EVNSPC

SOUTHERN POWER CORPORATION

EXPERIENCES OF UTILIZING AMORPHOUS TRANSFORMERS
&
TO JOIN THE JCM PROJECT WHICH IS FUNDED BY THE JAPANESE GOVERNMENT TO INTRODUCE AMORPHOUS TRANSFORMERS

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A. ABOUT SOUTHERN POWER CORPORATION EVN*SPC*

SOUTHERN POWER CORPORATION

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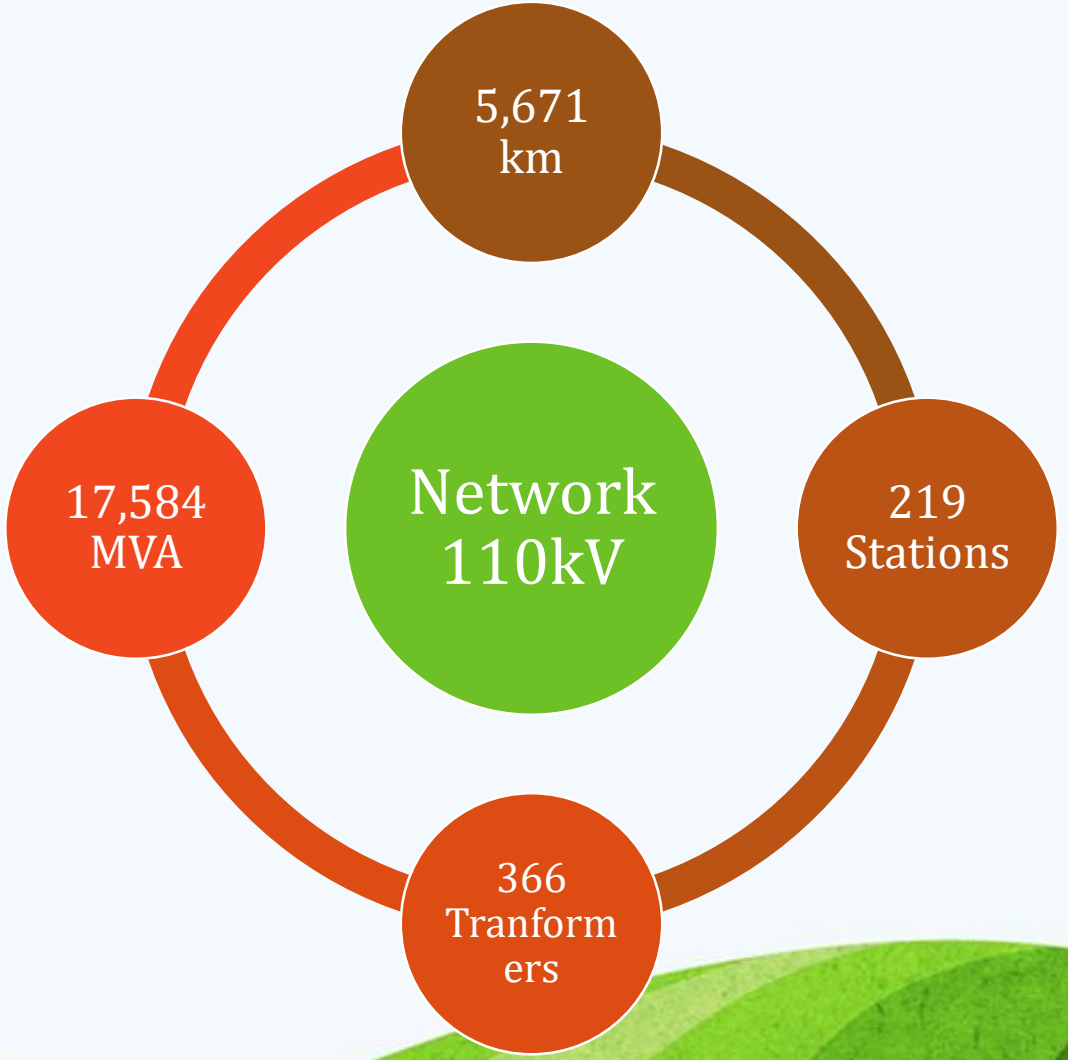
Southern Power Corporation (EVN*SPC*) is one of five power distribution Corporations in Viet Nam, responsible for 21 provinces of Vietnam southern area, except Ho Chi Minh City.

- 110kV (HV) Network: 5,671km, 219 station with 366 transformers, total capacity 17,584 MVA.



