

# Electric and Electronic Waste Recycling in Vietnam



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# OUTLINE

1

**E-waste in Vietnam**

2

**E-waste Recycling in Vietnam**

3

**Proper Recycling Technology**

4

**Conclusion Remarks**

# I. E-WASTE IN VIETNAM

## The properties of e-waste in Vietnam

- Does include electronic and electrical waste
- Does not classified by law yet
- Is considered as valuable things rather than waste by public
- Is considered as hazardous wastes by law
- Is related to the transboundary flow (legal and illegal)
- There is no official data or statistic index considering the amount of e-waste.
- Have high increasing rate

# I. E-WASTE IN VIETNAM

## The properties of e-waste in Vietnam (cont')

### Can be classified by the way to handle:

- Home appliances (TV, refrigerator, washing machine, air conditioner, PC, laptop, etc.)
- Office appliances (photocopier, scanner, printer, etc)
- Multimedia appliances – small appliances (cellphone, mp3 player, cameras, etc.)

### Come from:

- Household
- Office
- Industry
- Oversea

# Using

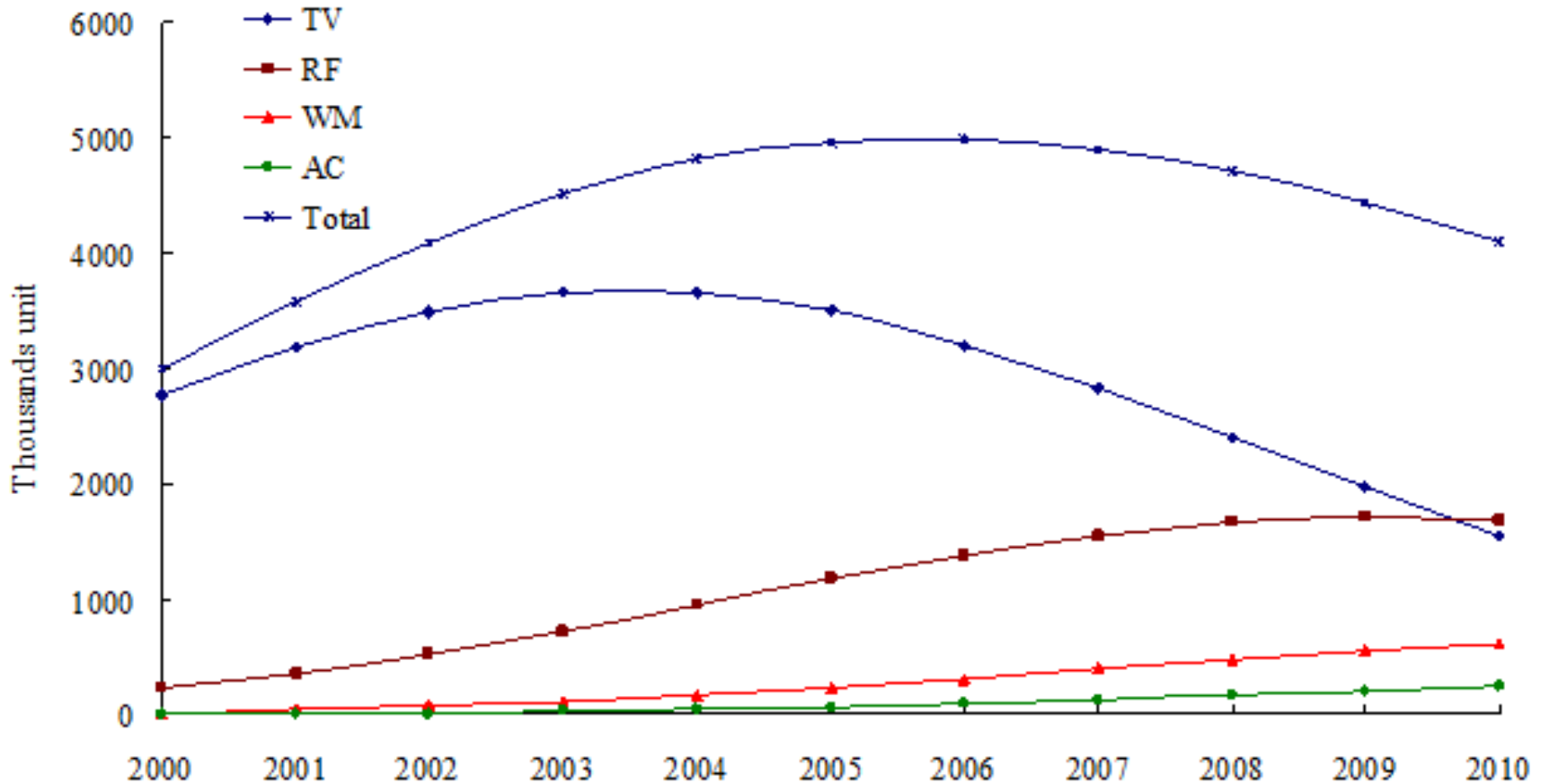
## 7.1 Tỷ lệ hộ có đồ dùng lâu bền chia theo thành thị nông thôn, vùng, 5 nhóm thu nhập, giới tính của chủ hộ và ngành sản xuất kinh doanh chính của hộ

*Percentage of households having durable goods by urban rural, region, income quintile, sex of household head and main economic industry*

	Đơn vị tính/ Unit: %									
	Tỷ lệ hộ có đồ dùng lâu bền/ Percentage of households having durable goods					Tỷ lệ hộ có mua sắm đồ dùng lâu bền trong 12 tháng qua/ Percentage of households purchased durable goods in the last 12 months				
	2002	2004	2006	2008	2010	2002	2004	2006	2008	2010
<b>CẢ NƯỚC/ WHOLE COUNTRY</b>	<b>96,9</b>	<b>98,5</b>	<b>99,0</b>	<b>99,0</b>	<b>98,4</b>	<b>32,8</b>	<b>43,3</b>	<b>41,4</b>	<b>44,1</b>	<b>48,4</b>
<b>Thành thị - Nông thôn/ Urban - Rural</b>										
Thành thị/ Urban	98,9	99,5	99,8	99,8	99,2	39,7	48,5	45,2	43,1	46,1
Nông thôn/ Rural	96,2	98,2	98,7	98,7	98,1	30,6	41,6	39,9	44,5	49,5
<b>8 Vùng/ 8 Regions</b>										
Đồng bằng sông Hồng/ Red River Delta	99,2	99,6	99,8	99,7	99,2	38,2	50,3	42,7	43,9	53,5
Đông Bắc/ North East	94,4	98,0	98,0	97,6	97,5	36,7	47,1	45,4	48,5	51,0
Tây Bắc/ North West	85,8	89,3	92,1	95,3	94,8	33,8	43,9	41,2	47,9	49,2
Bắc Trung Bộ/ North Central Coast	98,2	98,8	99,1	98,6	97,8	31,4	38,2	39,6	42,8	43,2
Duyên hải Nam Trung Bộ/ South Central Coast	95,5	97,7	98,9	99,0	97,4	28,9	36,9	34,9	38,2	43,1
Tây Nguyên/ Central Highlands	93,7	96,7	98,4	98,3	98,2	30,0	51,2	49,6	53,3	52,7
Đông Nam Bộ/ South East	98,5	99,3	99,5	99,2	99,6	36,6	46,0	43,1	45,3	43,8
Đồng bằng sông Cửu Long/ Mekong River Delta	96,1	98,6	99,2	99,6	98,3	24,5	35,1	37,9	41,4	49,3
<b>6 Vùng/ 6 Regions</b>										
Đồng bằng sông Hồng/ Red River Delta	...	...	...	99,5	99,2	...	...	...	43,5	52,7
Trung du và miền núi phía Bắc/ Northern midland and mountain areas	...	...	...	97,2	96,7	...	...	...	49,6	52,0
Bắc Trung Bộ và duyên hải miền Trung/ North Central area and Central coastal area	...	...	...	98,6	97,8	...	...	...	41,4	44,6
Tây Nguyên/ Central Highlands	...	...	...	98,3	98,2	...	...	...	53,3	52,7
Đông Nam Bộ/ South East	...	...	...	99,5	99,6	...	...	...	45,1	42,0
Đồng bằng sông Cửu Long/ Mekong River Delta	...	...	...	99,6	98,3	...	...	...	41,4	49,3

