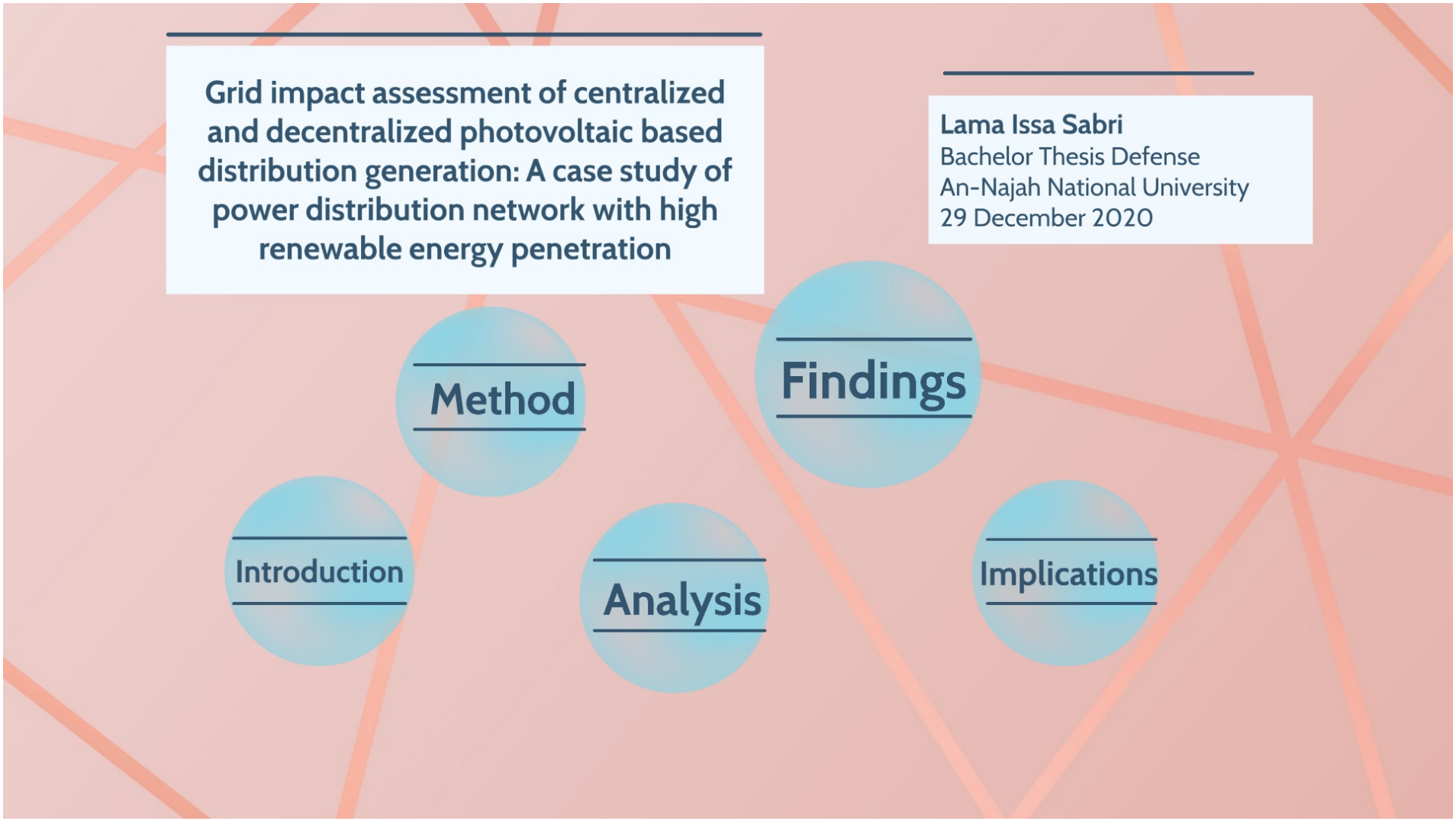
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Lama Issa Sabri
Bachelor Thesis Defense
An-Najah National University
29 December 2020
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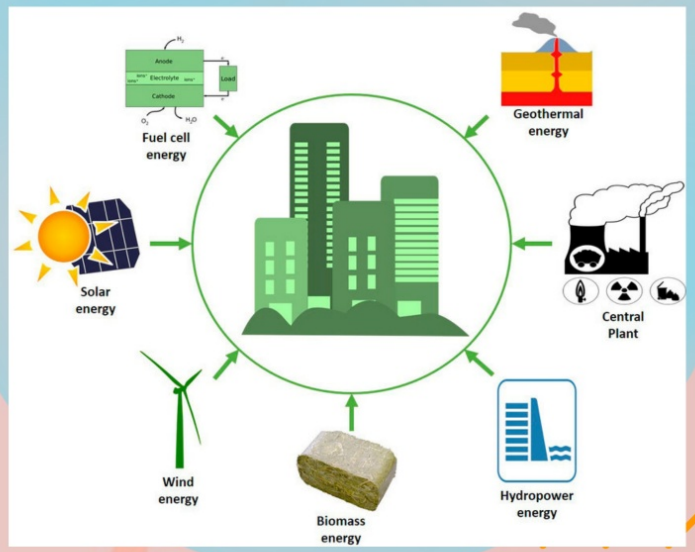
Analysis
Implications

Introduction



Definitions

Research Problem

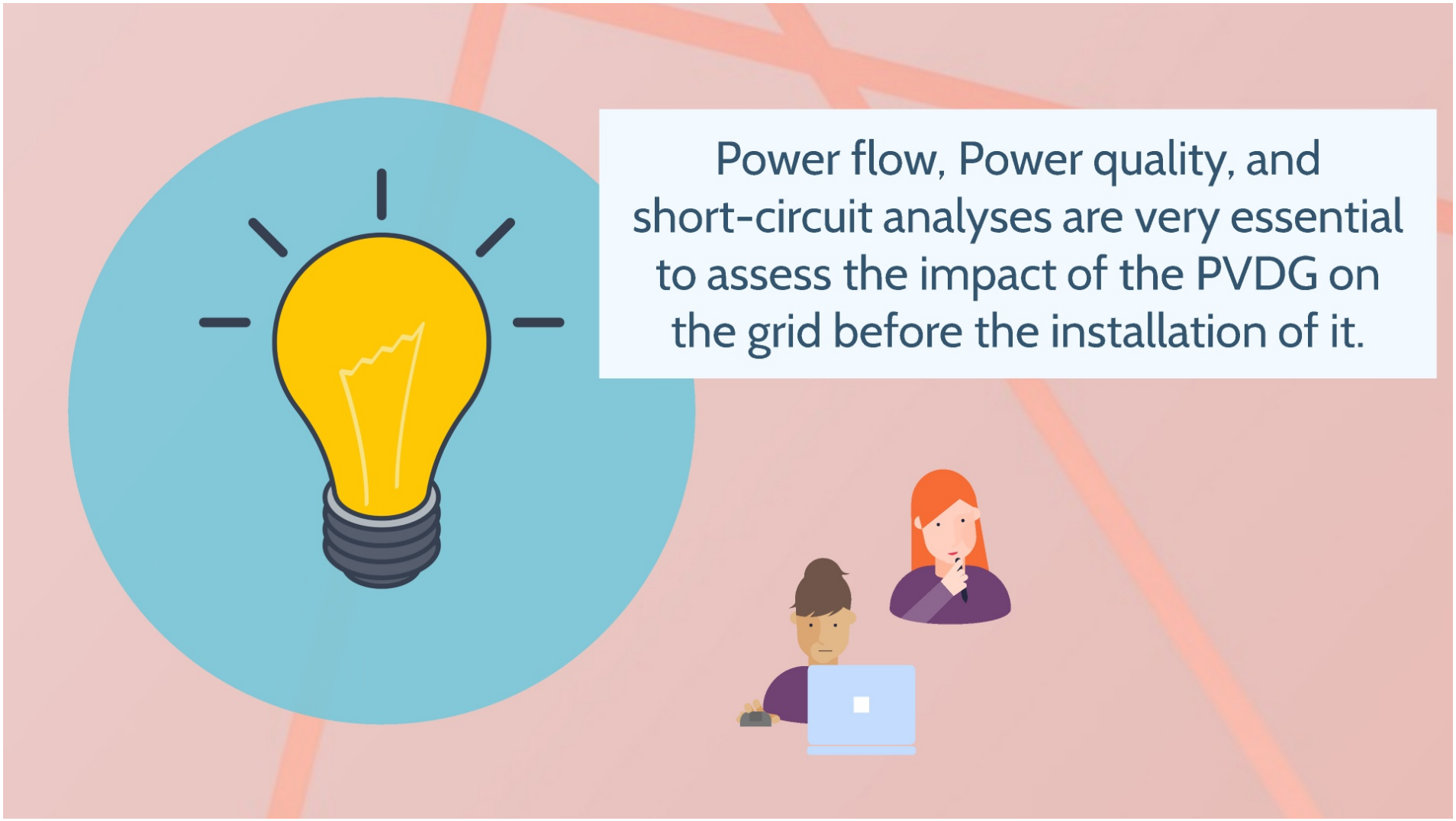
Research Questions

Photovoltaic based Distributed Generation (PVDG)

Reliable	Reduces peak load	Reduces grid losses

With high penetration levels, the impact of PVDG would be negative!!

Power flow, Power quality, and short-circuit analyses are very essential to assess the impact of the PVDG on the grid before the installation of it.


Power flow, Power quality, and short-circuit analyses are very essential to assess the impact of the PVDG on the grid before the installation of it.

Power flow, Power quality, and short-circuit analyses are very essential to assess the impact of the PVDG on the grid before the installation of it.


Research
Problem

Research Question:

What are the impacts of installing the 5 MW as centralized system?

