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A Case Study of Renewable Energies Investment Calculation for Anlong Tamey Village, Battambang Province

Group Members:

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2. Mr. PHAN Samsak

3. Mr. PHOR Vicheka

Topic

Group work 4 persons in one group

Village electrification and battery charging

1. Analyze the impacts of changes in interest rate
 - a. Higher interest rate
 - b. Low interest rate (e.g. 2.9 % per annum from World Bank)
2. Analyze the increase in electricity consumption:
 - a. Need for new investments
 - b. Need for increased work input
 - c. Need for increased maintenance
 - d. Need for grid extension
3. Analyze the impact of the change in diesel price and diesel generation efficiency
4. Analyze different combinations of changes 1. – 3.

Outline

Technologies cost

Methodologies

Performance Data

Part I: Village electrification with different technologies

Chapter 1: Gasifier village electrification

Chapter 2: PV village electrifications

Chapter 3: Hydro village electrification

Chapter 4: Diesel village electrification

Chapter 5: Conclusion

Part II: Village Battery charging with different technologies

Chapter 1: Gasifier village battery charging

Chapter 2: PV village battery charging

Chapter 3: Hydro village battery charging

Chapter 4: Diesel village battery charging

Chapter 5: Conclusion

Technologies Cost

- ❑ We need to analyze the types of data. There are two types of cost:
 - Variable cost
 - Fixed cost

- ❑ In our case study:
 - Variable cost:
 - Investment costs: Construction costs (grid cost), Loan
 - Operation & Maintenance costs: Repair & Maintenance, Lubricant, Worker
 - Fuel cost: Wood and Diesel
 - Fixed cost
 - Customer service: Phone & Accounting

Methodologies

- The methodology used in the calculations is divided into 3 points:
 - **Operation costs:** variable cost, fixed cost, and total operation cost.
 - **Incomes:** income from battery charging, income from household consumption, and total income.
 - **Others:** total gain, net annual profit, break even point or cumulative earning, simple payback period(SPP), return on investment(ROI), net present value(NPV), future value, and internal rate of return(IRR).

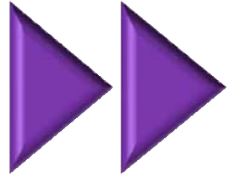
Methodologies(cont.)

But the methodology that we concentrate the most are:

- Loan form bank (US\$) = Machinery cost + Grid Cost - Own investment
- Total Gains = Sales revenue/year + Loan form bank
- Net Annual profit = (Own invest + Loan + Sale revenue) - (Total operation cost + VAT)
- Break Event Point or Cumulative Earning:
 - First year of Cumulative Earning = The first year of Net annual profit (US\$)
 - The following year of Cumulative Earning = The previous one+ Net annual of that year

Performance Data

Table. 1: Village electrification with different technologies



PART I

VILLAGE ELECTRIFICATION WITH DIFFERENT TECHNOLOGIES

I. Result

II. Sensitivity Analysis

III. Conclusion



I. Result

After getting the performance data and by using the technology cost, methodologies of calculation, we get the result of gasifier village electrification in **Table.2: Results of gasifier village electrification.**

II. Sensitivity Analysis

Then we are going to study about Sensitivity Analysis:

1. Analyze the Impacts of Change in Interest Rate
2. Analyze the Impacts of Increase in Electricity Consumption
3. Analyze the Impact of the Change in Diesel Price and Diesel Generation Efficiency
4. Analyze the Combination of Changes from 1-3

II. Sensitivity Analysis

1. Diagrams

2. Tables

3. Charts

❑ High interest rate(25%/year):



❑ Low interest rate(2.9%/year):

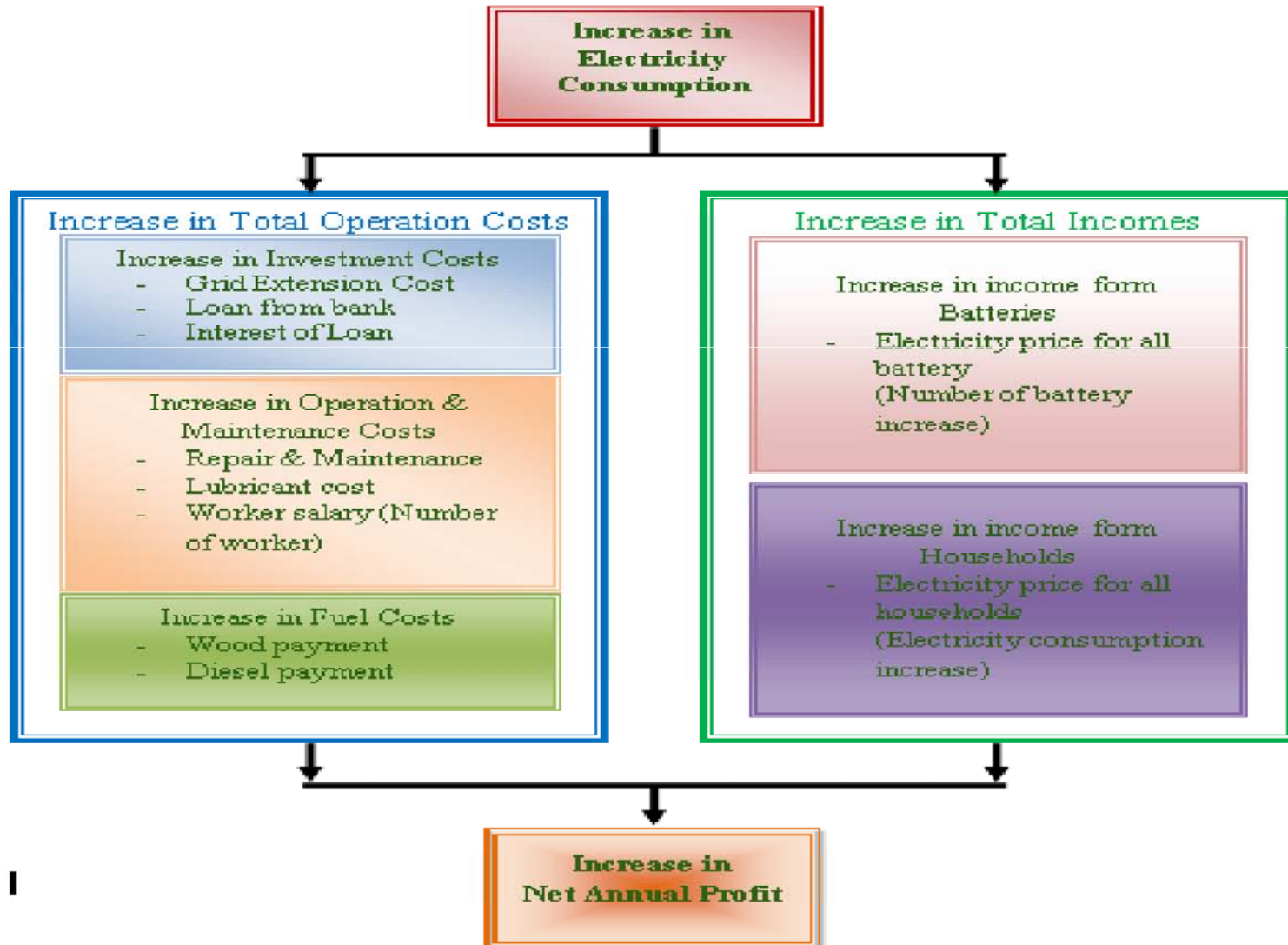


II. Sensitivity Analysis

1. Diagrams

2. Tables

3. Charts



II. Sensitivity Analysis

1. Diagrams

2. *Tables*

3. *Charts*

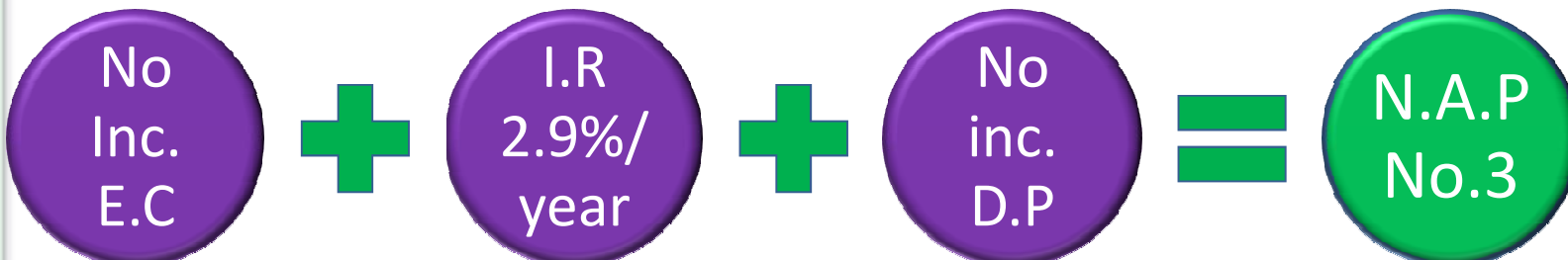
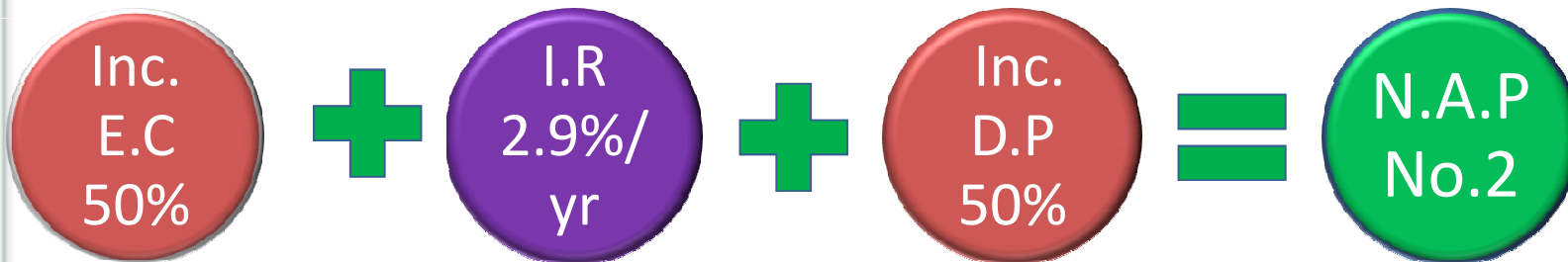
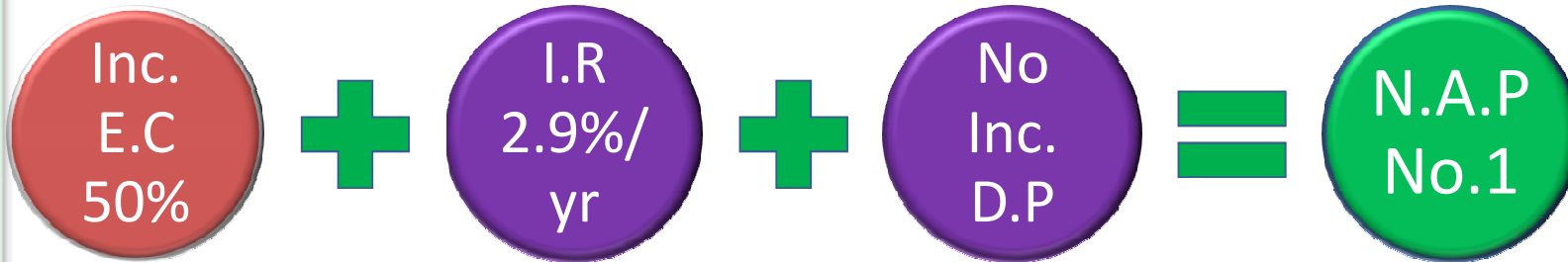


II. Sensitivity Analysis

1. Diagrams

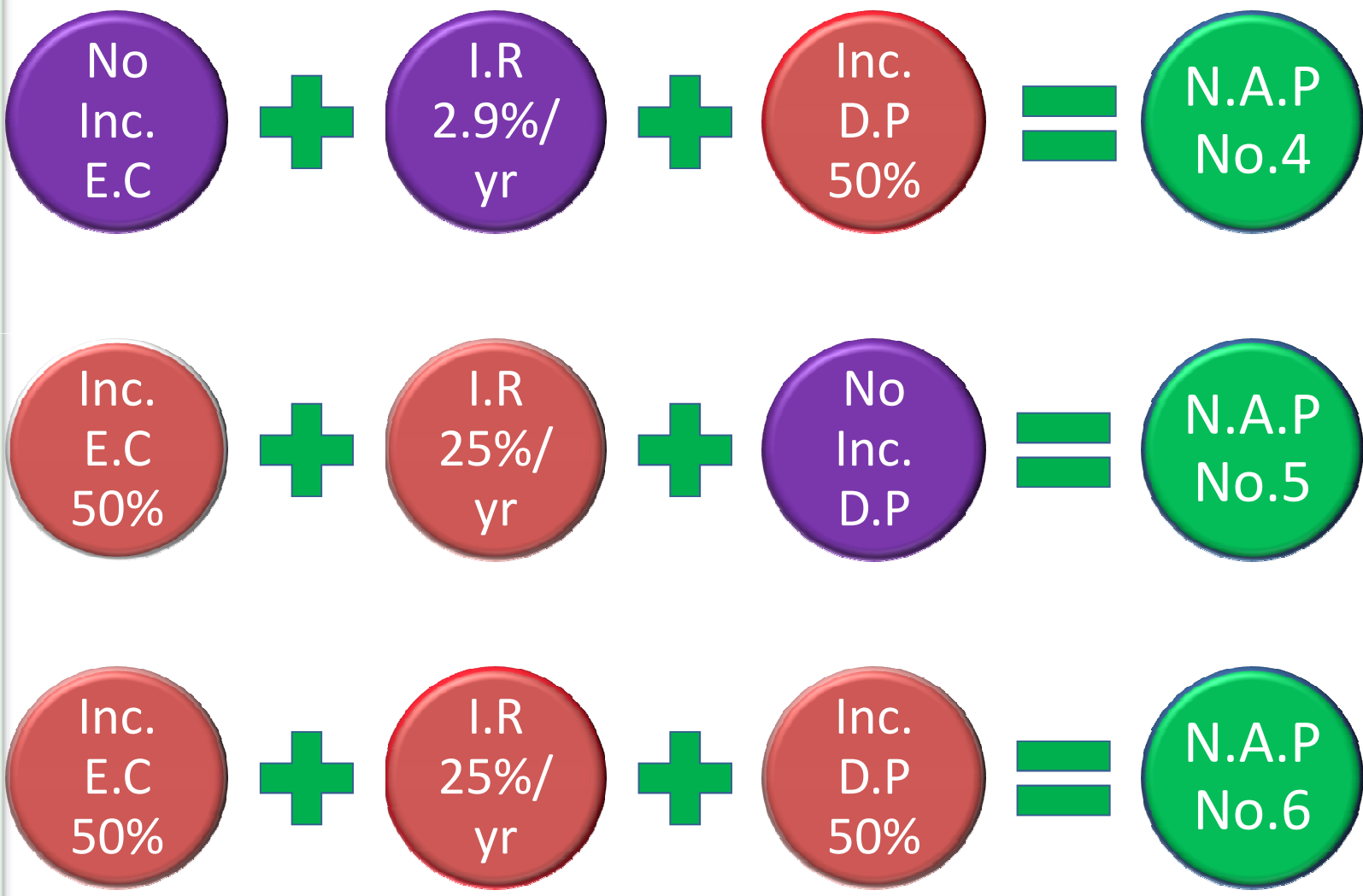
2. Tables

3. Charts



II. Sensitivity Analysis

1. Diagrams	2. Tables	3. Charts
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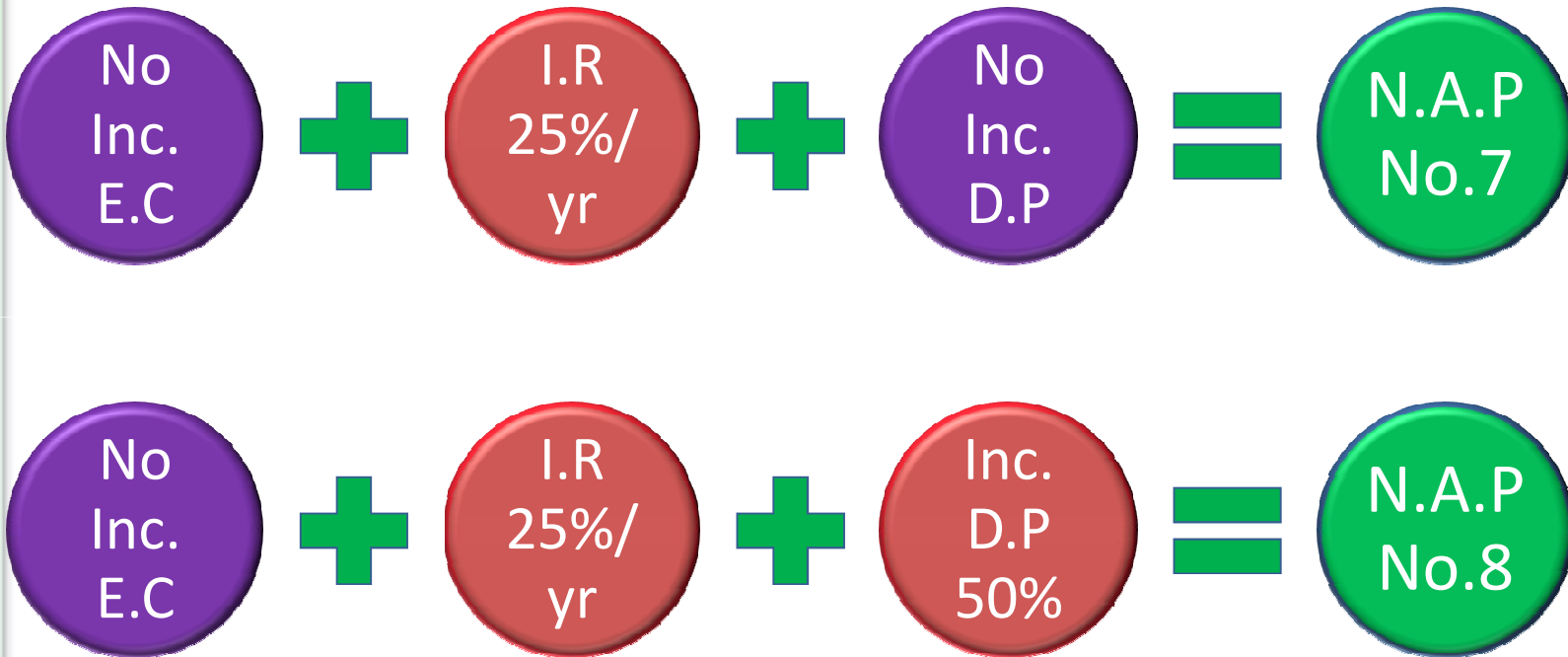


II. Sensitivity Analysis

1. Diagrams

2. Tables

3. Charts



II. Sensitivity Analysis

1. Diagrams

2. Tables

3. Charts

Table. 3: Analyze the Impacts of Changes in Interest Rate

Table. 4: Analyze the Increase in Electricity Consumption

Table. 5: Analyze the Increase in diesel price

Table. 6: The results of different combinations of changes of gasifier village electrification