GSO, 2011

# Second-hand market



Estimated of second-hand buying appliance in household

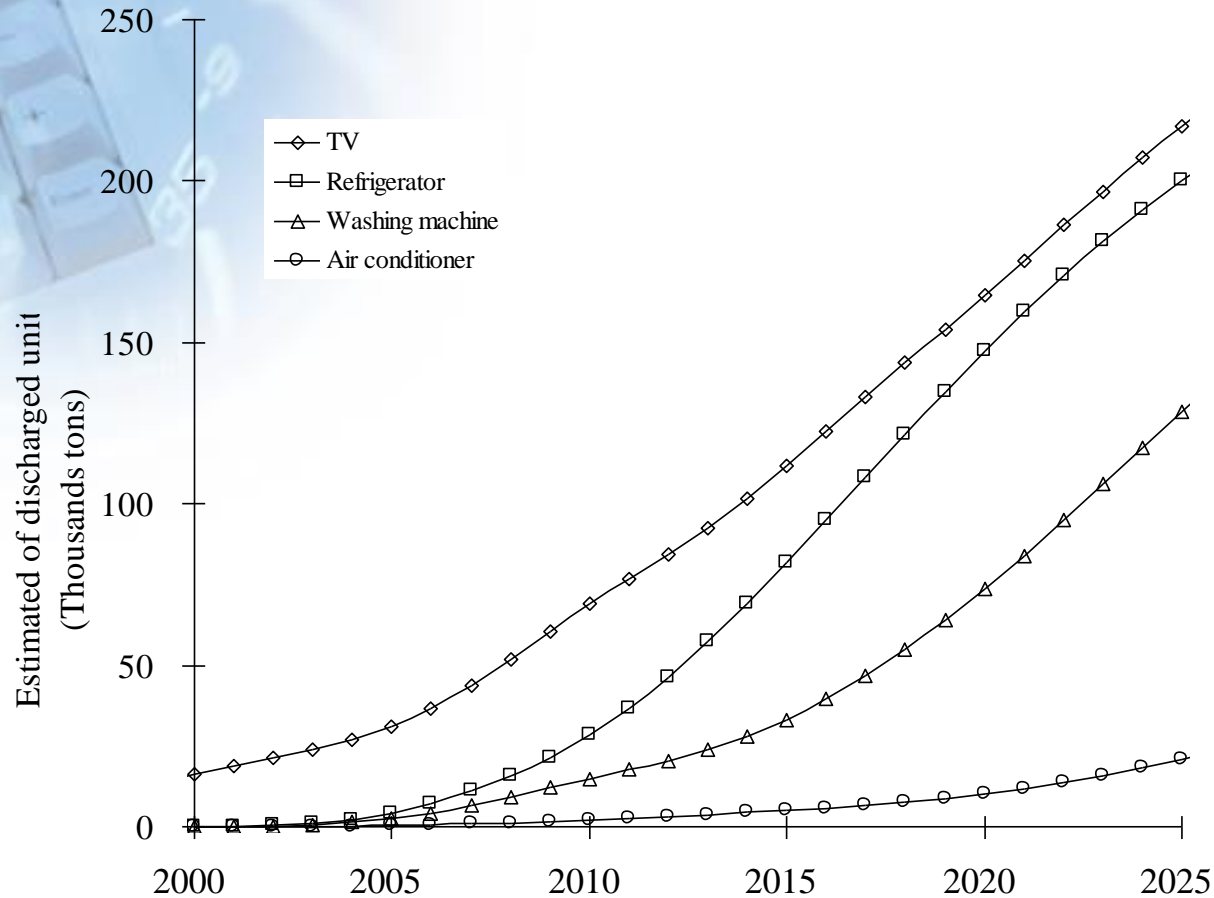
*Quang, et.al, 2010*

# Number of discarded appliances

Year	TV	PC	Refrigerator	Air conditioner	Washing machine
2002	190,445	62,771	112,402	17,778	184,140
2003	222,977	77,845	140,916	24,706	214,271
2004	261,542	90,447	162,262	29,853	249,094
2005	308,076	110,123	194,570	39,157	287,910
2006	364,684	131,536	230,856	49,782	327,649
2007	433,651	153,360	268,682	61,302	368,786
2008	517,523	174,305	305,063	72,676	415,526
2009	619,269	195,514	346,036	86,548	472,631
2010	742,509	217,189	397,972	107,519	542,918
2011	891,804	270,874	467,037	128,000	636,569
2012	1,072,933	369,061	546,733	132,607	775,838
2013	1,293,110	420,850	689,466	209,548	937,420
2014	1,561,087	486,752	825,410	313,336	1,083,151
2015	1,887,138	644,208	1,026,974	318,143	1,247,801
2016	2,282,966	736,993	1,190,945	409,545	1,444,845
2017	2,761,651	869,512	1,392,355	495,011	1,672,279
2018	3,337,803	1,028,052	1,634,982	598,020	1,939,401
2019	4,028,063	1,217,478	1,923,584	722,566	2,254,210
2020	4,852,039	1,444,038	2,267,318	873,163	2,625,882