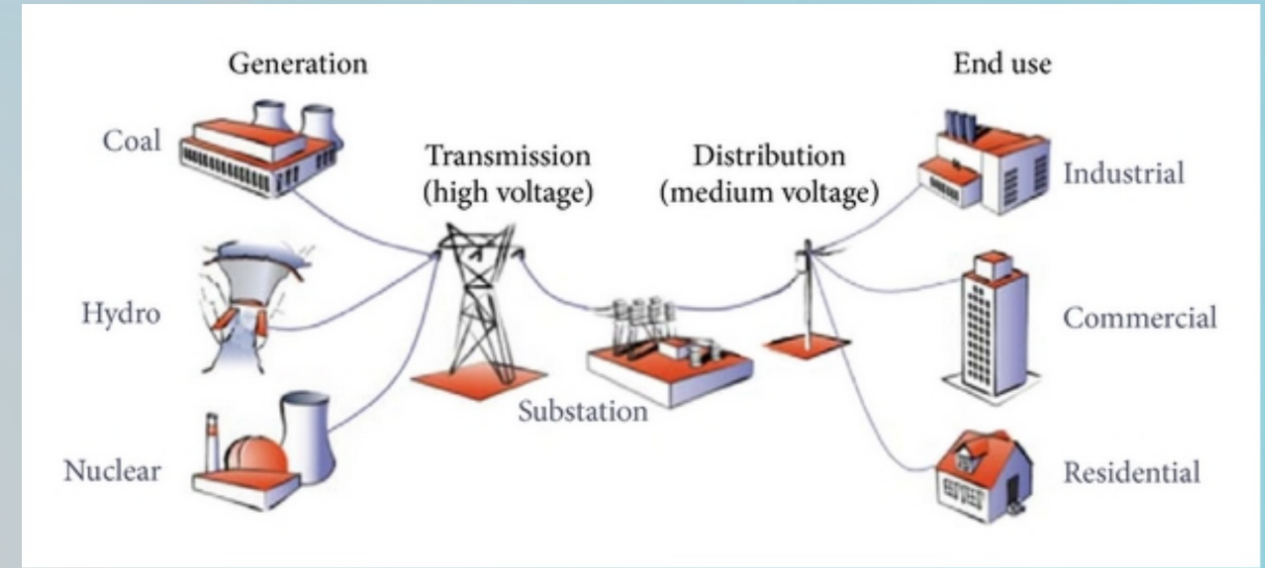
Sub-Q 1

Sub-Q 2

Sub-Q 3

Sub-question 1

How does the grid perform ?



Sub-question 2

How does the decentralized system will affect the grid performance?

Sub-question 2

How does the decentralized system will affect the grid performance?

Sub-question 2

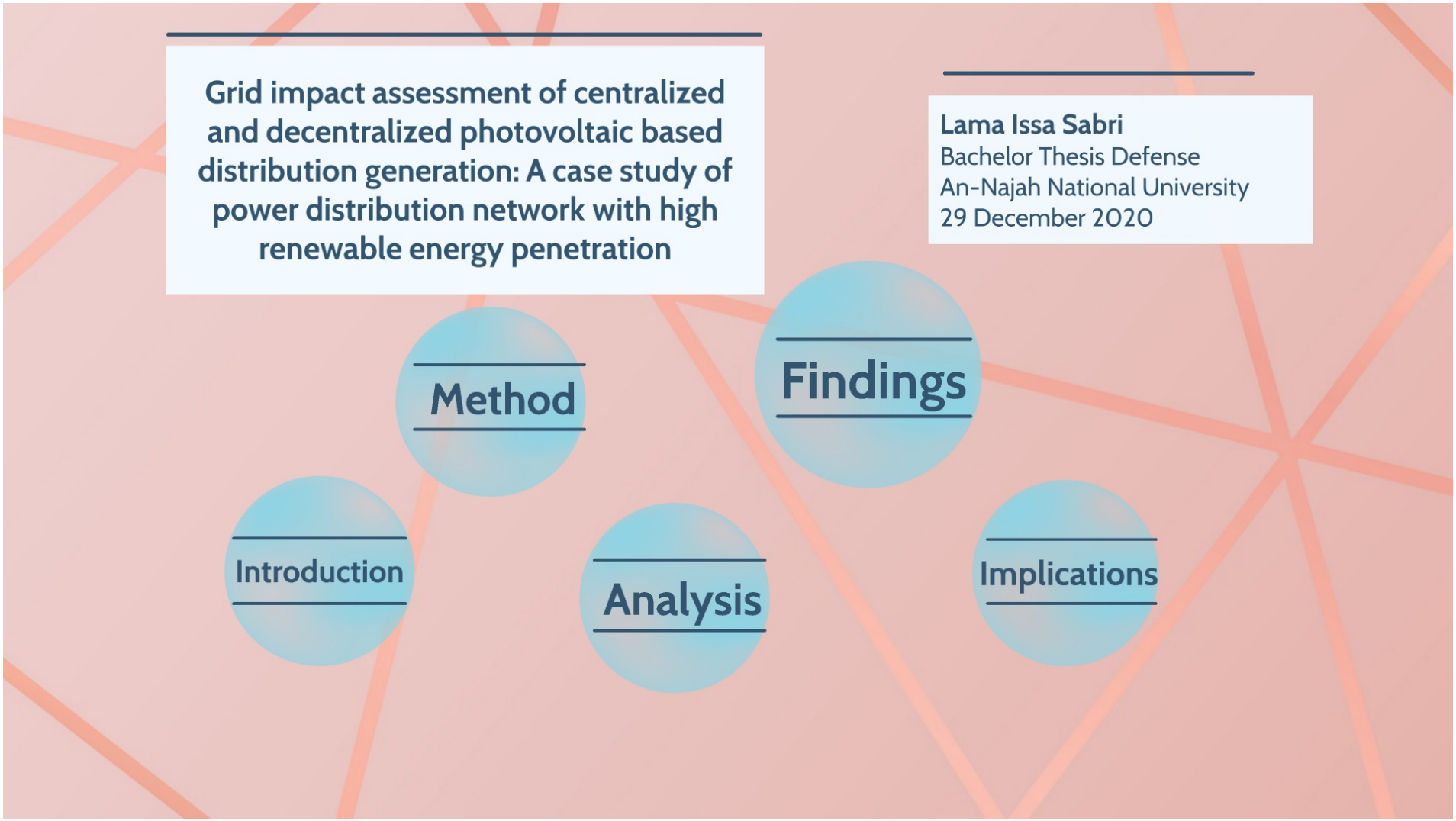
How does the decentralized system will affect the grid performance?

Sub-question 2

How does the decentralized system will affect the grid performance?

Sub-question 3

Which system is more viable ?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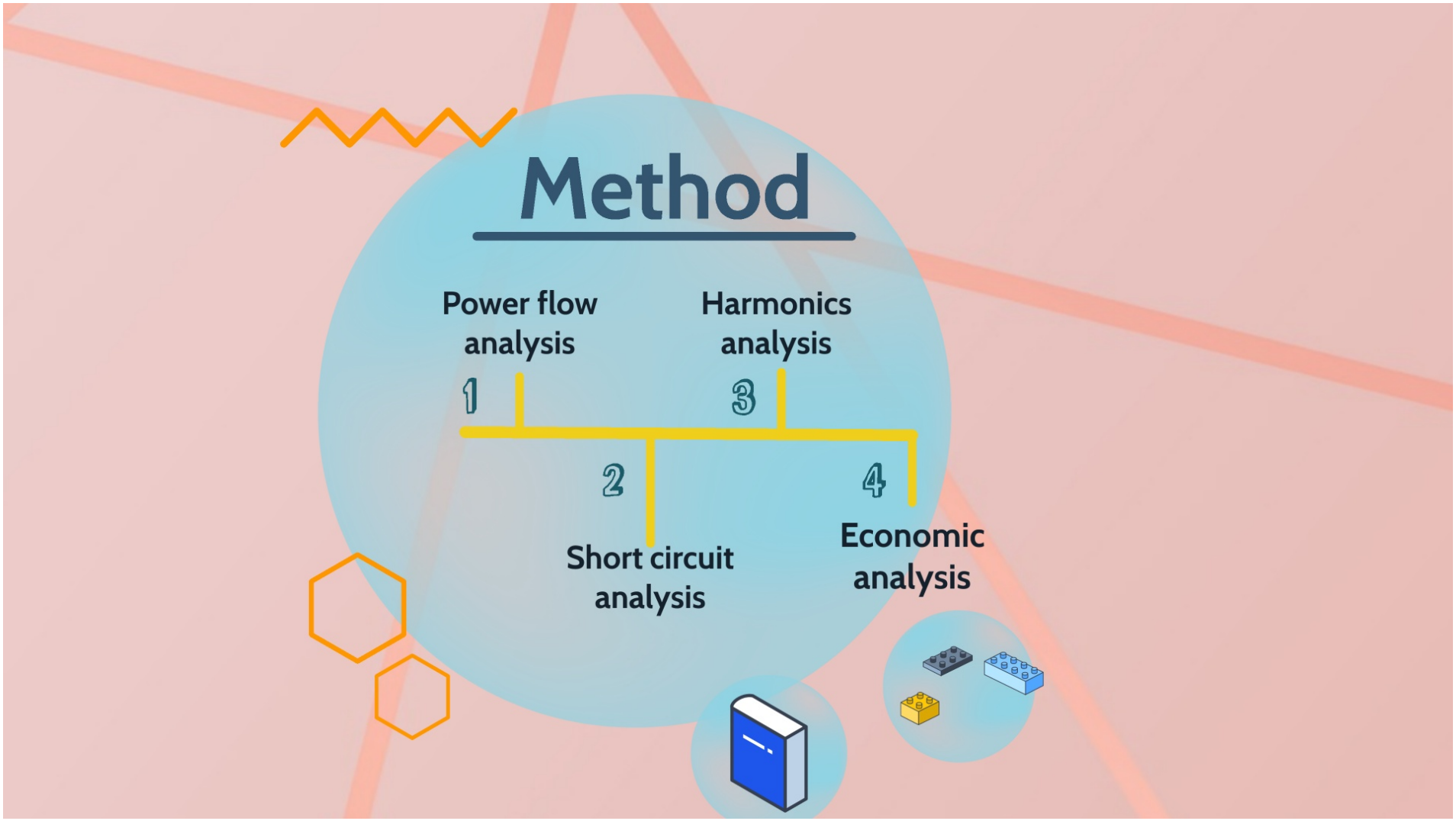
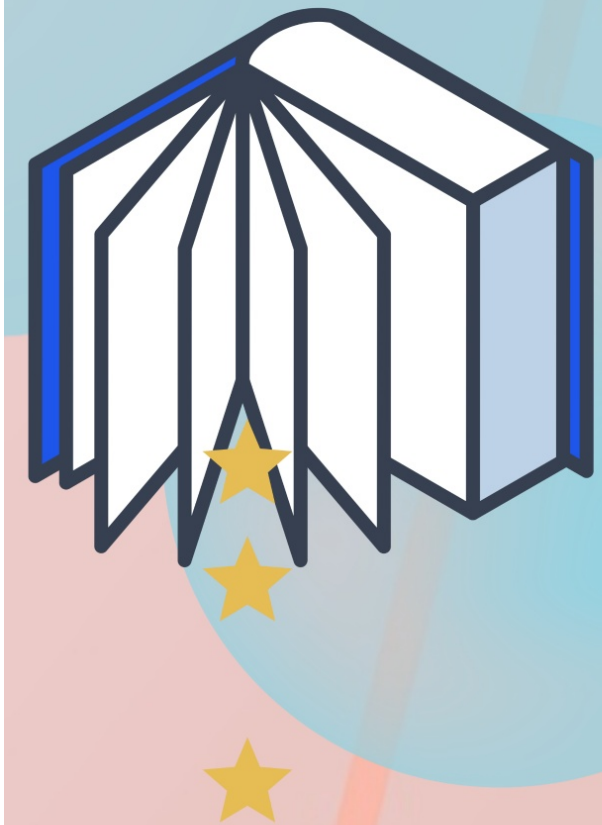
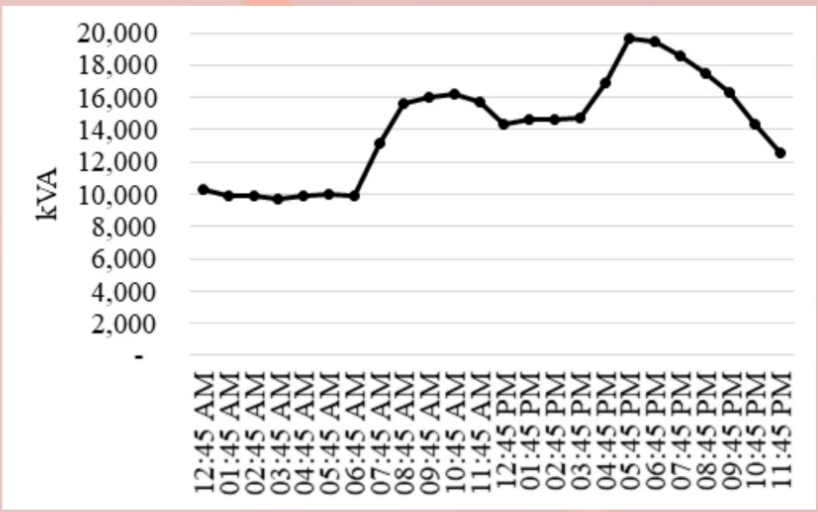