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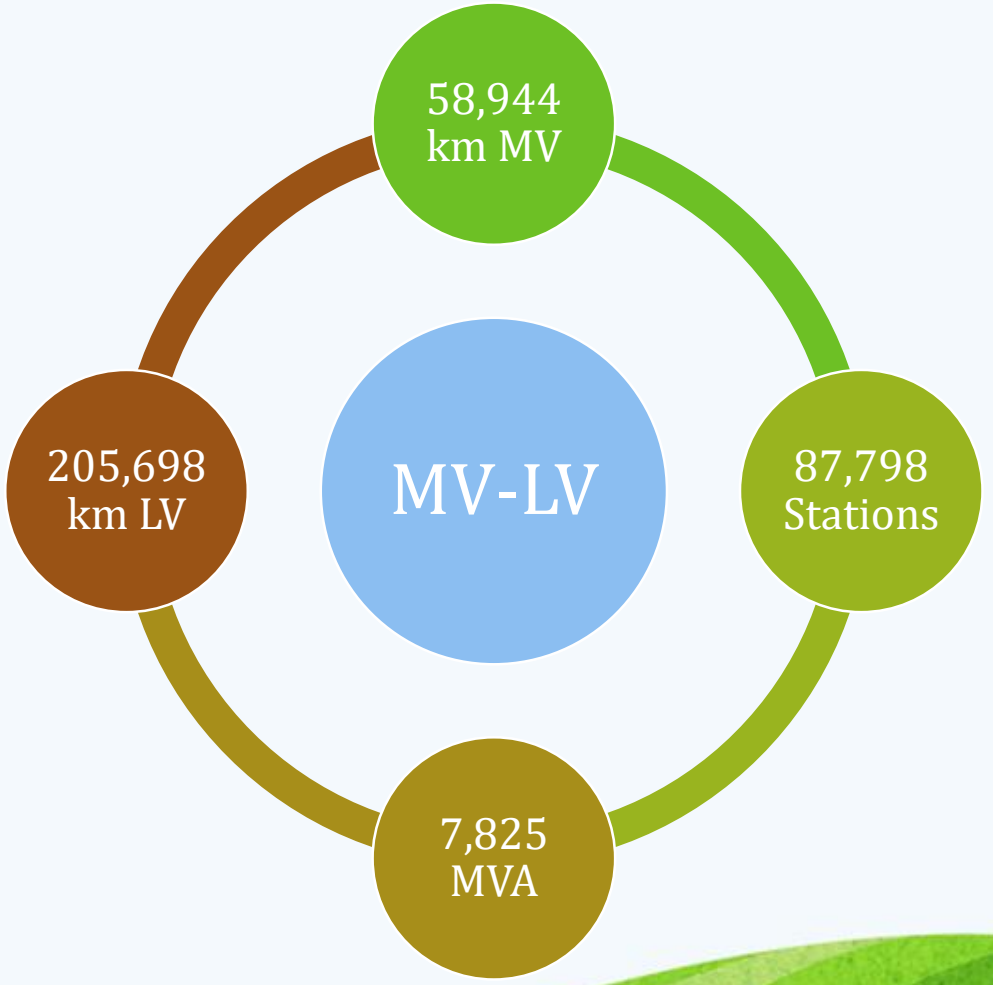
Distribution network of:

58,944 km medium voltage line, 87,919 distribution substations with total capacity of 7,825 MVA, 205,698 km low voltage line.



