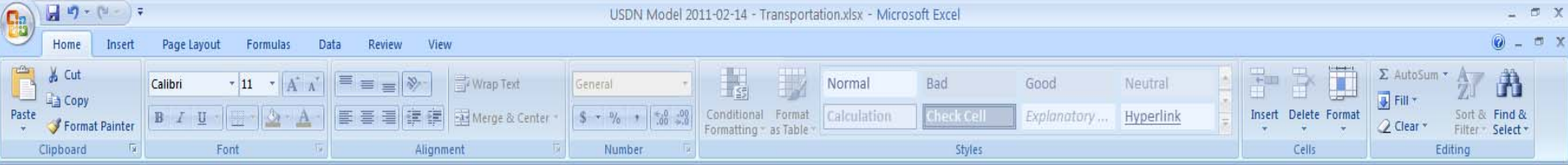
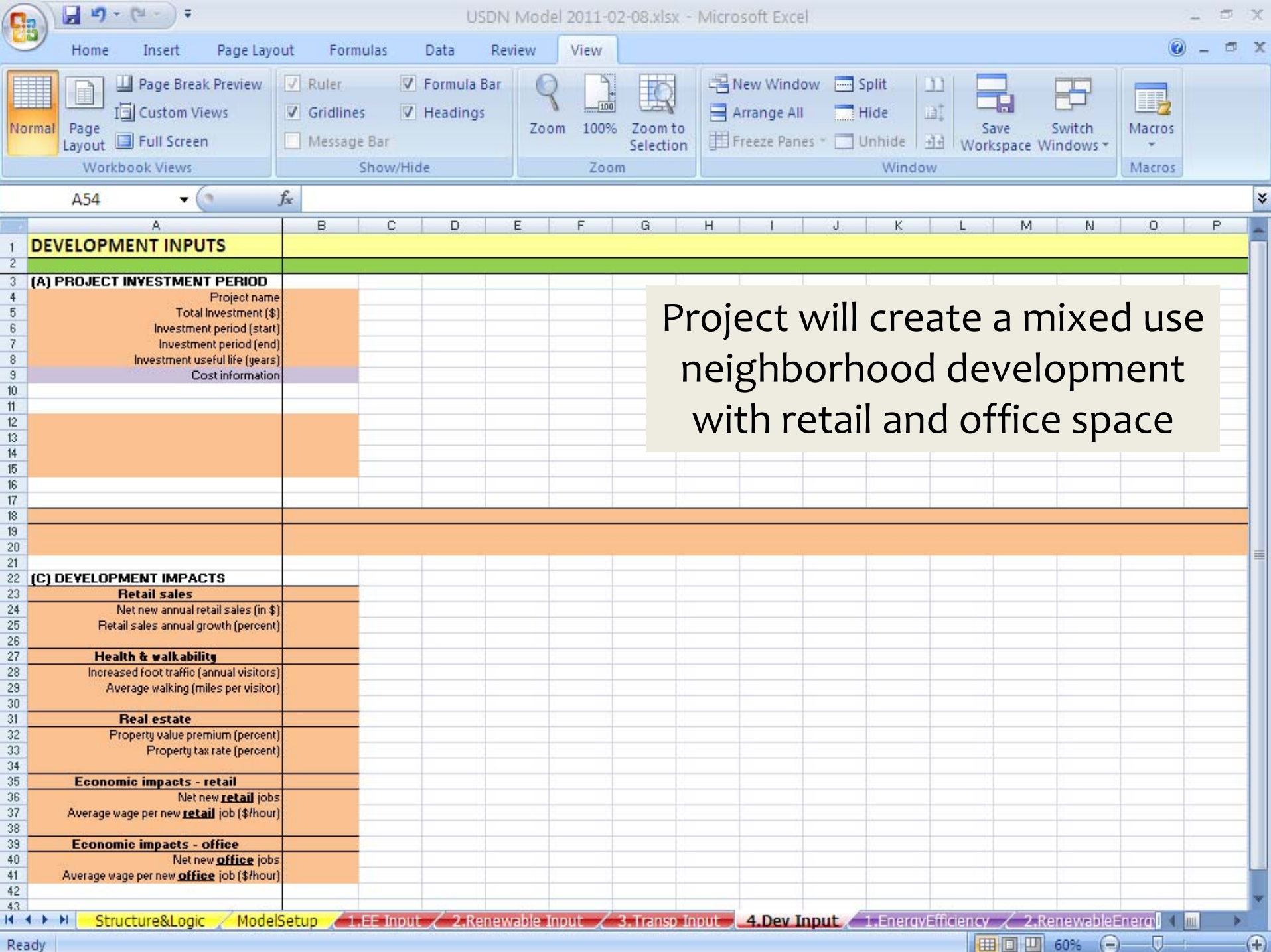