Method
Power flow analysis
1
Harmonics analysis
3
2
Short circuit analysis
4
Economic analysis



- Data collection was conducted including one-line diagram of Tubas LV and MV power network



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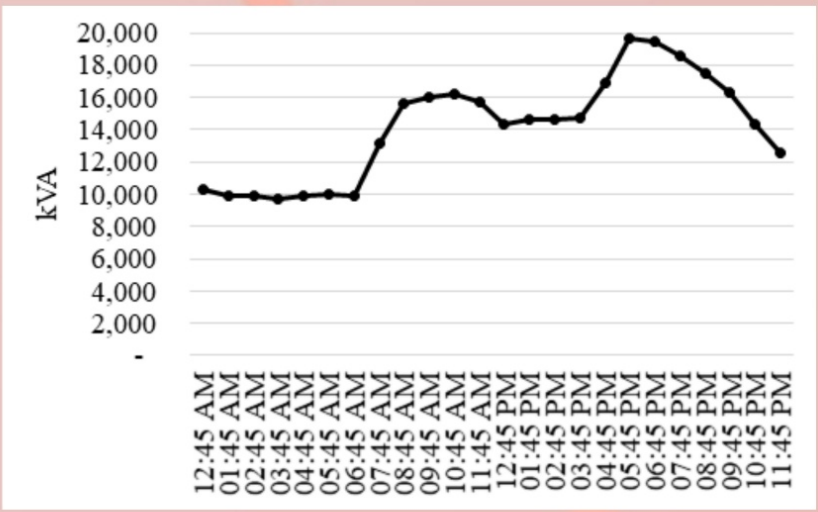
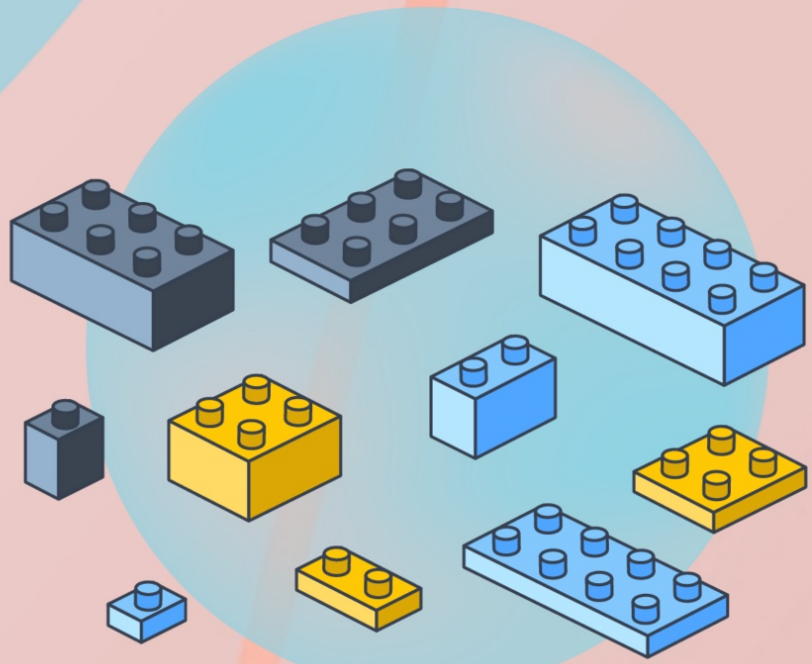
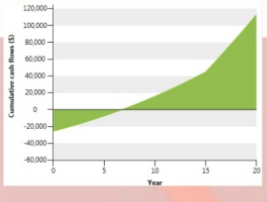


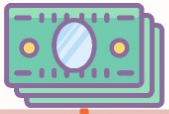


Economic analysis

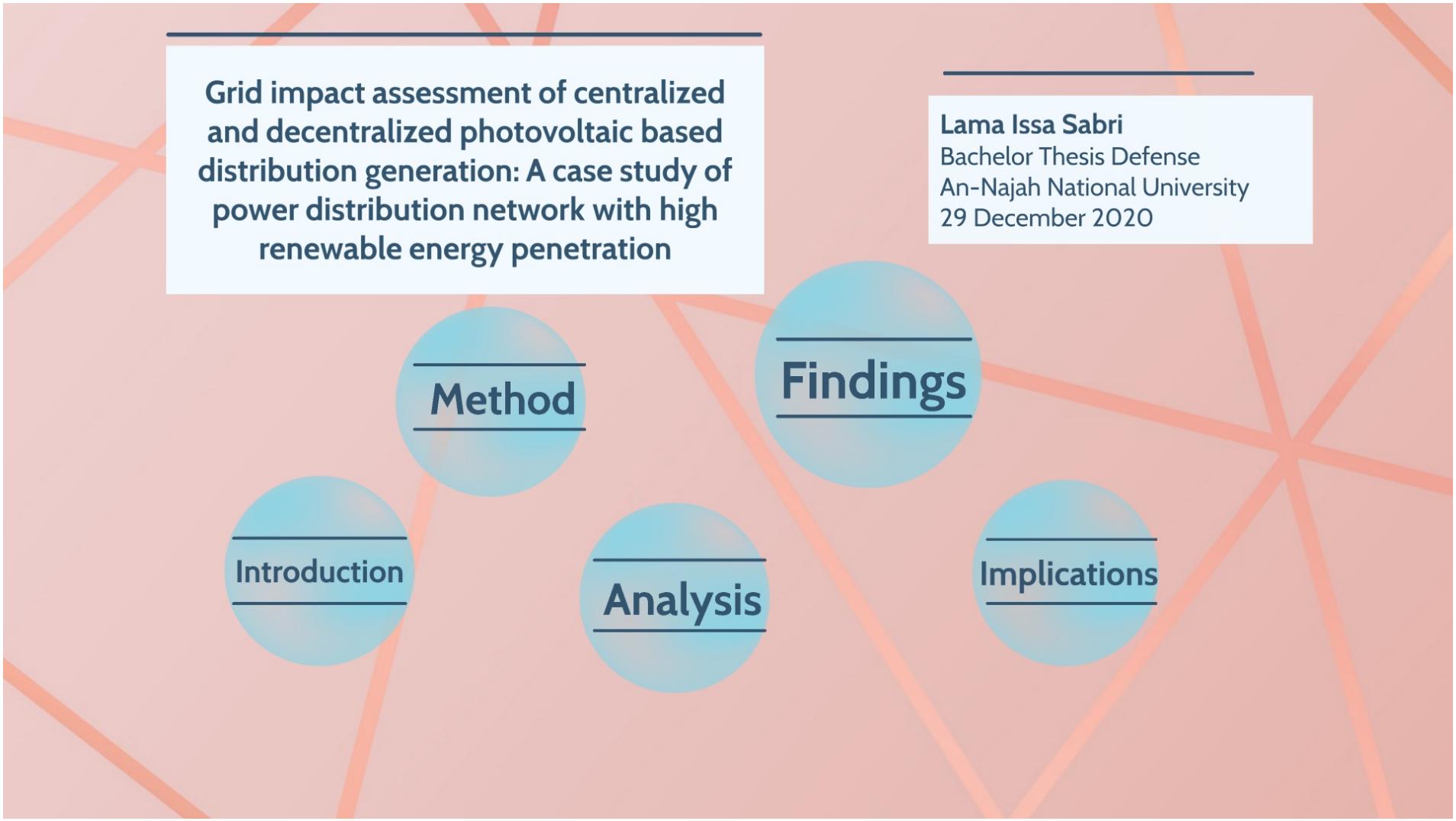
Simple payback period



Net present value



Internal Rate of Return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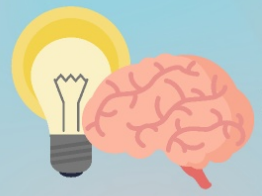
Analysis