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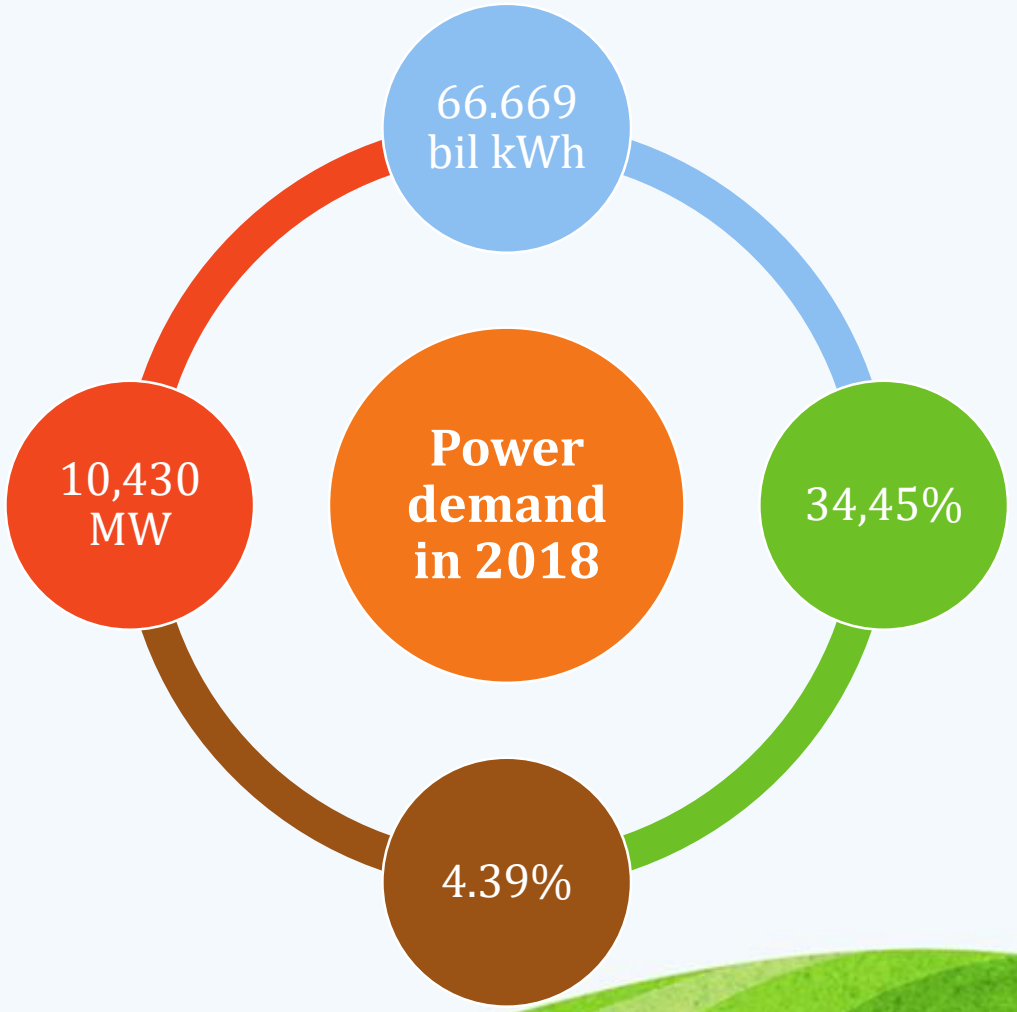
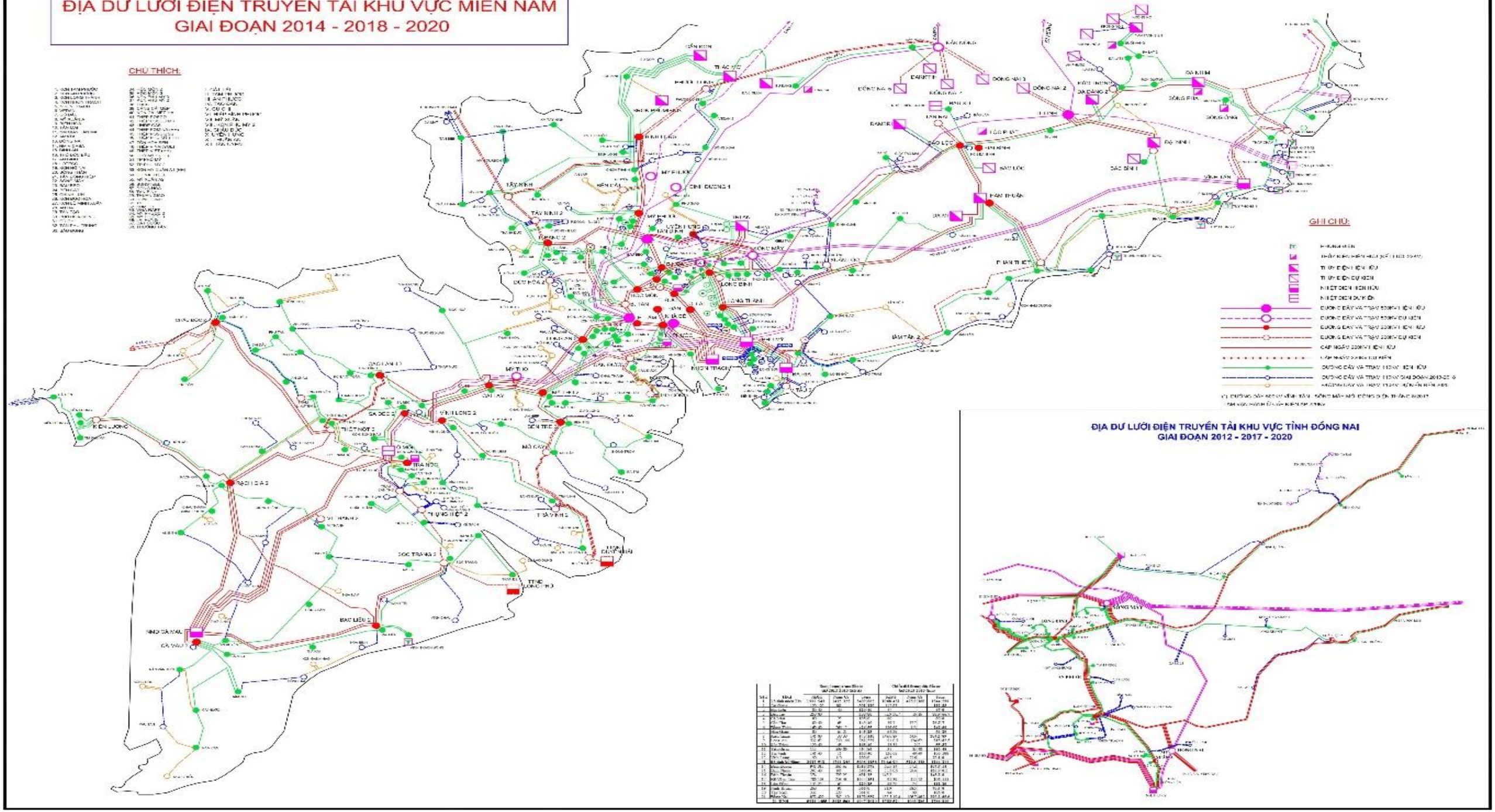
Power demand in 2018:

- 66.669 billion kWh equiv. 34.45% total electricity sale of EVN,
- Power loss 4.39%
- Pmax = 10,430 MW



ĐỊA DƯ LƯỚI ĐIỆN TRUYỀN TẢI KHU VỰC MIỀN NAM GIAI ĐOẠN 2014 - 2018 - 2020



B. EXPERIENCES OF UTILIZING AMORPHOUS TRANSFORMERS

1. UTILIZING AMORPHOUS TRANSFORMERS

1.1. Research of Amorphous Transformers (AT)

Amorphous transformers have been developed and utilized in many countries. This is an effective solution to reduce power losses as well as Greenhouse Gas Emissions.

During the premature phase, the cost difference comparing to conventional Silicon transformers was about 40%, but the difference has been reduced to 15-20% until now.

So, nowaday AT becomes a feasible solution to reduce technical power losses in power distribution.

Effective of power loss reduction

According to the Technical Specification of EVNSPC about Transformers, **the P_k of** the Silicon Transformers and AT being equal, but the Po of the AT is only 1/3 of Silicon Transformers,

Power loss effectively of AT is calculated as follows

ΔA = (Po Silic - Po Amorphous) x the number of operation hours in year

= (Po Silic - Po Amorphous) x (8760 – SAIDI)

= (Po Silic - Po Amorphous) x (8162)

With:

Po Silic : No-load load of Silicon Transformers.

Po Amorphous : No-load loss of AT.

SAIDI : The system average interruption duration index (2018: 598 minutes)

8760 : Total hours in a year.

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The power losses testing on Amorphous steel core and Silic steel core

5.5. Difference of No Load Loss(NLL) : Amorphous vs. CRGO

Amorphous
NLL : 7.39 W

NLL of AM-core is around 40 % compared to CRGO-core's

CRGO
NLL : 18.04 W

Amorphous Core

CRGO Core
(Use High grade CRGO)