*Unit: piece, URENCO, 2007*

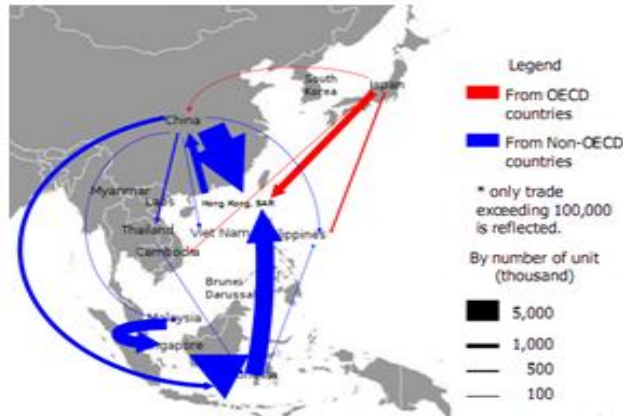
# Number of discarded appliances



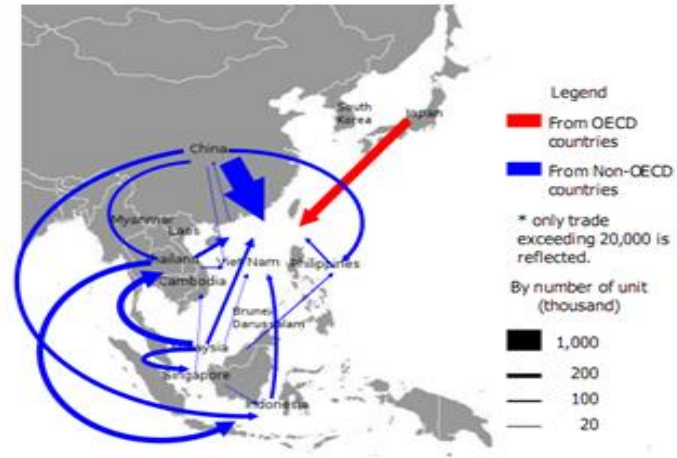
Quang et.al, 2009



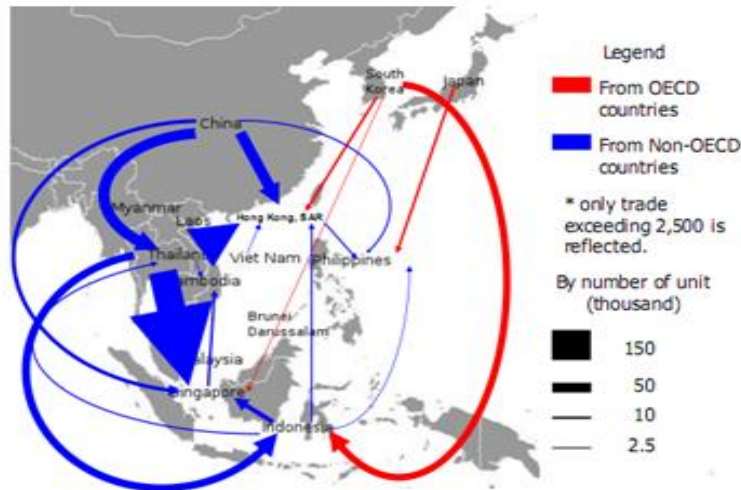
# Tranboundary flow



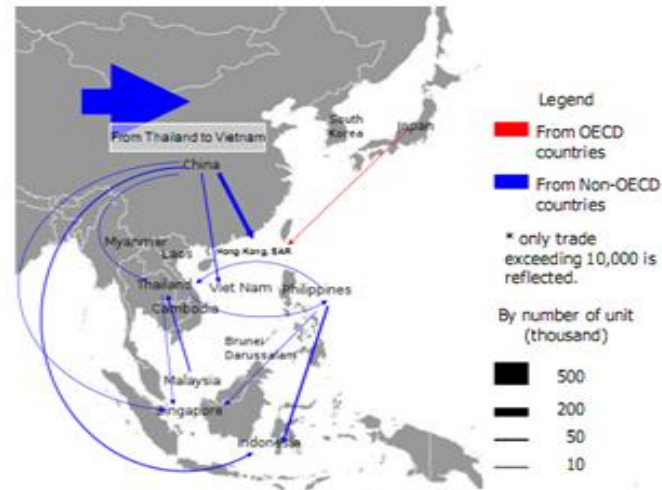
TV



AC

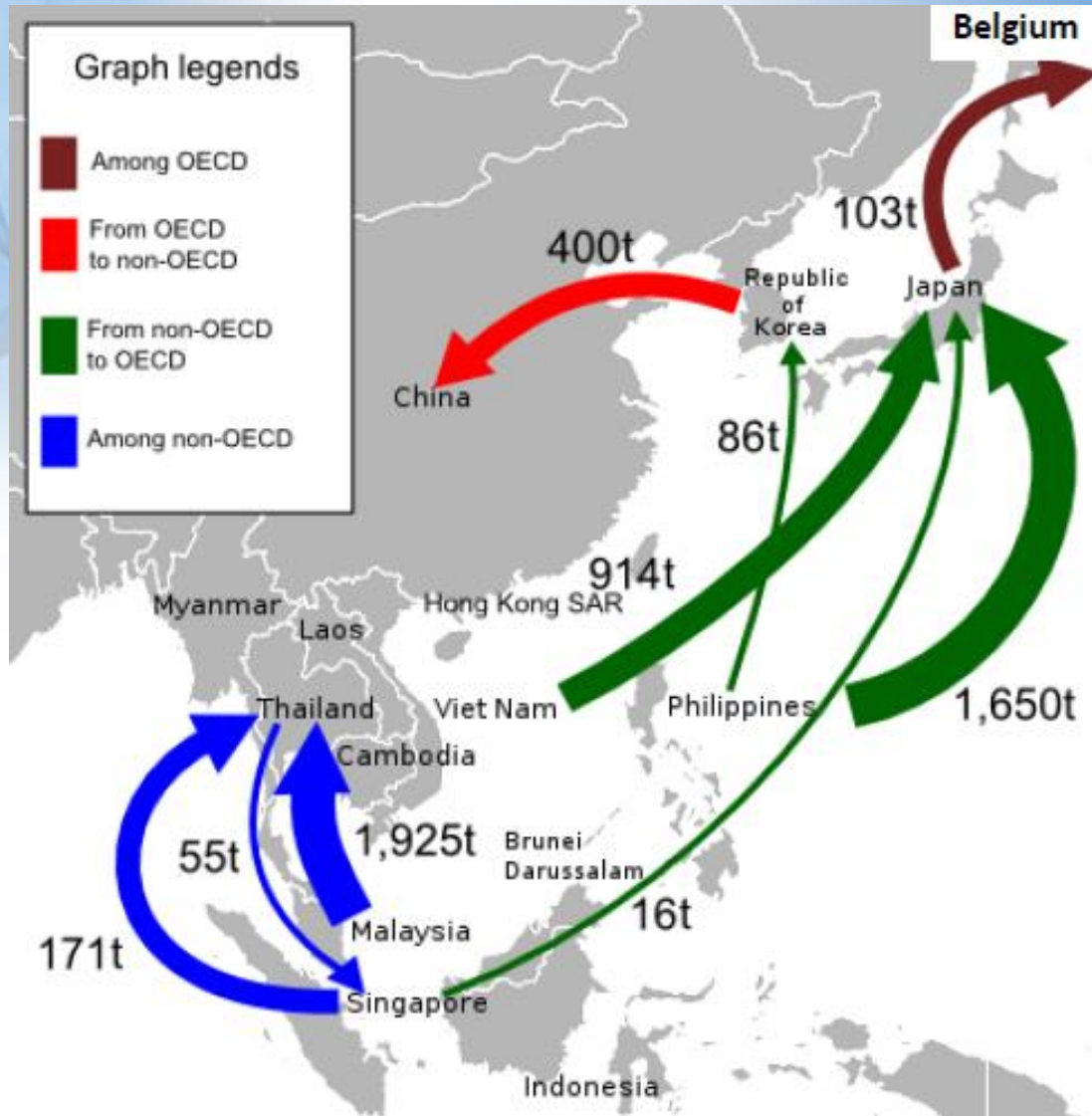


RF



WM

# Tranboundary flow



# II. E-WASTE RECYCLING IN VIETNAM

## Involved stake holders:

- Producer/importer;
- Consumer;
- Collector/dismantler;
- Service shop;
- Recycler;
- Exporter

# II. E-WASTE RECYCLING IN VIETNAM

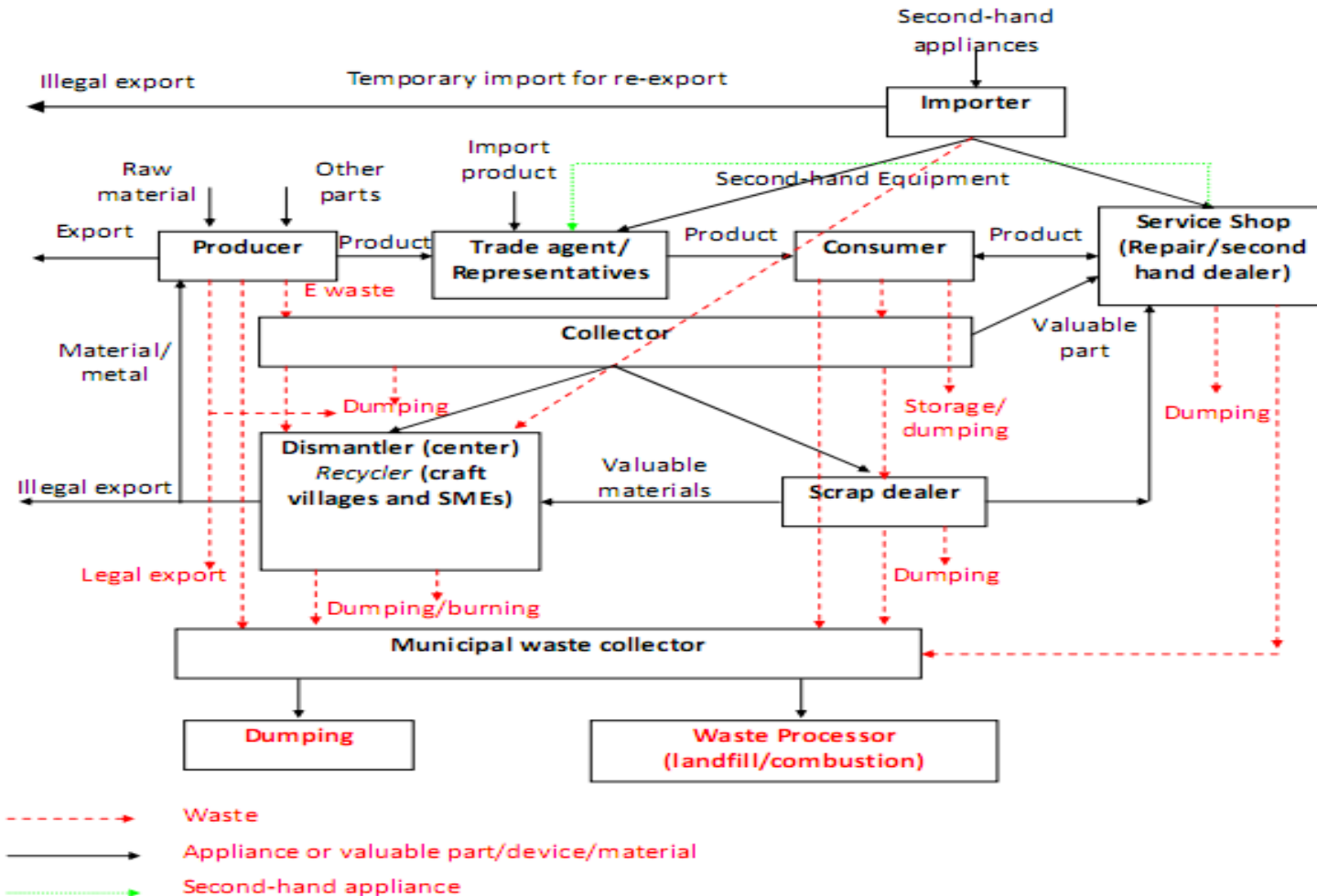


Fig 1. The flow of electronic home appliance and electronic waste in Vietnam

# Related Activities

## Related activities:

- Disposal (customer)
- Collection (collector)
- Repairing and Refurbishing (service shop)
- Dismantling (dismantling center, service shop)
- Recycling (craft village for basis metals, plastic)
- Burning, landfill (disposal of part/devices)
- Storing, keep at home (user)
- Exporting (exporter, illegal/legal)



# Disposal

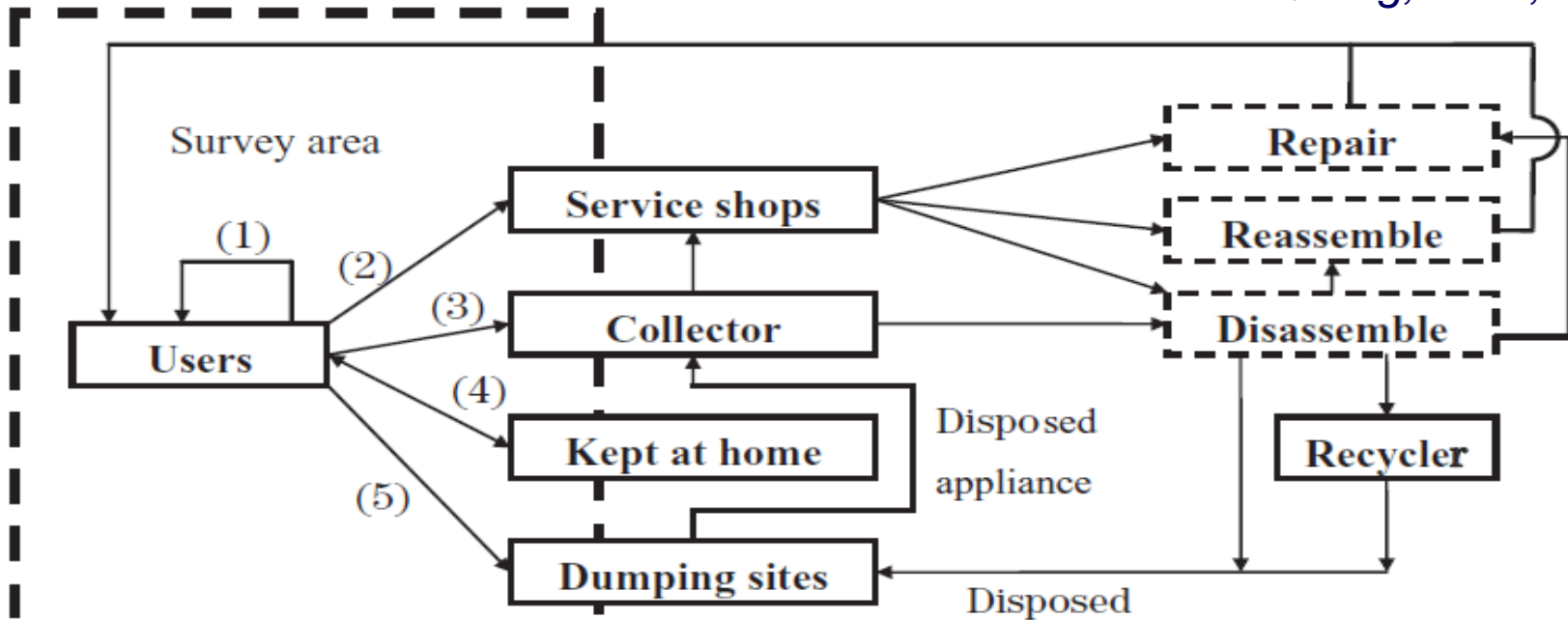
## Major manners:

- Sell/give to next user
- Sell to the collector or service shop
- Keep at home
- Open dumping/disposing with domestic waste (for small)



# Disposal

Quang, et.al., 2009



	TV		Refrigerator		Washing machine		PC		Air conditioner	
<i>Discarded ratio (%)</i>	8.8		5.6		2.6		8.5		1.1	
<i>Average using year of discarded appliance</i>	7.0		6.9		7.0		4.8		9.0	
<b>Options</b>	<b>Unit</b>	<b>%</b>	<b>Unit</b>	<b>%</b>	<b>Unit</b>	<b>%</b>	<b>Unit</b>	<b>%</b>	<b>Unit</b>	<b>%</b>
Give or sell to next user	49	55	17	51.5	6	54.6	21	47.7	-	-
Sell to service shop	20	22.5	9	27.3	1	9.1	9	20.5	1	33
Sell to collector	5	5.6	3	9.1	1	9.1	2	4.6	-	-
Landfill	0	0	0	0	0	0	0	0	-	-
Kept at home	15	16.9	4	12.1	3	27.3	12	27.3	2	66
<b>Total</b>	<b>89</b>	<b>100</b>	<b>33</b>	<b>100</b>	<b>11</b>	<b>100</b>	<b>44</b>	<b>100</b>	<b>3</b>	<b>100</b>

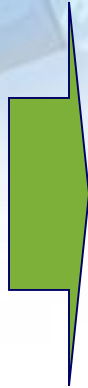
# Collection

## Conducted by:

- Private collector and collection agent
- Service shop
- Sell agent (by program)
- URENCO







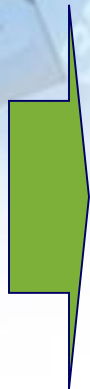
... and agent

Disposal

Collection by private collector



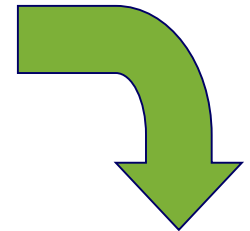
Disposal



Collection



Service shop



Domestic waste

# Dismantling

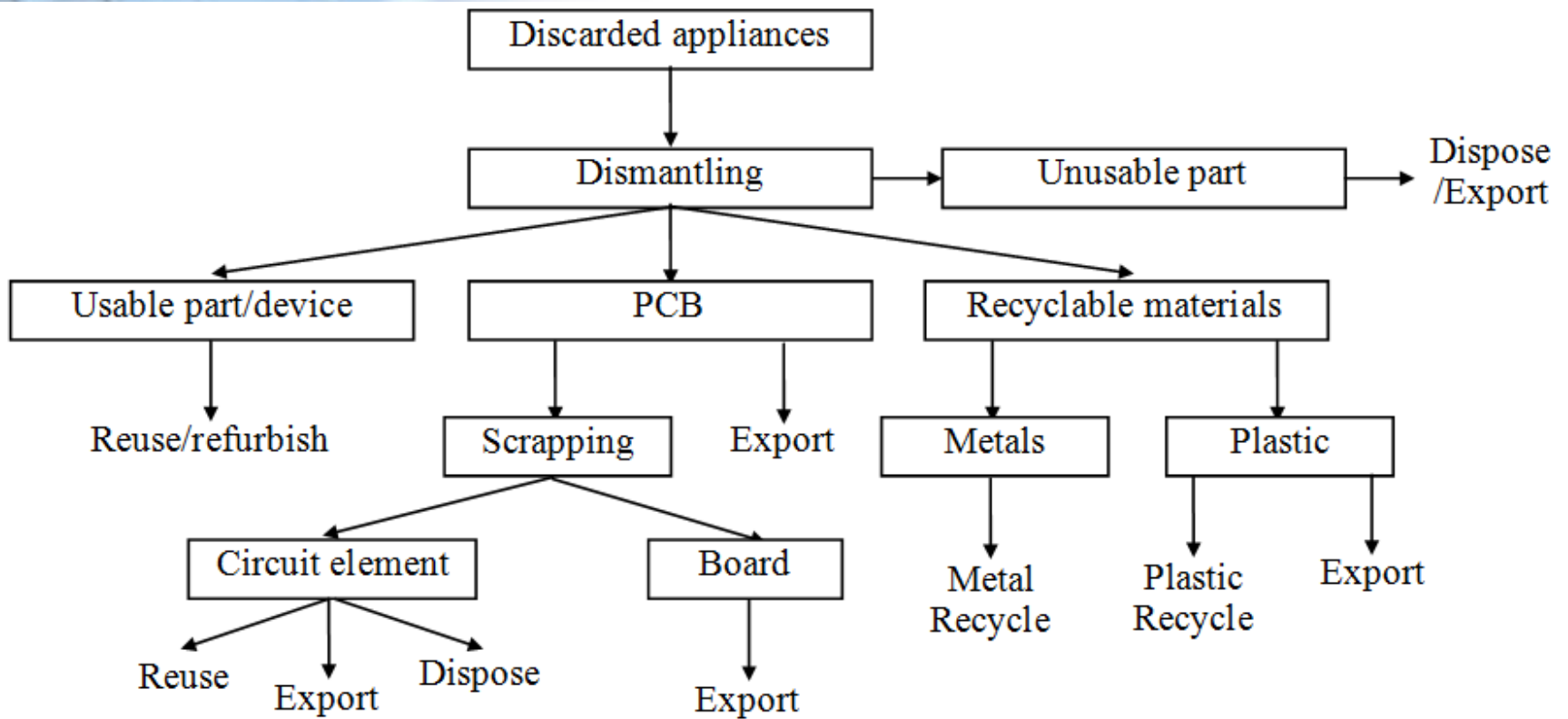
- Conducted to recover some basic materials (ferrous copper, aluminum, plastic, lead-free glass, part/device)
- Conducted in some dismantling centers (Trang Minh, HP; Bui Dau, Phan Boi, HY; Te Lo, VP; Văn Môn, BN, v.v.) and the service shop
- Under the control of private sector
- Is considered as the major recycling activity of e-waste