Table. 7: The best and the worst Net Annual Profit

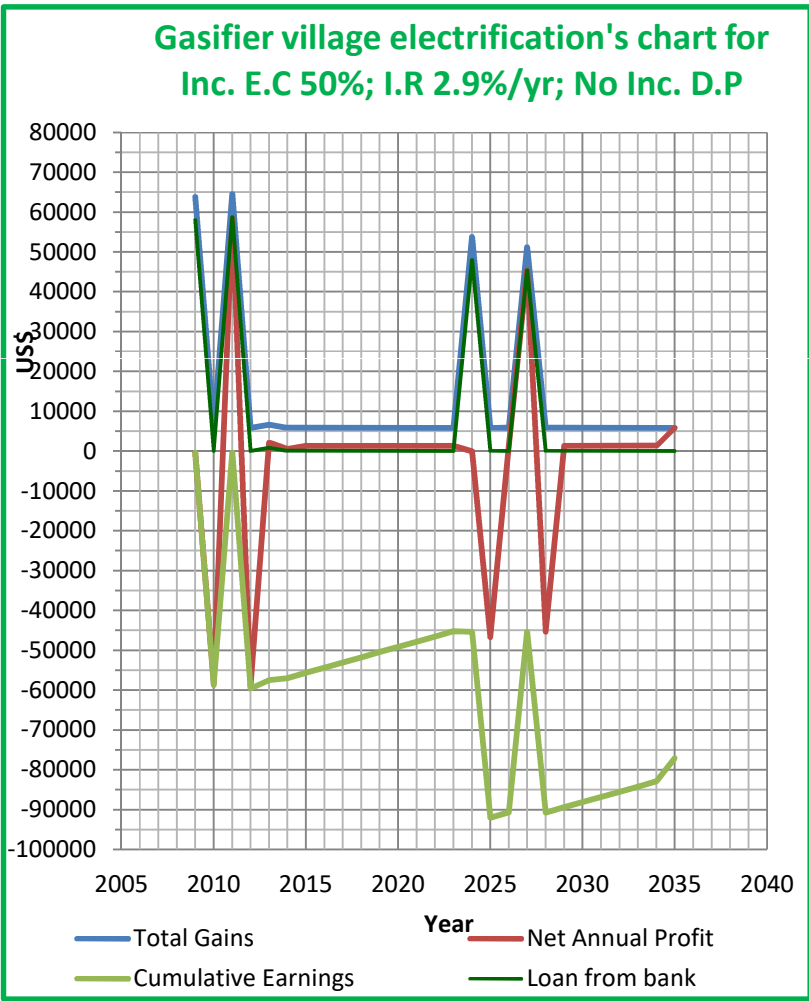
II. Sensitivity Analysis

1. Diagrams

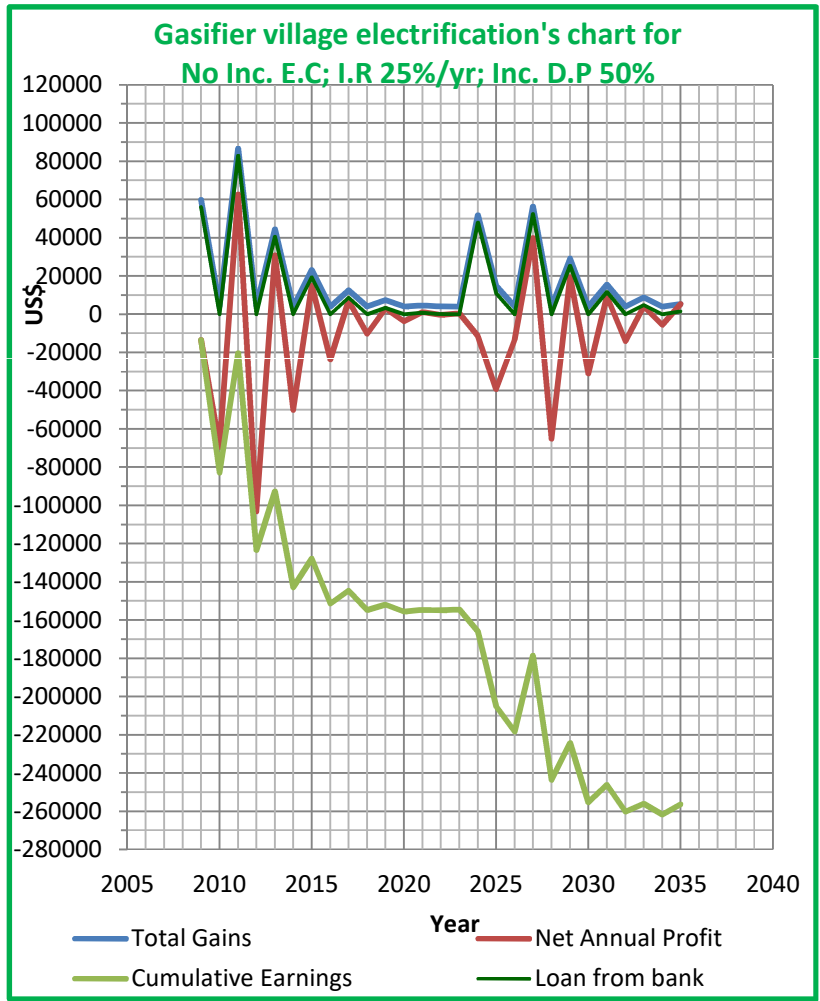
2. Tables

3. Charts

Net Annual Profit No. 1



Net Annual Profit No. 8



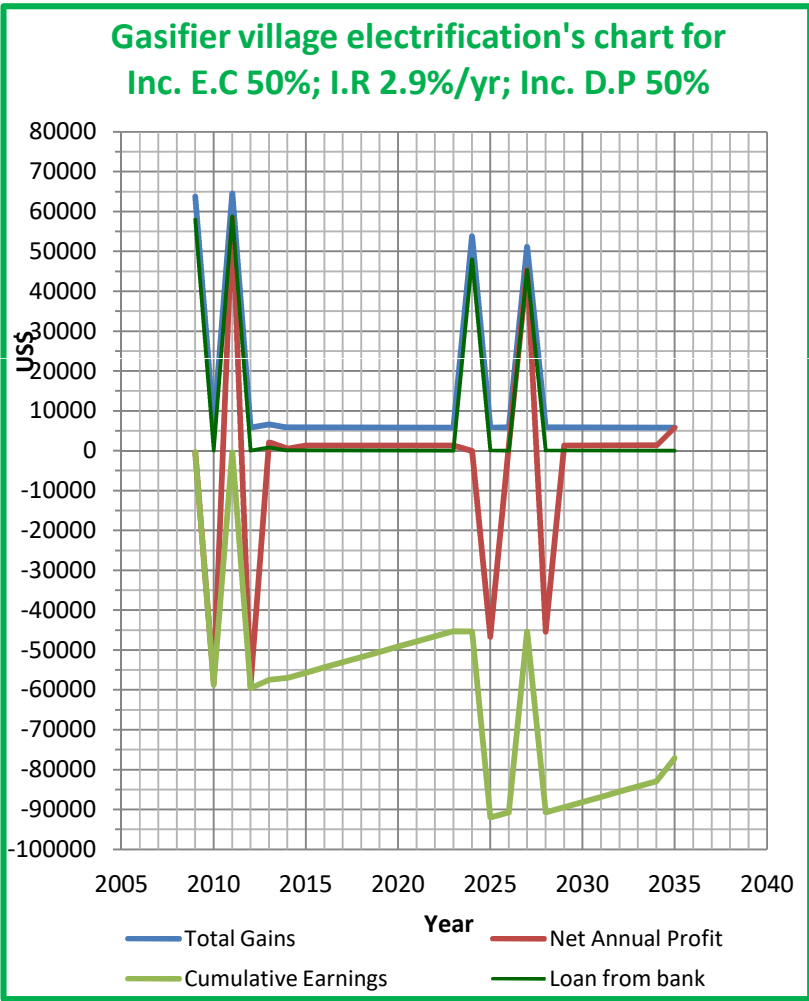
II. Sensitivity Analysis

1. Diagrams

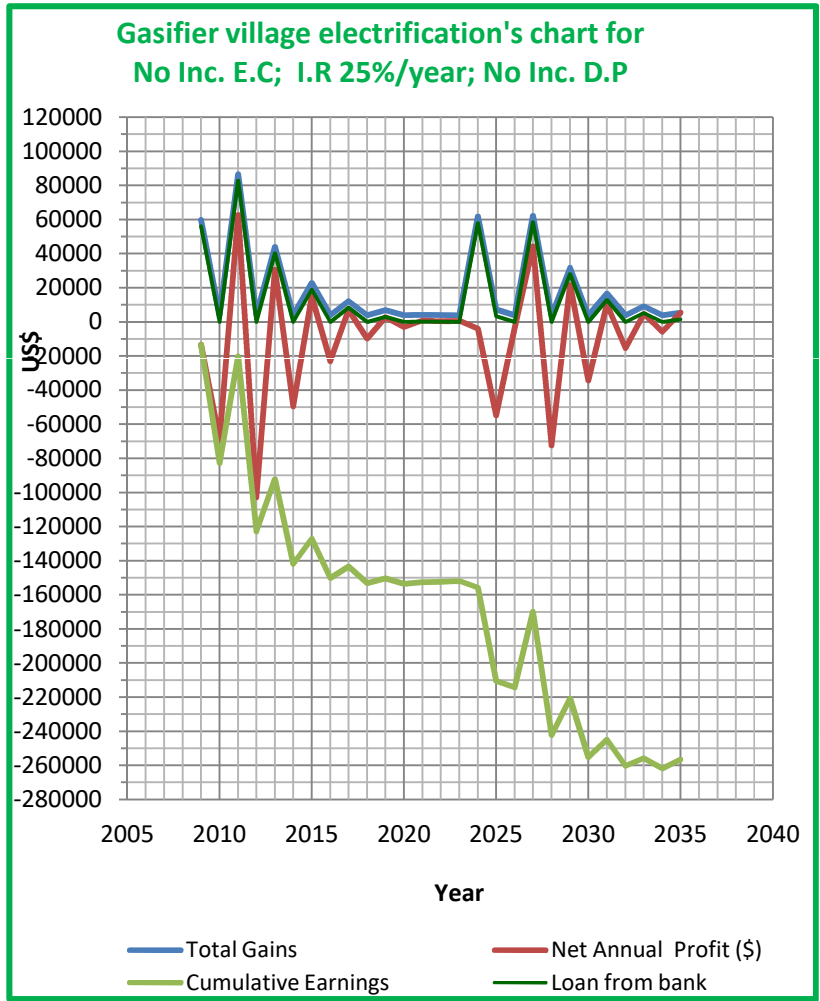
2. Tables

3. Charts

Net Annual Profit No. 2



Net Annual Profit No. 7



II. Sensitivity Analysis

1. Diagrams

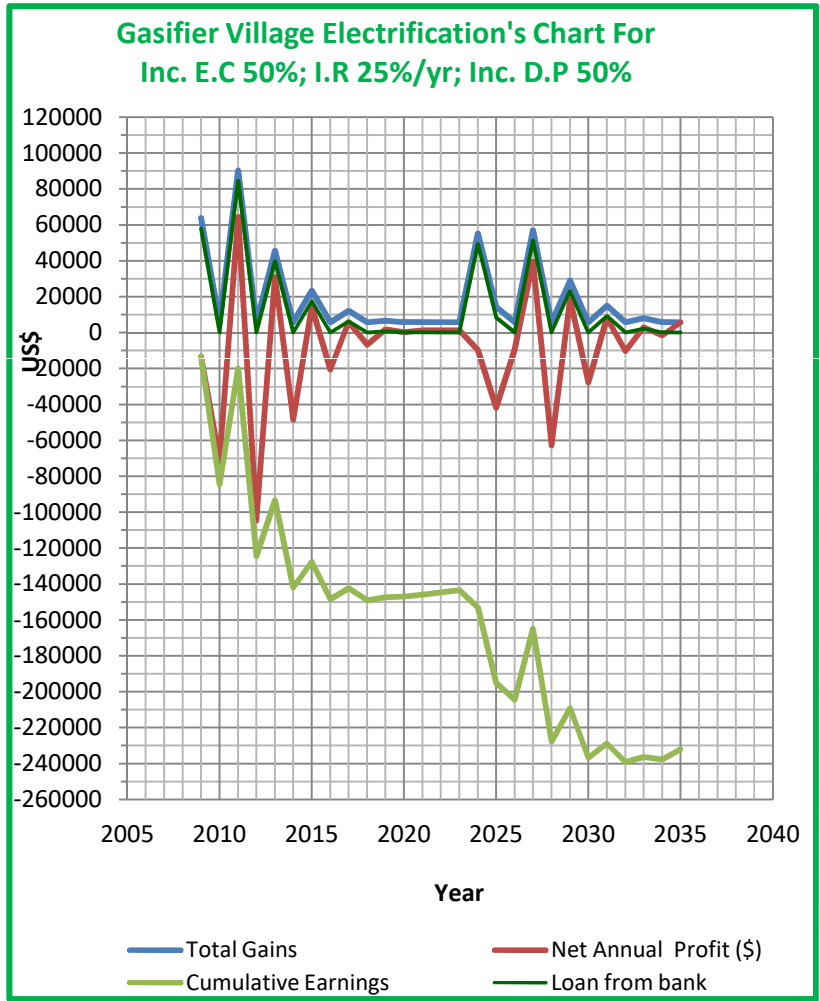
2. Tables

3. Charts

Net Annual Profit No. 3



Net Annual Profit No. 6



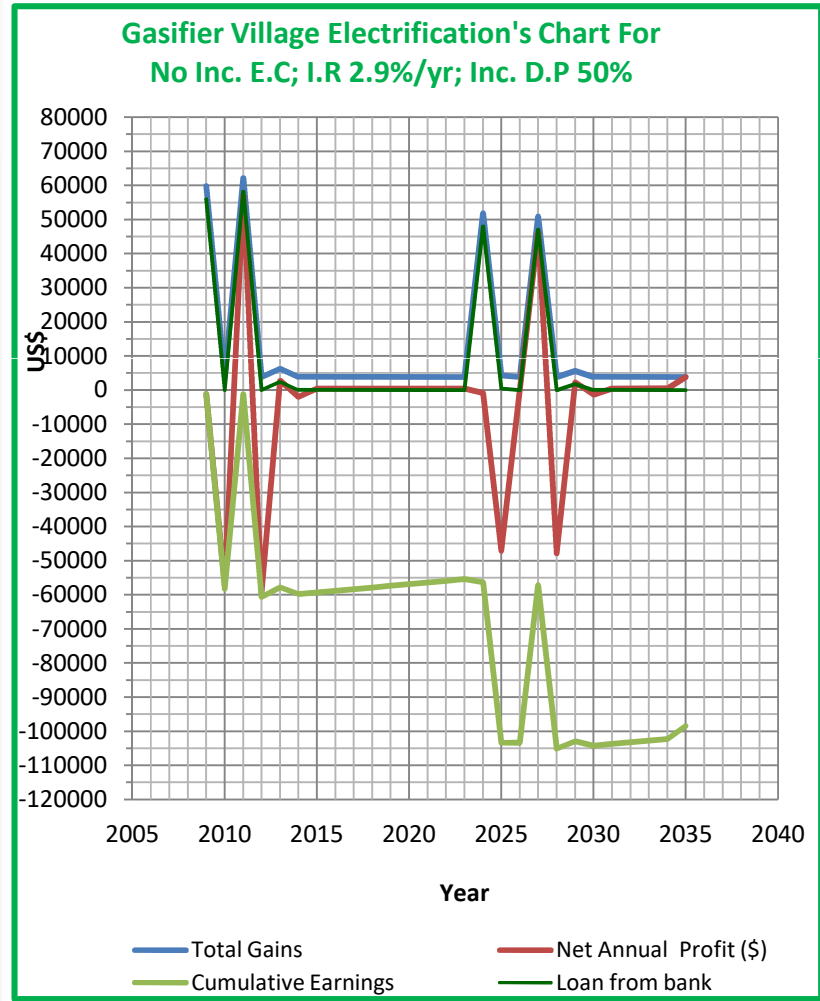
II. Sensitivity Analysis

1. Diagrams

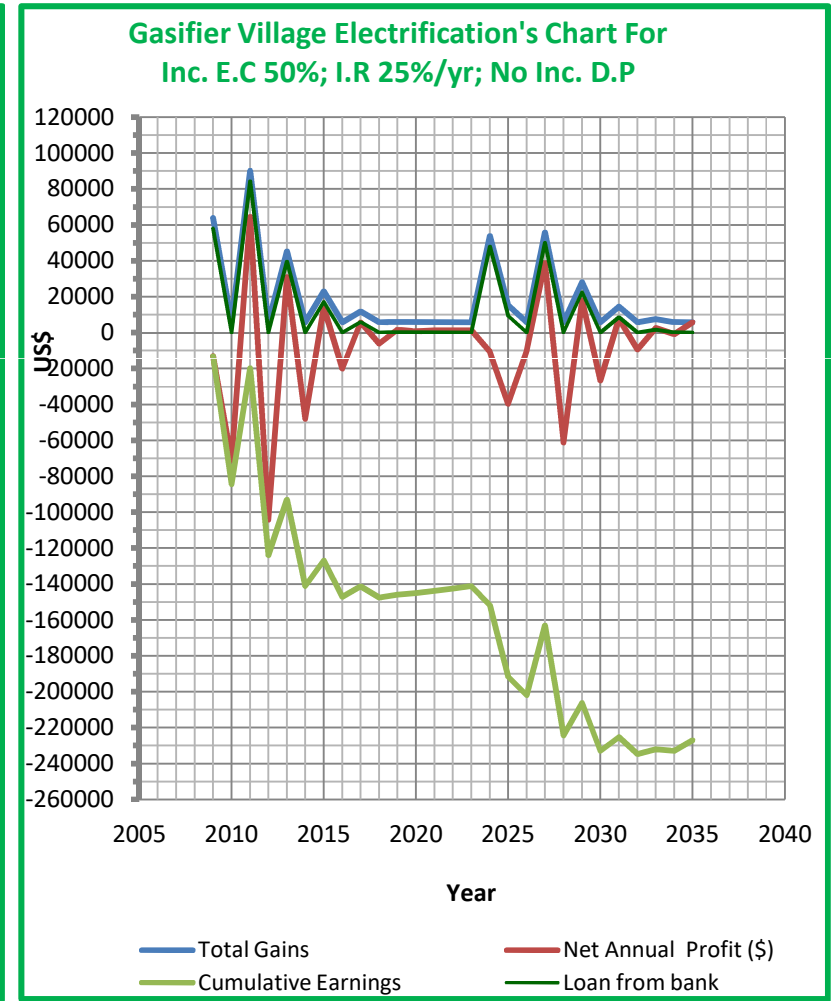
2. Tables

3. Charts

Net Annual Profit No. 4



Net Annual Profit No. 5



III. Conclusion

- ❑ The minimum year of Loan from bank started to remain zero is in year **2014** which is the case of **the best Net Annual Profit No. 1 (Increase 50% in electricity consumption, Interest rate 2.9%, No Increase in diesel price).**
- ❑ The maximum year of Loan from bank started to remain zero is in year **2023** which is the case of **the worst Net Annual Profit No. 8 (No increase in electricity consumption, Interest rate 25%, Increase 50% in diesel price).**

I. Result

II. Sensitivity Analysis

III. Conclusion



I. Result

After getting the performance data and by using the technology cost, methodologies of calculation, we get the **Table. 8: Results of PV village Electrification.**

II. Sensitivity Analysis

Then we are going to study about Sensitivity Analysis:

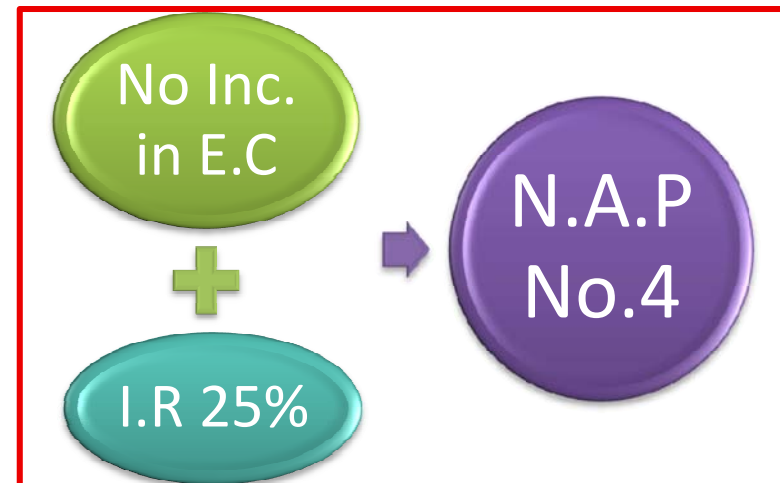
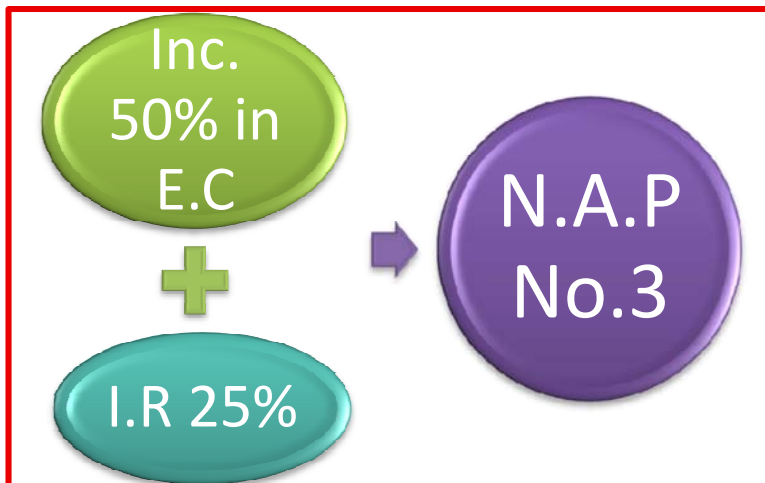
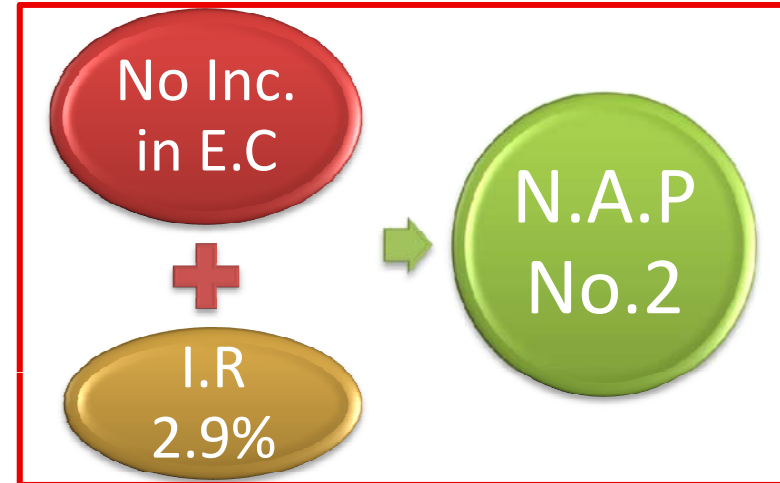
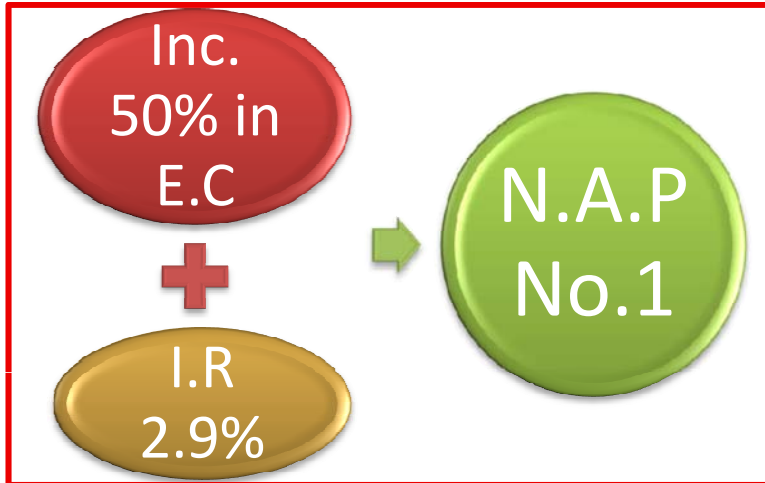
1. Analyze the Impacts of Change in Interest Rate
2. Analyze the Impacts of Increase in Electricity Consumption
3. Analyze the Combination of Changes from 1-2

II. Sensitivity Analysis

1. Diagrams

2. Table

3. Charts



II. Sensitivity Analysis

1. Diagrams

2. Table

3. Charts

Table. 9: The results of different combinations of changes of PV village electrification

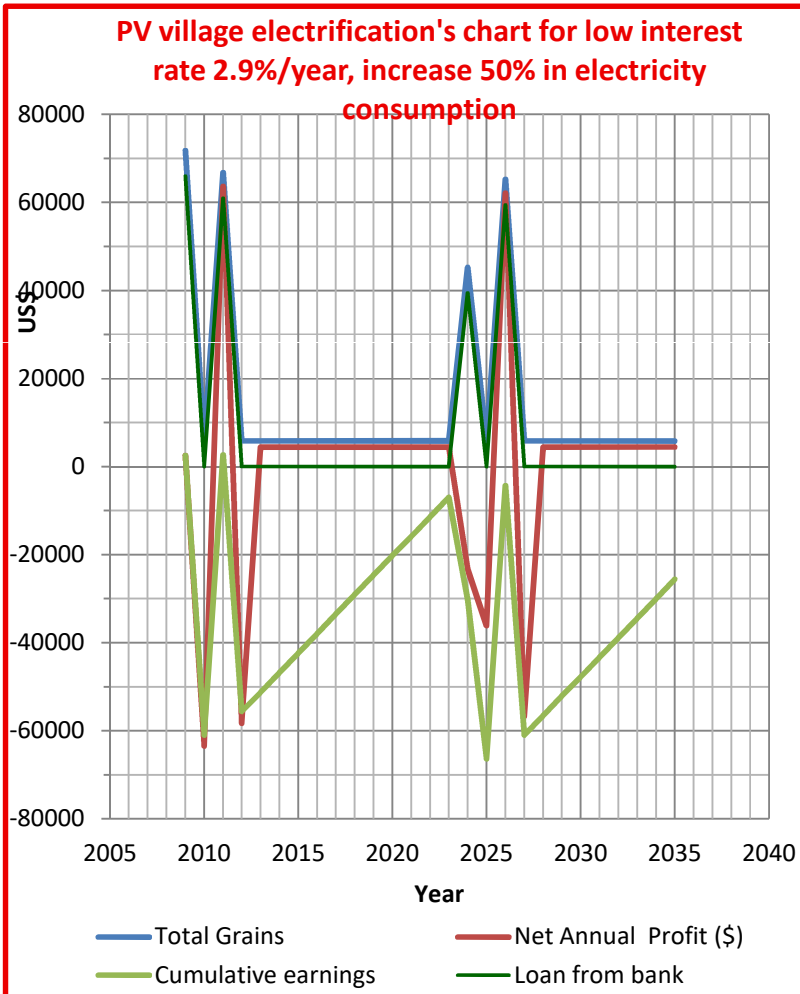
II. Sensitivity Analysis

1. Diagrams

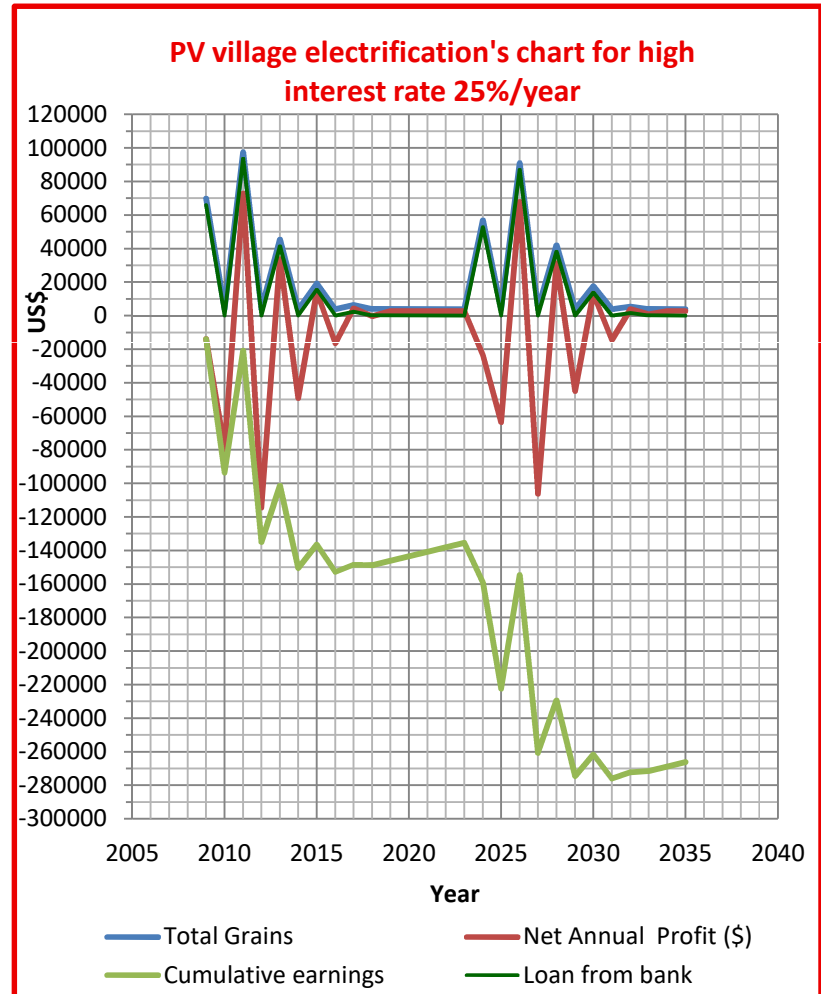
2. Table

3. Charts

Net Annual Profit No. 1



Net Annual Profit No. 4



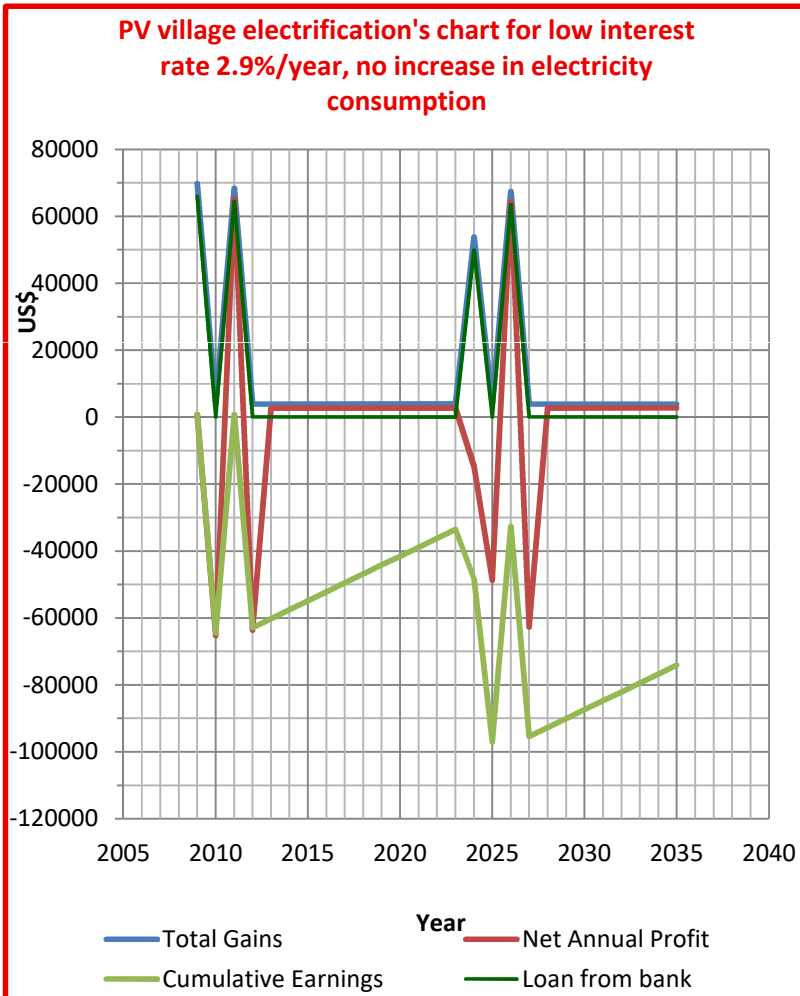
II. Sensitivity Analysis

1. Diagrams

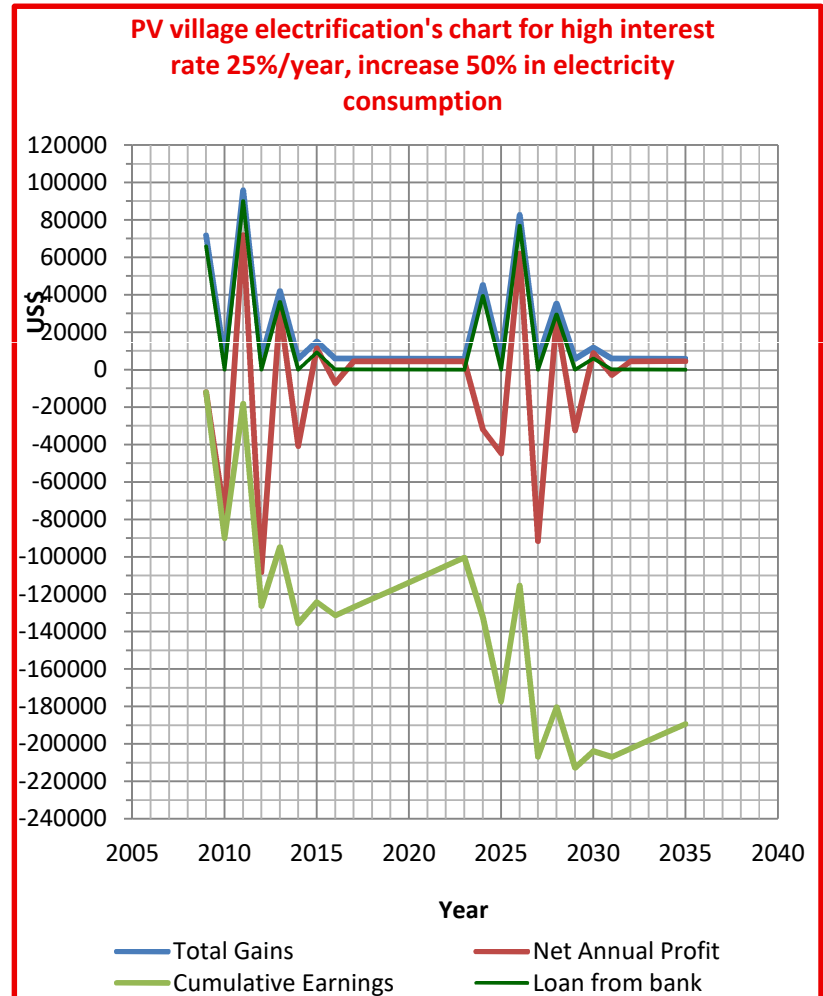
2. Table

3. Charts

Net Annual Profit No. 2



Net Annual Profit No. 3



III. Conclusion

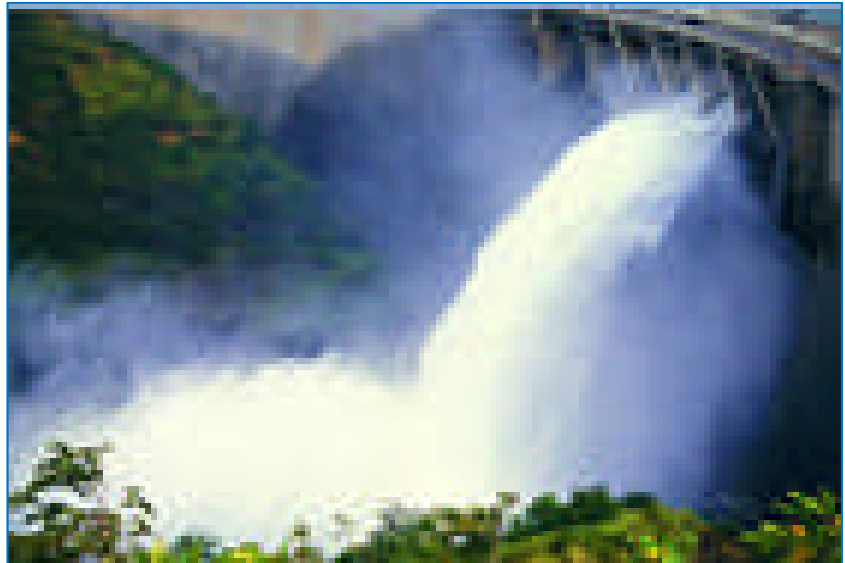
- ❑ The minimum year of Loan from bank started to remain zero is in year **2012** which is the case of **the best Net Annual Profit: Increase 50% in electricity consumption, Lower Interest rate 2.9%.**
- ❑ The maximum year of Loan from bank started to remain zero is in year **2023** which is the case of **the worst Net Annual Profit: No increase in electricity consumption, Higher Interest rate 25%.**