1. The adapted case study
2. Centralized system
3. Decentralized system

The adapted case study



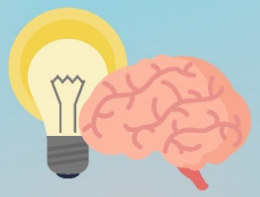
Penetration level

Currently is 21.74%

Evaluation

Proposed system

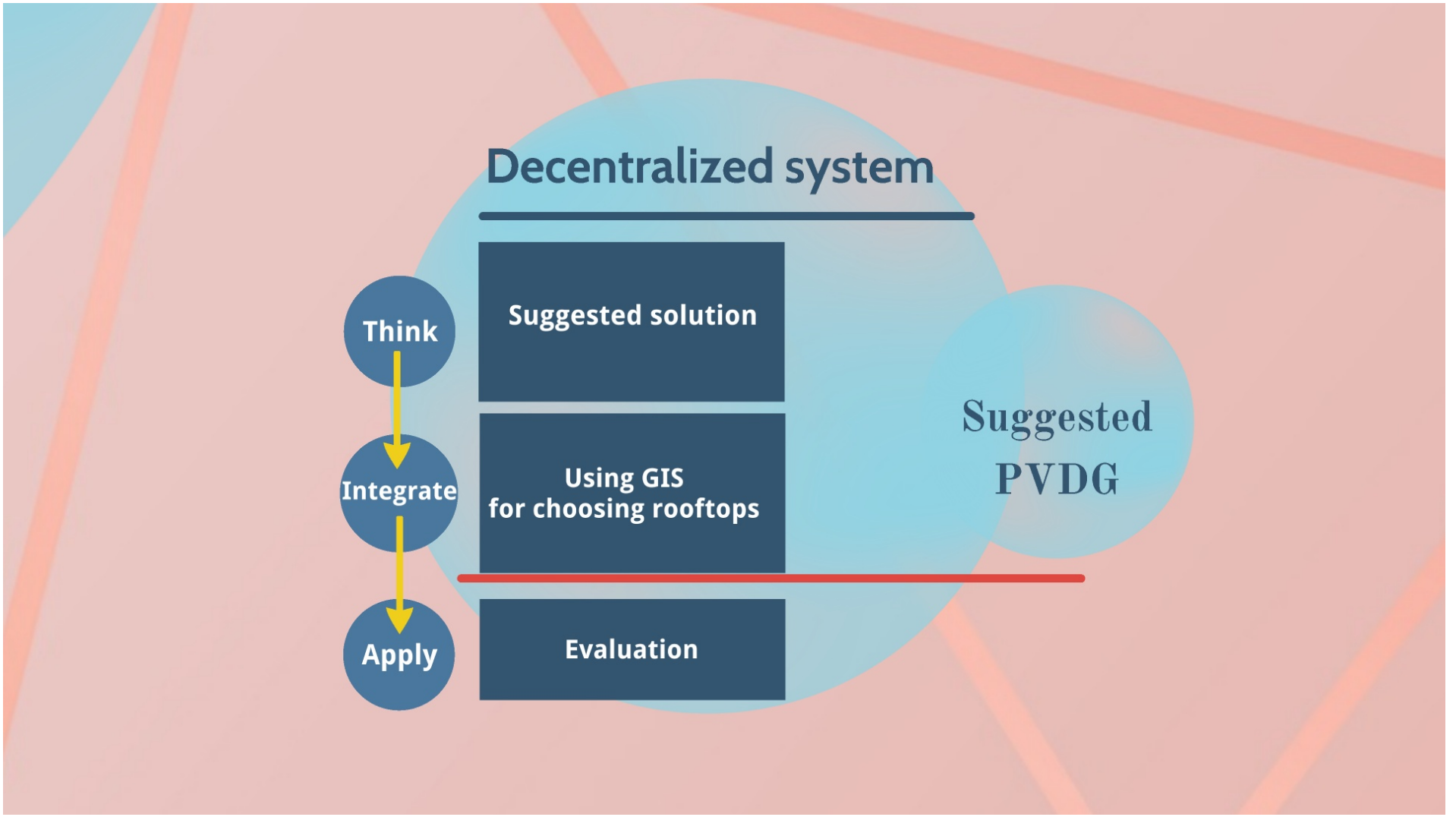
Centralized system

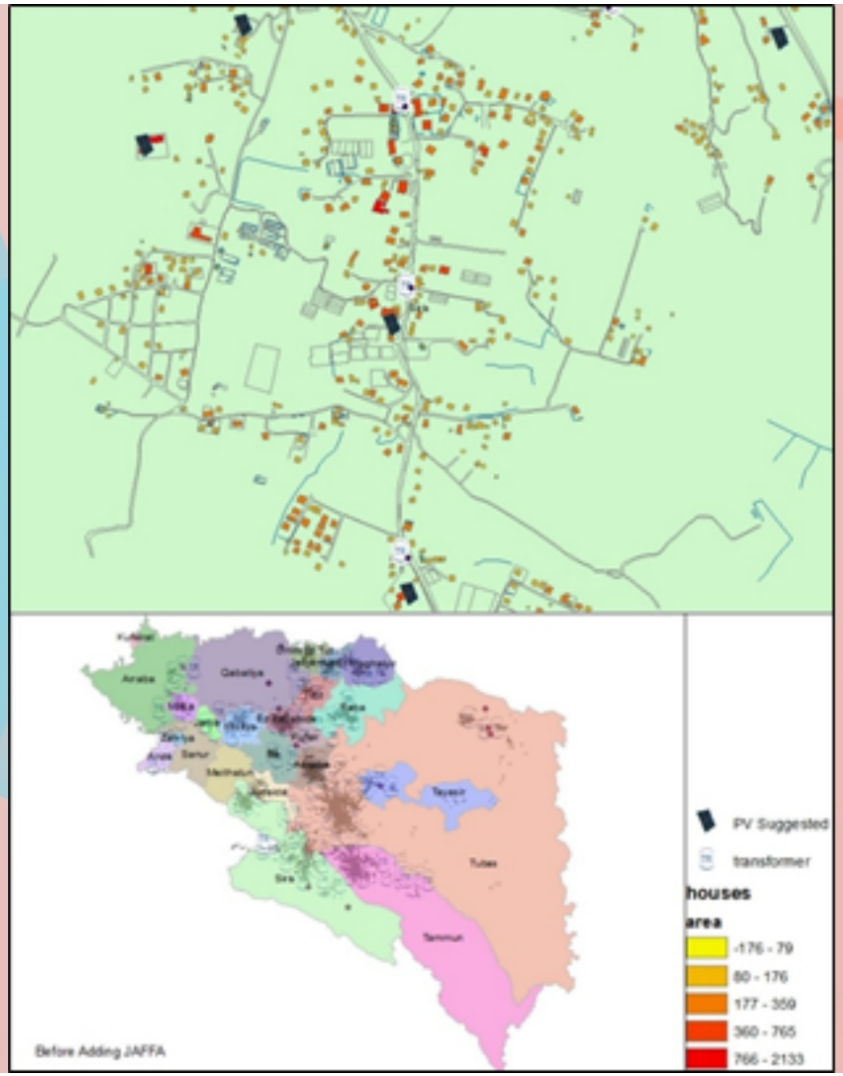


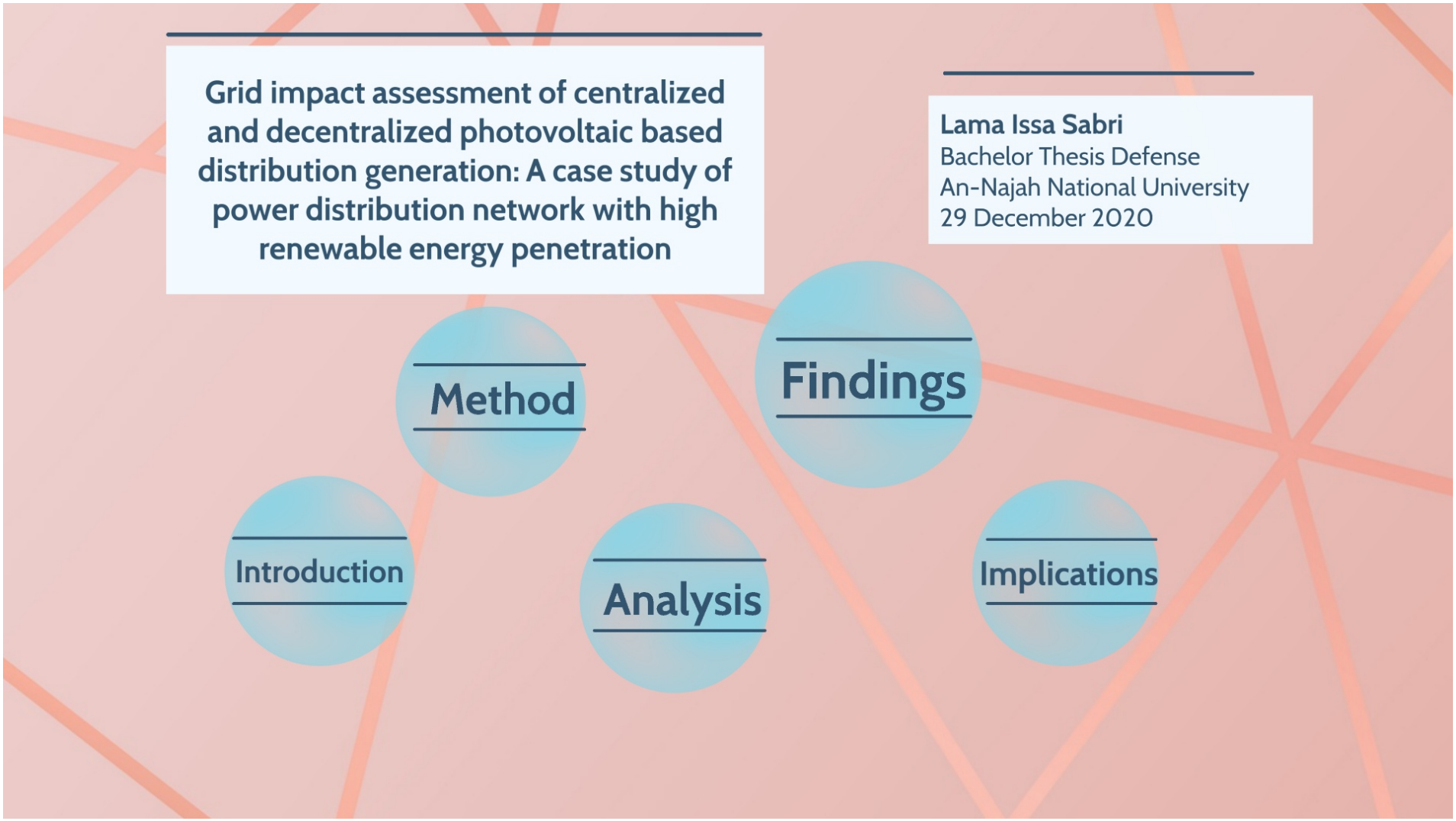
Penetration level

If 5 MW centralized system installed it will be 43.47%

Evaluation


Decentralized system
Think
Integrate
Apply
Suggested solution
Using GIS
for choosing rooftops
Evaluation
Suggested
PVDG