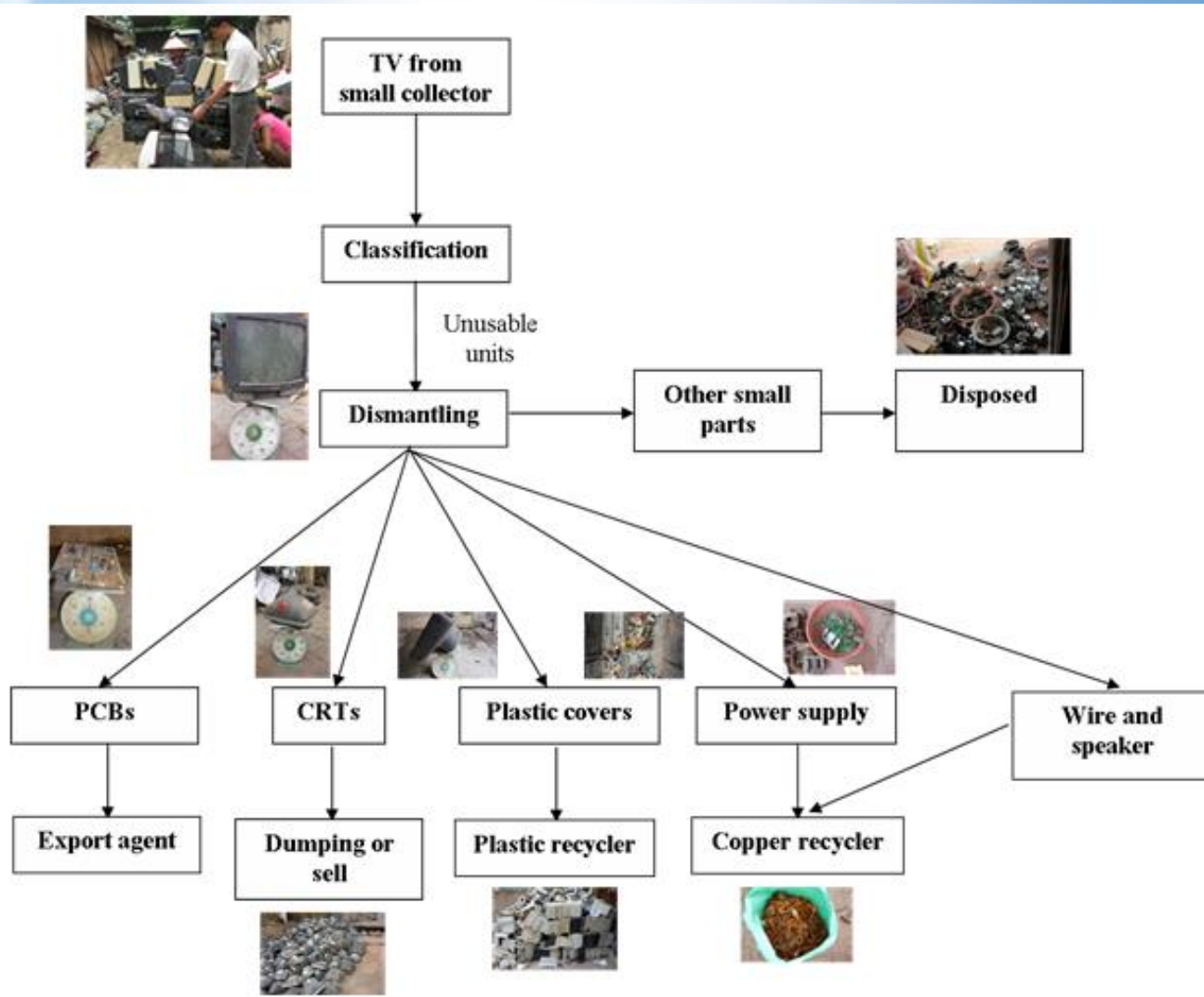








## General flow of WEEE dismantling

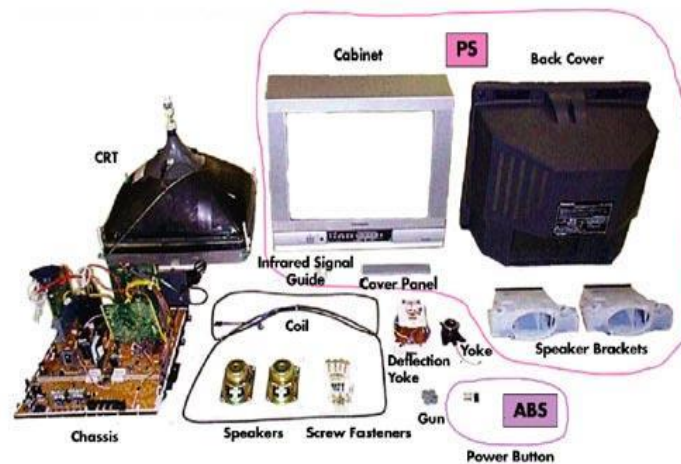


The common dismantling process of TV



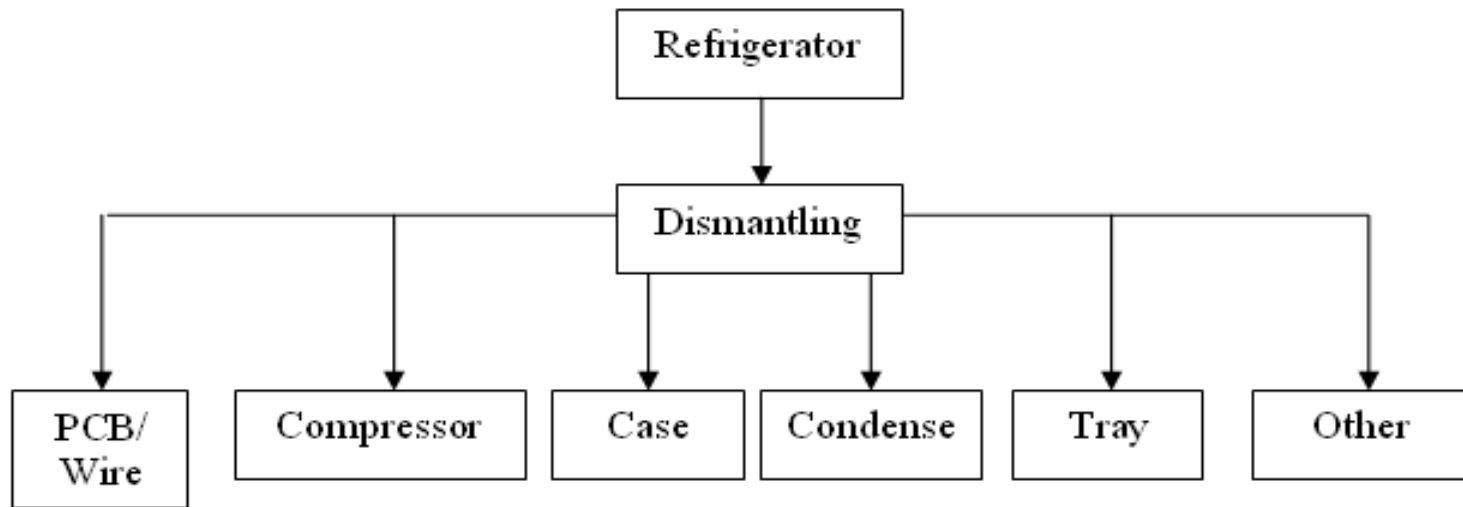
# Television (TV)

- Valuable recycling material : ~ 0.3 - 0.5 kg/unit copper, < 1 kg steel and aluminum, front cover (vary)
- CRT is dumped or exported
- Back cover, PCB and a part of whole CRT are exported
- Other small parts can be reused or disposed to landfill
- Rate of recycling is about 20% weight