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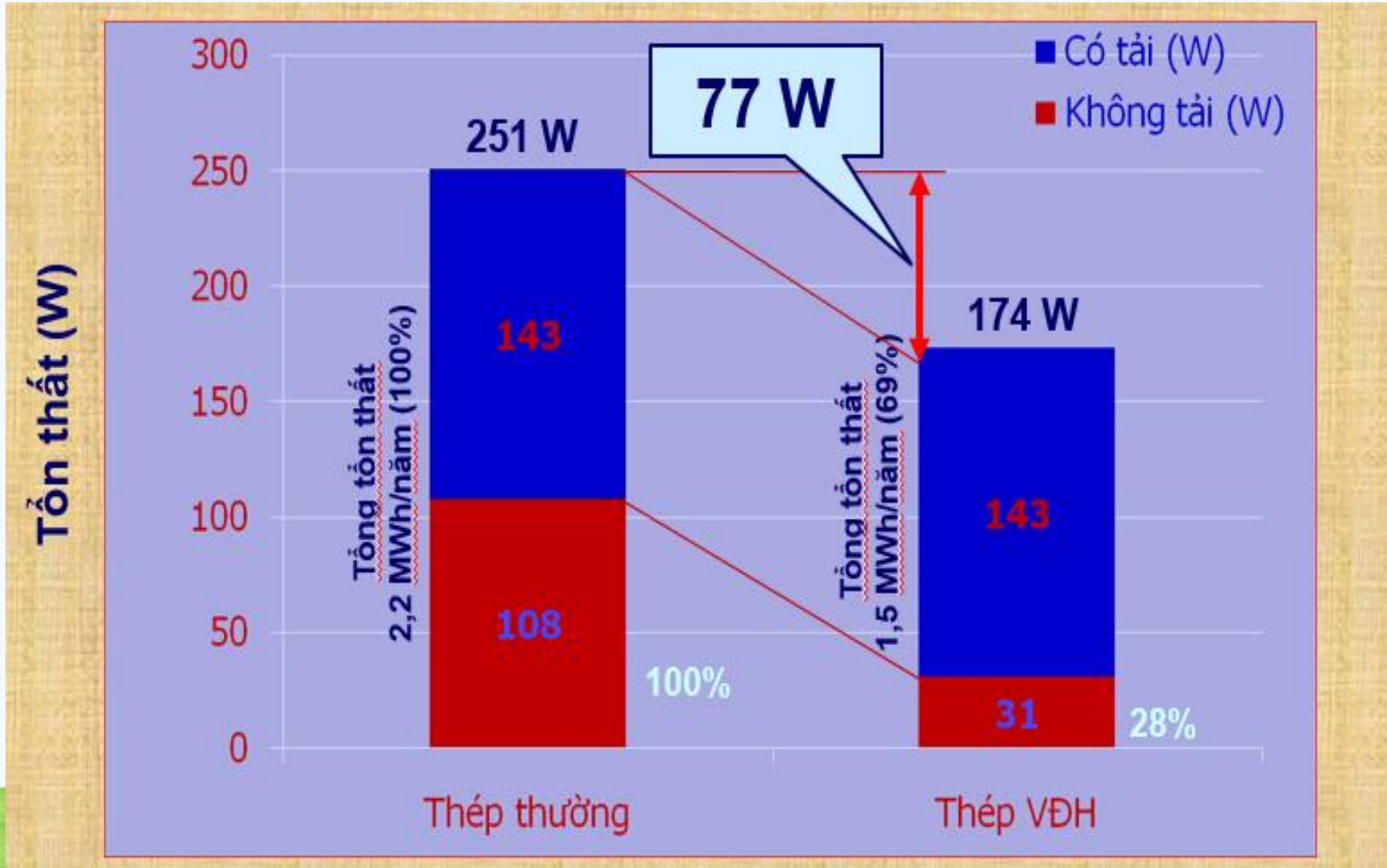
Effective of power loss reduction

The chart compares the losses in 50% load factor (Transformer 50kVA)



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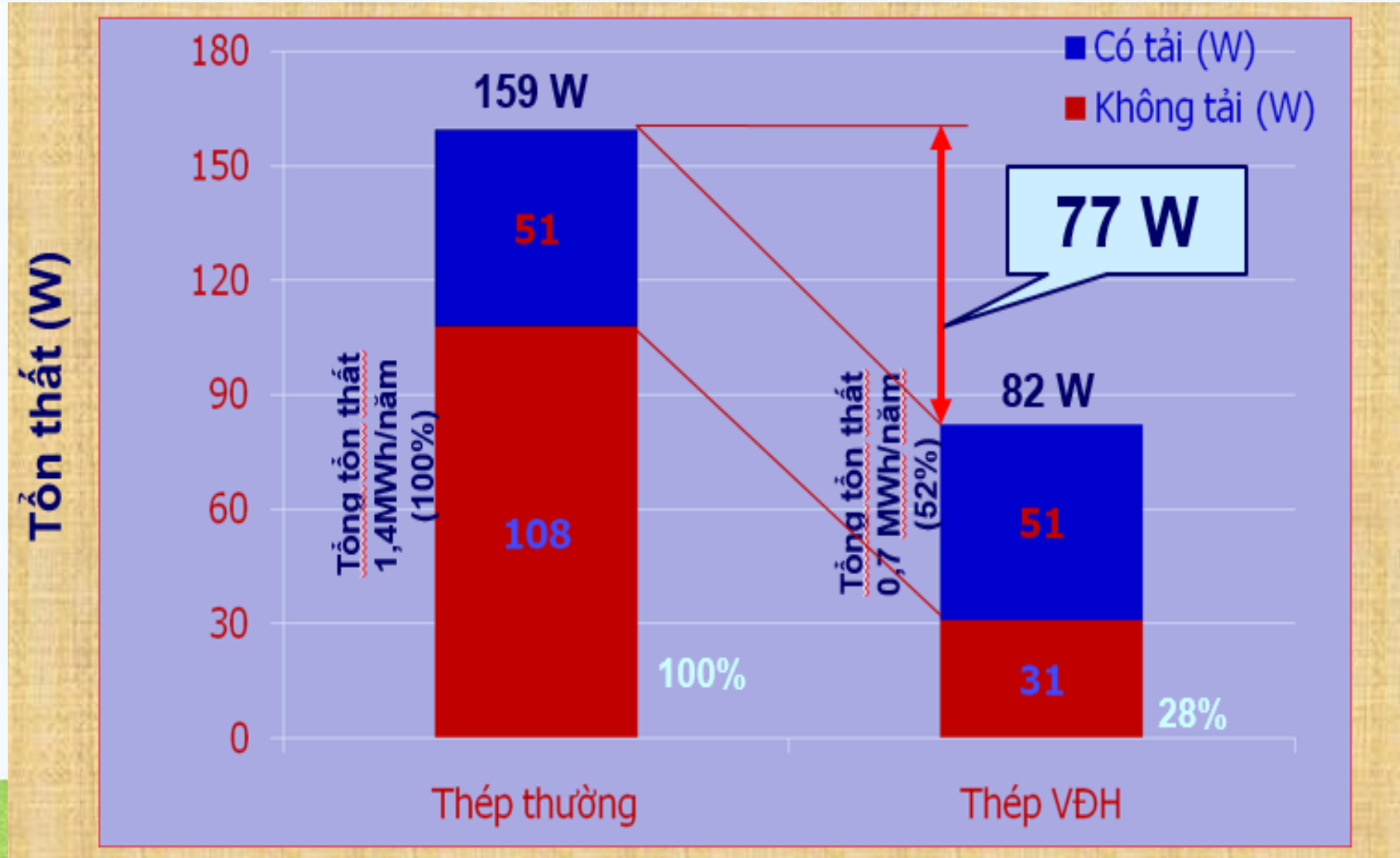
Effective of power loss reduction