PV Suggested
transformer
houses
area
-176 - 79
80 - 176
177 - 359
360 - 765
766 - 2133
Before Adding JAFFA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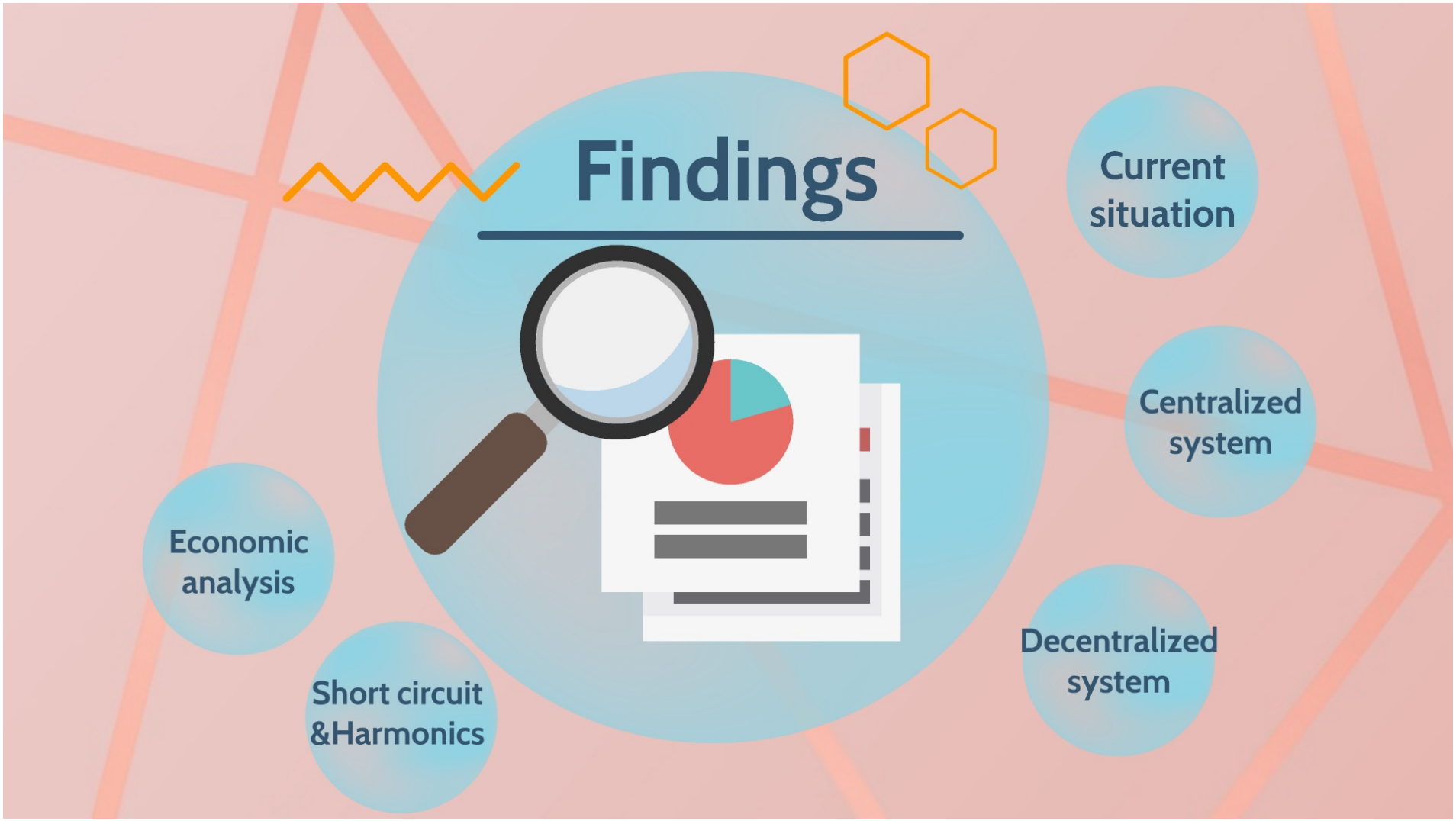