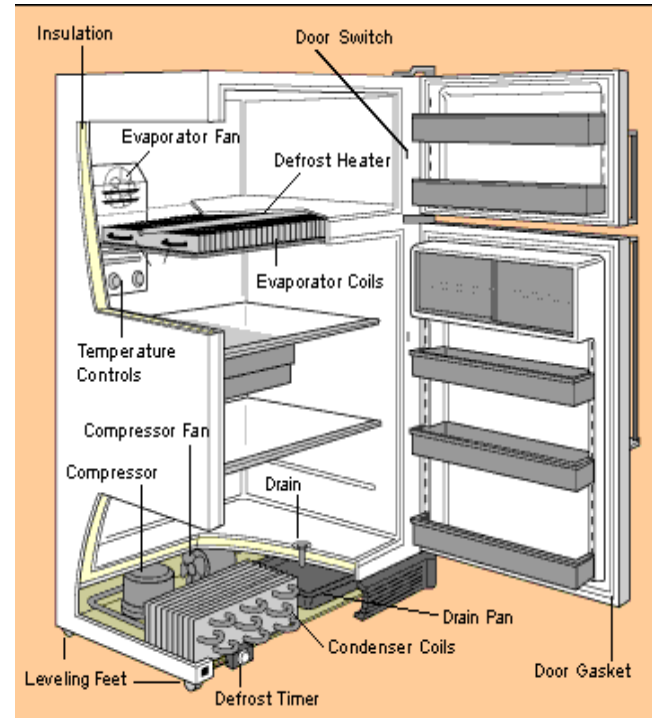
# Refrigerator



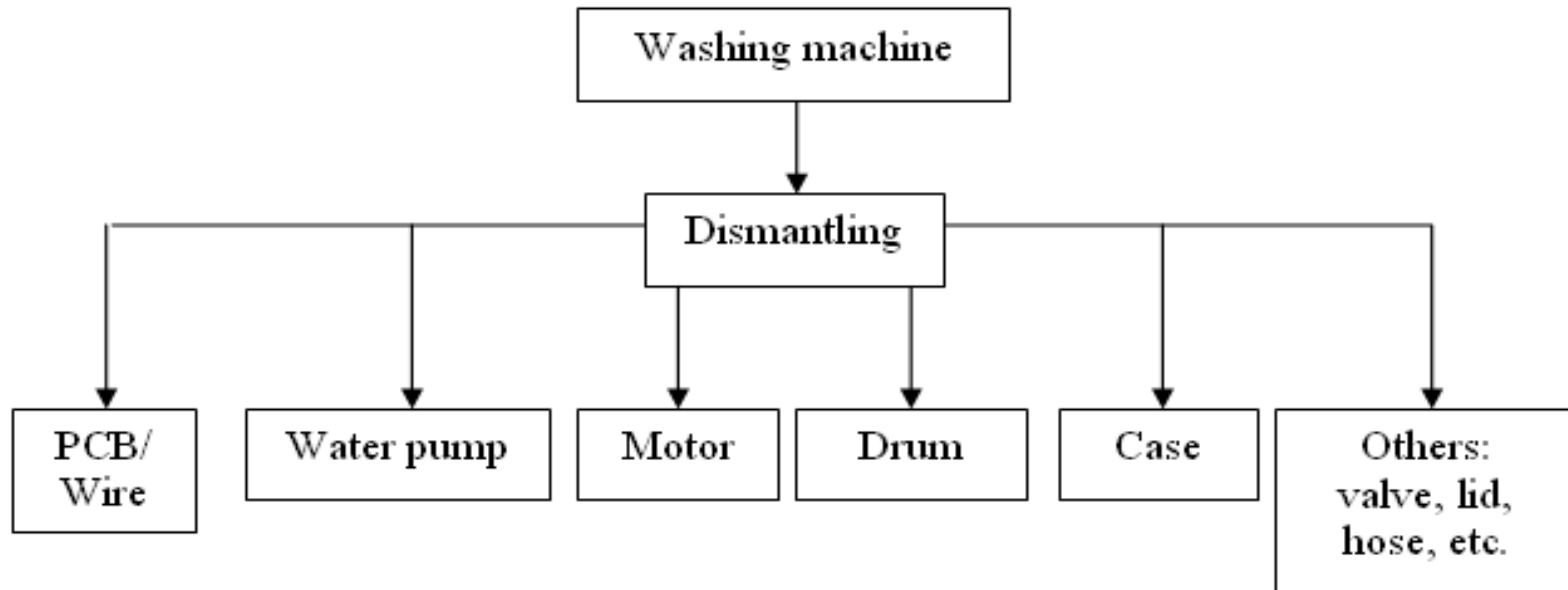
Type	80 liter	140 liter	200 liter
	Weight (in kg)		
<b>The whole</b>	~ 30	~ 40	~ 60
<b>Compressor</b>	~ 7	~ 10	~ 15
<b>Case</b>	~ 18	~ 20 - 22	~ 30 - 35
<b>Condenser</b>	~ 2	~ 3	~ 4
<b>Others</b>	~ 3	~ 5	~ 6

# Refrigerator

- Valuable recycling material: steel: 10-15 kg/unit, copper: 1.5 - 2 kg, aluminum < 1 kg
- Hard plastic > 10 kg can be exported or disposed
- Other small parts can be reused or dumped into landfill
- The recycling rate is about < 40 % weight



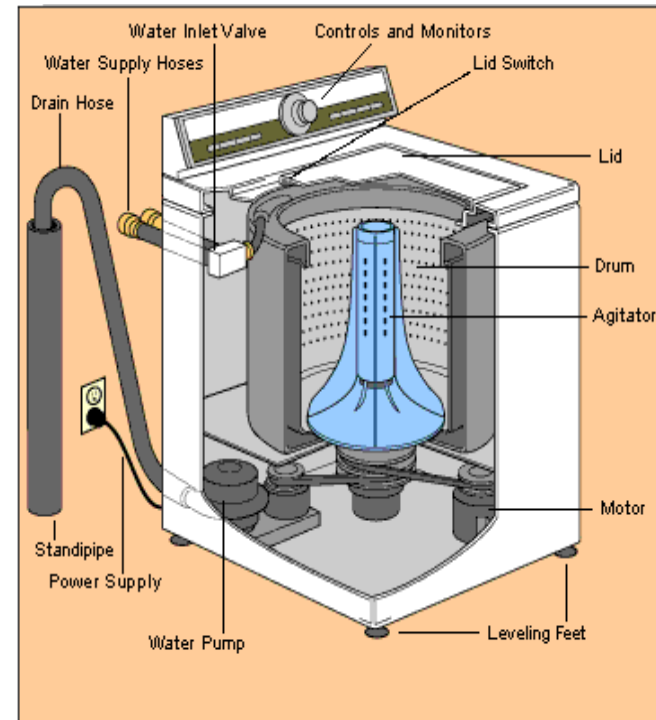
# Washing machine



Part	Total	PCB	Motor and pump	Drum and agitator	Case and hose	Wire
Weight (in kg)	~ 30	~ 0.5	~ 12	~ 5	~ 10	~ 0.5

# Washing machine

- Valuable recycling material: steel: ~ 10 kg/unit, copper: ~1 kg, aluminum ~ 0.5 - 1 kg
- Hard plastic ~ 10 kg can be exported or disposed
- Other small parts can be reused or dumped into landfill
- The recycling rate is about 30 % weight



# Air conditioner

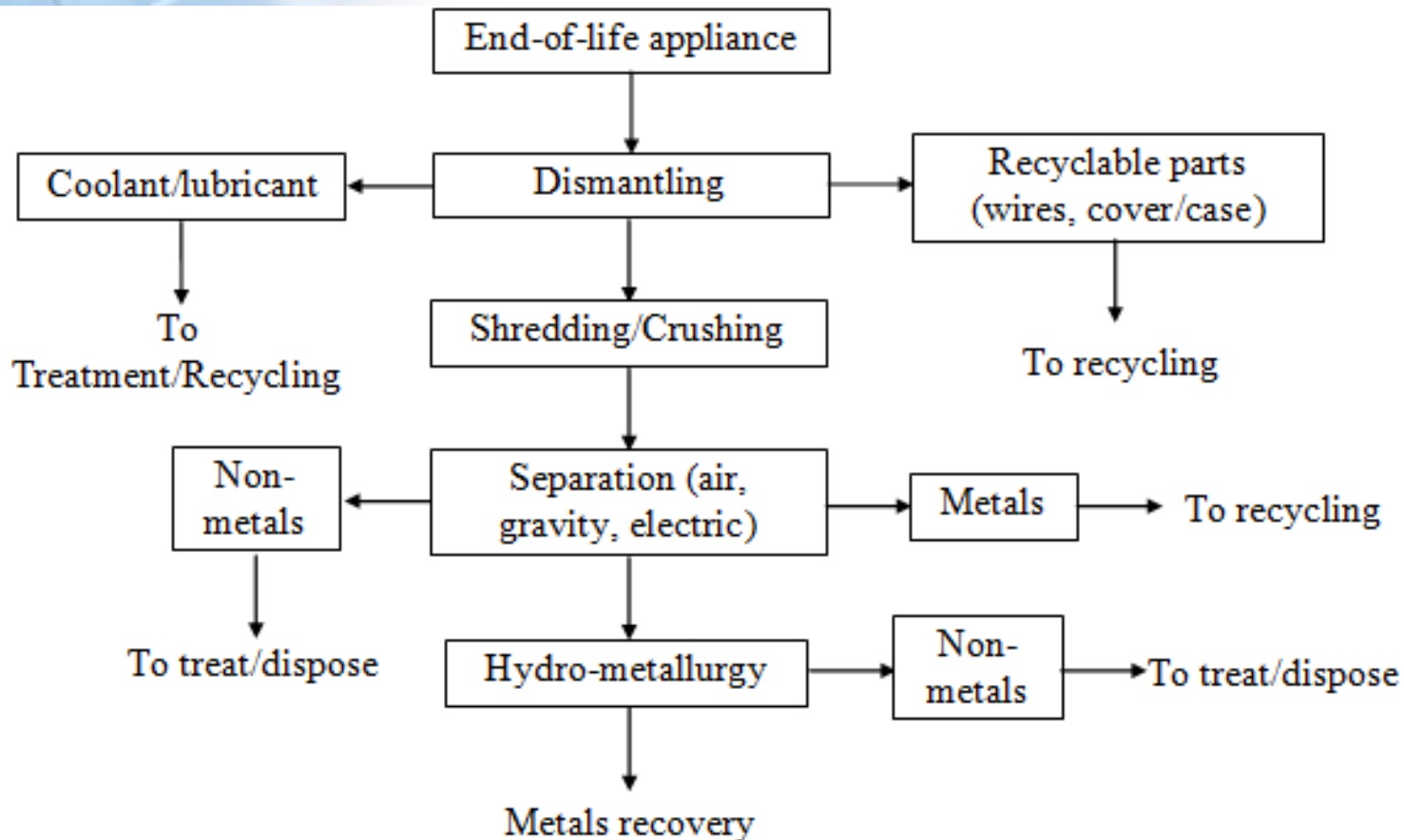
- Valuable recycling material:  
steel: up to 20 kg/unit, copper:  
~2 - 3 kg, aluminum < 1.5 kg
- Small amount of plastic can  
be recycled
- The recycling rate is about  
75 % weight