Transportation Results

TBL Results 2020	Expected	Notes
Annual Value of Benefits	$59,667,019	The total value of the benefits in the 10th year
Time savings	$27,110	
Accidents	$1,256,711	
Vehicle O&M savings	$92,373	
Health benefits	$97,792	
Pavement maintenance	$312	
Congestion reduction	$17,416	
Total Green House Gas Savings	$17	Externality
Total Criteria Air Contaminant Savings	$1,349,688	Externality
Net Present Value	$9,872,918	PV Benefits - PV All Costs
Return on Investment	1%	Arithmetic Average Rate of Return on Capital Investment
Discounted Payback Period	2024	Time in years till positive discounted cash flow
Internal Rate of Return (%)	12%	Discount rate which would make NPV = 0
Benefit to Cost Ratio	1.43	PV Benefits / PV Costs

Transportation Benefits 2020	
NOX (Tons)	-
CO2 (Tons)	0.61
VOC (Tons)	669.91
PM (Tons)	0.22
SO2 (Tons)	0.03
Fuel (gallons)	12,416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DEVELOPMENT INPUTS
(A) PROJECT INVESTMENT PERIOD
Project name
Total Investment ($)
Investment period (start)
Investment period (end)
Investment useful life (years)
Cost information
Project will create a mixed use neighborhood development with retail and office space
(C) DEVELOPMENT IMPACTS
Retail sales
Net new annual retail sales (in $)
Retail sales annual growth (percent)
Health & walkability
Increased foot traffic (annual visitors)
Average walking (miles per visitor)
Real estate
Property value premium (percent)
Property tax rate (percent)
Economic impacts - retail
Net new retail jobs
Average wage per new retail job ($/hour)
Economic impacts - office
Net new office jobs
Average wage per new office job ($/hour)
Structure&Logic
ModelSetup
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2.Renewable Input
3.Transp Input
4.Dev Input
1.EnergyEfficiency
2.RenewableEnerg
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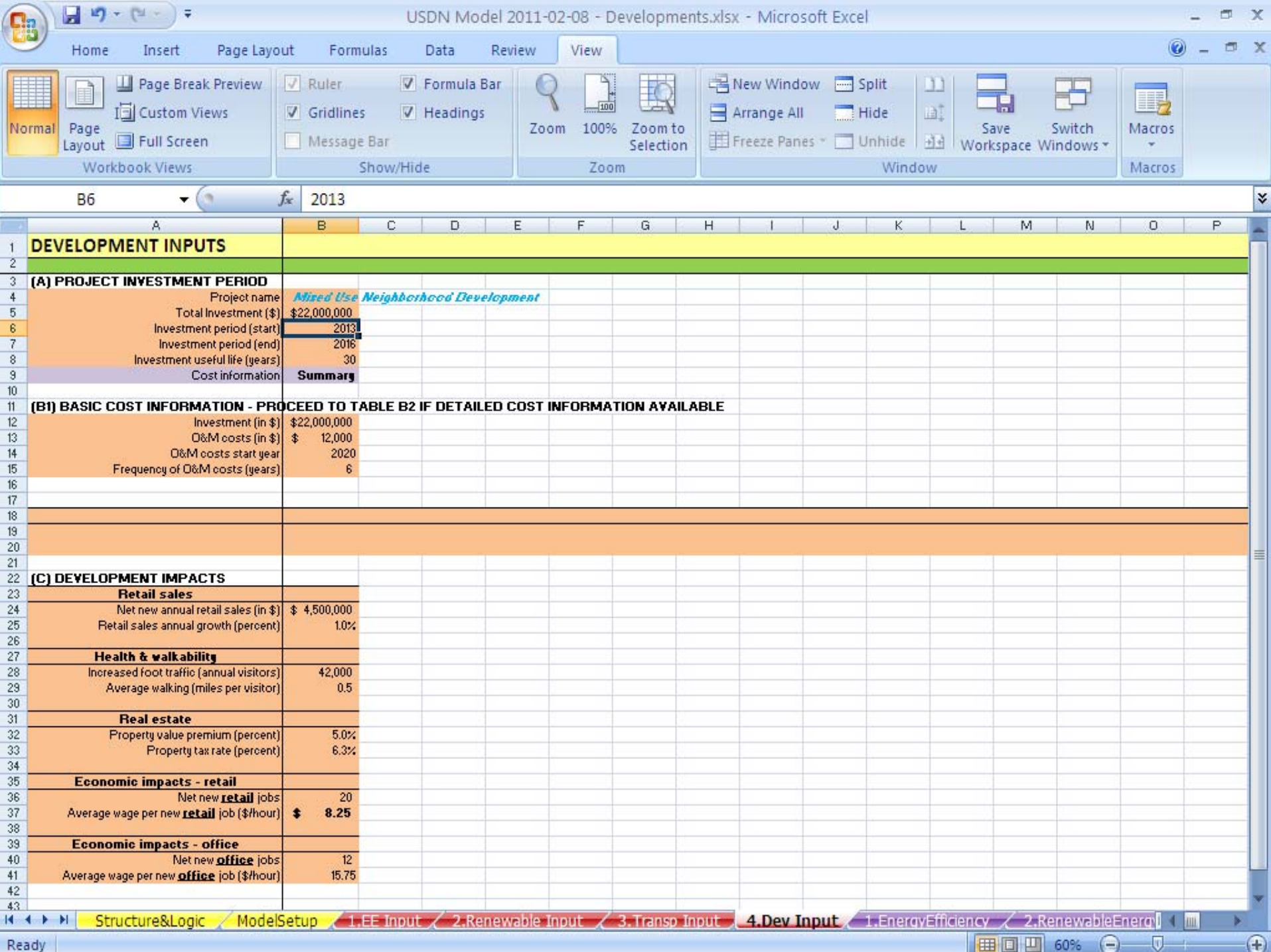
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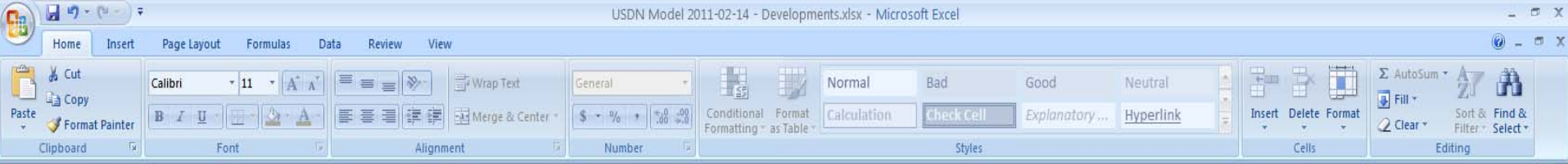
2013
DEVELOPMENT INPUTS
(A) PROJECT INVESTMENT PERIOD
Project name
Mixed Use Neighborhood Development
Total Investment ($)
$22,000,000
Investment period (start)
2013
Investment period (end)
2016
Investment useful life (years)
30
Cost information
Summary
(B1) BASIC COST INFORMATION - PROCEED TO TABLE B2 IF DETAILED COST INFORMATION AVAILABLE
Investment (in $)
$22,000,000
O&M costs (in $)
$ 12,000
O&M costs start year
2020
Frequency of O&M costs (years)
6
(C) DEVELOPMENT IMPACTS
Retail sales
Net new annual retail sales (in $)
$ 4,500,000
Retail sales annual growth (percent)
1.0%
Health & walkability
Increased foot traffic (annual visitors)
42,000
Average walking (miles per visitor)
0.5
Real estate
Property value premium (percent)
5.0%
Property tax rate (percent)
6.3%
Economic impacts - retail
Net new retail jobs
20
Average wage per new retail job ($/hour)
$ 8.25
Economic impacts - office
Net new office jobs
12
Average wage per new office job ($/hour)
15.75
Structure&Logic
ModelSetup
1.EE Input
2.Renewable Input
3.Transp Input
4.Dev Input
1.EnergyEfficiency
2.RenewableEnergy
Ready
60%