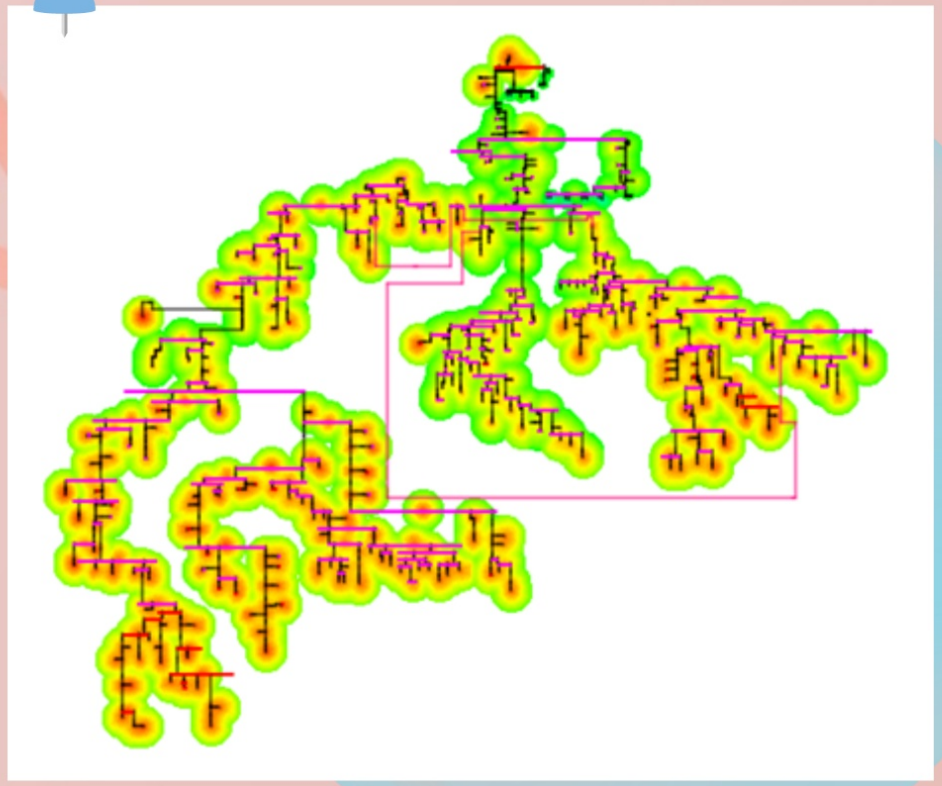
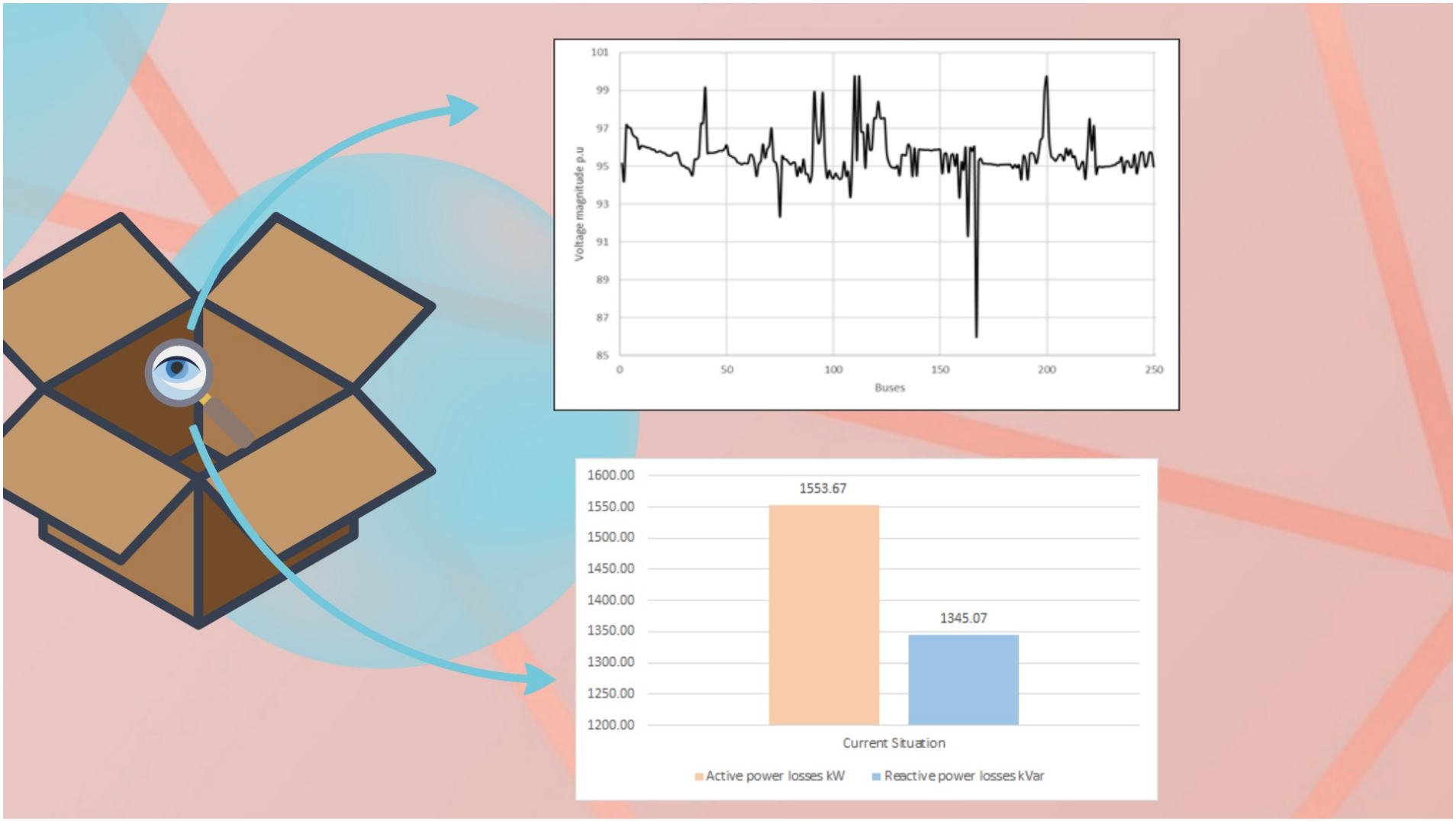
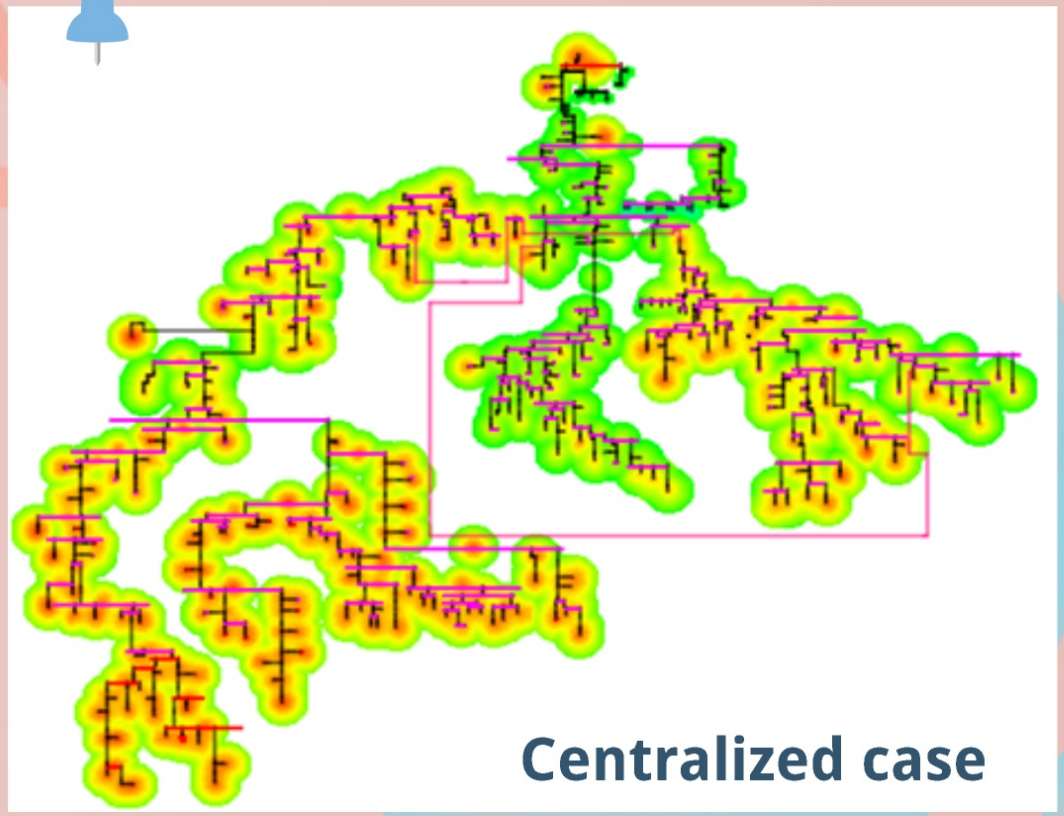
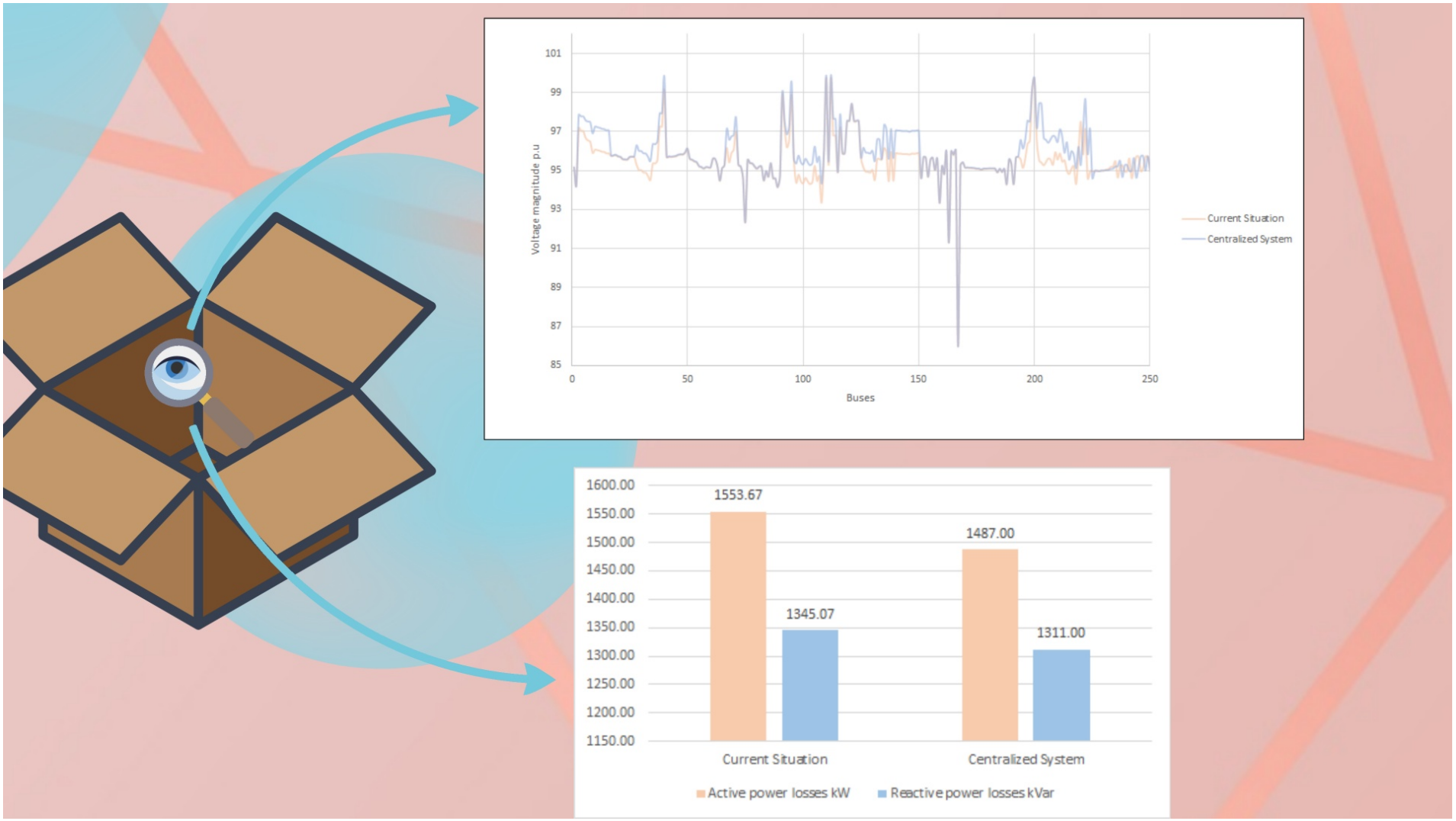
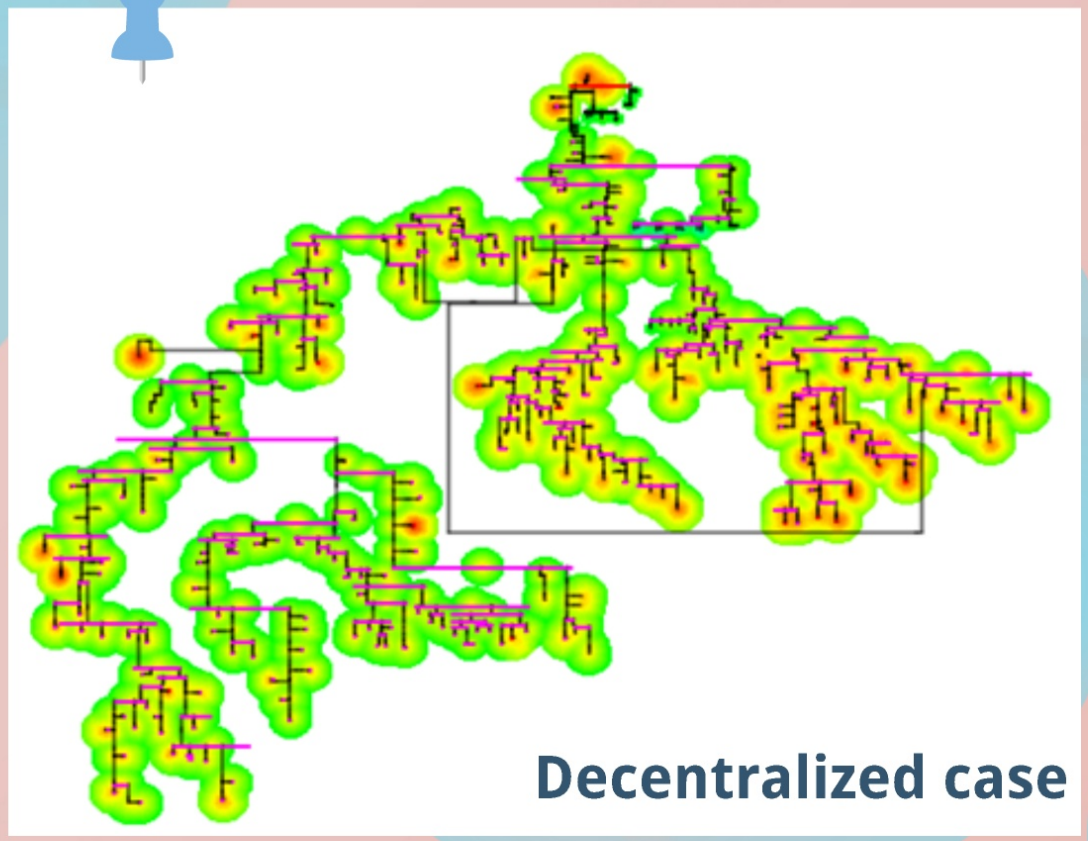