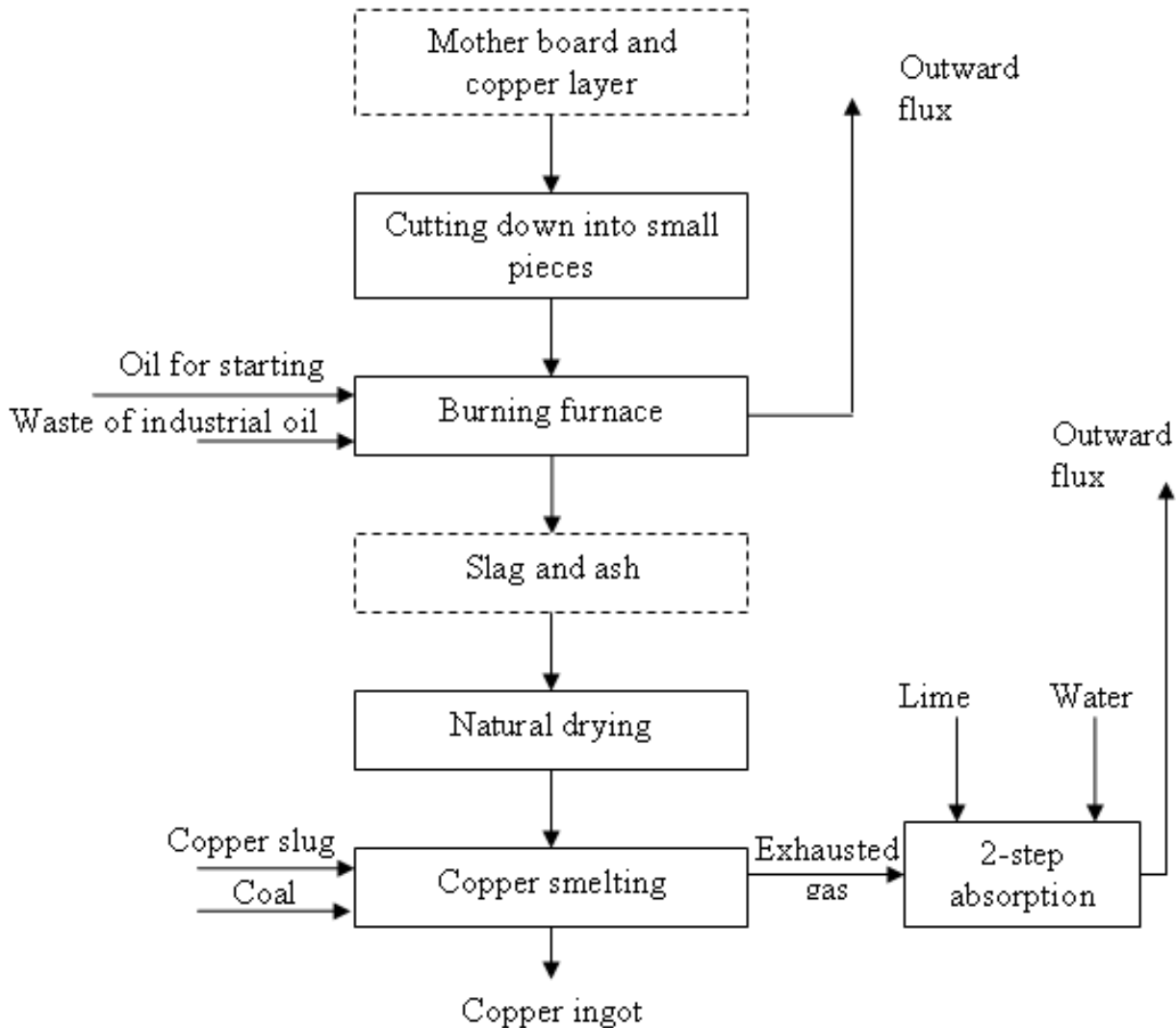
# Recycling

- Conducted by the craft village (private sector) and some producers that used e-waste as the secondary material source
- Conducted by informal and back-dated technology and equipment, which is effected to environment and public health, and produced low quality products
- It is lacked of research and research development for e-waste recycling
- Out of number of the licensed companies for e-waste treatment, there are only 3 companies have the possessing e-waste treatment line

# Common process for treatment/recycling of WEEE



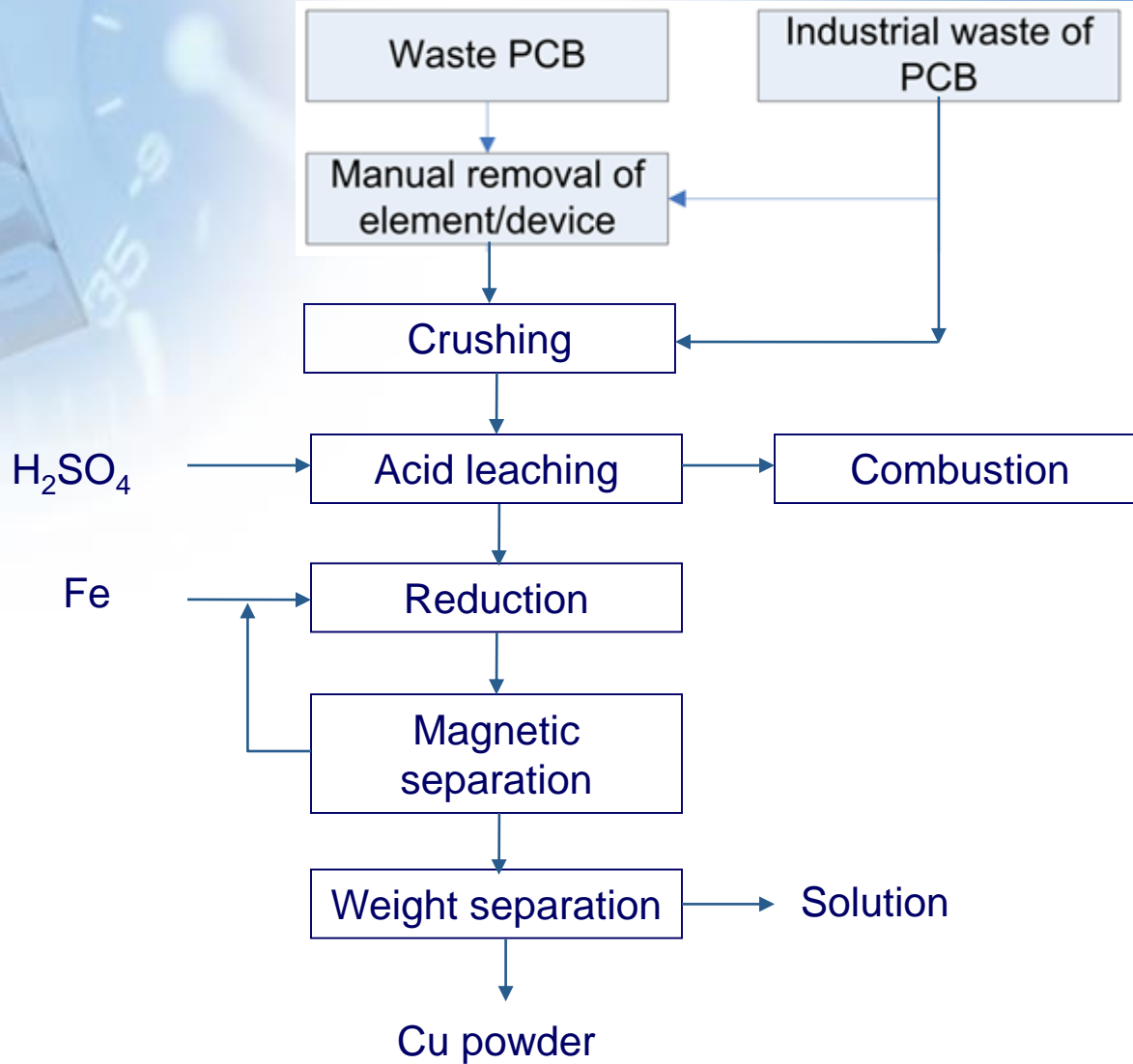
# Example (1): recycling process of WEEE



The common process for treat PCB and ribbon cable



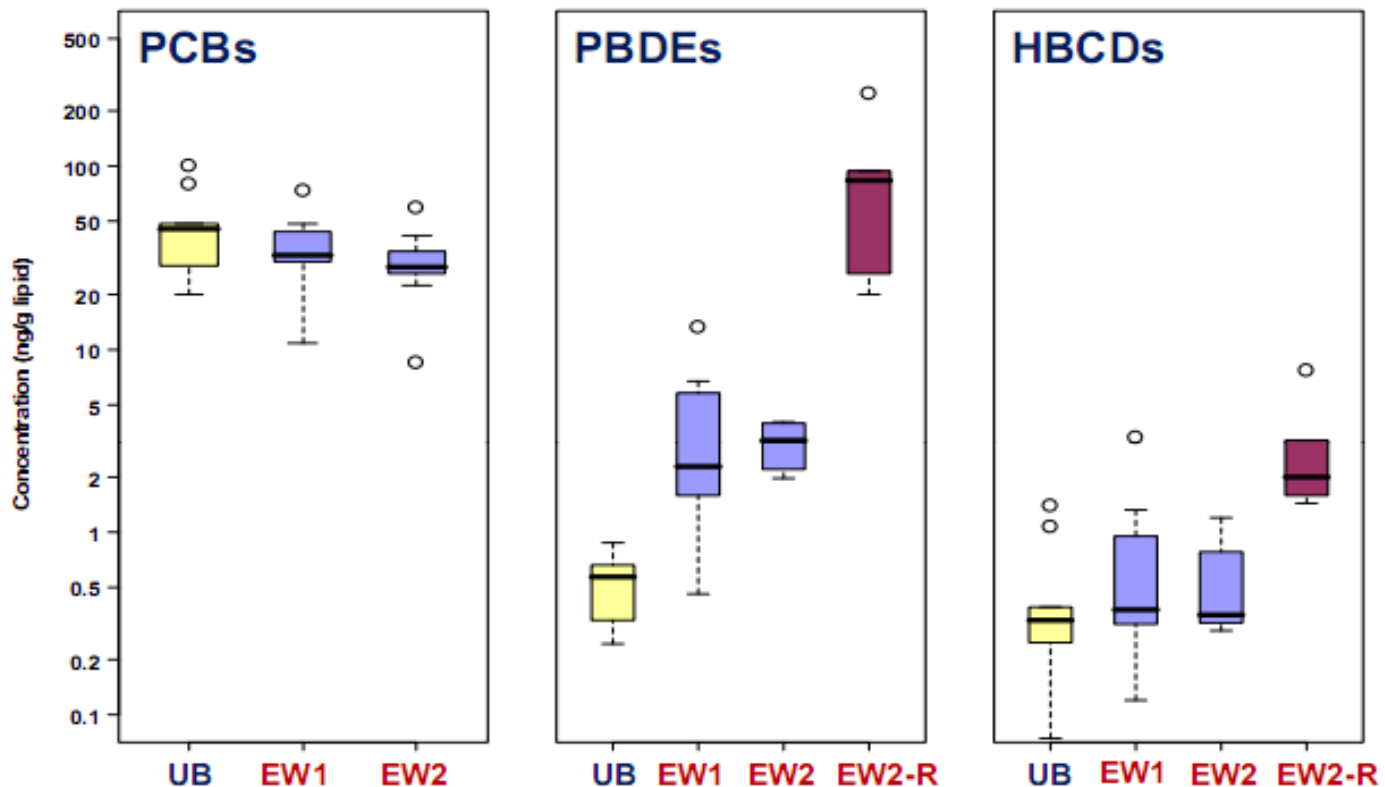
# Example (2): recycling process of WEEE