CHAPTER 3: Hydro Village
Electrification

I. Result

II. Sensitivity Analysis

III. Conclusion



I. Result

After getting the performance data and by using the technology cost, methodologies of calculation, we get the result of Hydro village electrification in **Table. 10: Results of Hydro village electrification.**

II. Sensitivity Analysis

Then we are going to study about Sensitivity Analysis:

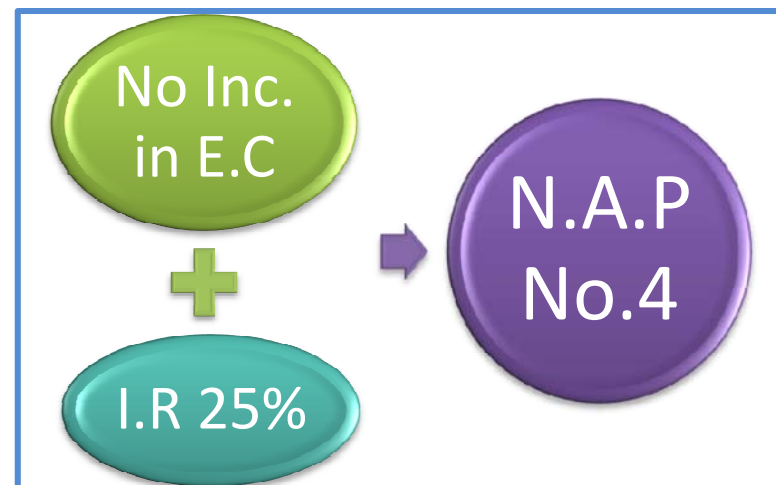
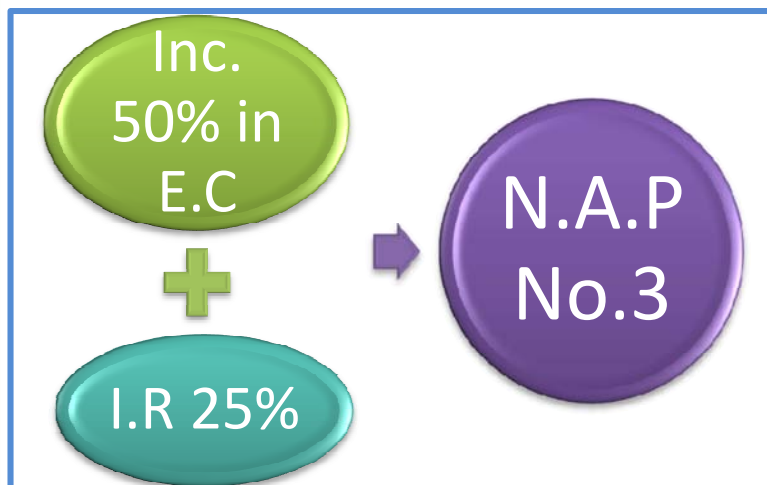
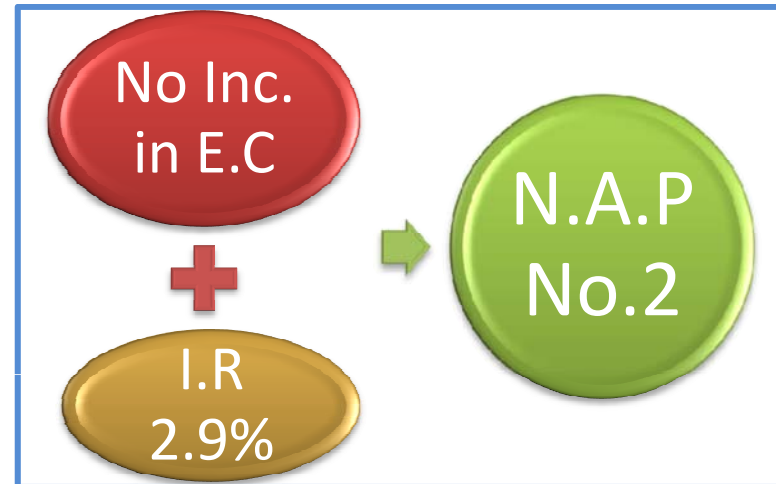
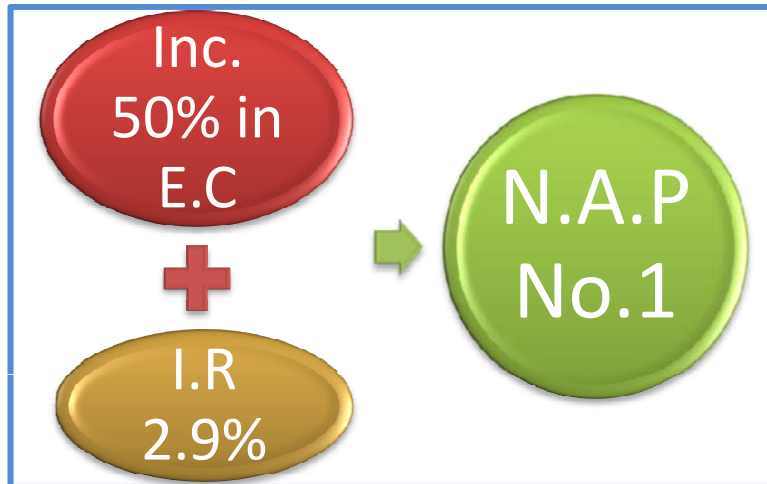
1. Analyze the Impacts of Change in Interest Rate
2. Analyze the Impacts of Increase in Electricity Consumption
3. Analyze the Combination of Changes from 1-2

II. Sensitivity Analysis

1. Diagrams

2. Table

3. Charts



II. Sensitivity Analysis

1. Diagrams

2. Table

3. Charts

Table. 11: The results of different combinations of changes of hydro village electrification

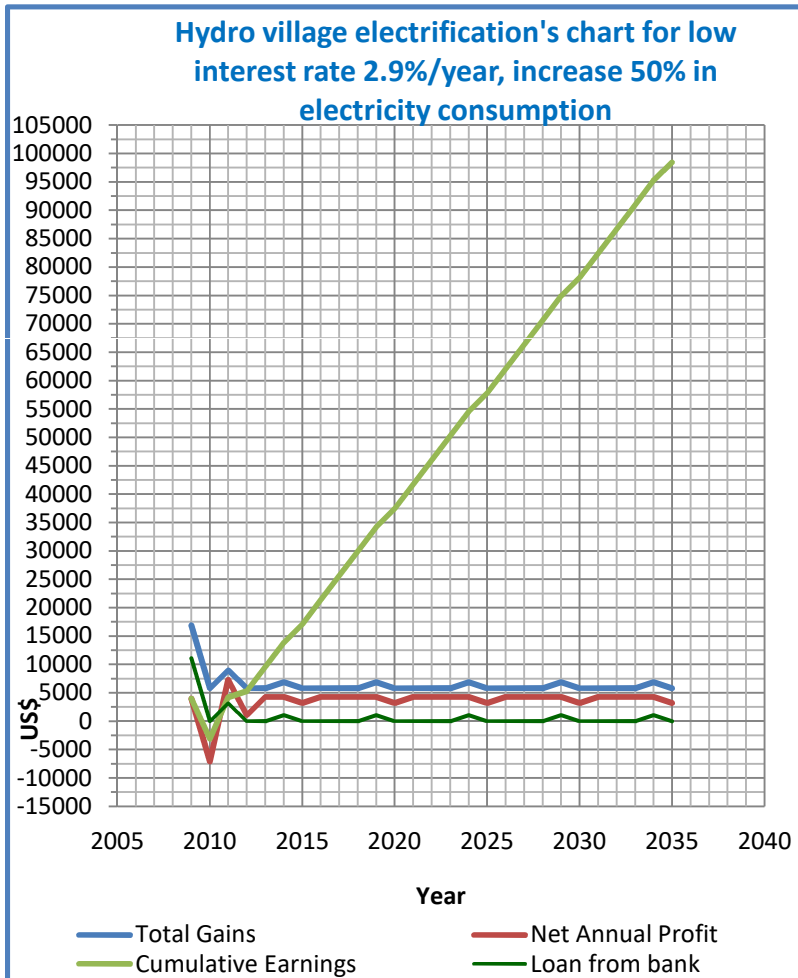
II. Sensitivity Analysis

1. Diagrams

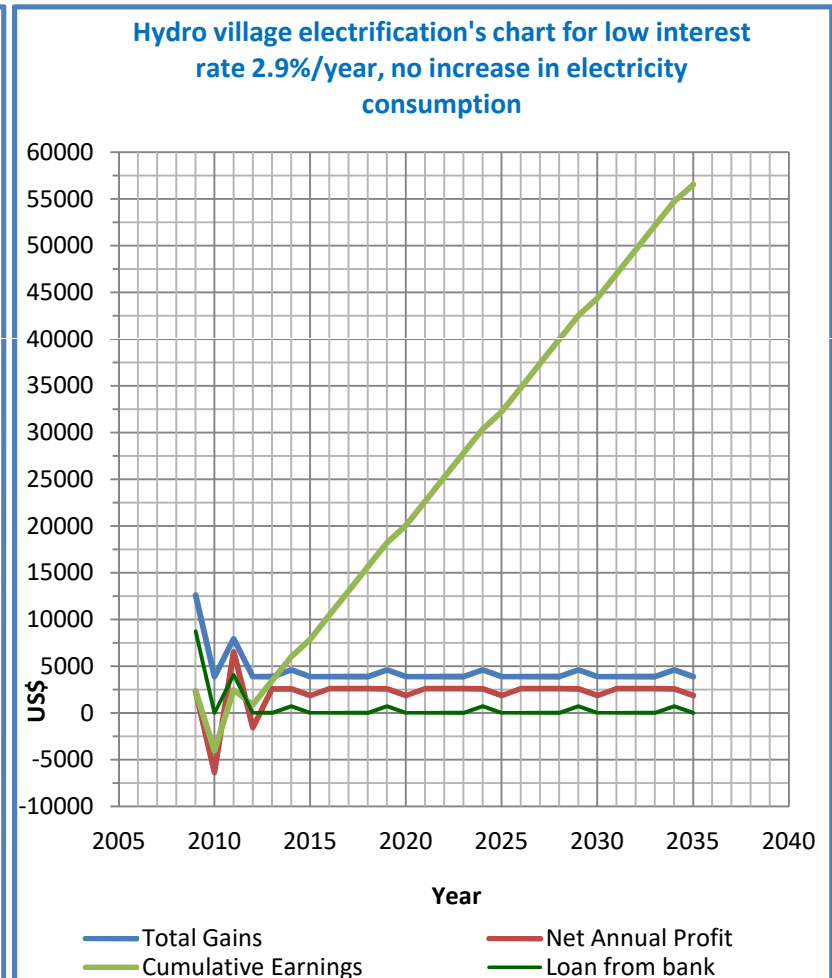
2. Table

3. Charts

Net Annual Profit No. 1



Net Annual Profit No. 2



II. Sensitivity Analysis

1. Diagrams

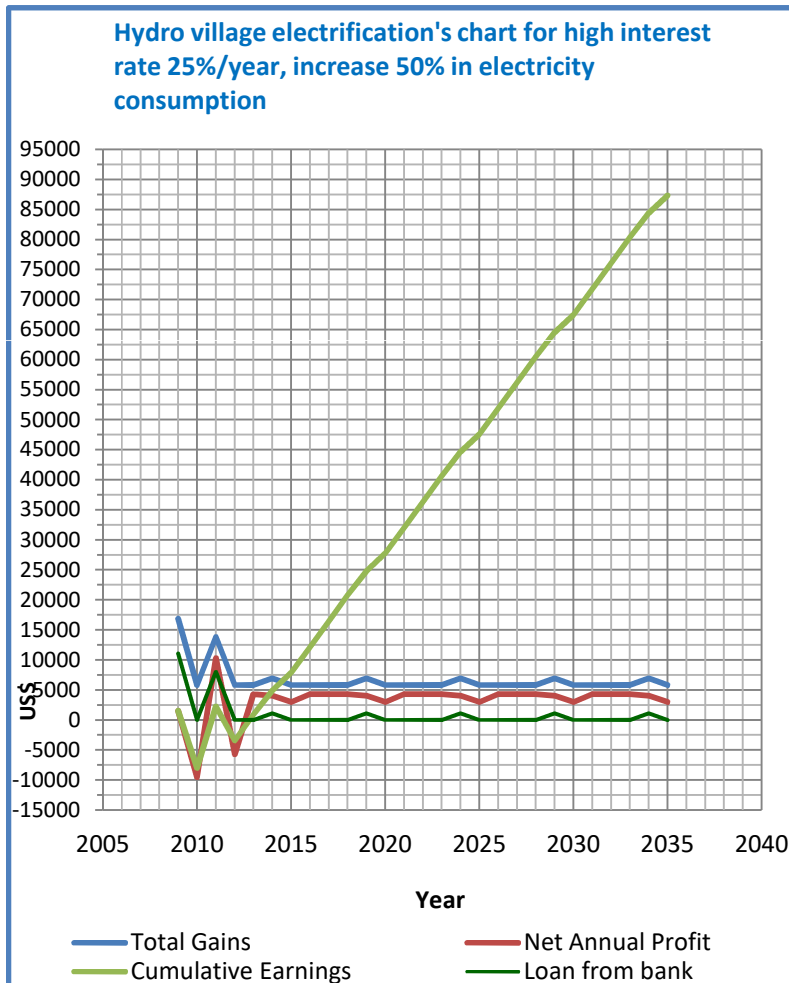
2. Table

3. Charts

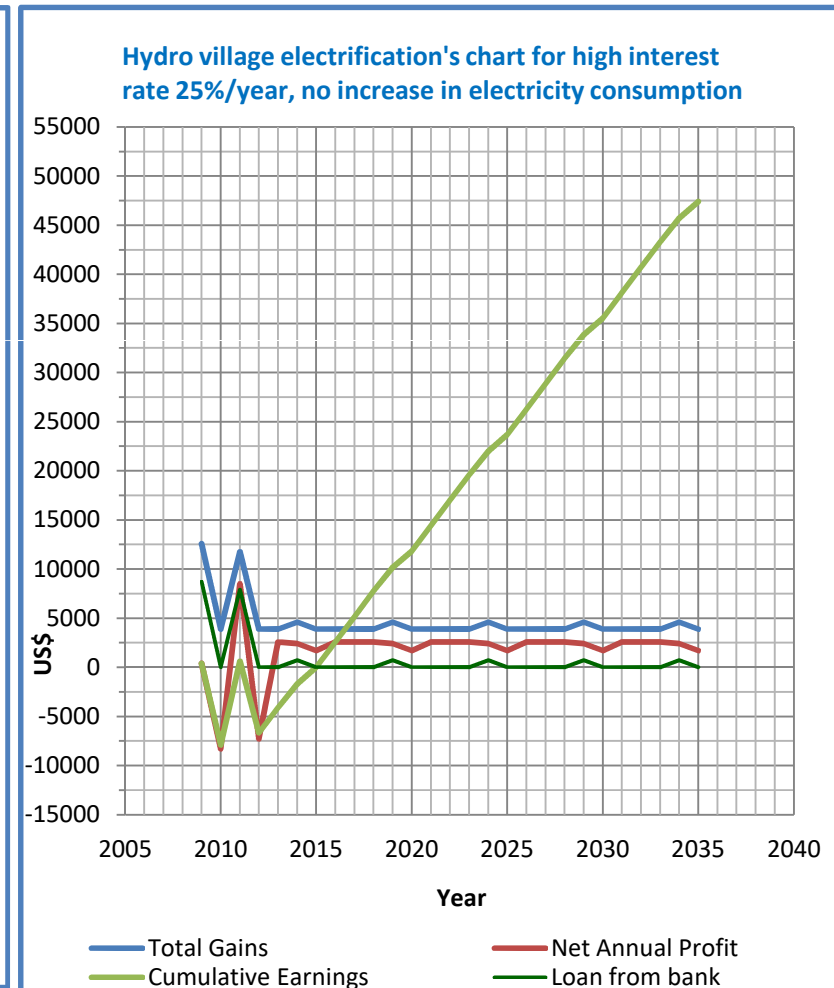
CHAPTER 3: HYDRO VILLAGE ELECTRIFICATION

ELECTRIFICATION

Net Annual Profit No. 3



Net Annual Profit No. 4



III. Conclusion

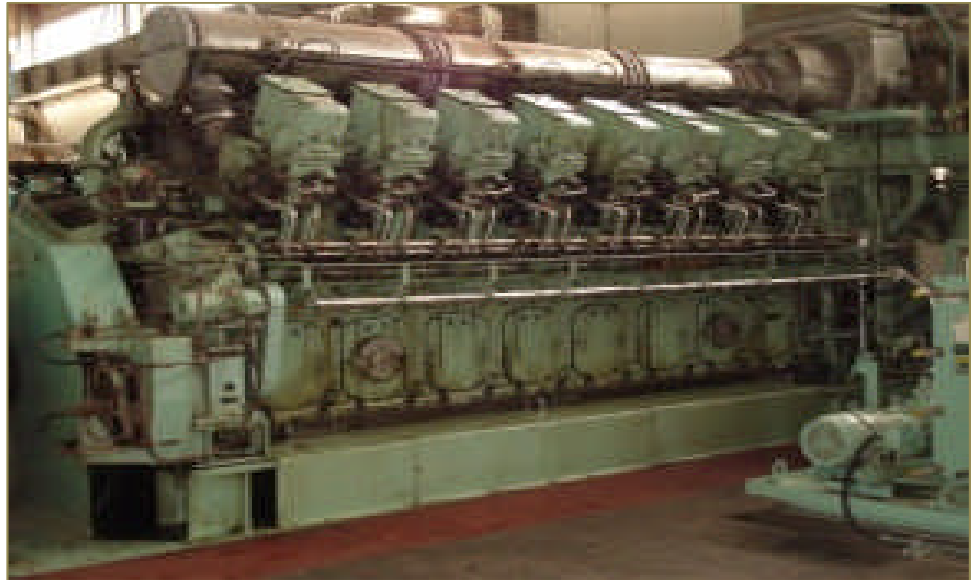
- ❑ The best case of sensitivity analysis which Loan from bank started to remain zero is in year **2012** which is the case of **the best Net Annual Profit: Increase 50% in electricity consumption, Lower Interest rate 2.9%**.
- ❑ The worst case of sensitivity analysis which Loan from bank started to remain zero is also in year **2012** which is the case of **the worst Net Annual Profit: No increase in electricity consumption, Higher Interest rate 25%**.
- ❑ Even the best case and the fairly good case of sensitivity analysis which loan form bank equal to zero is in the same year 2012, **the different of earning in US dollar of both case is quite high.**

I. Result

II. Sensitivity Analysis

III. Conclusion

Chapter 4: Diesel Village
Electrification



I. Result

After getting the performance data and by using the technology cost, methodologies of calculation, we get the result of Diesel village electrification in **Table. 12: Results of Diesel village electrification.**

II. Sensitivity Analysis

Then we are going to study about Sensitivity Analysis:

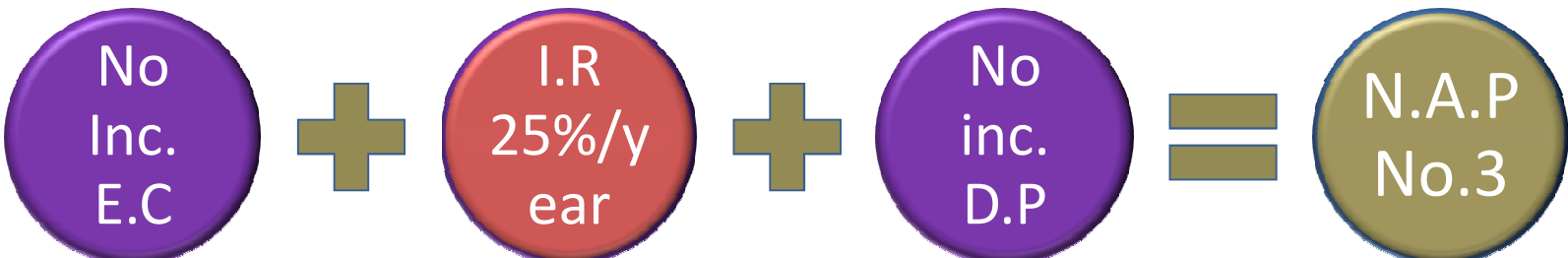
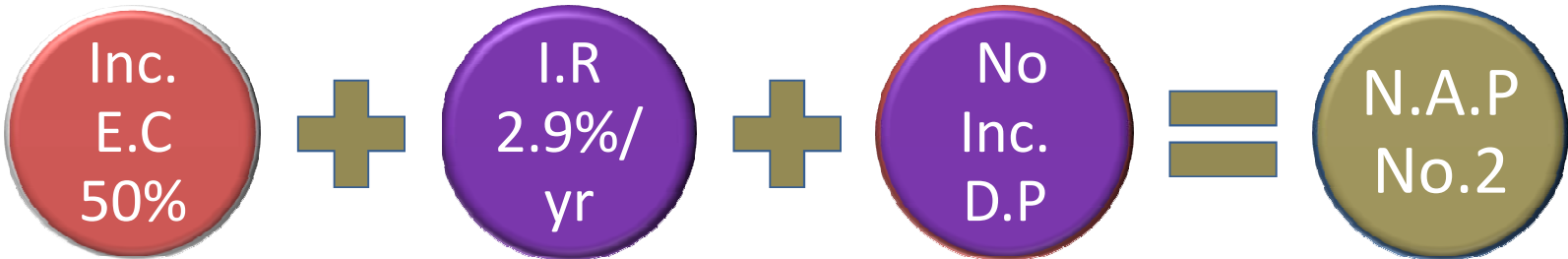
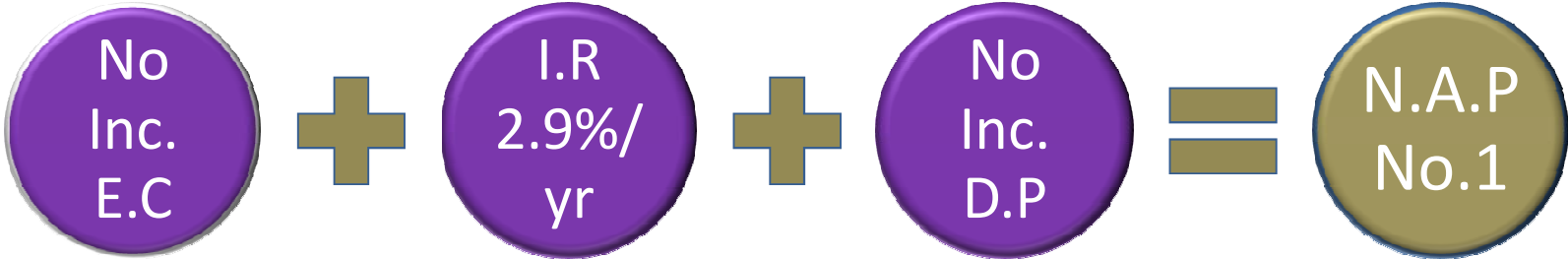
1. Analyze the Impacts of Change in Interest Rate
2. Analyze the Impacts of Increase in Energy Consumption
3. Analyze the Impact of the Change in Diesel Price and Diesel Generation Efficiency
4. Analyze the Combination of Changes from 1-3

II. Sensitivity Analysis

1. Diagrams

2. *Table*

3. *Charts*

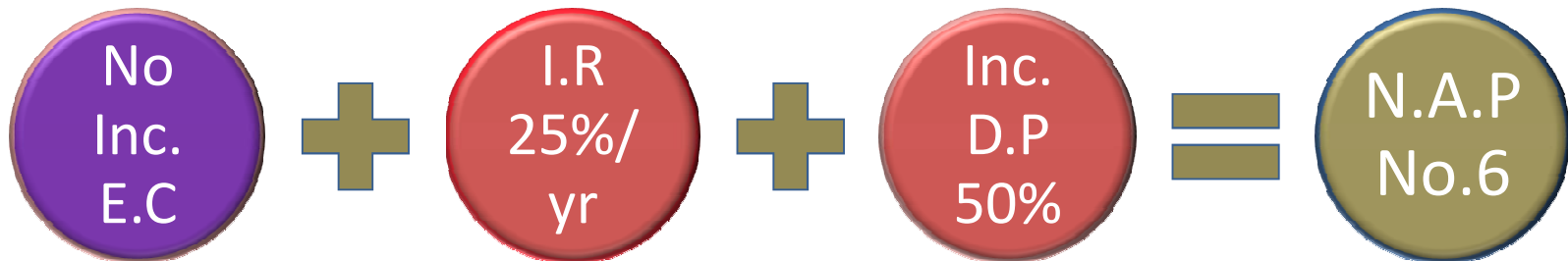
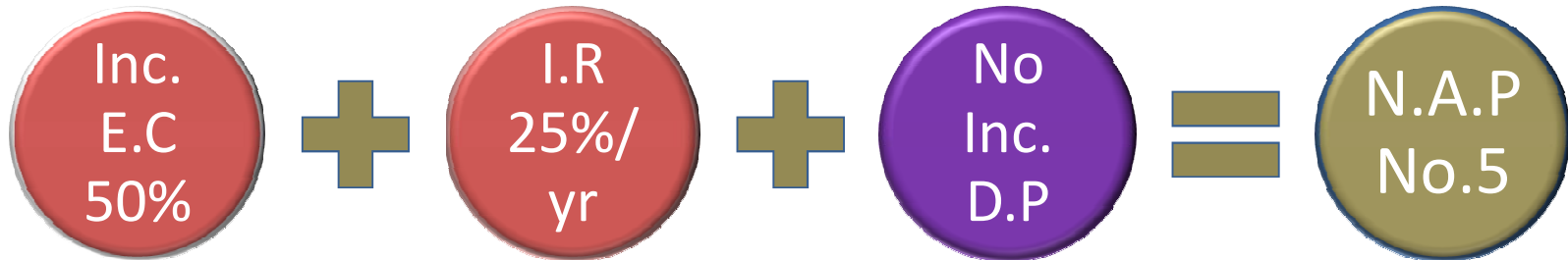
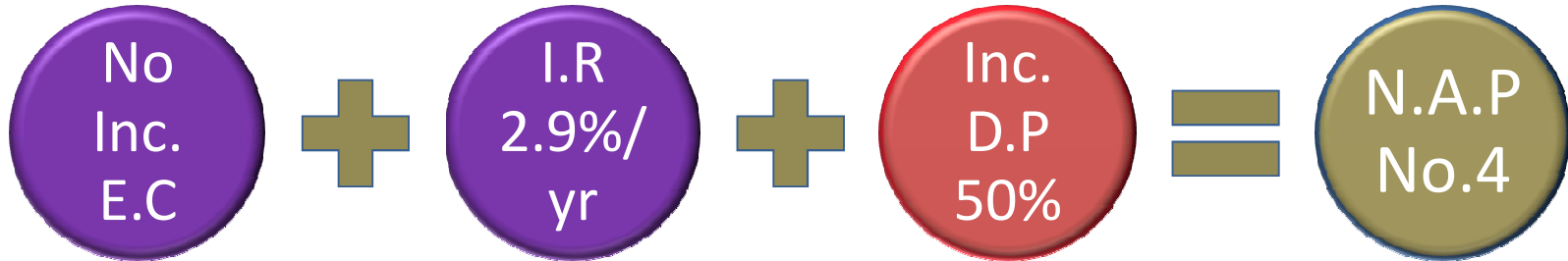