Findings
Current situation
Centralized system
Decentralized system
Short circuit &Harmonics
Economic analysis

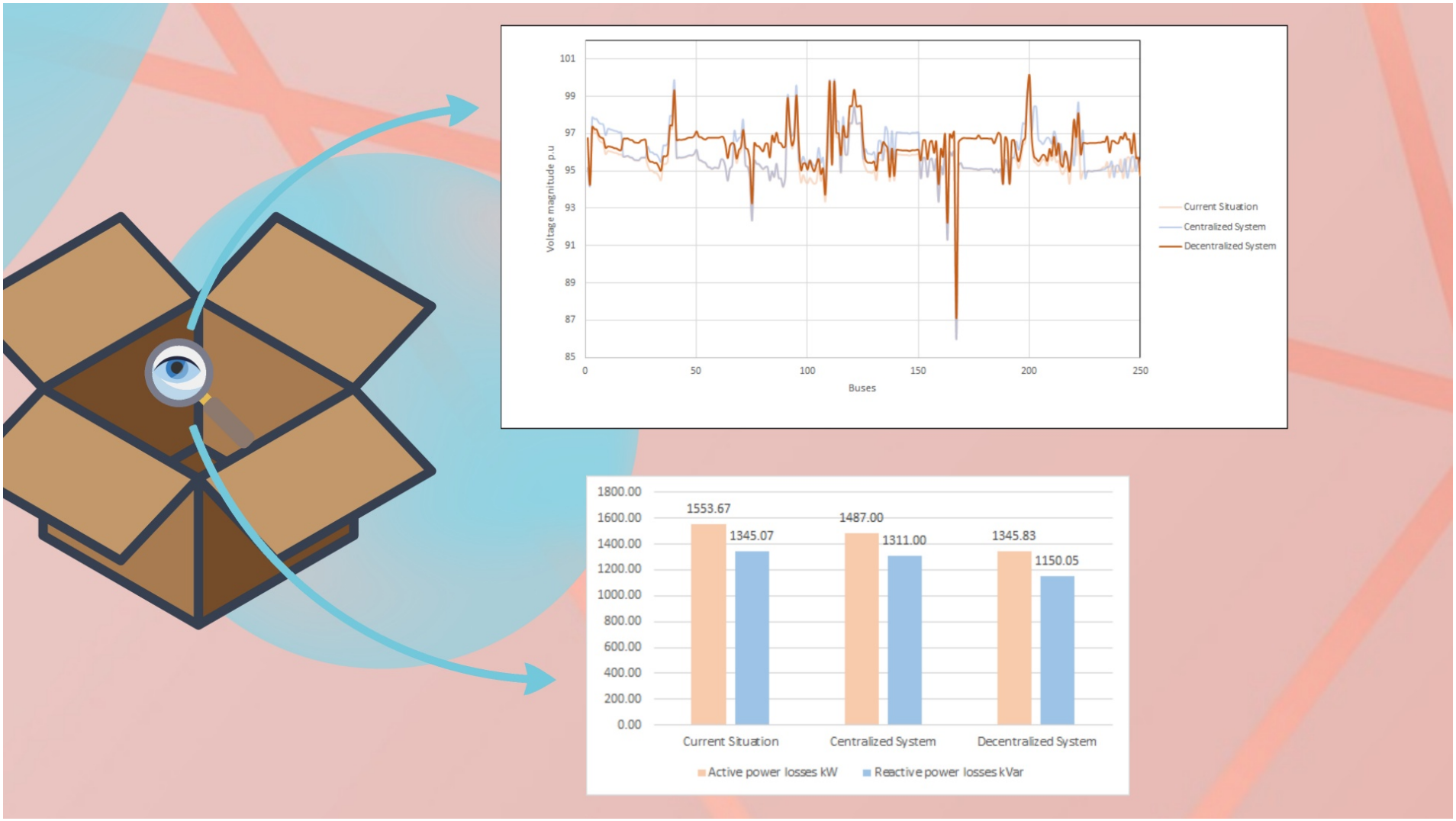



101
99
97
95
93
91
89
87
85
Voltage magnitude p.u
0
50
100
150
200
250
Buses
1600.00
1550.00
1500.00
1450.00
1400.00
1350.00
1300.00
1250.00
1200.00
1553.67
1345.07
Current Situation
Active power losses kW
Reactive power losses kVar


Centralized case


101
99
97
95
93
91
89
87
85
Voltage magnitude p.u
0
50
100
150
200
250
Buses
Current Situation
Centralized System
1600.00
1550.00
1500.00
1450.00
1400.00
1350.00
1300.00
1250.00
1200.00
1150.00
1553.67
1345.07
1487.00
1311.00
Current Situation
Centralized System
Active power losses kW
Reactive power losses kVar


Decentralized case

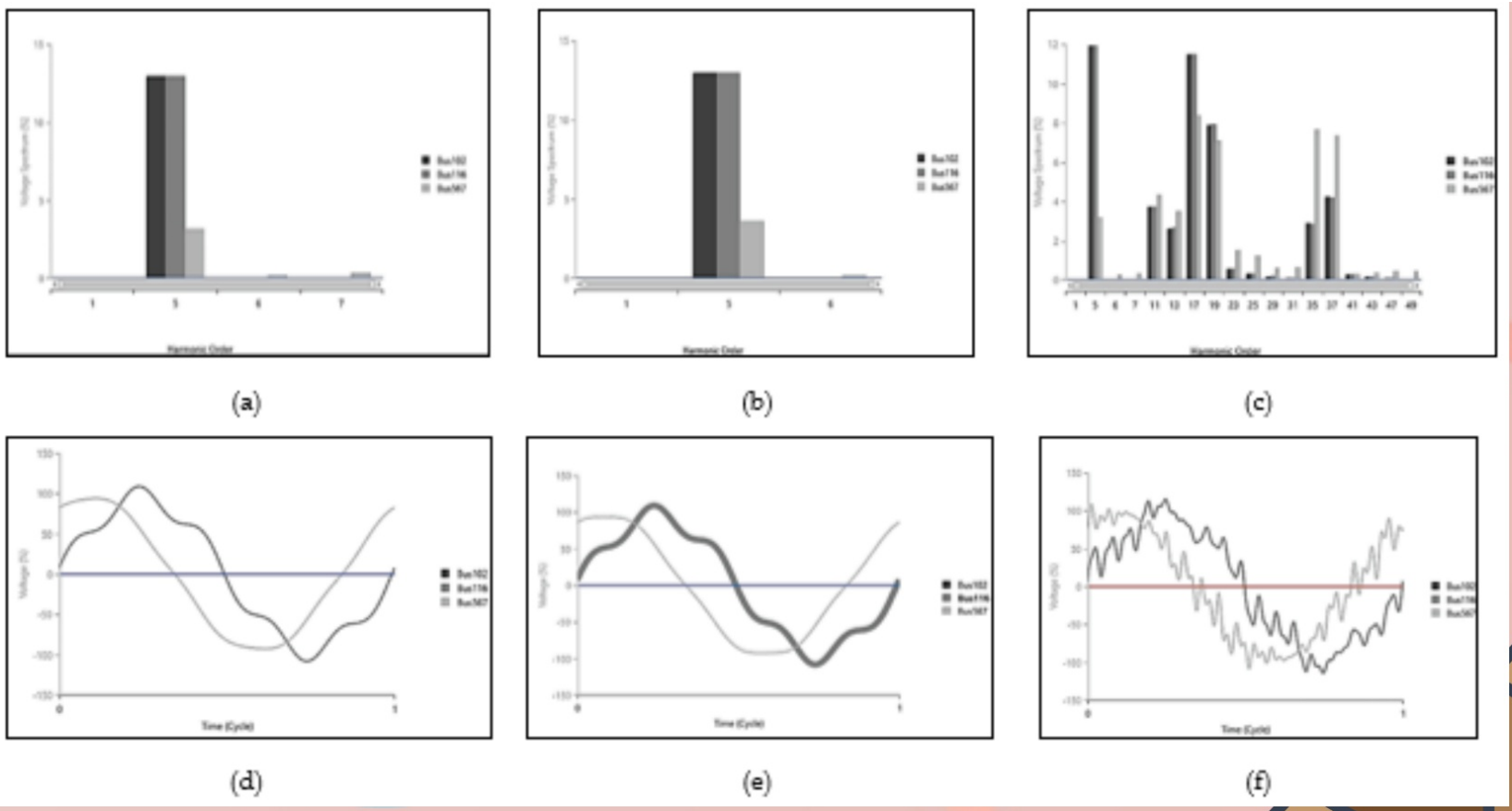

101
99
97
95
93
91
89
87
85
Voltage magnitude p.u
0
50
100
150
200
250
Buses
Current Situation
Centralized System
Decentralized System
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
1553.67
1345.07
1487.00
1311.00
1345.83
1150.05
Current Situation
Centralized System
Decentralized System
Active power losses kW
Reactive power losses kVar

Short circuit&Harmonics

Highest short circuit current in the three cases

	Highest short circuit current (kA)	% Increase in short circuit current
Current situation	64.85	-
Centralized Case	67.51	4.11
Decentralized Case	68.93	6.30