The chart compares the losses in 30% load factor (Transformer 50kVA)



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Effective of power loss reduction

According to the two illustrate charts above, we can see that, at 50% or 30% load factor, to use AT will save 0,077 x 365 x 24 = 670kWh/year.

As calculation and verification of purchasing costs in 2018, the purchasing price of AT is about 15%-20% higher than Silicon Transformer.

To compare with the cost of reducing power losses, estimated time to recovery difference cost about 8 years

Effective of Greenhouse Gas emission (CO_2) reduction

The reduction of power losses will help to reduce Greenhouse Gas emission. The formula is as follows:

$$\mathbf{E = \Delta A \times EF\ grid}$$

With:

ΔA : The amount of Power reduction each year;

EF grid : Emission factor CO_2 of network;

According to data from the Ministry of Natural Resources and Environment: EF grid = 0.6612 tons CO_2/MWh

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Effective of Greenhouse Gas emission (CO_2) reduction

No	Transfomer Capacity (kVA)	No-load loss		Difference of No-load loss (W)	Ratio % of No load loss of AT on Silicon Transformer (%)	Reduction of Energy loss per year of AT (kWh)	Reduction of CO2 emissions per year of AT (ton CO_2)
		Silicon Transformers (W)	Amorphous Transformers (W)				
	Single phase transformers						
1	15	52	17	35	32.69	305	0.202
2	25	67	22	45	32.83	393	0.260
3	37,5	92	31	61	33.69	532	0.352
4	50	108	36	72	33.33	628	0.415
5	75	148	49	99	33.10	864	0.571
6	100	192	64	128	33.33	1117	0.739
	Three phase transformer						
1	100	205	75	130	36.58	1134	0.750
2	160	280	95	185	33.92	1614	1.067
3	180	315	115	200	36.50	1745	1.154
4	250	340	125	215	36.76	1876	1.240
5	320	390	145	245	37.17	2138	1.414
6	400	433	165	268	38.10	2338	1.546
7	560	580	220	360	37.93	3141	2.077
8	630	787	270	517	34.30	4511	2.983
9	750	855	290	565	33.91	4930	3.260
10	800	880	310	570	35.22	4973	3.288
11	1000	980	350	630	35.71	5497	3.635
12	1250	1020	420	600	41.17	5235	3.461
13	1500	1223	470	753	38.43	6570	4.344

Economic effective of the Amorphous Transformer

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No	Capacity (kVA)	Silicon Transformer Unit Price (thousand VNĐ)	Amorphous Transformer Unit Price (thousand VNĐ)	Price Difference between 2 types of Transformer (thousand VNĐ)	Reduction of Energy loss per year of AT (kWh)	Reduction cost per year of Power load of AT (VNĐ/kWh)	Expected recovery period of cost difference (year)
	Single phase transformers						
1	15	18.808	22.842	4.034	305	486.170	8
2	25	24.090	29.257	5.167	393	626.442	8
3	37,5	30.044	36.488	6.444	532	848.008	8
4	50	37.070	44.499	7.429	628	1.001.032	7
5	75	48.956	58.767	9.811	864	1.377.216	7
6	100	58.009	69.635	11.626	1117	1.780.498	7
	Three phase transformers						
1	100	92.030	102.816	10.786	1134	1.807.596	6
2	160	96.035	118.167	22.132	1614	2.572.716	9
3	180	104.032	132.947	28.915	1745	2.781.530	10
4	250	140.032	169.802	29.770	1876	2.990.344	10
5	320	175.035	204.918	29.883	2138	3.407.972	10
6	400	202.032	239.343	37.311	2338	3.726.772	10
7	560	222.032	274.311	52.279	3141	5.006.754	10
8	630	239.030	283.653	44.623	4511	7.190.534	6
9	750	272.025	301.381	29.356	4930	7.858.420	4
10	800	299.025	321.498	22.473	4973	7.926.962	3
11	1000	350.000	384.983	34.983	5497	8.762.218	4
12	1250	395.500	454.283	58.783	5235	8.344.590	7
13	1500	431.130	527.557	96.427	6570	10.472.580	9

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2. Orientation on utilizing Amorphous transformers

In 2014, EVN has directed Subsidiaries to use AT to reduce power losses.