II. Sensitivity Analysis

1. Diagrams

2. Table

3. Charts

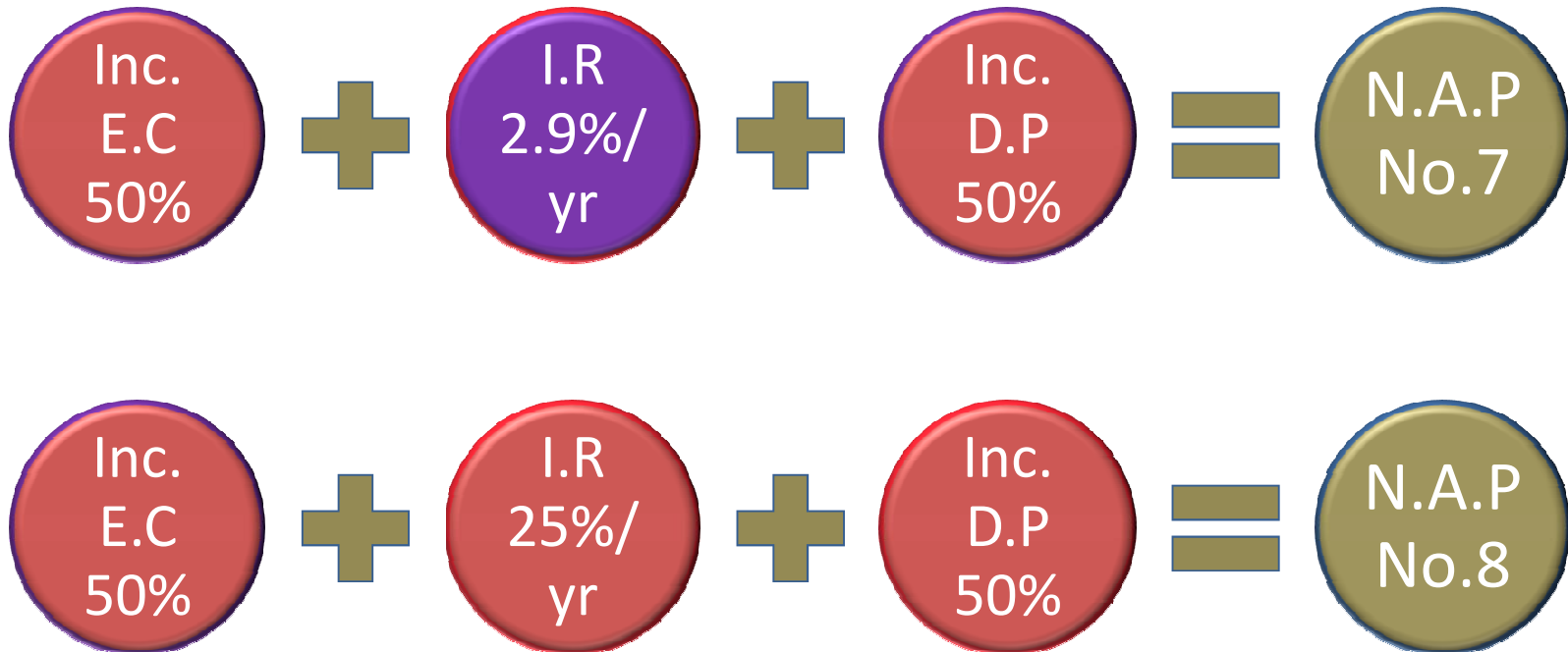


II. Sensitivity Analysis

1. Diagrams

2. *Table*

3. *Charts*



II. Sensitivity Analysis

1. Diagrams

2. Table

3. Charts

Table. 13: The results of different combinations of changes of diesel village electrification

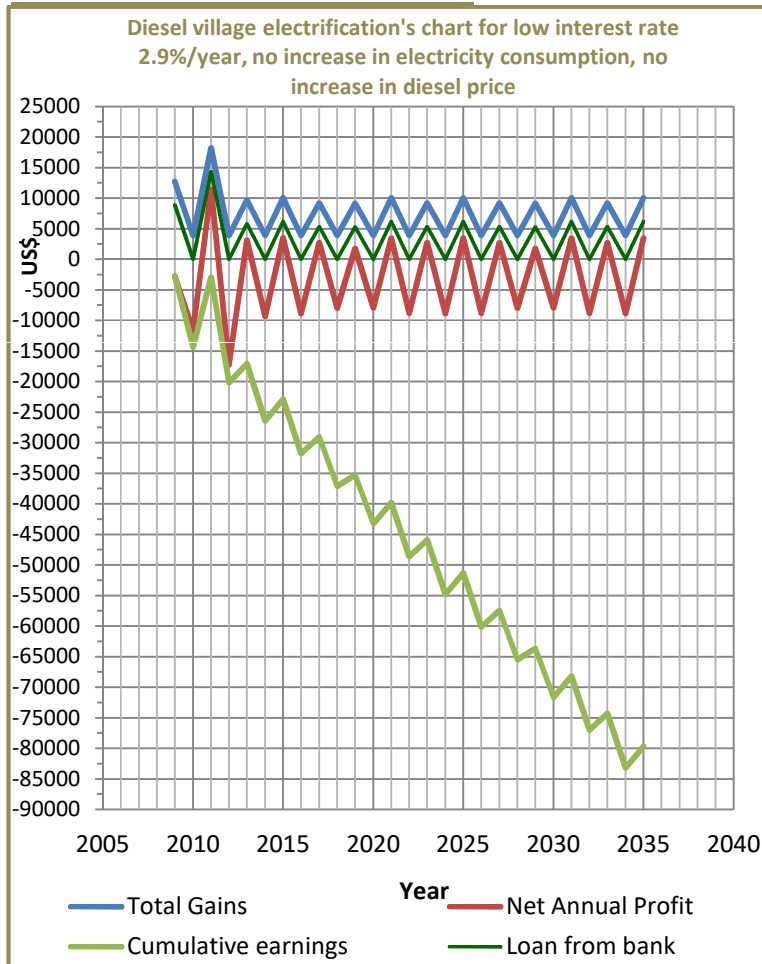
II. Sensitivity Analysis

1. Diagrams

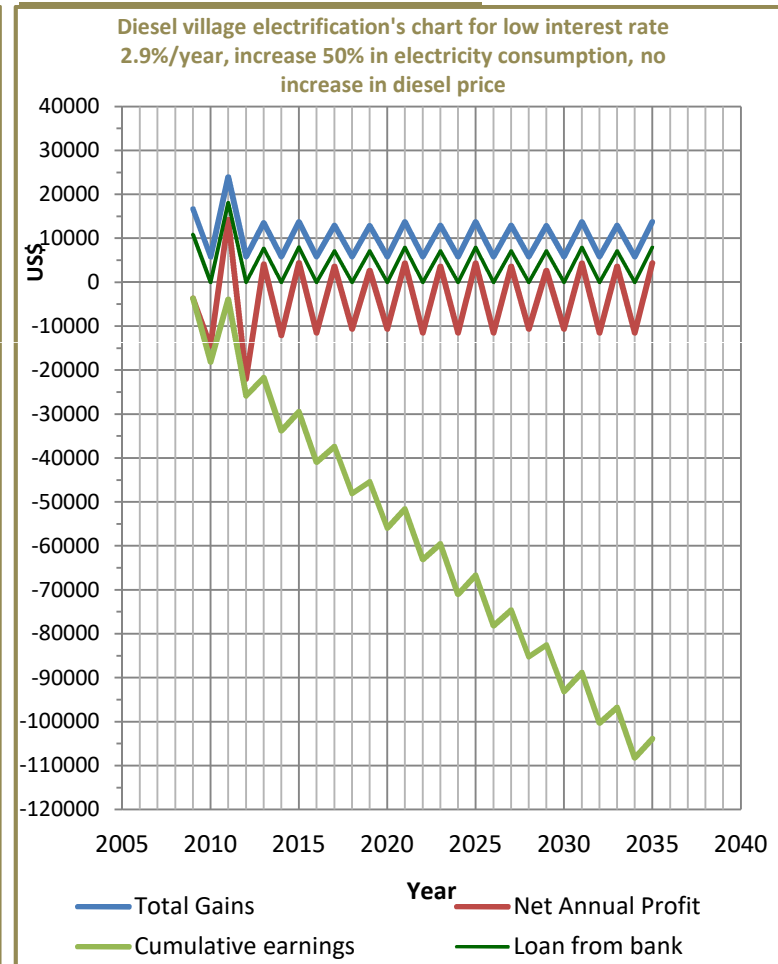
2. Table

3. Charts

Net Annual Profit No. 1



Net Annual Profit No. 2



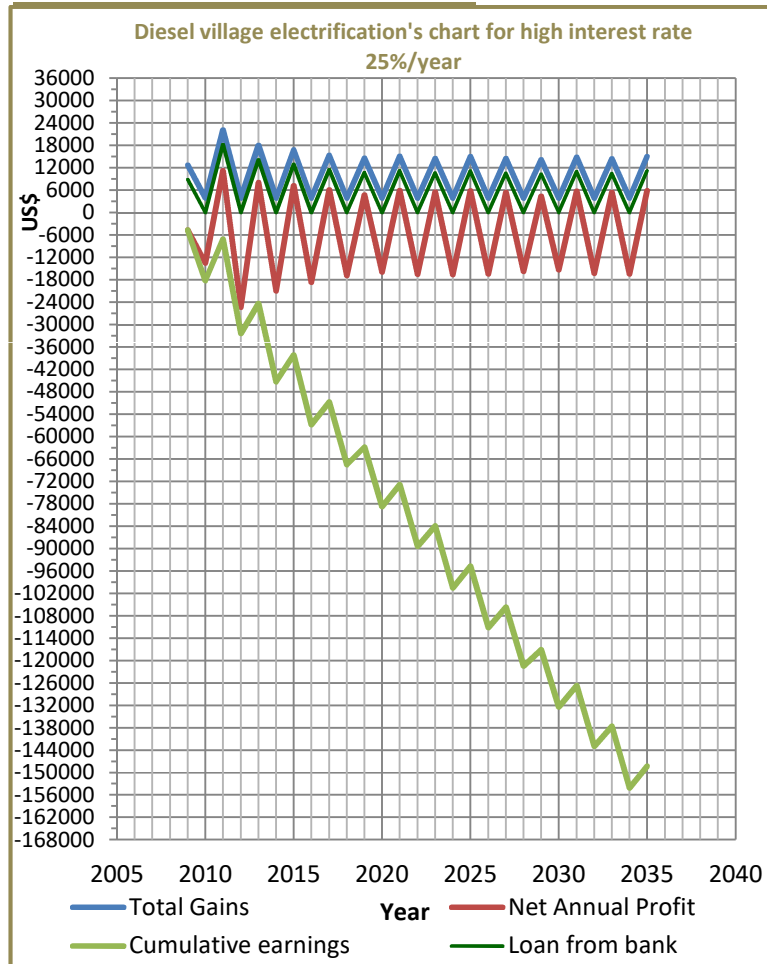
II. Sensitivity Analysis

1. Diagrams

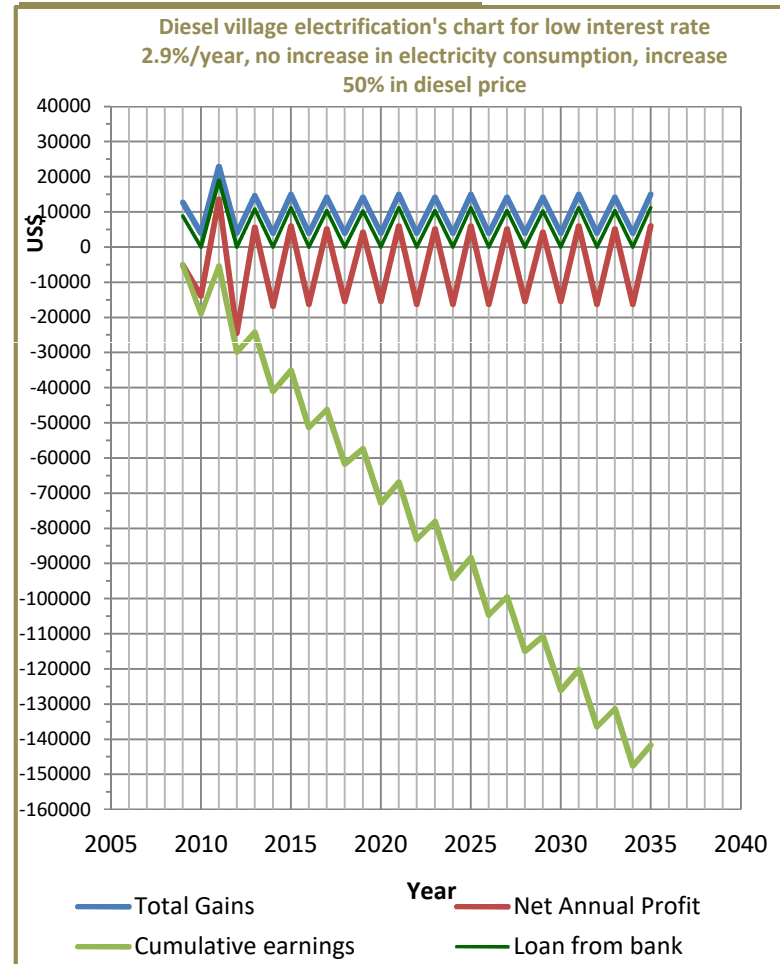
2. Table

3. Charts

Net Annual Profit No. 3



Net Annual Profit No. 4



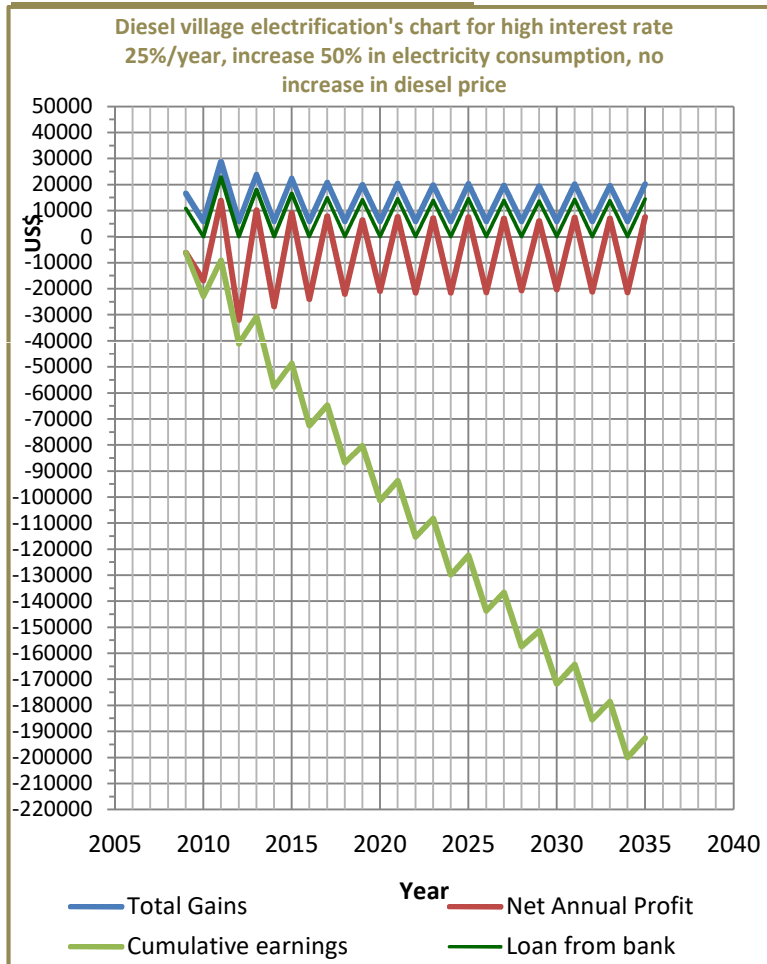
II. Sensitivity Analysis

1. Diagrams

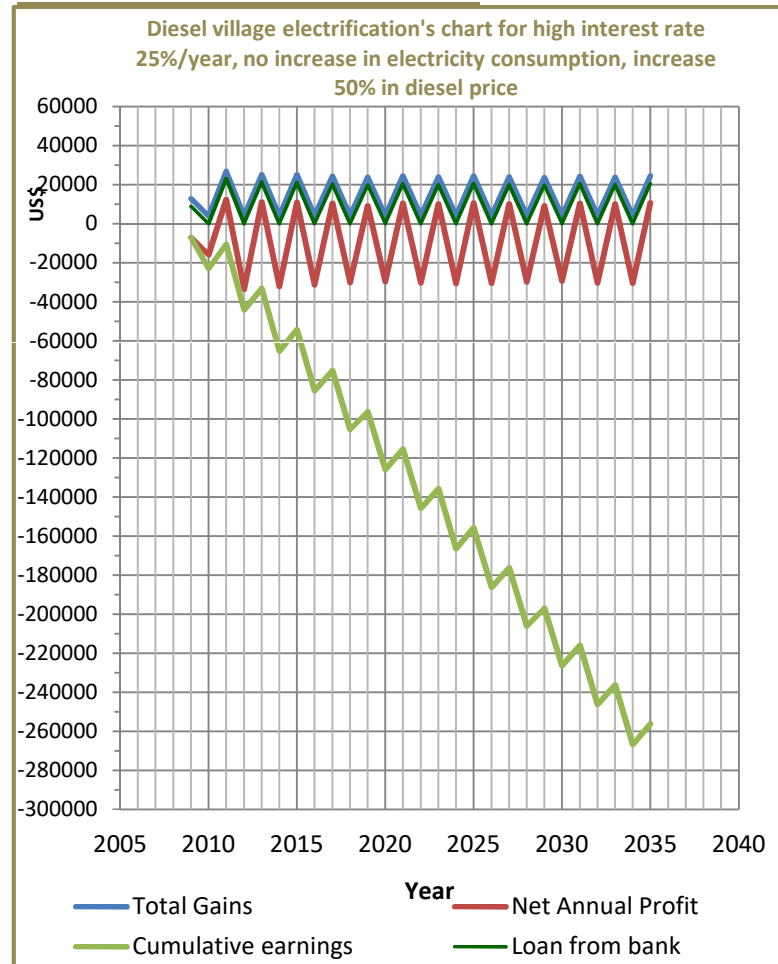
2. Table

3. Charts

Net Annual Profit No. 5



Net Annual Profit No. 6



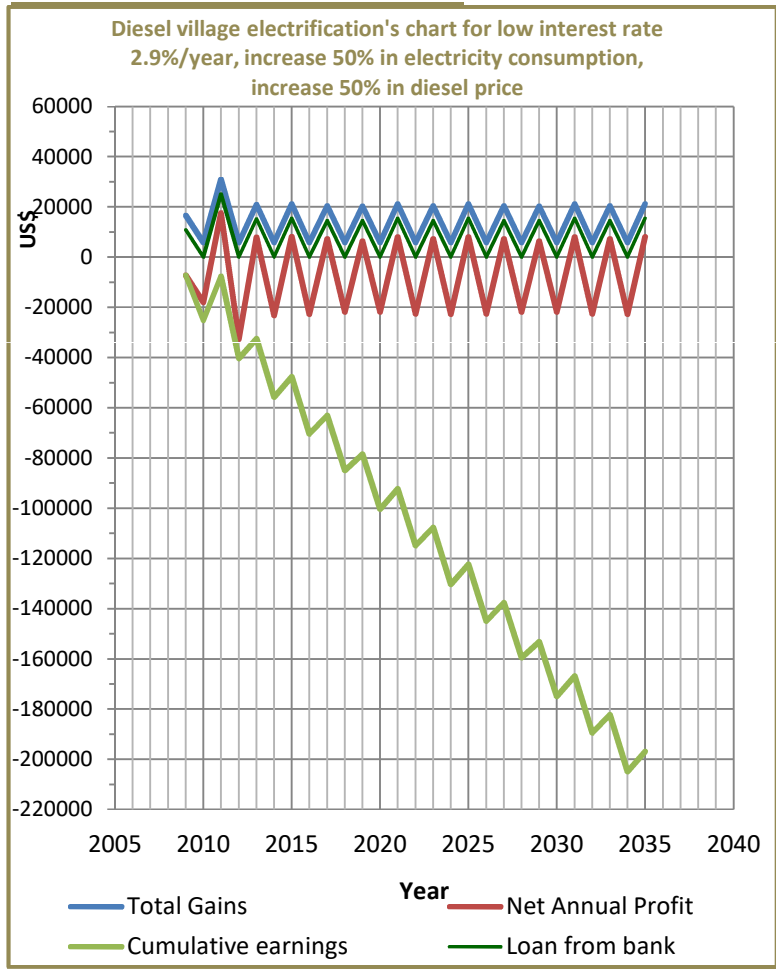
II. Sensitivity Analysis

1. Diagrams

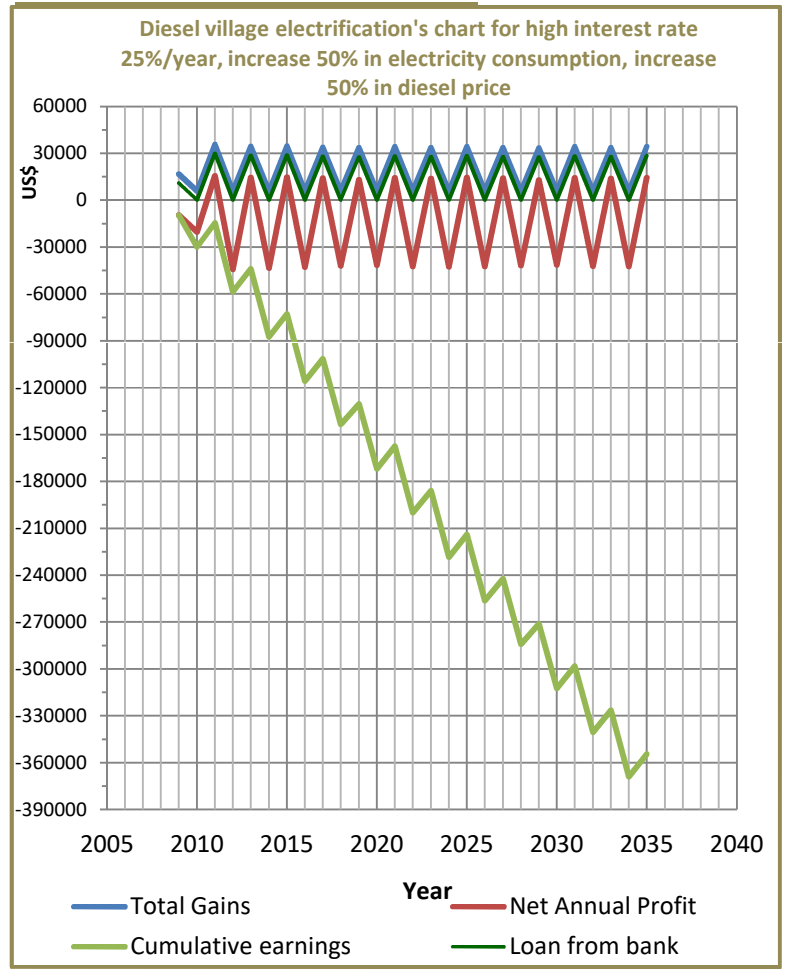
2. Table

3. Charts

Net Annual Profit No.7



Net Annual Profit No. 8



III. Conclusion

- ❑ The best Net Annual Profit is the shortest period of payback loan, and the best choice of investment.
- ❑ For our diesel village electrification, the year of Loan from bank is **fluctuated gradually**. It means that it is **unacceptable investment for the cases of sensitivity analysis**.

**Table 14: Result of Sensitivity Analysis of
Village Electrification with
Different Technologies**

- The best: Hydro Village Electrification
- 2nd : PV Village Electrification
- 3rd : Gasifier Village Electrification
- The Worst: Diesel Village Electrification

1. Table

2. Conclusion

3. Decision

CHAPTER 5: Conclusion

Part I

SWOT analysis to identify strengths, weaknesses, opportunities and threats of bio gasifier

Strength (S)	Weakness (W)	Opportunity (O)	Threat (T)
<ul style="list-style-type: none">• Community Energy Cooperative as a way of ownership and as functional structure (sense of working for a common cause)• The development of production and refining chain (growing Leuceana tree in the area)• The low price of grid electricity compared to using battery and kerosine lamps• The good quality of light• Environmentally friendly• A motivating way of producing electricity• Continuous controlling of the process possible because of labour force	<ul style="list-style-type: none">• High initial investment cost• Productization of gasifiers not yet advanced• Relatively complex system, lack of local know-how• Gasifier unreliable which leads to need for additional energy supply (diesel is expensive)• Technology based on foreign equipment and components, difficult to have spare parts• Need for proactive maintenance (Filters need to be cleaned often)• The shortness of the grid• No electricity for the whole day• Not yet economically profitable• Demand is bigger than supply	<ul style="list-style-type: none">• Opportunity to expand market, (mini)grids can be extended• The development of livelihood• Increase in consumption and improvement of the standard of living• More time for studying• Increase in information flow• In the future, the development of technology enables building of hybrids in which gas or diesel can be used in the same generator	<ul style="list-style-type: none">• System failure due to mal operation or maintenance• Unreliability of electricity supply• Threats to the production of Leuceana• The extension of national grid will affect the local business and change livelihood• Changing Government policies

➤ Gasifier Village Electrification



The Power of Group Work...
The Power of Renewable Energy...
The Power of Saving Our World!!!

Thank for your kind
attention!!!