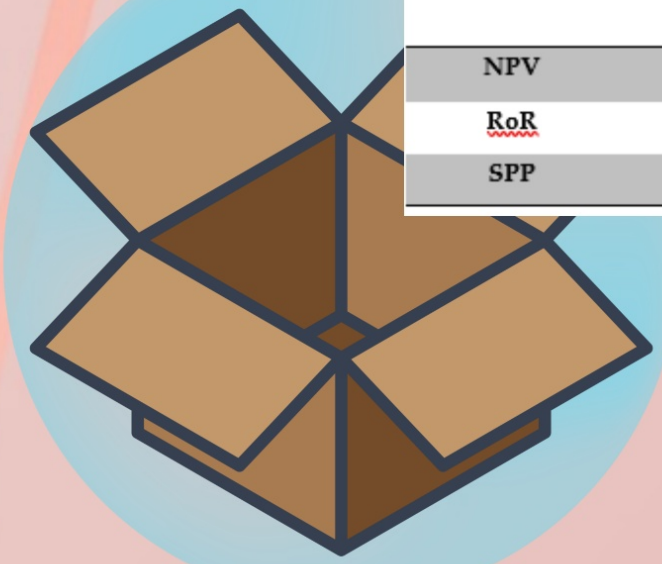
Harmonics



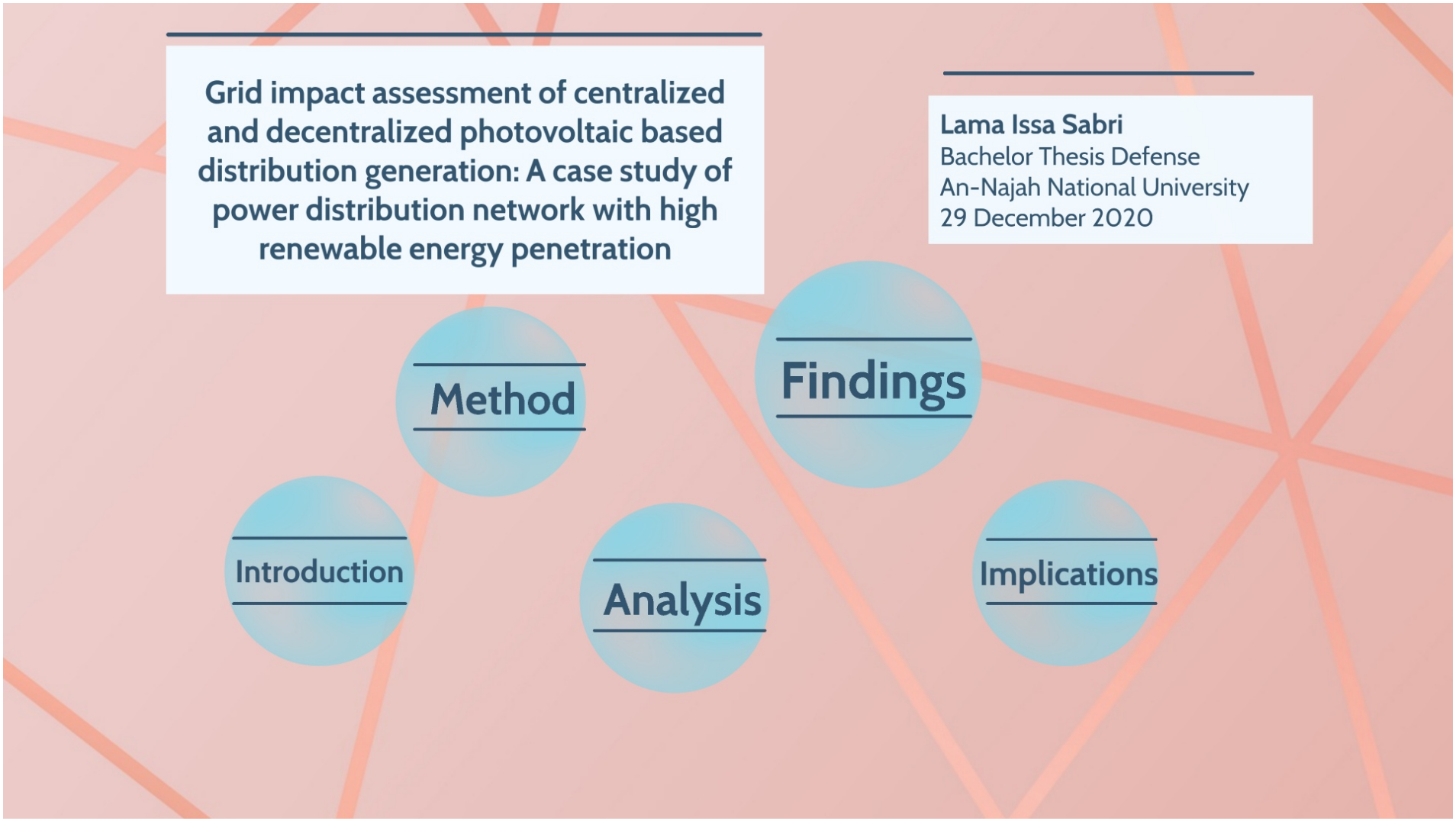
Spectrum view of harmonics order and harmonic waveform at different buses. (a), (d) harmonic spectrum and waveform for the current situation. (b), (e) for the centralized case. (c), (f) for the decentralized case.

Economic analysis

EOY	O&M+Engineers	Savings	Net Savings	Depreciation	Total	Taxable Income	Tax	ATCF	ATCF with inflation	Balance
0					($4,837,710)			($4,837,710)	($4,837,710)	($4,837,710)
1	($137,000)	$875,000.00	$738,000	($241,886)		$496,114	$49,611	$787,611	$764,671	($4,073,039)
2	($137,000)	$868,000.00	$731,000	($241,886)		$489,114	$48,911	$779,911	$735,141	($3,337,898)
3	($137,000)	$861,056.00	$724,056	($241,886)		$482,170	$48,217	$772,273	$706,739	($2,631,158)
4	($137,000)	$854,167.55	$717,168	($241,886)		$475,282	$47,528	$764,696	$679,422	($1,951,736)
5	($137,000)	$847,334.21	$710,334	($241,886)		$468,449	$46,845	$757,179	$653,149	($1,298,587)
6	($137,000)	$840,555.54	$703,556	($241,886)		$461,670	$46,167	$749,723	$627,881	($670,706)
7	($137,000)	$833,831.09	$696,831	($241,886)		$454,946	$45,495	$742,326	$603,579	($67,127)
8	($137,000)	$827,160.44	$690,160	($241,886)		$448,275	$44,827	$734,988	$580,206	$513,079
9	($137,000)	$820,543.16	$683,543	($241,886)		$441,658	$44,166	$727,709	$557,728	$1,070,807
10	($137,000)	$813,978.82	$676,979	($241,886)		$435,093	$43,509	$720,488	$536,111	$1,606,918
11	($137,000)	$807,466.99	$670,467	($241,886)		$428,581	$42,858	$713,325	$515,321	$2,122,239
12	($137,000)	$801,007.25	$664,007	($241,886)		$422,122	$42,212	$706,219	$495,328	$2,617,567
13	($137,000)	$794,599.19	$657,599	($241,886)		$415,714	$41,571	$699,171	$476,101	$3,093,669
14	($137,000)	$788,242.40	$651,242	($241,886)		$409,357	$40,936	$692,178	$457,611	$3,551,280
15	($137,000)	$781,936.46	$644,936	($241,886)		$403,051	$40,305	$685,242	$439,830	$3,991,110
16	($137,000)	$775,680.97	$638,681	($241,886)		$396,795	$39,680	$678,361	$422,732	$4,413,842
17	($137,000)	$769,475.52	$632,476	($241,886)		$390,590	$39,059	$671,535	$406,289	$4,820,132
18	($137,000)	$763,319.72	$626,320	($241,886)		$384,434	$38,443	$664,763	$390,478	$5,210,610
19	($137,000)	$757,213.16	$620,213	($241,886)		$378,328	$37,833	$658,046	$375,274	$5,585,884
20	($137,000)	$751,155.45	$614,155	($241,886)		$372,270	$37,227	$651,382	$360,655	$5,946,539



	Decentralized	Centralized
NPV	-$768,212.88	-$246,021.02
RoR	7%	11%
SPP	9.434	7.116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Recommendations

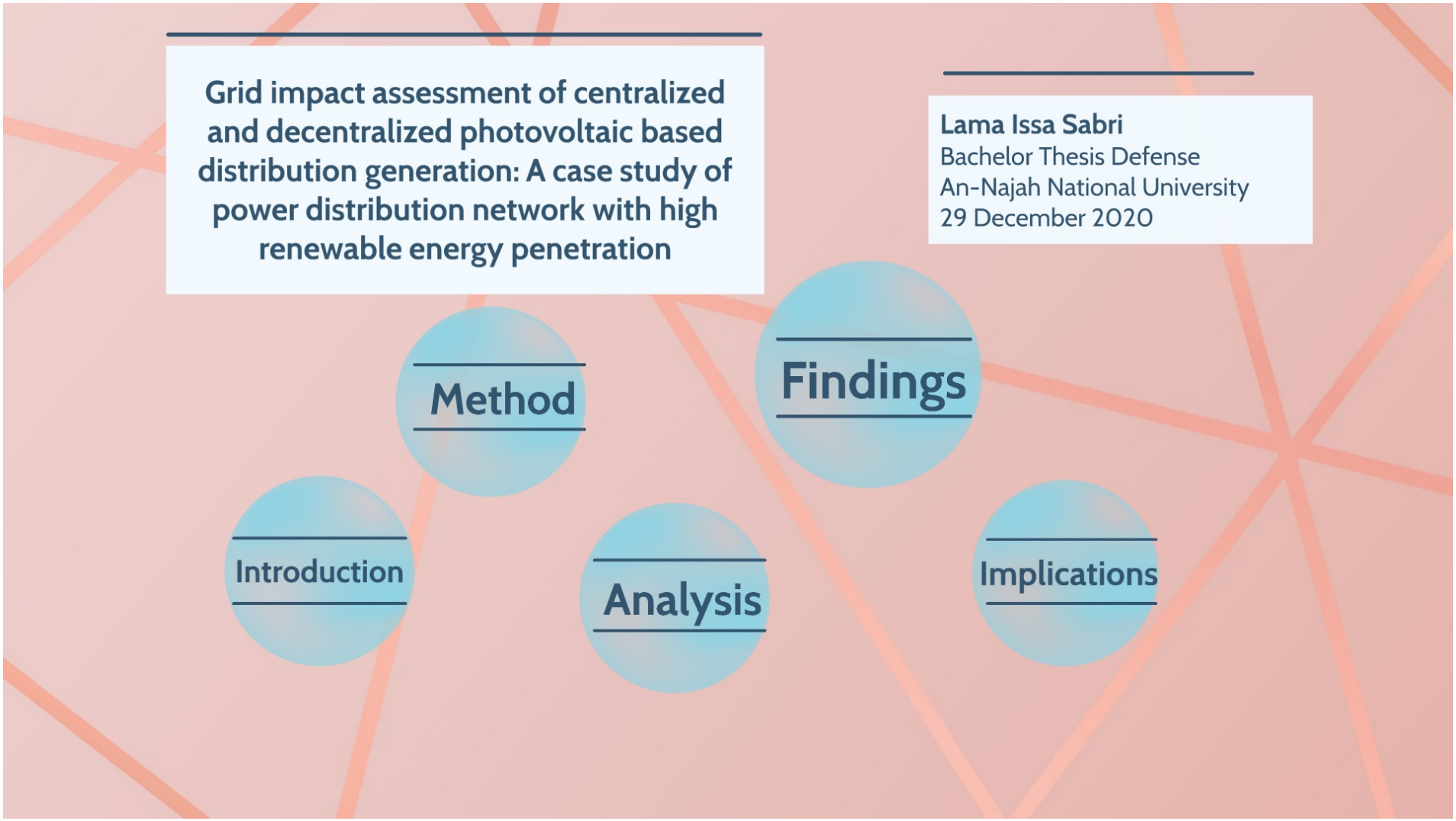
Conclusion & Recommendations

- **Grid impact assessment of PVDG** is proposed for medium voltage distribution network

-> **Comparison** based on grid assessment results between **centralized** and **decentralized** photovoltaic based distributed generation

= Enhance the network & the techno-economic of the installation of new PVDG


THANK YOU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