As the result of analyzing the effectiveness of the AT, in 2015, EVNSPC has promoted to use the AT. To purchase 2,840 AT (total capacity of 204 MVA).

In 2015, all of AT listed above has been completed installations, EVNSPC could save 2.2 mil. kWh of energy loss, equivalent to 0,004% of power loss ratio of EVNSPC and reduce 1.200 tons CO_2 emission.

2. Orientation on utilizing Amorphous transformers

Realizing the effectiveness of AT, in 2015 EVNSPC issued guidelines that promote to use AT for all electricity projects of EVNSPC; besides, to recommend of utilizing AT for customer substations, especially customers with seasonal production line, pump stations for agriculture irrigation,...

Until Dec 2018, EVNSPC has installed 13,233 AT with total capacity of 1,053MVA, reduce the rate of power loss of approximately 0.018% annually (Power loss of EVN SPC is 4,39%).

C. TO JOIN THE JCM PROJECT

1. THE PROCESS OF PROJECT DEPLOYMENT

1. MOU between two Governments was signed on 2 July 2013 in Hanoi.

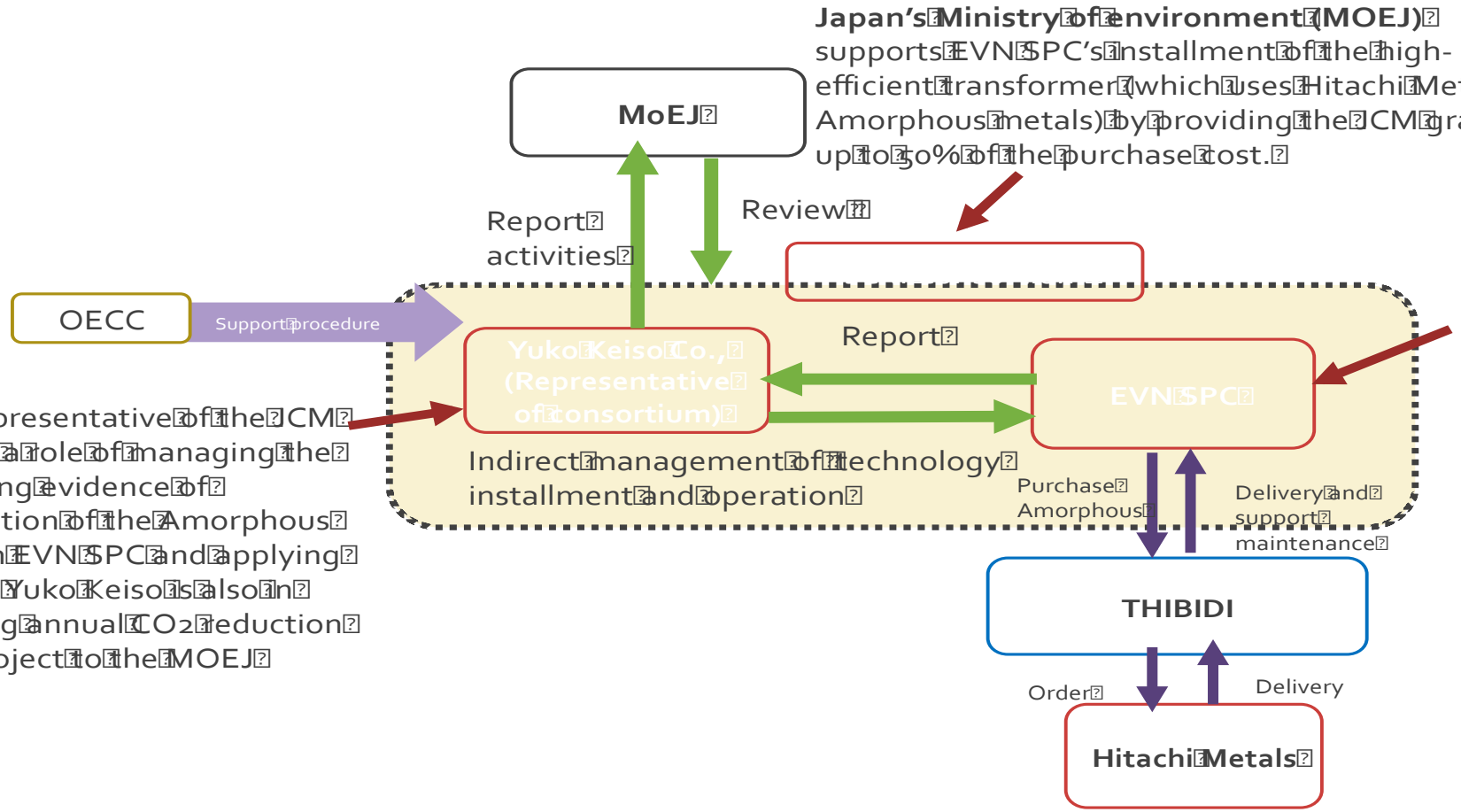
2. On 6 January 2015: OECC invited EVNSPC to join the JCM consortium. After studying legal documents on JCM project supporting the investment on amorphous transformer, EVNSPC agreed to join.