PART II

BATTERY CHARGING WITH
BATTERY CHARGING WITH

DIFFERENT TECHNOLOGIES
DIFFERENT TECHNOLOGIES



BATTERY CHARGING WITH DIFFERENT TECHNOLOGIES

Part II: Village Battery charging with different technologies

Chapter 1: Gasifier village battery charging

Chapter 2: PV village battery charging

Chapter 3: Hydro village battery charging


Chapter 4: Diesel village battery charging

Chapter 5: Conclusion



CHAPTER 1: GASIFIER VILLAGE BATTERY CHARGING

After getting the performance data and by using the technology cost, methodologies of calculation, we get the **Table. 15: Results of gasifier village battery charging.**



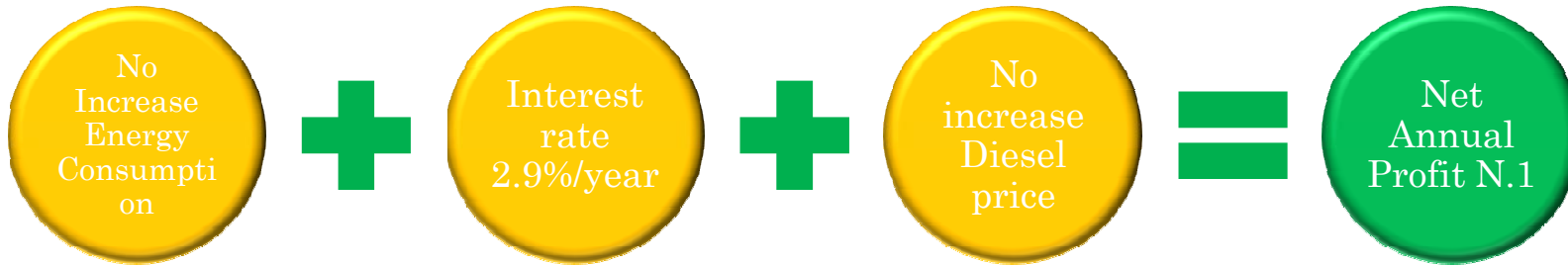


CHAPTER 1: GASIFIER VILLAGE BATTERY CHARGING

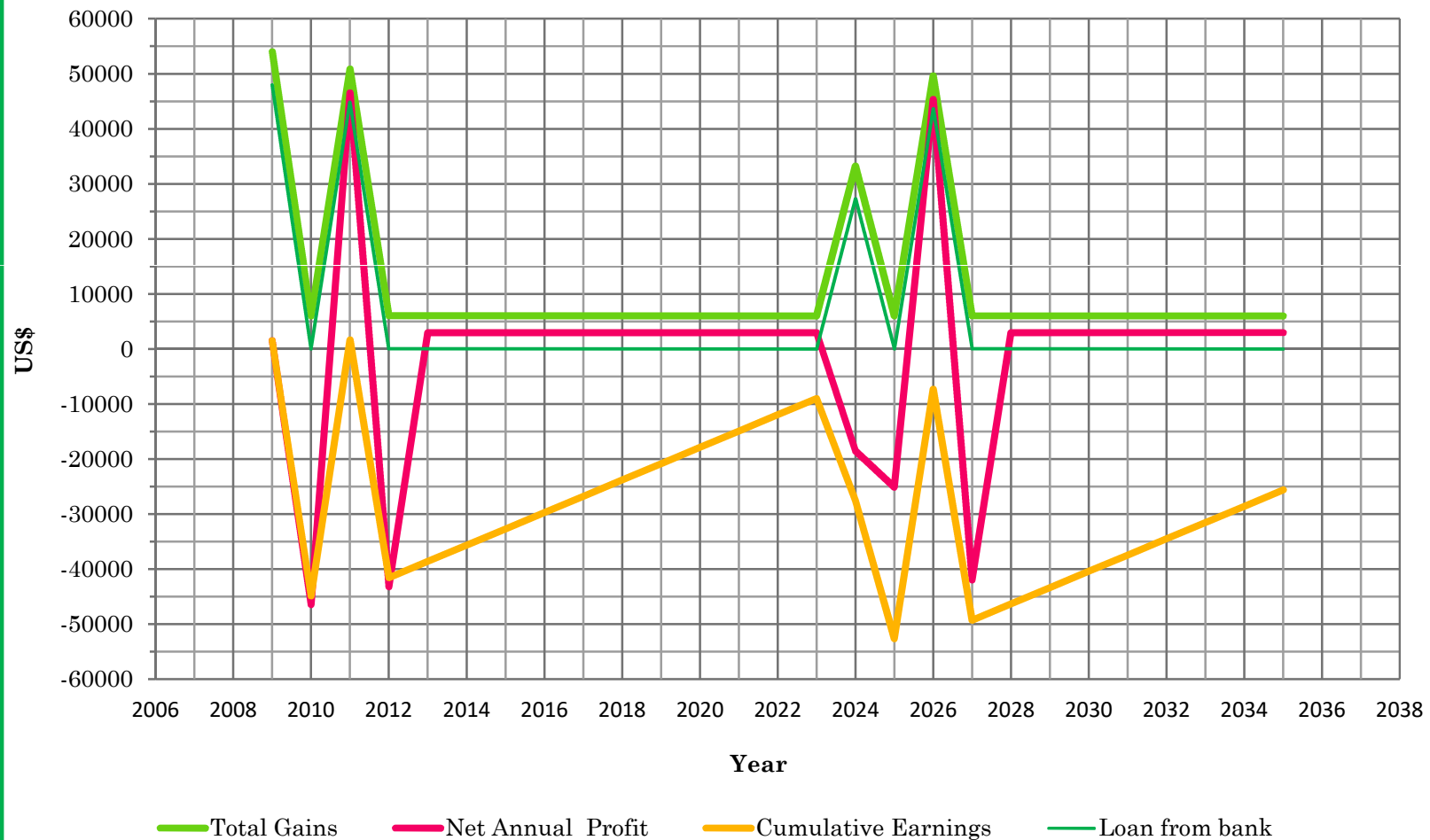
Then we are going to study about Sensitivity Analysis:

1. Analyze the Impacts of Change in Interest Rate
2. Analyze the Impacts of Increase in Electricity Consumption
3. Analyze the Impact of the Change in Diesel Price and Diesel Generation Efficiency
4. Analyze the Combination of Changes from 1-3

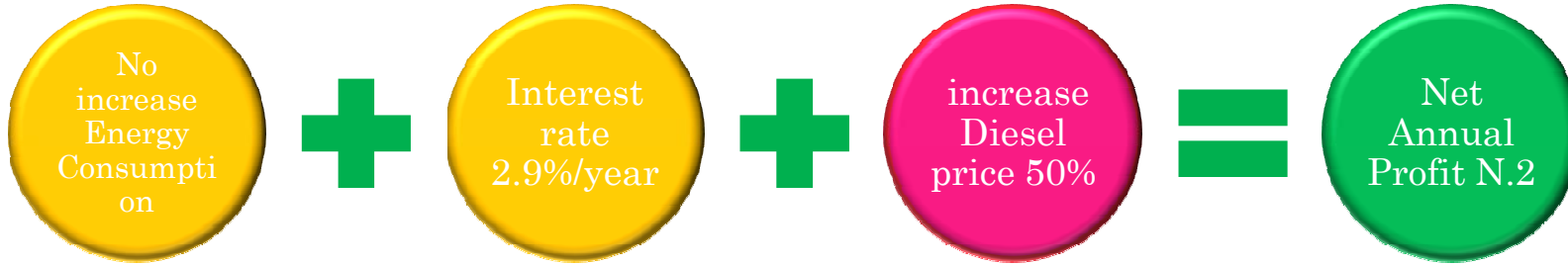
1.



Gasifier village battery charging's chart for low interest rate 2.9%/year, no increase in electricity consumption, no increase in diesel price



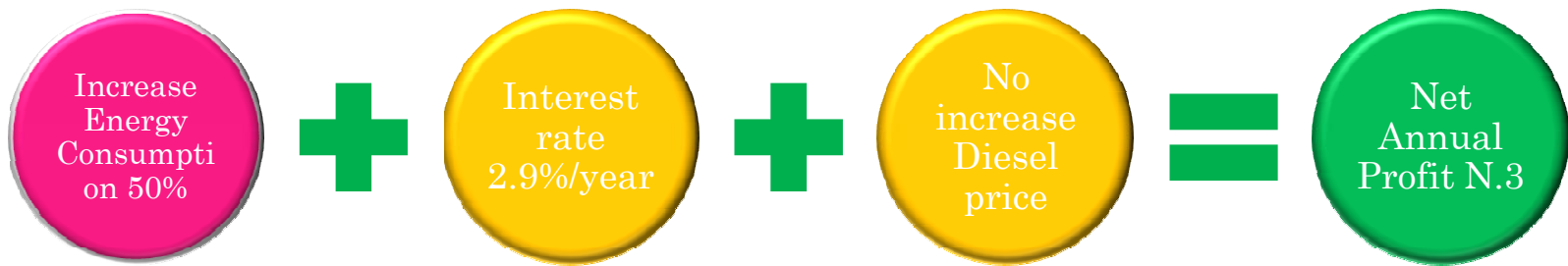
2.



Gasifier village battery charging's chart for low interest rate 2.9%/year, no increase in electricity consumption, increase 50% in diesel price



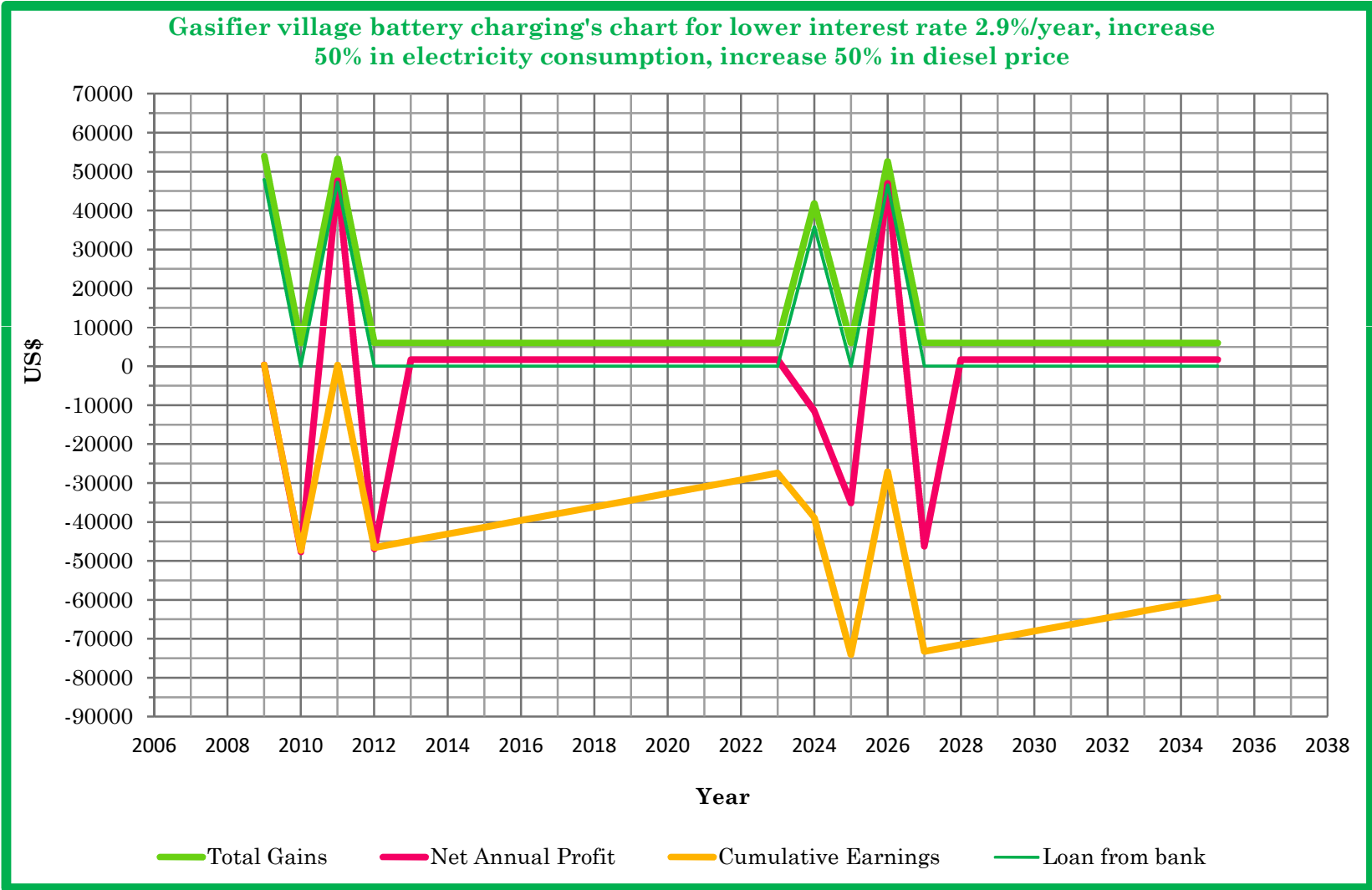
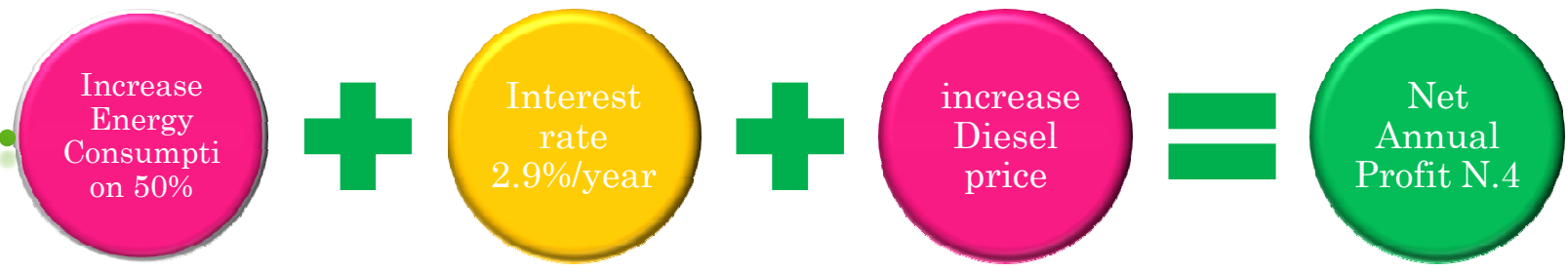
3.



Gasifier village battery charging's chart for lower interest rate 2.9%/year, increase 50% in electricity consumption, no increase in diesel price



4.



5.

No increase Energy Consumption



Interest rate 25%/year

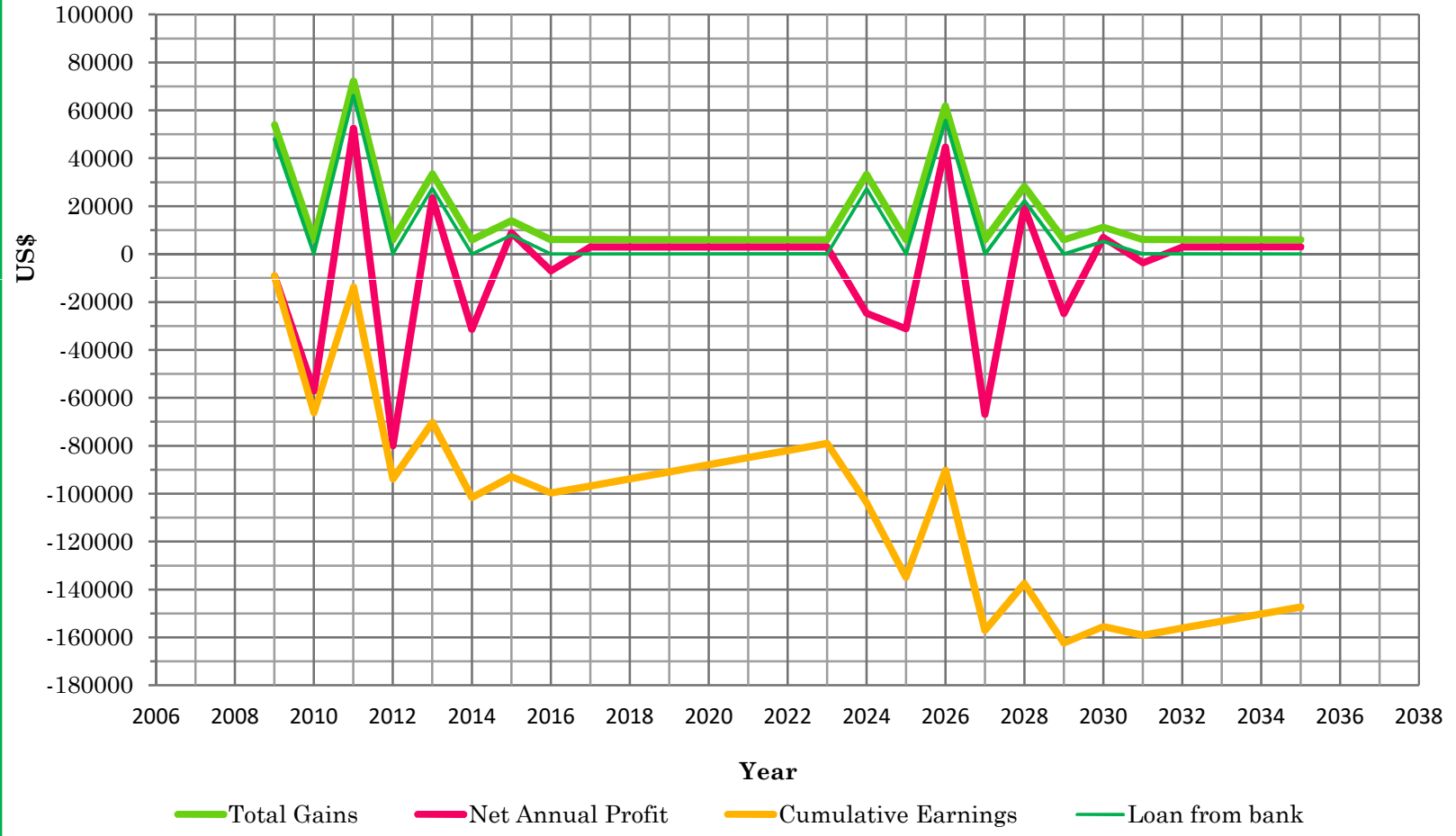


No increase Diesel price



Net Annual Profit N.5

Gasifier village battery charging's chart for high interest rate 25%/year, no increase in electricity consumption, no increase in diesel price



6.

No Increase Energy Consumption



Interest rate 25%/year

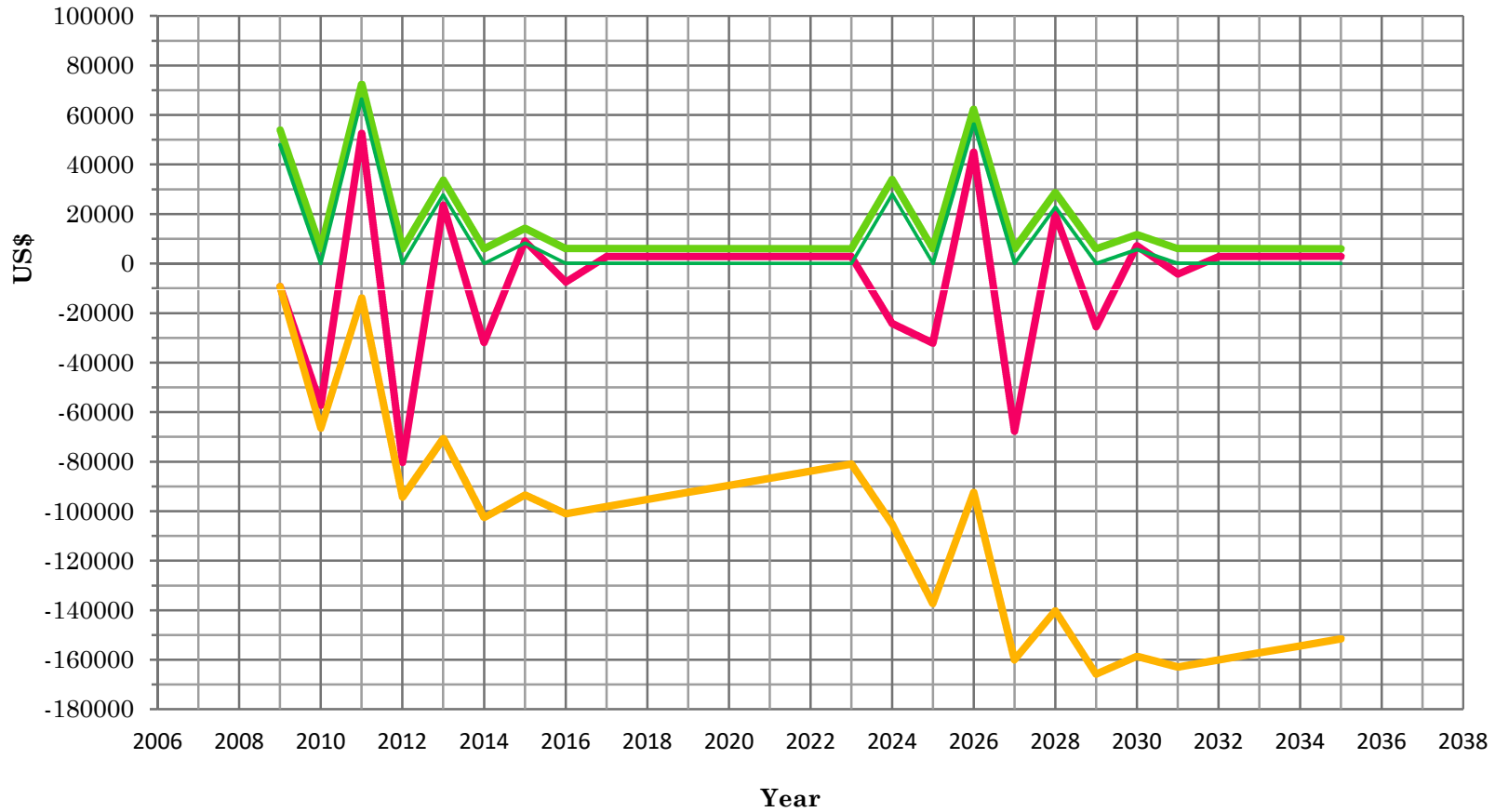


Increase Diesel price 50%

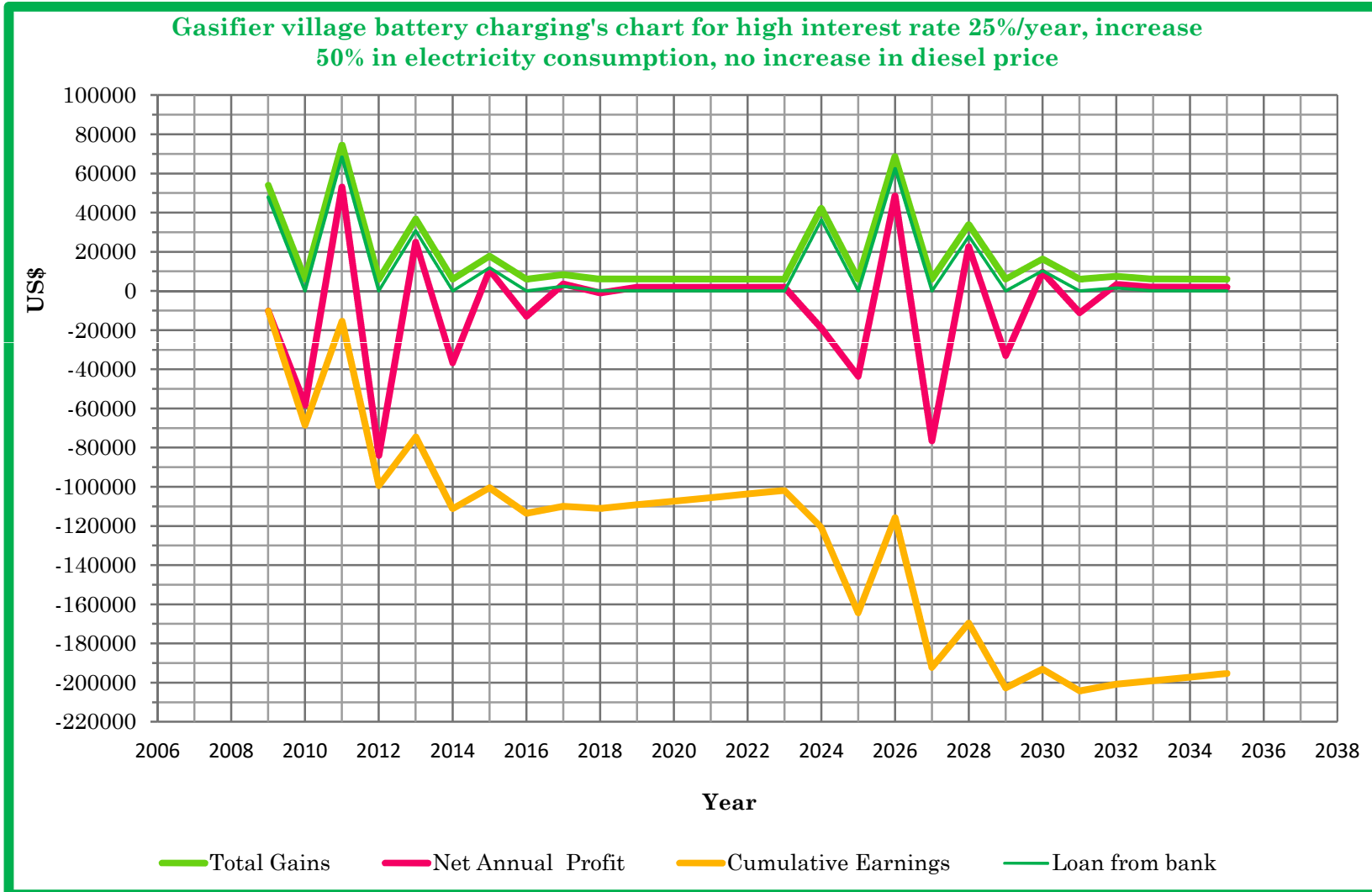
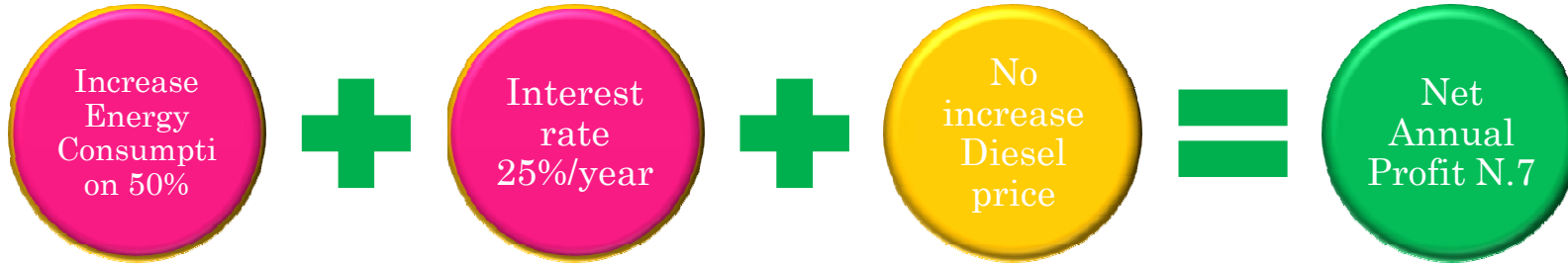


Net Annual Profit N.6

Gasifier village battery charging's chart for high interest rate 25%/year, no increase in electricity consumption, increase 50% in diesel price



7.





Increase Energy Consumption on 50%



Interest rate 25%/year

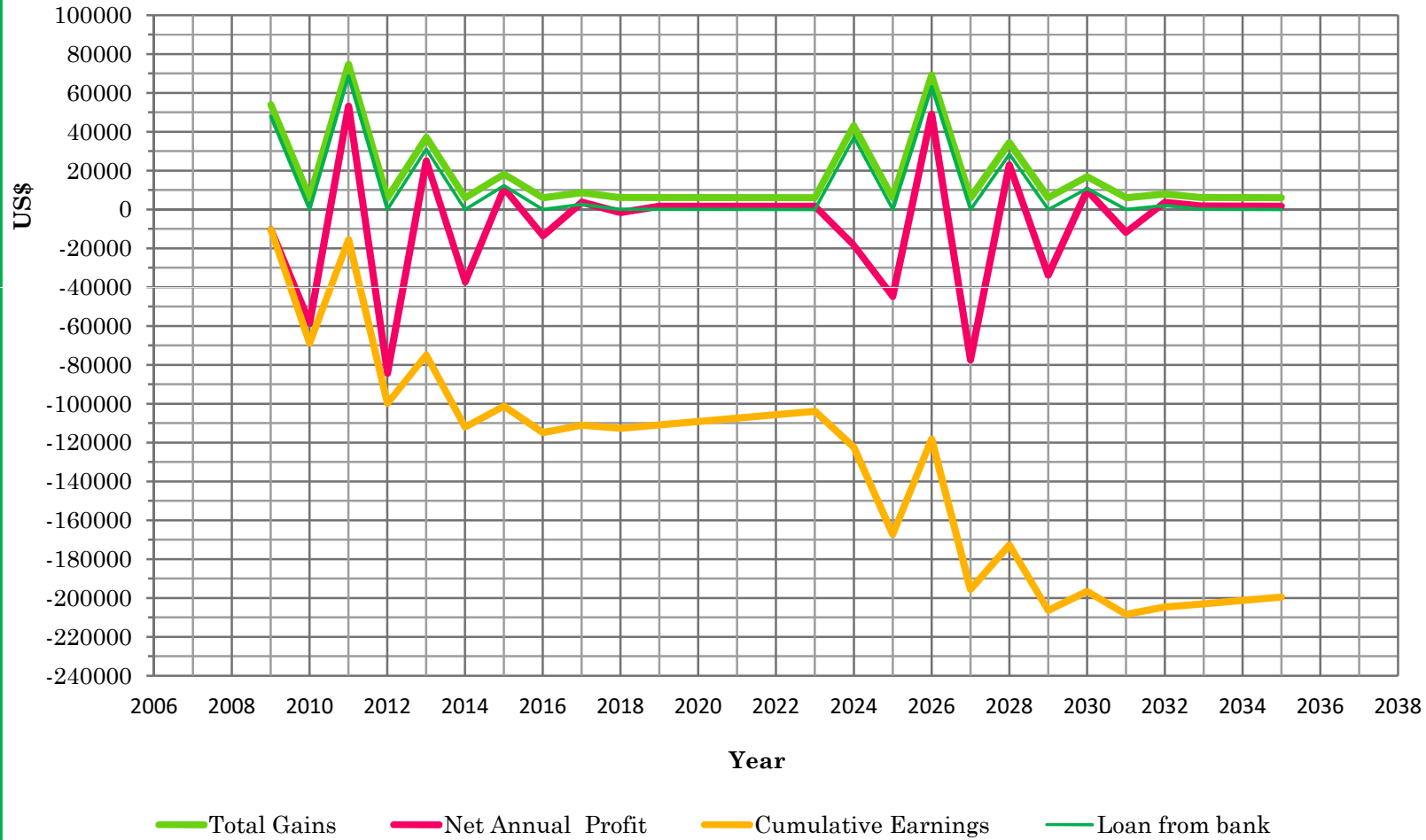


Increase Diesel price 50%



Net Annual Profit N.8

Gasifier village battery charging's chart for high interest rate 25%/year, increase 50% in electricity consumption, increase 50% in diesel price



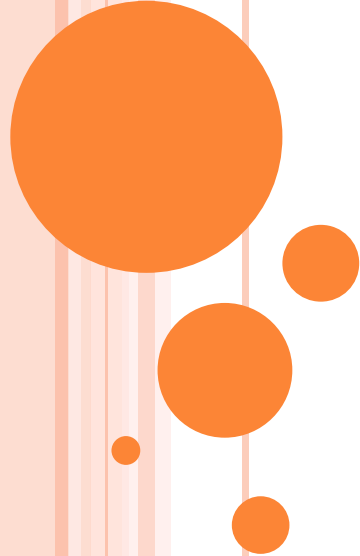
CONCLUSION

- ❑ **Table. 16: The results of different combinations of changes of gasifier village battery charging**
- ❑ The minimum year of Loan from bank started to remain zero is in year **2013** which is the case of **the best Net Annual Profit No.1: No increase in electricity consumption, No increase in diesel price, Lower Interest rate 2.9%.**
- ❑ The maximum year of Loan from bank started to remain zero is in year **2019** which is the case of **the worst Net Annual Profit No.8: Increase 50% in electricity consumption, Increase 50% in diesel price, Higher Interest rate 25%.**



CHAPTER 2: PV VILLAGE BATTERY CHARGING

After getting the performance data and by using the technology cost, methodologies of calculation, we get the **Table. 17: Results of PV village battery charging.**



CHAPTER 2: PV VILLAGE BATTERY CHARGING

Then we are going to study about Sensitivity Analysis:

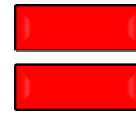
1. Analyze the Impacts of Change in Interest Rate
2. Analyze the Impacts of Increase in Electricity Consumption
3. Analyze the Combination of Changes from 1-2

1.