C32

	A	B	C
1	**Developments Results**		
2	**TBL Results 2020**	**Expected**	**Notes**
3	**Annual Value of Benefits**	$944,769	The total value of the benefits in the 10th year
4			
5	**Net Present Value**	-$967,923	PV Benefits - PV All Costs
6	**Return on Investment**	0%	Arithmetic Average Rate of Return on Capital Investment
7	**Discounted Payback Period**	Doesn't Payback	Time in years till positive discounted cash flow
8	**Internal Rate of Return (%)**	5%	Discount rate which would make NPV = 0
9	**Benefit to Cost Ratio**	0.95	PV Benefits / PV Costs
10			
11			
12	**Benefits 2020**		
13	Total retail sales	$48,331,476	
14	Property value	$36,667	
15	Property tax	$161,207	
16	Wages	$736,320	
17			
18			
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28			

Summary of the TBL Calculator

- With knowledge of a few key variables related to capital investments, it is possible to estimate key impacts, such as:
  - Energy savings
  - Water saving
  - Cost-Benefit Ratios
  - Payback periods
- This information can be used to help city decide how to strategically invest capital dollar or to help provide support for investment decisions.

CITY OF BOSTON
Thomas M. Menino
Mayor

Boston Redevelopment Authority
John F. Palmieri, *Director*

HDR