3. A JCM Minutes of Agreement and a Technical support contract has been signed with Japanese company Yuko Keiso.

4. As informed by OECC and Yuko Keiso, the project has been accepted. GEC (Global Environment Center under MOEJ) will be in charge of preparing financial plan and monitoring the implementation.

1. THE PROCESS OF PROJECT DEPLOYMENT

Structure of “JCM consortium”



Japan’s Ministry of environment (MOEJ) supports EVN SPC’s installment of the high-efficient transformers (which uses Hitachi Metal’s Amorphous metals) by providing the JCM grant up to 50% of the purchase cost.

EVN SPC, as the representative of the consortium in Vietnam side buys and installs the Amorphous transformers utilized Hitachi Metal’s Amorphous metals and reports the operation status to Yuko Keiso by submitting evidence records. EVN SPC also required to report the annual operation records to Yuko Keiso for calculating annual CO_2 reduction volumes.

Yuko Keiso, as representative of the JCM consortium, plays a role of managing the project by collecting evidence of installation, operation of the Amorphous transformers from EVN SPC and applying for the JCM grant. Yuko Keiso is also in charge of reporting annual CO_2 reduction volumes of the project to the MOEJ annually.

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1. THE PROCESS OF PROJECT DEPLOYMENT

- Responsibilities of the EVN*SPC*
- Responsibilities of Yuko Keiso
- Amount of funding
- Support terms

EVNSPC

2. MEMORANDUM OF AGREEMENT OF JCM CONSORTIUM

RESPONSIBILITIES OF THE EVNSPC:

- Purchasing, installing, operating amorphous transformers under the supervision of Yuko Keiso.
- Providing financial and technical documents so that Yuko Keiso could complete the required procedure to get funding from MOEJ.
- Providing operational data of purchased amorphous transformers for calculating the GHG emission reductions.
- Implementing maintenance scheme and routines as recommended by Yuko.

2. MEMORANDUM OF AGREEMENT OF JCM CONSORTIUM

RESPONSIBILITIES OF YUKO KEISO:

- Monitoring the purchasing, installation, operation of amorphous transformers.

- Applying for JCM financing from MOEJ

- Transferring the grant to EVN SPC.

- Monitoring the number of purchased transformers as required.

- Monitoring and reporting, on behalf of the consortium, the GHG emission reductions to MOEJ.

2. MEMORANDUM OF AGREEMENT OF JCM CONSORTIUM

AMOUNT OF GRANT:

- Currency: Japanese Yen.

- EVN SPC has participated in 3 JCM projects with the grant as follows:

+ Project 1 (in 2015): 50% of AT purchasing cost.

+ Project 2 (in 2016): 31.93% of AT purchasing cost.

+ Project 3 (in 2017): 30% of AT purchasing cost.

- As instructed by MOEJ, EVNSPC as the beneficiary should receive the whole amount of grant via Yuko Keiso.

3. THE PROJECT DEPLOYMENT SITUATION

1. Receiving Amorphous Transformers from THIBIDI:

3. THE PROJECT DEPLOYMENT SITUATION

2. Installation Amorphous Transformers

- End of November (each project year), EVN SPC finished installing number of Amorphous Transformers.

- In December (each project year), EVN SPC completed and submitted installation reports to Yuko Keiso.

- In Feb of the following year, Global Environment Centre (GEC) representatives carried out site survey of the installed ATs. Then GEC report to the MOEJ to approve the disbursement of funds.

3. THE PROJECT DEPLOYMENT SITUATION

3. Orientation of AT utilizing

- To continue promoting the use of Amorphous transformers in EVN*SPC* area;

- Amorphous transformers is recommended for customers who build private substations, especially seasonal production customers, agricultural irrigation pumping stations ...

THANK YOU
FOR YOUR ATTENTION!