Interest rate
2.9%/year

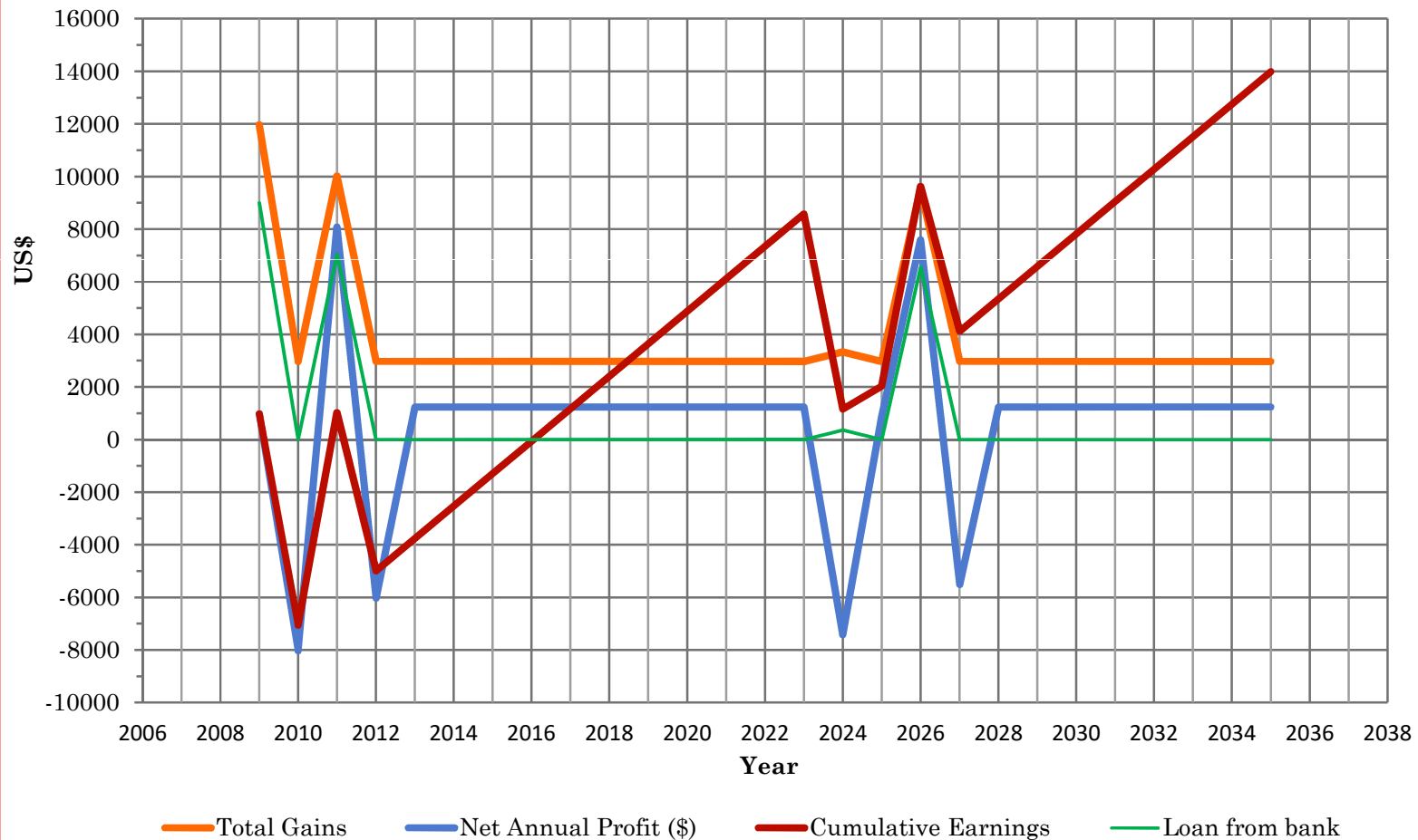


Increase
Energy
consumption
50%

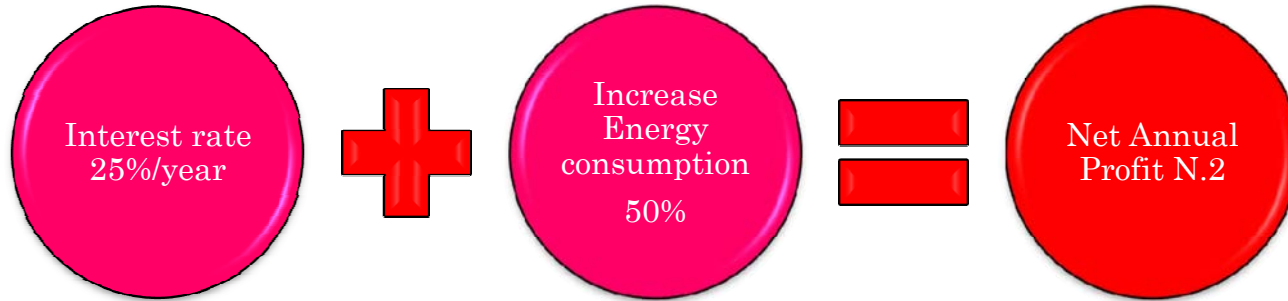


Net Annual
Profit N.1

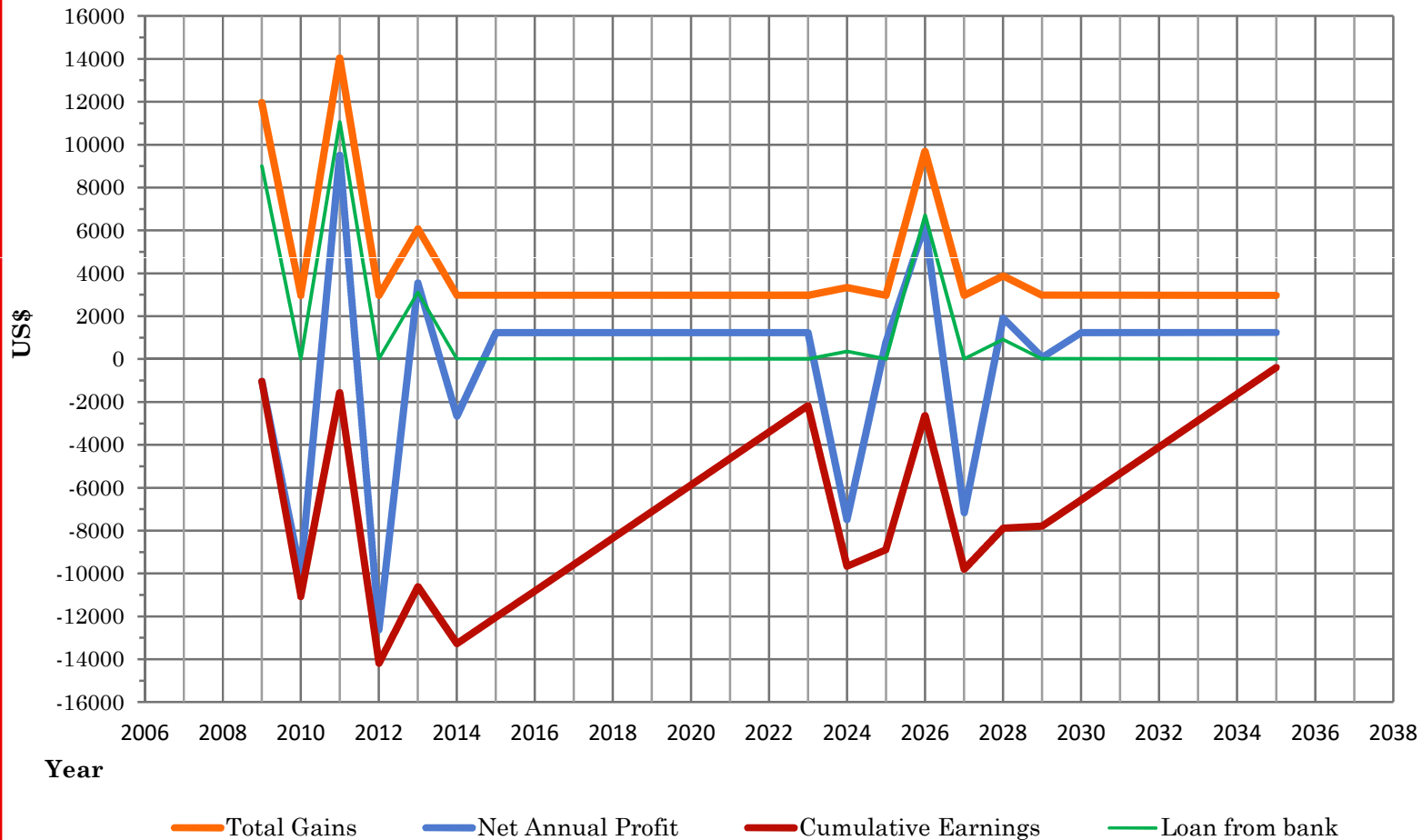
PV village battery charging's chart for interest rate 2.9%/year & increase consumption 50%



2.



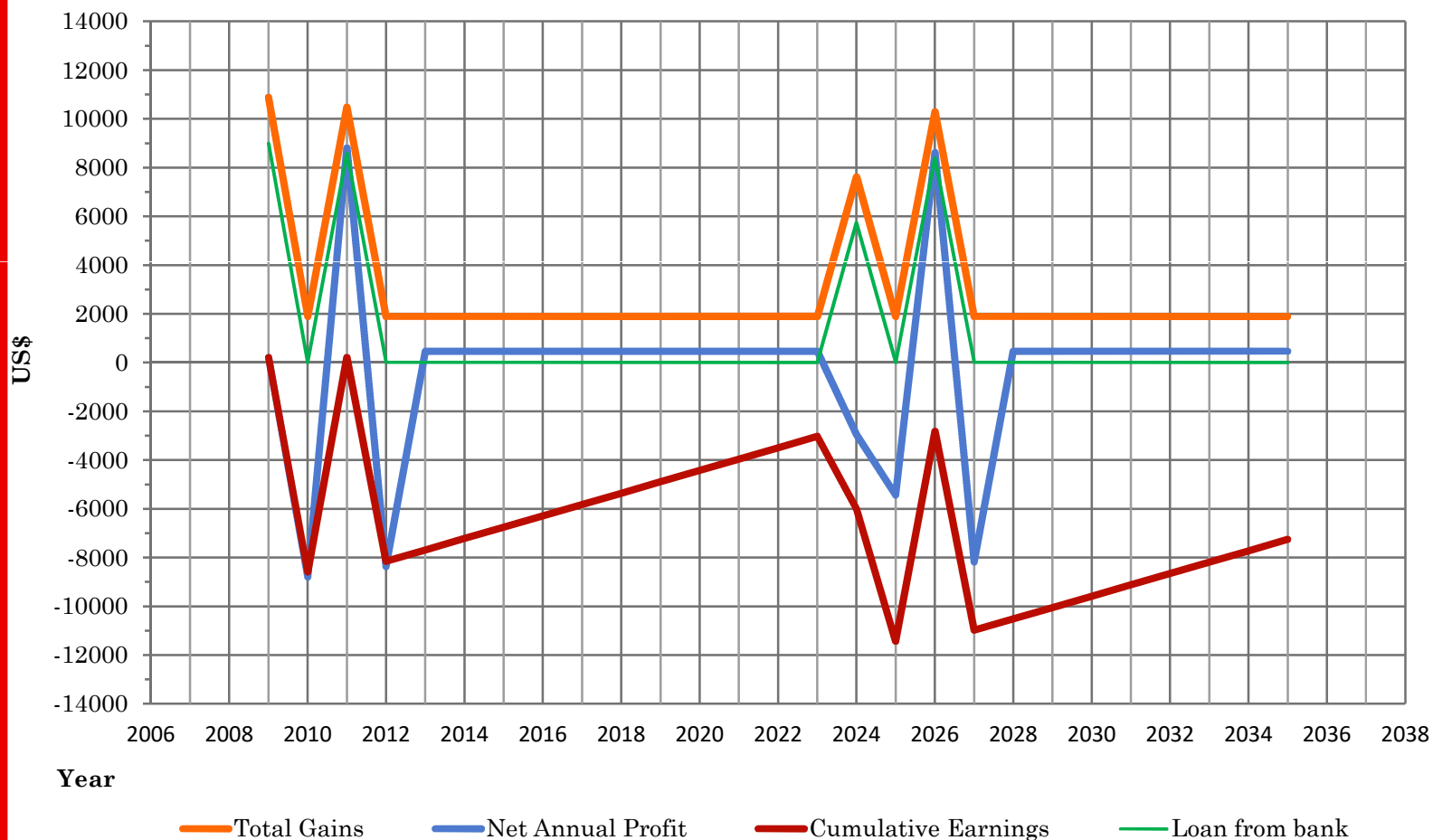
PV village battery charging's chart for high interest rate 25%/year, increase 50% in electricity consumption



3.



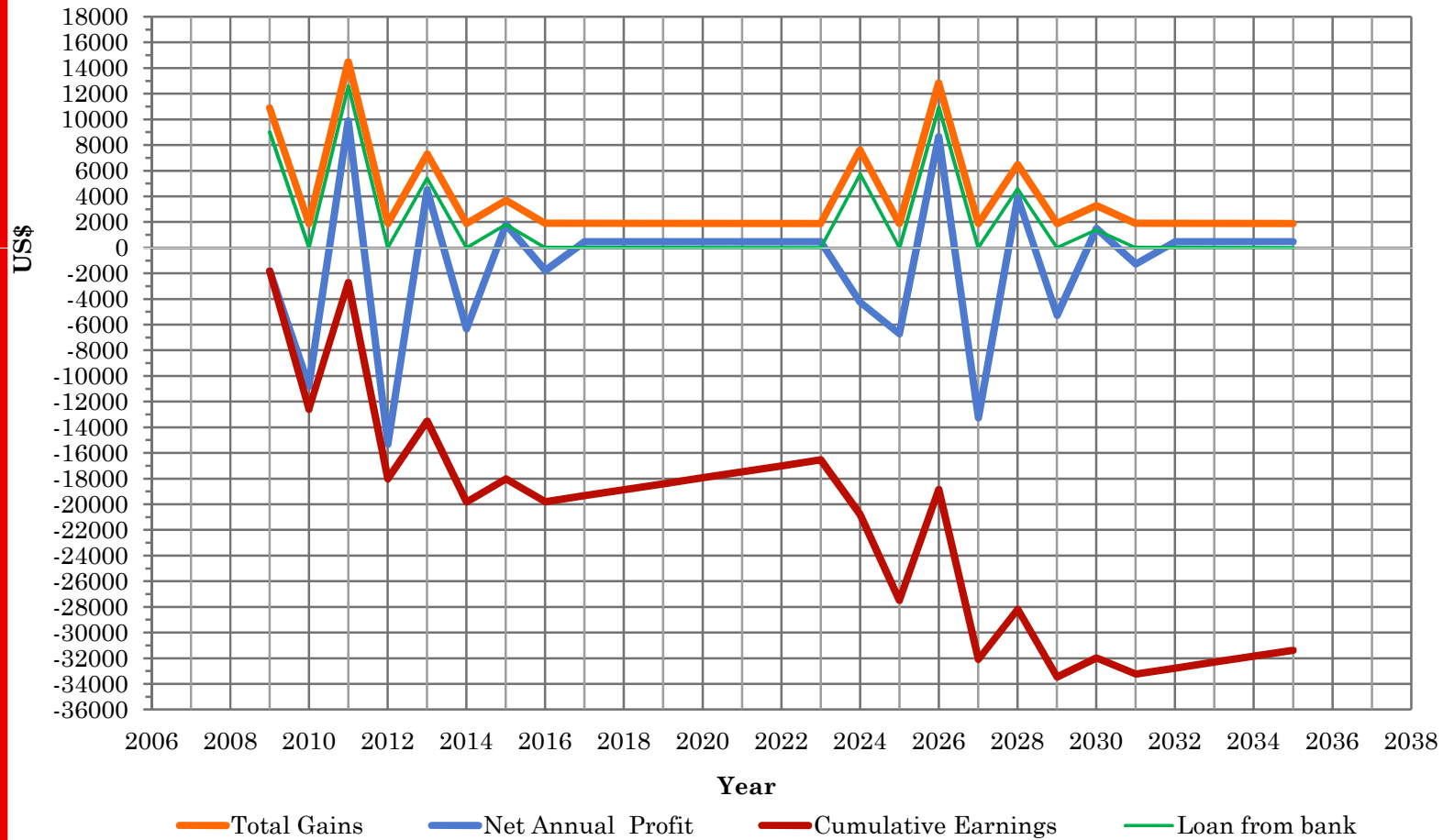
PV village batter charging's chart for lower interest rate 2.9%/year, no increase in electricity consumption



4.



PV village battery charging's chart for high interest rate 25%/year



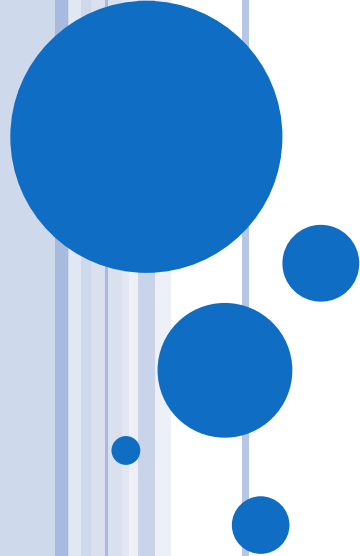
CONCLUSION

- ❑ **Table. 18: The results of different combinations of changes of PV village battery charging**
- ❑ The minimum year of Loan from bank started to remain zero is in year **2013** which is the case of **the best Net Annual Profit No.1: Increase 50% in electricity consumption, Lower Interest rate 2.9%.**
- ❑ The maximum year of Loan from bank started to remain zero is in year **2017** which is the case of **the worst Net Annual Profit No.4: No increase in electricity consumption, Higher Interest rate 25%.**



CHAPTER 3: HYDRO VILLAGE BATTERY CHARGING

After getting the performance data and by using the technology cost, methodologies of calculation, we get the **Table. 19: Results of Hydro village battery charging.**

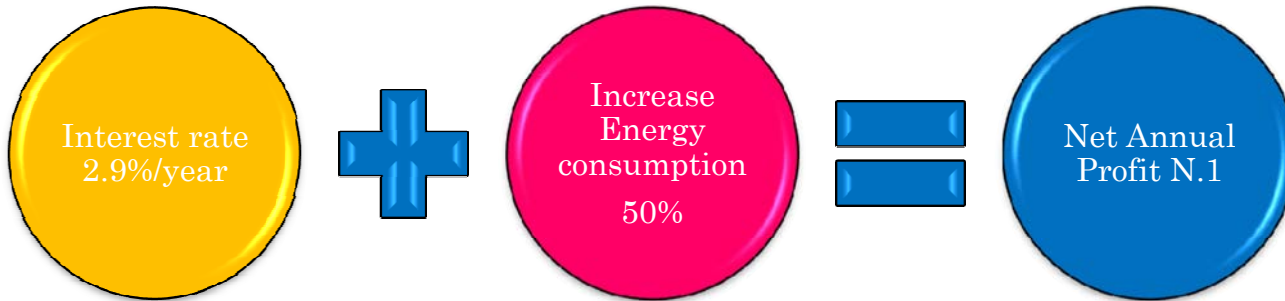


CHAPTER 3: HYDRO VILLAGE BATTERY CHARGING

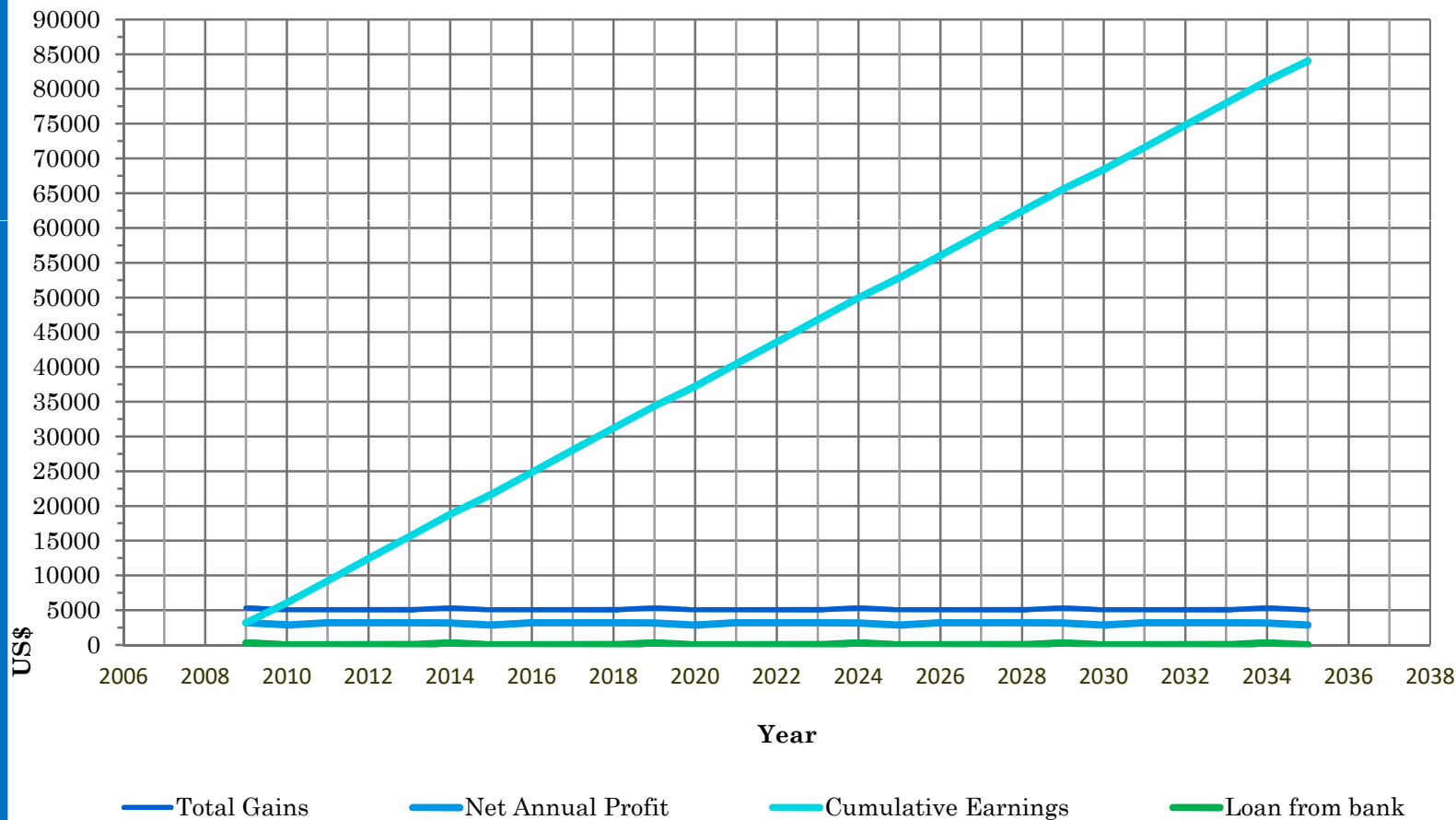
Then we are going to study about Sensitivity Analysis:

1. Analyze the Impacts of Change in Interest Rate
2. Analyze the Impacts of Increase in Electricity Consumption
3. Analyze the Combination of Changes from 1-2

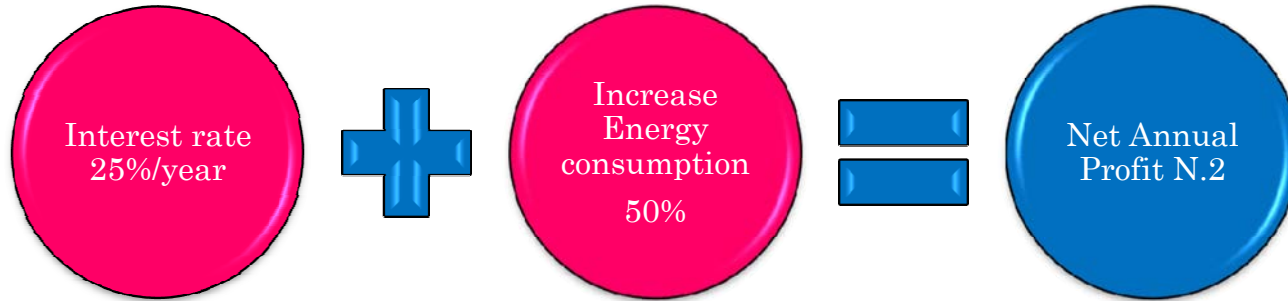
1.



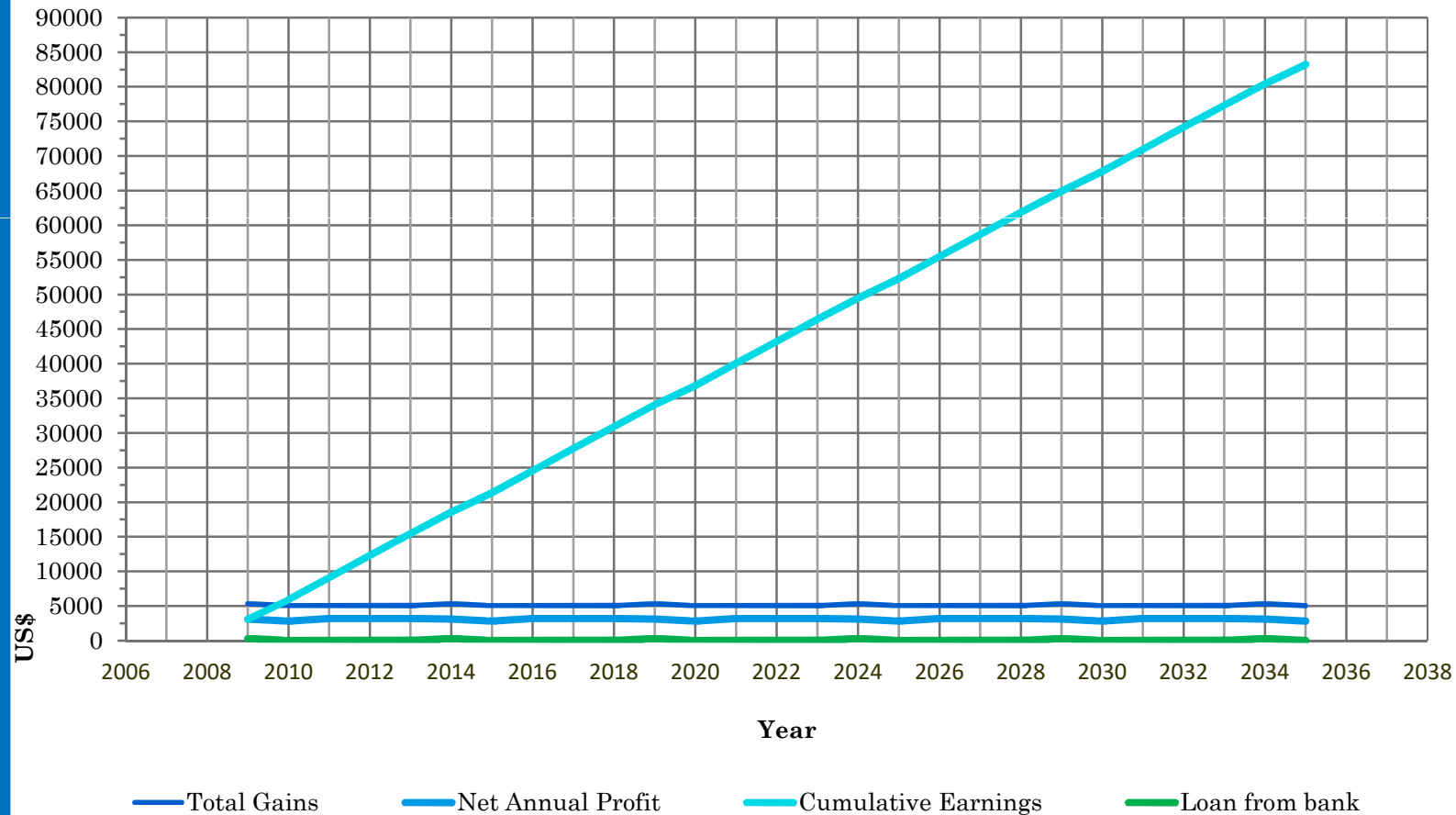
Hydro village battery charging's chart for low interest rate 2.9%/year, increase 50% in electricity consumption



2.



Hydro village battery charging's chart for high interest rate 25%/year, increase 50% in electricity consumption



3.

Interest rate
2.9%/year

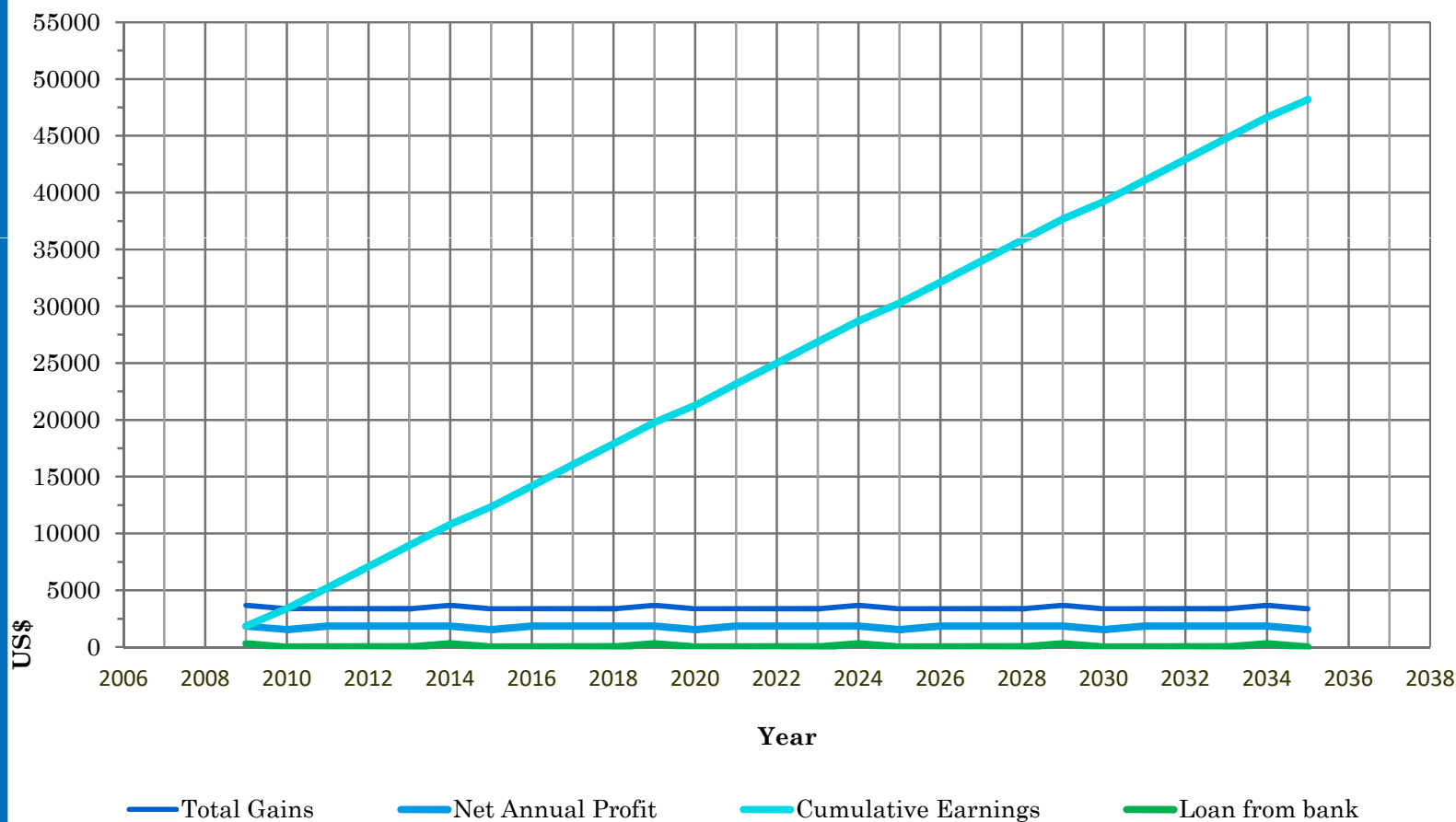


No Increase
Energy
consumption



Net Annual
Profit N.3

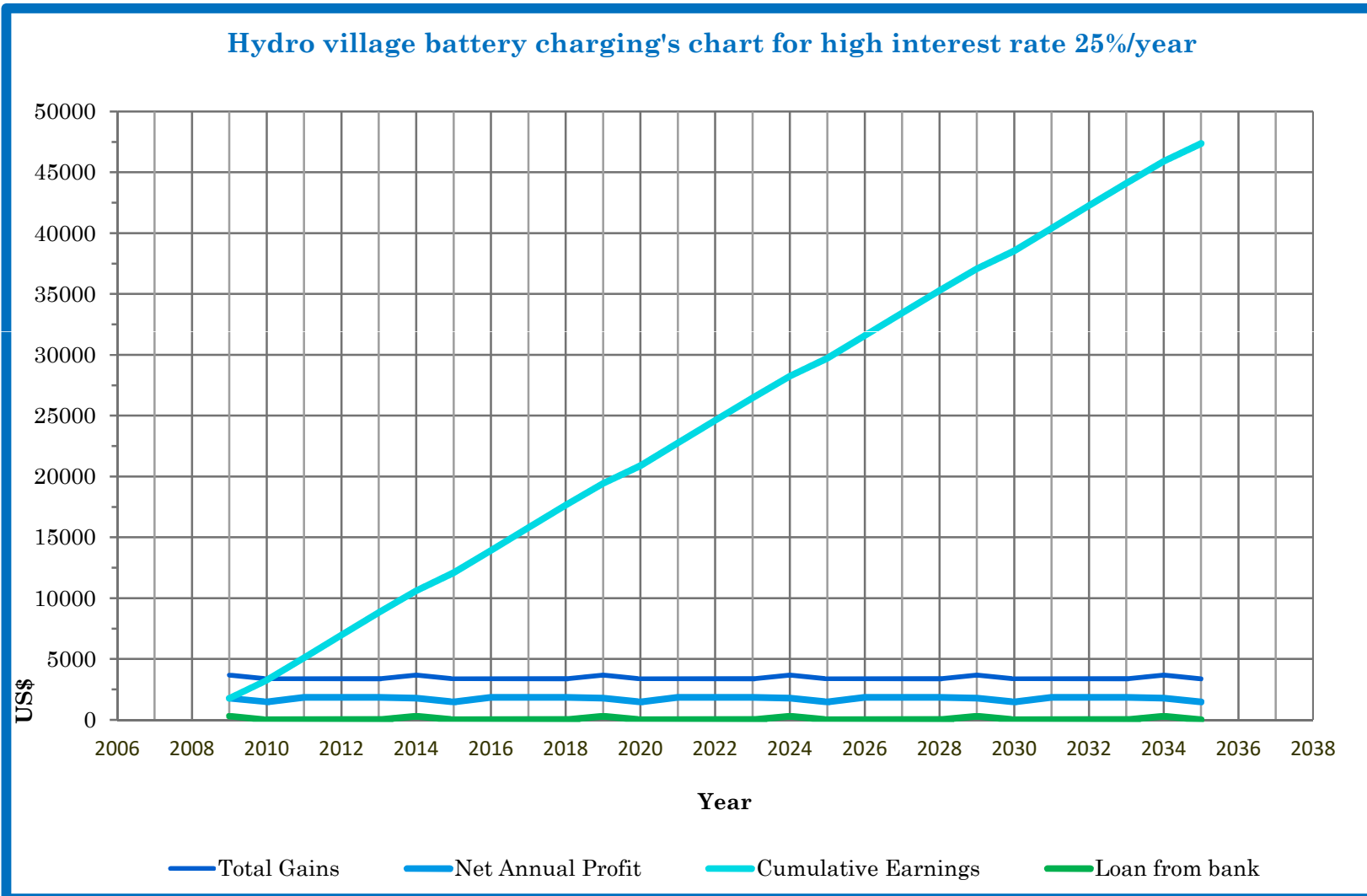
Hydro village battery charging's chart for low interest rate 2.9%/year, no increase in electricity consumption



4.



Hydro village battery charging's chart for high interest rate 25%/year



CONCLUSION

- ❑ **Table. 20: The results of different combinations of changes of hydro village battery charging**
- ❑ The best case of sensitivity analysis which Loan from bank started to remain zero is in year **2010** which is the case of **the best Net Annual Profit No. 1: Increase 50% in electricity consumption, Lower Interest rate 2.9%.**
- ❑ The worst case of sensitivity analysis which Loan from bank started to remain zero is also in year **2010** which is the case of **the worst Net Annual Profit No.4: No increase in electricity consumption, Higher Interest rate 25%.**



CHAPTER 4: DIESEL VILLAGE BATTERY CHARGING

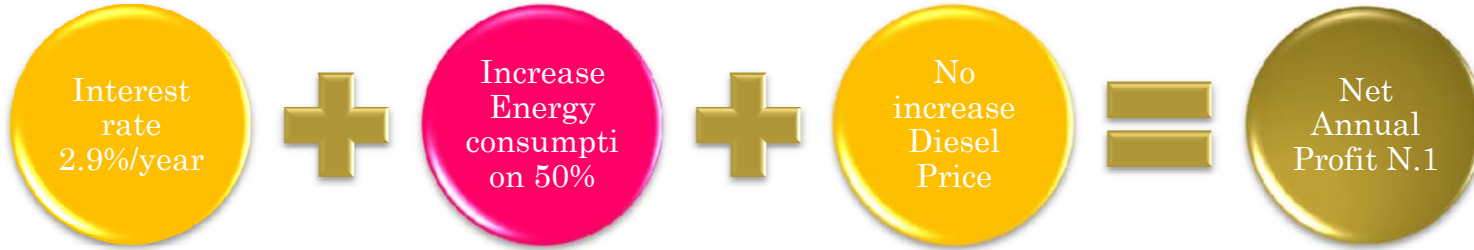
After getting the performance data and by using the technology cost, methodologies of calculation, we get the **Table. 21: Results of Diesel village battery charging**

CHAPTER 4: DIESEL VILLAGE BATTERY CHARGING

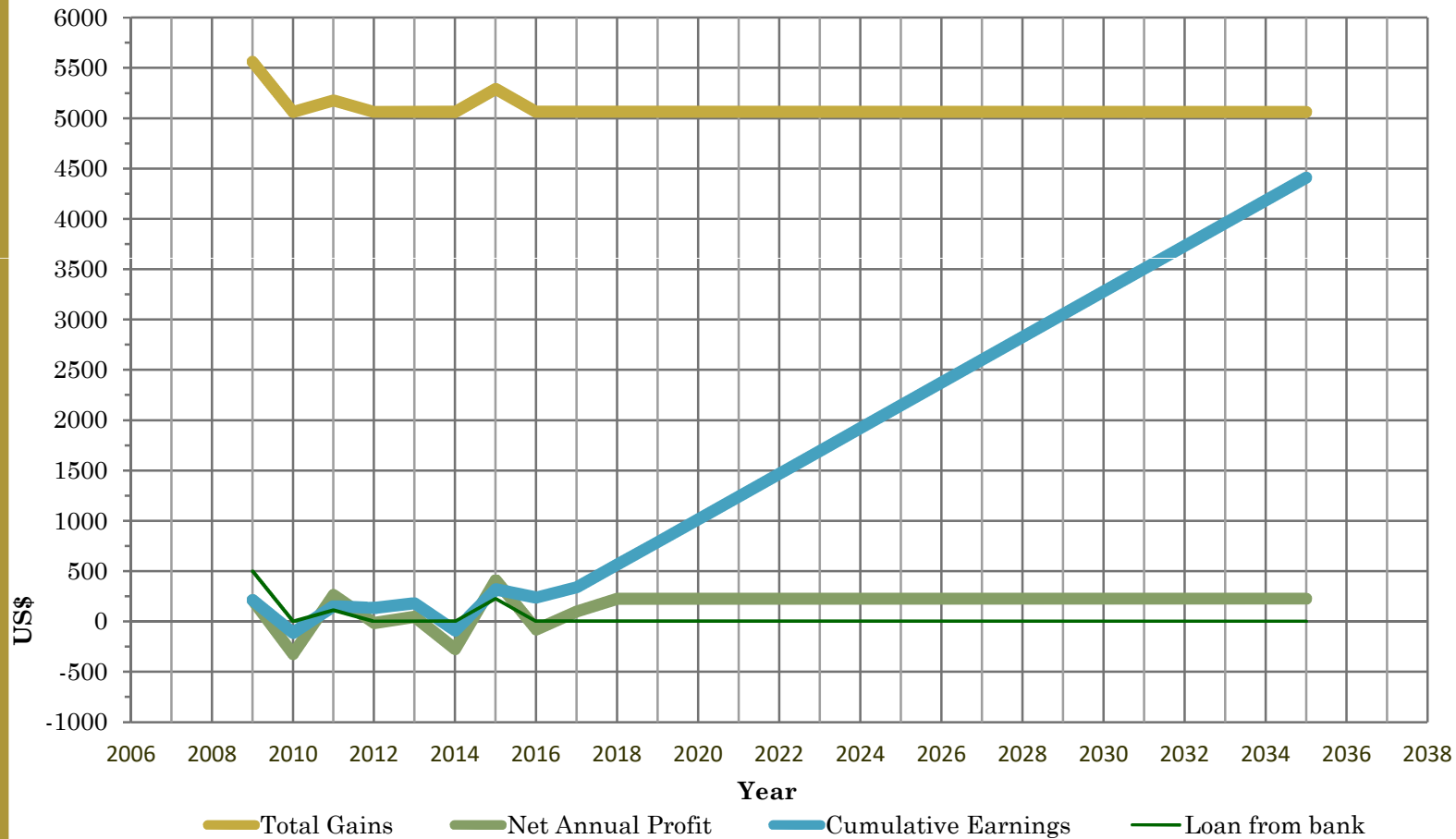
Then we are going to study about Sensitivity Analysis:

1. Analyze the Impacts of Change in Interest Rate
2. Analyze the Impacts of Increase in Electricity Consumption
3. Analyze the Impact of the Change in Diesel Price and Diesel Generation Efficiency
4. Analyze the Combination of Changes from 1-3

1.



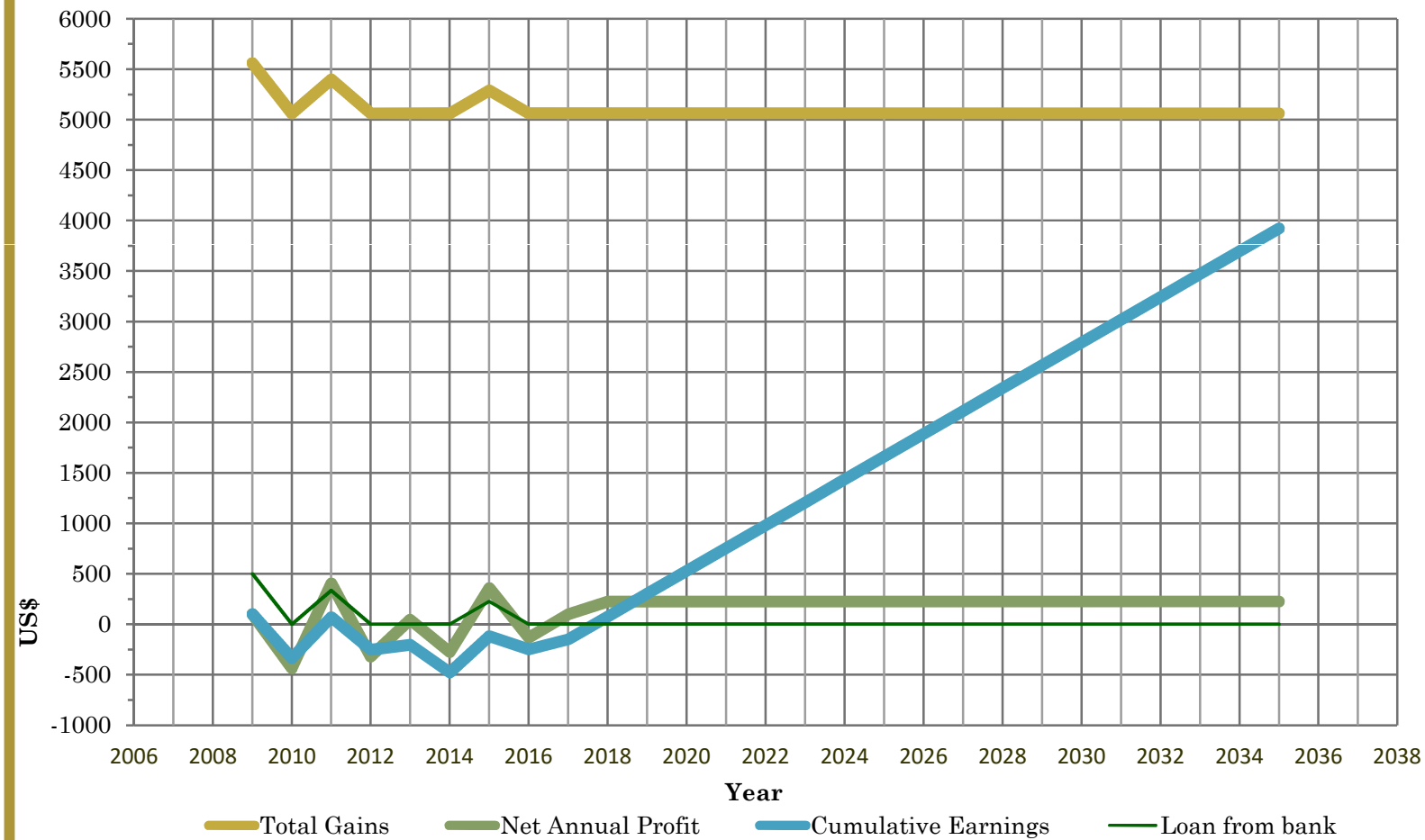
Diesel village battery charging's chart for low interest rate 2.9%/year, increase 50% in electricity consumption, no increase in diesel price



2.



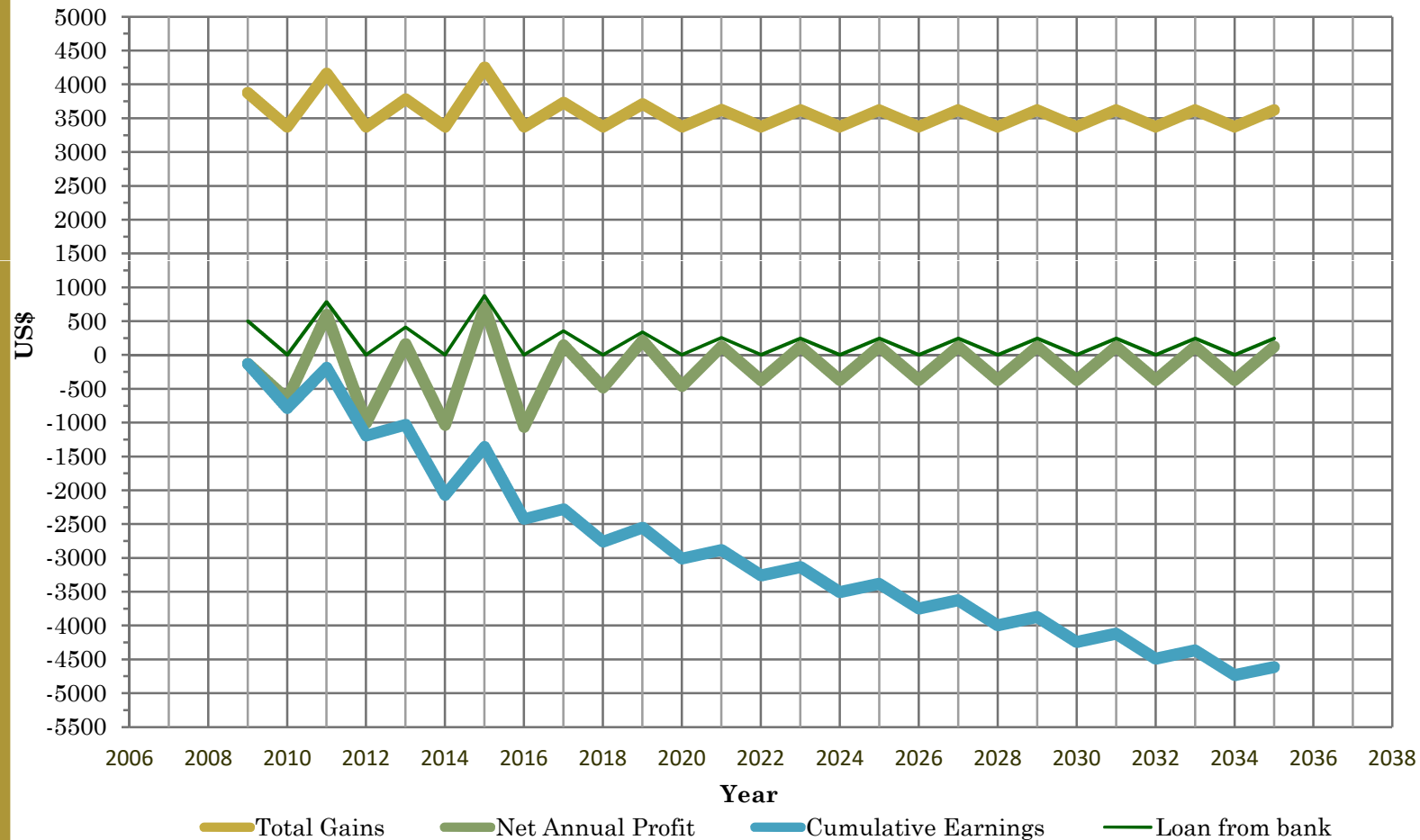
Diesel village battery charging's chart for high interest rate 25%/year, increase 50% in electricity consumption, no increase in diesel price



3.



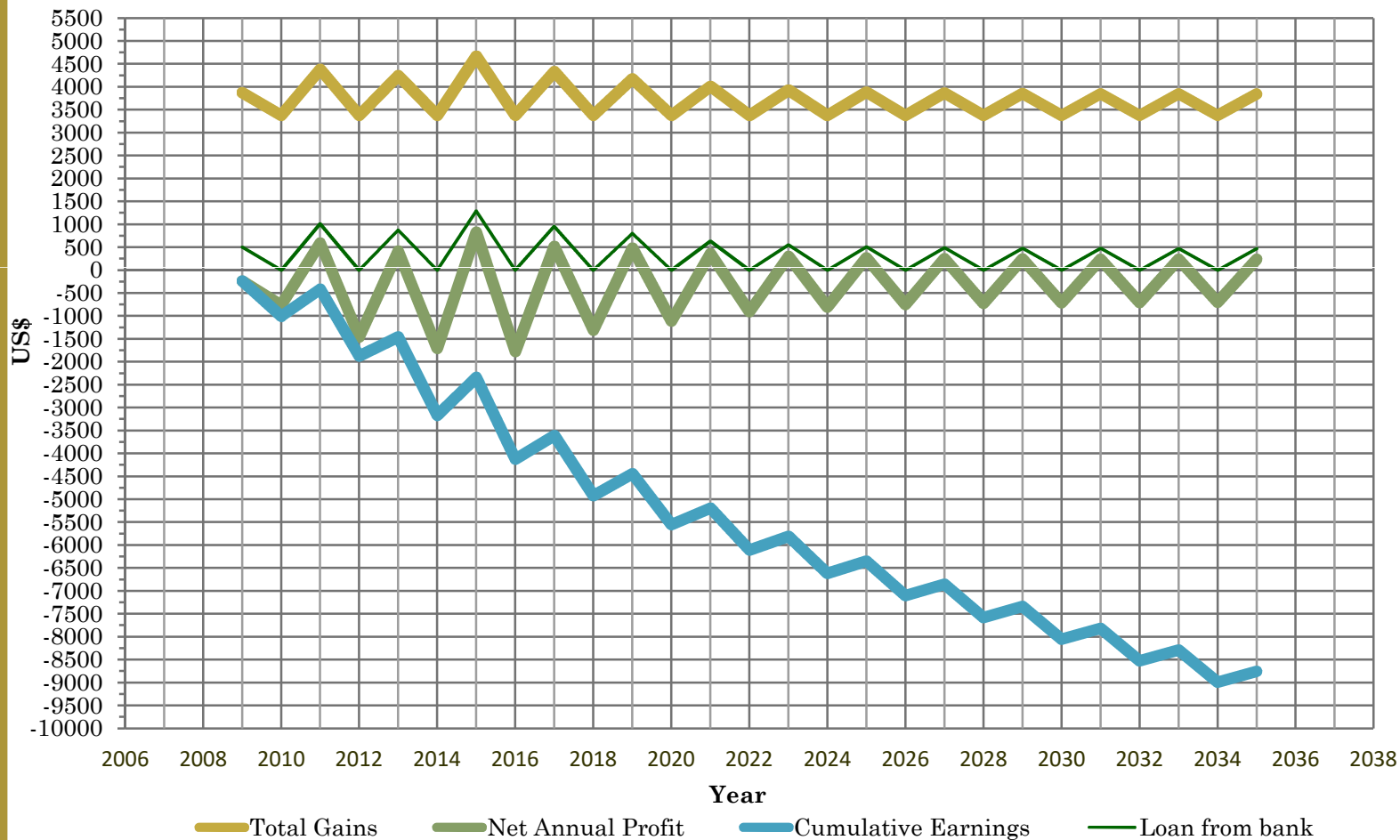
Diesel village battery charging's chart for low interest rate 2.9%/year, no increase in electricity consumption, no increase in diesel price



4.



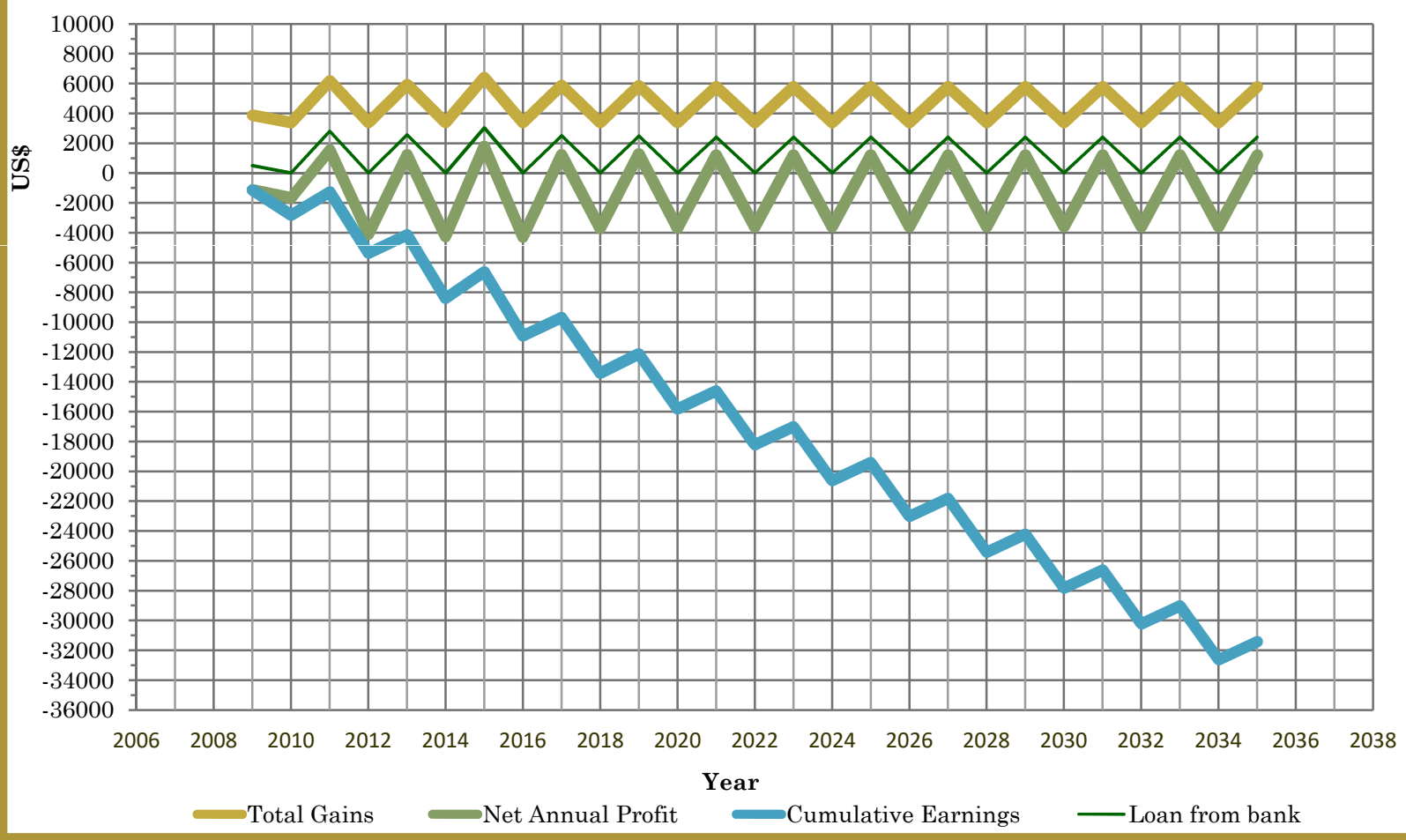
Diesel village battery charging's chart for high interest rate 25%/year, no increase in electricity consumption, no increase in diesel price



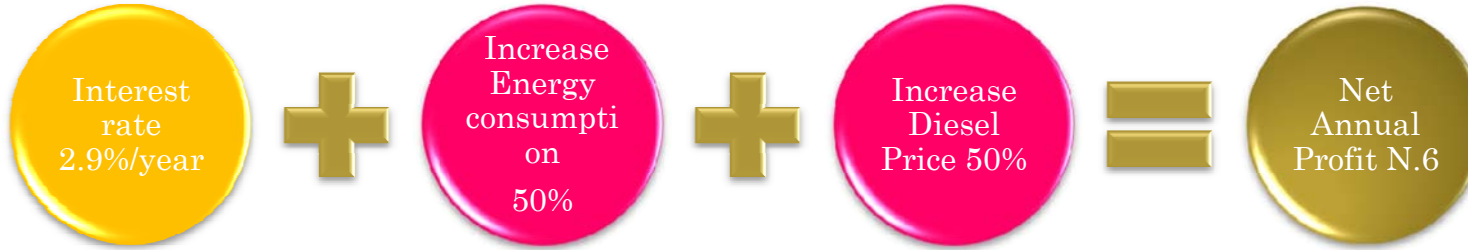
5.



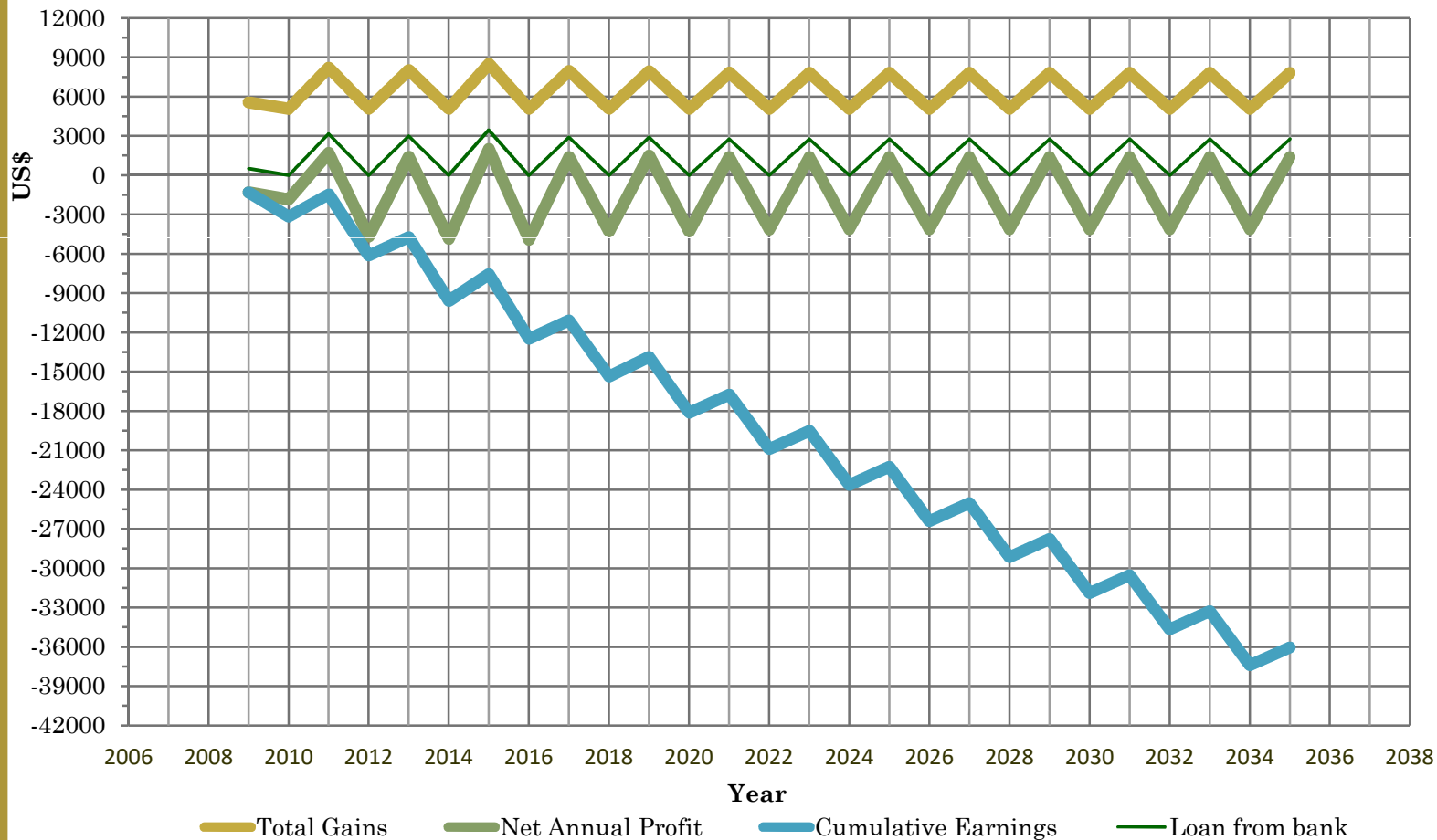
Diesel village battery charging's chart for low interest rate 2.9%/year, no increase in electricity consumption, increase 50% in diesel price



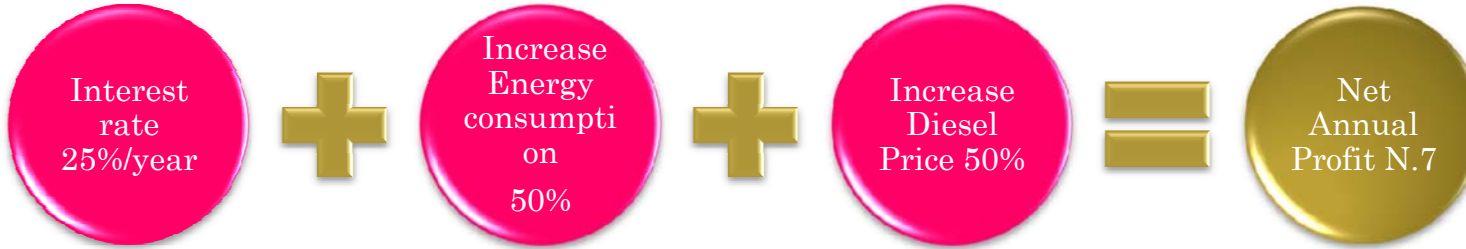
6.



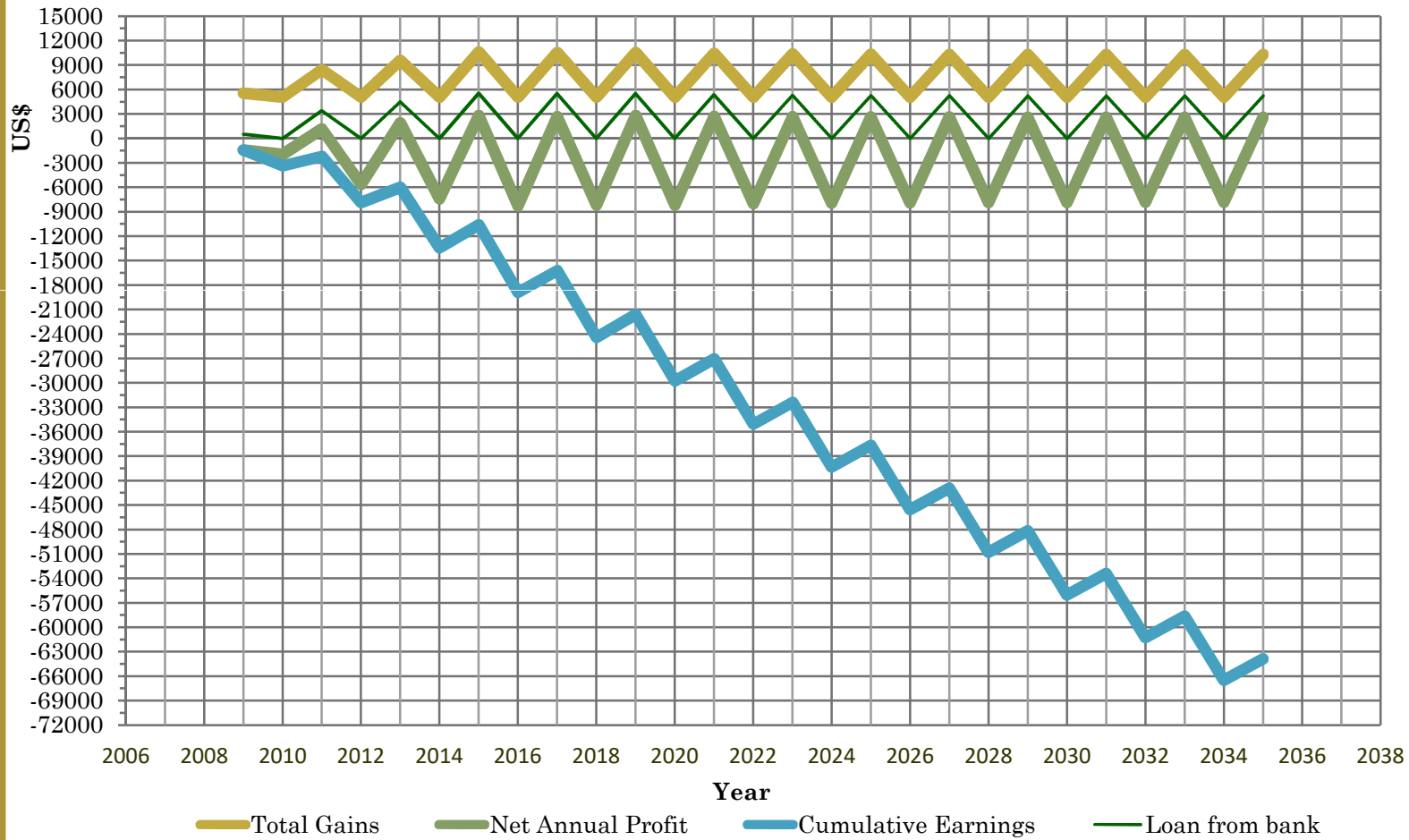
Diesel village battery charging's chart for low interest rate 2.9%/year, increase 50% in electricity consumption, increase 50% in diesel price



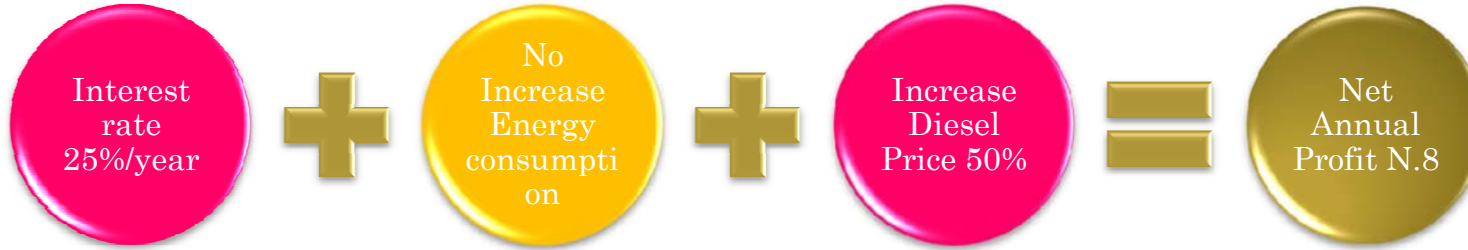
7.



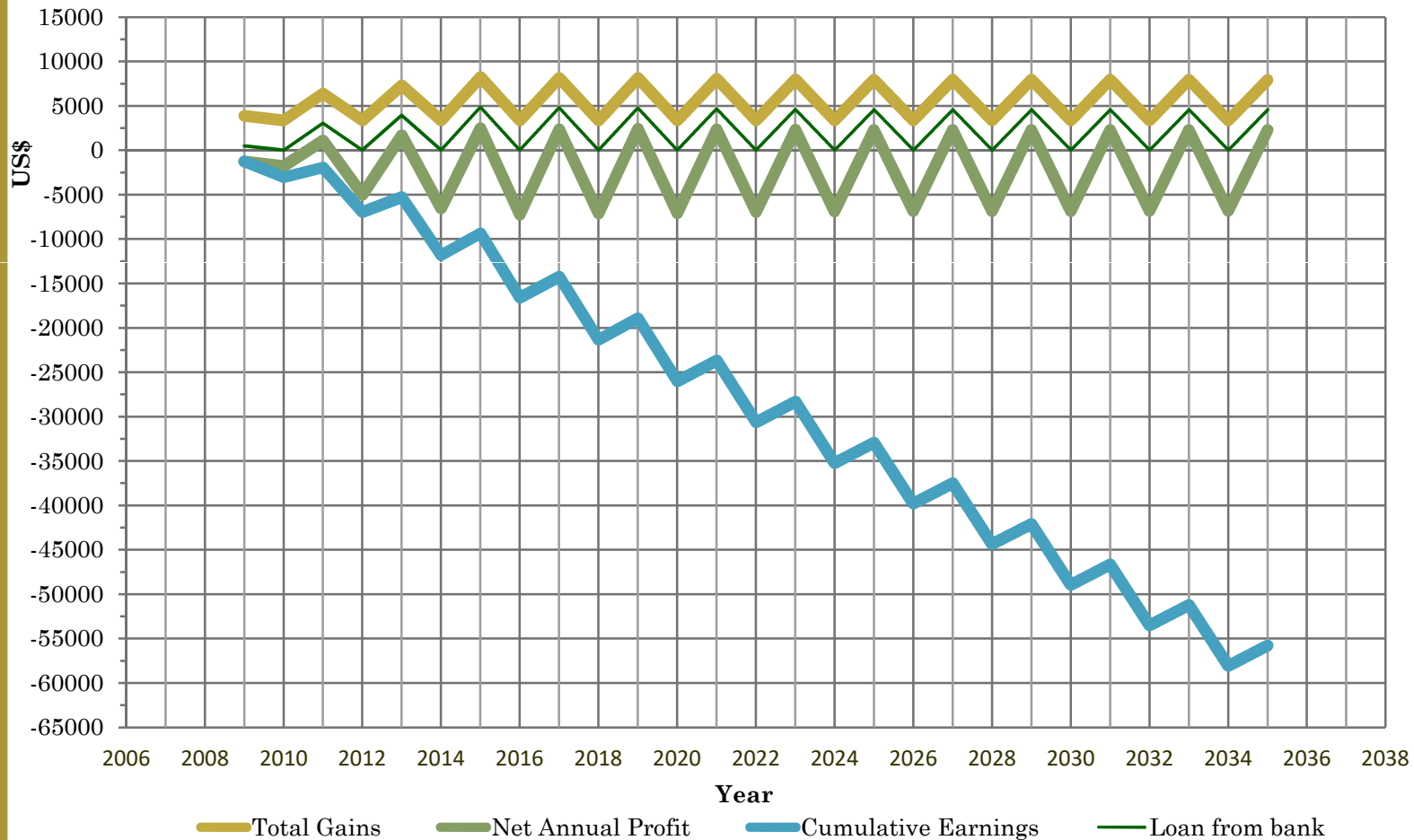
Diesel village battery charging's chart for high interest rate 25%/year, increase 50% in electricity consumption, increase 50% in diesel price



8.



Diesel village battery charging's chart for high interest rate 25%/year, no increase in electricity consumption, increase 50% in diesel price



CONCLUSION

- ❑ **Table. 22: The results of different combinations of changes of diesel village battery charging**
- ❑ The best case of sensitivity analysis which Loan from bank started to remain zero is in year 2010 which is the case of the best Net Annual Profit No.1: Increase 50% in electricity consumption, Low Interest rate 2.9%, no increase in diesel price.
- ❑ The worst case of sensitivity analysis which is the case of the worst Net Annual Profit No.8: No increase in electricity consumption, High Interest rate 25%, Increase 50% in diesel price. For this case, the year of Loan from bank is fluctuated gradually.

CHAPTER 5: CONCLUSION

Table 23: Result of sensitivity analysis of village battery charging with different technologies

		Investment calculation for the Anlong Tamey gasifier in Battambang province												
1	Change interest rate	2.9%												
	Change Consumption	50%	Gasifier 3			Diesel 1			Hydro 1			PV 1		
	Change Diesel cost	0%	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
	Interest of loan (US\$/year)		1392	1392	1366	15	15	2	9	9	0	261	261	205
	Total operation costs (US\$/year)		53552	53552	5526	5351	5351	4839	2189	2189	1880	10997	10997	1941
	Sales revenue(US\$/year)		6000	6000	6000	5063	5063	5063	5063	5063	5063	2970	2970	2970
	Loan form Bank (US\$)		48000	0	47104	500	0	77	300	0	0	9000	0	7054
	Total Gains (US\$)		54000	6000	53104	5563	5063	5139	5363	5063	5063	11970	2970	10024
	Net Annual Profit (US\$)		448	-47552	47578	212	-288	301	3174	2874	3183	973	-8027	8083
	Cumulative Earnings (US\$)		448	-47104	474	212	-77	224	3174	6048	9230	973	-7054	1029
2	Change interest rate	2.9%												
	Change Consumption	50%	Gasifier 4			Diesel 7			Hydro			PV		
	Change Diesel cost	50%	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
	Interest of loan (US\$/year)		1392	1392	1372	15	15	91						
	Total operation costs (US\$/year)		53652	53652	5632	6874	6874	6450						
	Sales revenue(US\$/year)		6000	6000	6000	5063	5063	5063						
	Loan form Bank (US\$)		48000	0	47304	500	0	3123						
	Total Gains (US\$)		54000	6000	53304	5563	5063	8186						
	Net Annual Profit (US\$)		348	-47652	47672	-1312	-1812	1735						
	Cumulative Earnings (US\$)		348	-47304	368	-1312	-3123	-1388						
3	Change interest rate	2.9%												
	Change Consumption	0%	Gasifier 1			Diesel 3			Hydro 3			PV 2		
	Change Diesel cost	0%	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
	Interest of loan (US\$/year)		1392	1392	1301	15	15	22	9	9	0	261	261	249
	Total operation costs (US\$/year)		52432	52432	4341	4005	4005	3513	1829	1829	1520	10685	10685	1673
	Sales revenue(US\$/year)		6000	6000	6000	3375	3375	3375	3375	3375	3375	1890	1890	1890
	Loan form Bank (US\$)		48000	0	44864	500	0	761	300	0	0	9000	0	8590
	Total Gains (US\$)		54000	6000	50864	3875	3375	4136	3675	3375	3375	10890	1890	10480
	Net Annual Profit (US\$)		1568	-46432	46523	-130	-630	623	1846	1546	1855	205	-8795	8807
	Cumulative Earnings (US\$)		1568	-44864	1659	-130	-761	-138	1846	3393	5248	205	-8590	217

Table 23: Result of sensitivity analysis of village battery charging with different technologies

4	Change interest rate	2.9%	Investment calculation for the Anlong Tamey gasifier in Battambang province											
	Change Consumption	0%	Gasifier 2			Diesel 5			Hydro			PV		
	Change Diesel cost	50%	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
	Interest of loan (US\$/year)		1392	1392	1307	15	15	81						
	Total operation costs (US\$/year)		52532	52532	4447	5021	5021	4587						
	Sales revenue(US\$/year)		6000	6000	6000	3375	3375	3375						
	Loan form Bank (US\$)		48000	0	45064	500	0	2792						
	Total Gains (US\$)		54000	6000	51064	3875	3375	6167						
	Net Annual Profit (US\$)		1468	-46532	46617	-1146	-1646	1579						
	Cumulative Earnings (US\$)		1468	-45064	1553	-1146	-2792	-1212						
5	Change interest rate	25.0%	Investment calculation for the Anlong Tamey gasifier in Battambang province											
	Change Consumption	50%	Gasifier 7			Diesel 2			Hydro 2			PV 3		
	Change Diesel cost	0%	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
	Interest of loan (US\$/year)		12000	12000	17080	125	125	74	75	75	0	2250	2250	2758
	Total operation costs (US\$/year)		64160	64160	21240	5461	5461	4911	2255	2255	1880	12986	12986	4494
	Sales revenue(US\$/year)		6000	6000	6000	5063	5063	5063	5063	5063	5063	2970	2970	2970
	Loan form Bank (US\$)		48000	0	68320	500	0	298	300	0	0	9000	0	11032
	Total Gains (US\$)		54000	6000	74320	5563	5063	5360	5363	5063	5063	11970	2970	14002
	Net Annual Profit (US\$)		-10160	-58160	53080	101	-399	449	3108	2808	3183	-1016	-10016	9508
	Cumulative Earnings (US\$)		-10160	-68320	-15240	101	-298	152	3108	5915	9098	-1016	-11032	-1524
6	Change interest rate	25.0%	Investment calculation for the Anlong Tamey gasifier in Battambang province											
	Change Consumption	50%	Gasifier 8			Diesel 8			Hydro			PV		
	Change Diesel cost	50%	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
	Interest of loan (US\$/year)		12000	12000	17130	125	125	836						
	Total operation costs (US\$/year)		64260	64260	21390	6985	6985	7196						
	Sales revenue(US\$/year)		6000	6000	6000	5063	5063	5063						
	Loan form Bank (US\$)		48000	0	68520	500	0	3344						
	Total Gains (US\$)		54000	6000	74520	5563	5063	8407						
	Net Annual Profit (US\$)		-10260	-58260	53130	-1422	-1922	1211						
	Cumulative Earnings (US\$)		-10260	-68520	-15390	-1422	-3344	-2133						

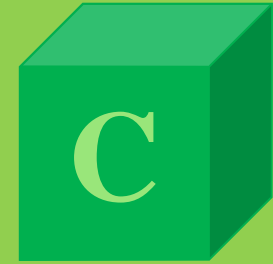
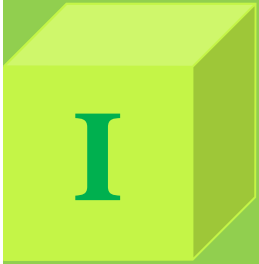
Table 23: Result of sensitivity analysis of village battery charging with different technologies

7	Change interest rate	25.0%	Investment calculation for the Anlong Tamey gasifier in Battambang province											
	Change Cosumption	0%	Gasifier 5			Diesel 4			Hydro 4			PV 4		
	Change Diesel cost	0%	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
	Interest of loan (US\$/year)		12000	12000	16520	125	125	245	75	75	0	2250	2250	3142
	Total operation costs (US\$/year)		63040	63040	19560	4116	4116	3736	1895	1895	1520	12674	12674	4566
	Sales revenue(US\$/year)		6000	6000	6000	3375	3375	3375	3375	3375	3375	1890	1890	1890
	Loan form Bank (US\$)		48000	0	66080	500	0	982	300	0	0	9000	0	12568
	Total Gains (US\$)		54000	6000	72080	3875	3375	4357	3675	3375	3375	10890	1890	14458
	Net Annual Profit (US\$)		-9040	-57040	52520	-241	-741	620	1780	1480	1855	-1784	-10784	9892
	Cumulative Earnings (US\$)		-9040	-66080	-13560	-241	-982	-361	1780	3260	5115	-1784	-12568	-2676
8	Change interest rate	25.0%	Investment calculation for the Anlong Tamey gasifier in Battambang province											
	Change Cosumption	0%	Gasifier 6			Diesel 6			Hydro			PV		
	Change Diesel cost	50%	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
	Interest of loan (US\$/year)		12000	12000	16570	125	125	753						
	Total operation costs (US\$/year)		63140	63140	19710	5131	5131	5260						
	Sales revenue(US\$/year)		6000	6000	6000	3375	3375	3375						
	Loan form Bank (US\$)		48000	0	66280	500	0	3013						
	Total Gains (US\$)		54000	6000	72280	3875	3375	6388						
	Net Annual Profit (US\$)		-9140	-57140	52570	-1256	-1756	1128						
	Cumulative Earnings (US\$)		-9140	-66280	-13710	-1256	-3013	-1885						

CONCLUSION PART II

SWOT analysis to identify strengths, weaknesses, opportunities and threats of bio gasifier

Strength (S)	Weakness (W)	Opportunity (O)	Threat (T)
<ul style="list-style-type: none"> • Community Energy Cooperative as a way of ownership and as functional structure (sense of working for a common cause) • The development of production and refining chain (growing Leuceana tree in the area) • The low price of grid electricity compared to using battery and kerosine lamps • The good quality of light • Environmentally friendly • A motivating way of producing electricity • Continuous controlling of the process possible because of labour force 	<ul style="list-style-type: none"> • High initial investment cost • Productization of gasifiers not yet advanced • Relatively complex system, lack of local know-how • Gasifier unreliable which leads to need for additional energy supply (diesel is expensive) • Technology based on foreign equipment and components, difficult to have spare parts • Need for proactive maintenance (Filters need to be cleaned often) • The shortness of the grid • No electricity for the whole day • Not yet economically profitable • Demand is bigger than supply 	<ul style="list-style-type: none"> • Opportunity to expand market, (mini)grids can be extended • The development of livelihood • Increase in consumption and improvement of the standard of living • More time for studying • Increase in information flow • In the future, the development of technology enables building of hybrids in which gas or diesel can be used in the same generator 	<ul style="list-style-type: none"> • System failure due to mal operation or maintenance • Unreliability of electricity supply • Threats to the production of Leuceana • The extension of national grid will affect the local business and change livelihood • Changing Government policies



The Power of Group Work...
The Power of Renewable Energy...
The Power of Saving Our World!!!

Thank for your kind
attention!!!