Common process for production of metal by-products from waste of PCB

# Environmental impact to the public health

## PCBs and BFRs in Human Milk



- PCBs are the most abundant contaminants but unrelated to e-waste
- High PBDE exposure in the EWRS, especially for EW2 recyclers
- Significant HBCD exposure only for EW2 recyclers



# Environmental impact



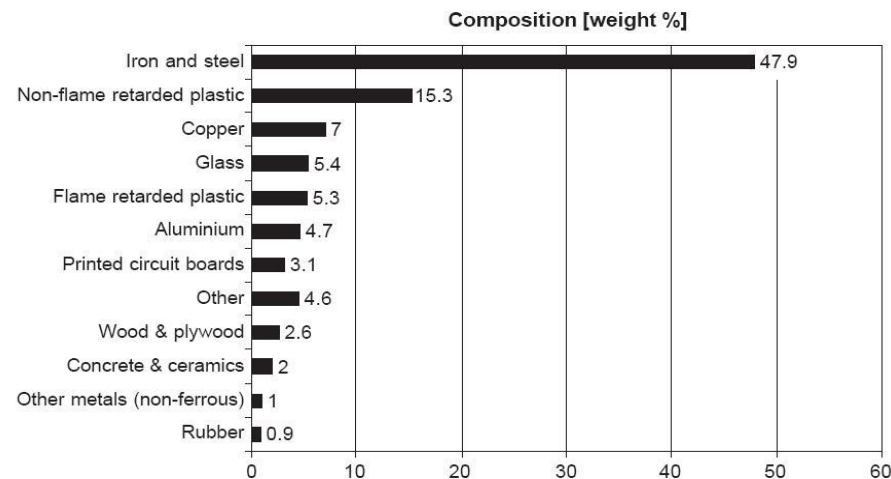


# Lost of natural resources

Hàm lượng trung bình của một số kim loại và phi kim trong chất thải điện tử

(Nguồn: Leo S. Morf et.al, Waste Management)

Kim loại/phi kim	Giá trị trung bình (mg/kg)
Al	49.000
Sb	1.700
Pb	2.900
Cd	180
Cr	9.900
Fe	360.000
Cu	41.000
Ni	10.300
Hg	0,68
Zn	5.100
Sn	2.400
Cl	9.600
P	360
PCB	13



WEEE material composition. (European Topic Centre on Resource and Waste Management).

Item	Au ppm	Ag ppm	Cu %	Pd ppm	Pb %	Bi %	Se %	Zn %	Cd %	Hg %	As %
MD Player	230	1,400	8.7	10	0.003	0.001	<0.001	0.022	0.002		<0.001
CD Player	130	1,210	5.5	6	0.180	0.002	0.001	0.003	0.002		0.010
Tape Recorder	40	850	8.2	6	0.140	0.004	0.004	0.008	<0.001		0.006
Digital Camera	170	500	5.6	4	0.020	0.040	<0.001	0.005	0.001		<0.001
Video Cam.	100	630	6.9	30	0.190	0.013	0.001	0.011	0.001	Tr.	0.014
Silicon Audio	500	2,400	11.3	50	0.400	0.003	0.001	0.011	0.002		0.023
Mobile Phone	400	2,300	17.2	100	0.37	0.02	<0.01	1.4	<0.01		0.003

Nguồn: DOWA Eco-system Co. Ltd, 2006

# Properties of Recycling system

- Dismantling is major activities:
  - Based on the private sector
  - The use of backward technology and rudimentary equipment;
  - The employment of manual labor;
  - Only treat the ordinary material
- The lack of proper environmental protection, which are considered as the cause of harmful effect on environment and public health.
- Separated with the science research

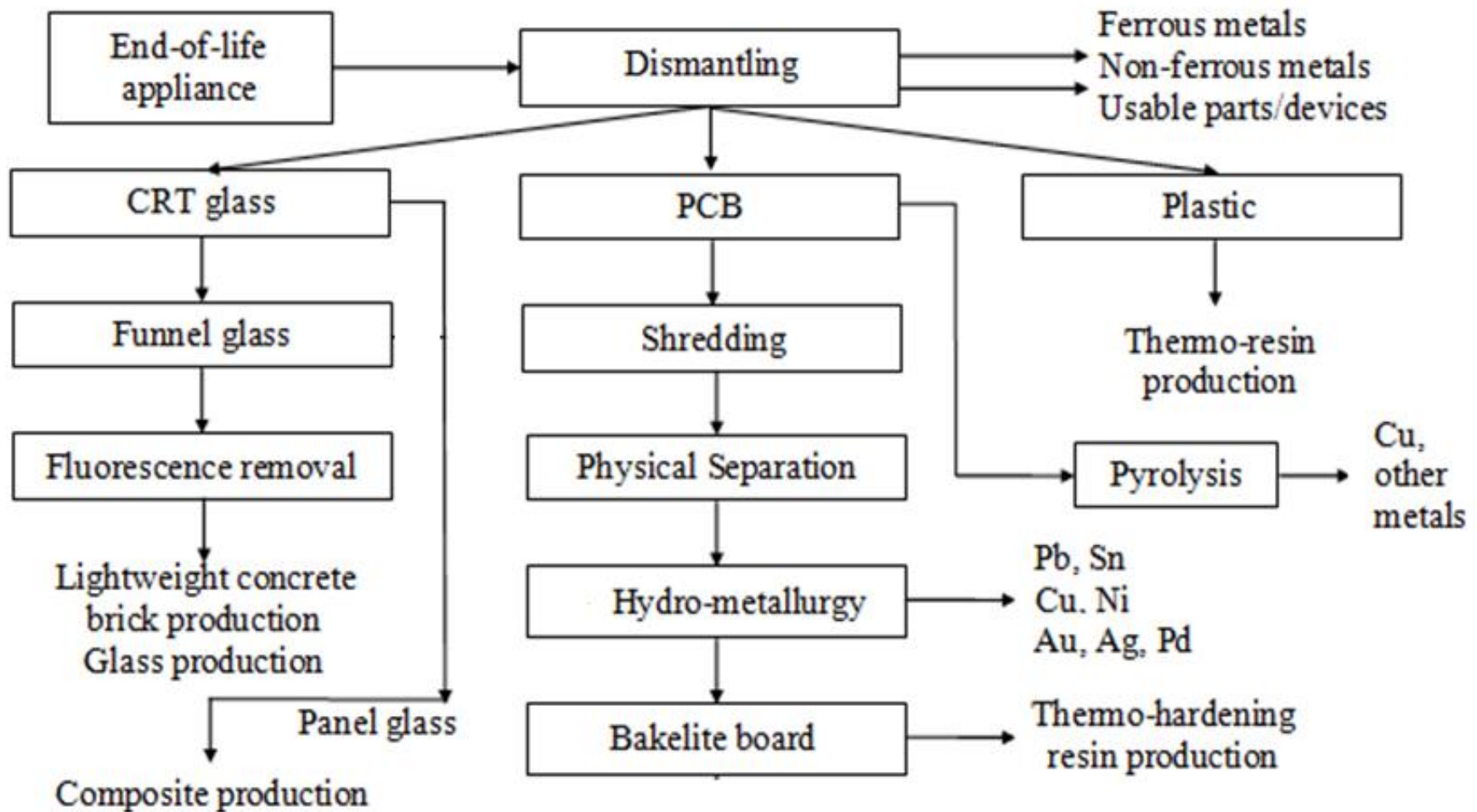


# The defined problems related to e-waste recycling

- Environmental impact to the public health in the dismantling process, which is done manually without any prevention manner
- Lost of natural resources due to ineffective recycling process
- Limit the development of environmental technology/industry.

**It is needed the proper recycling technology**

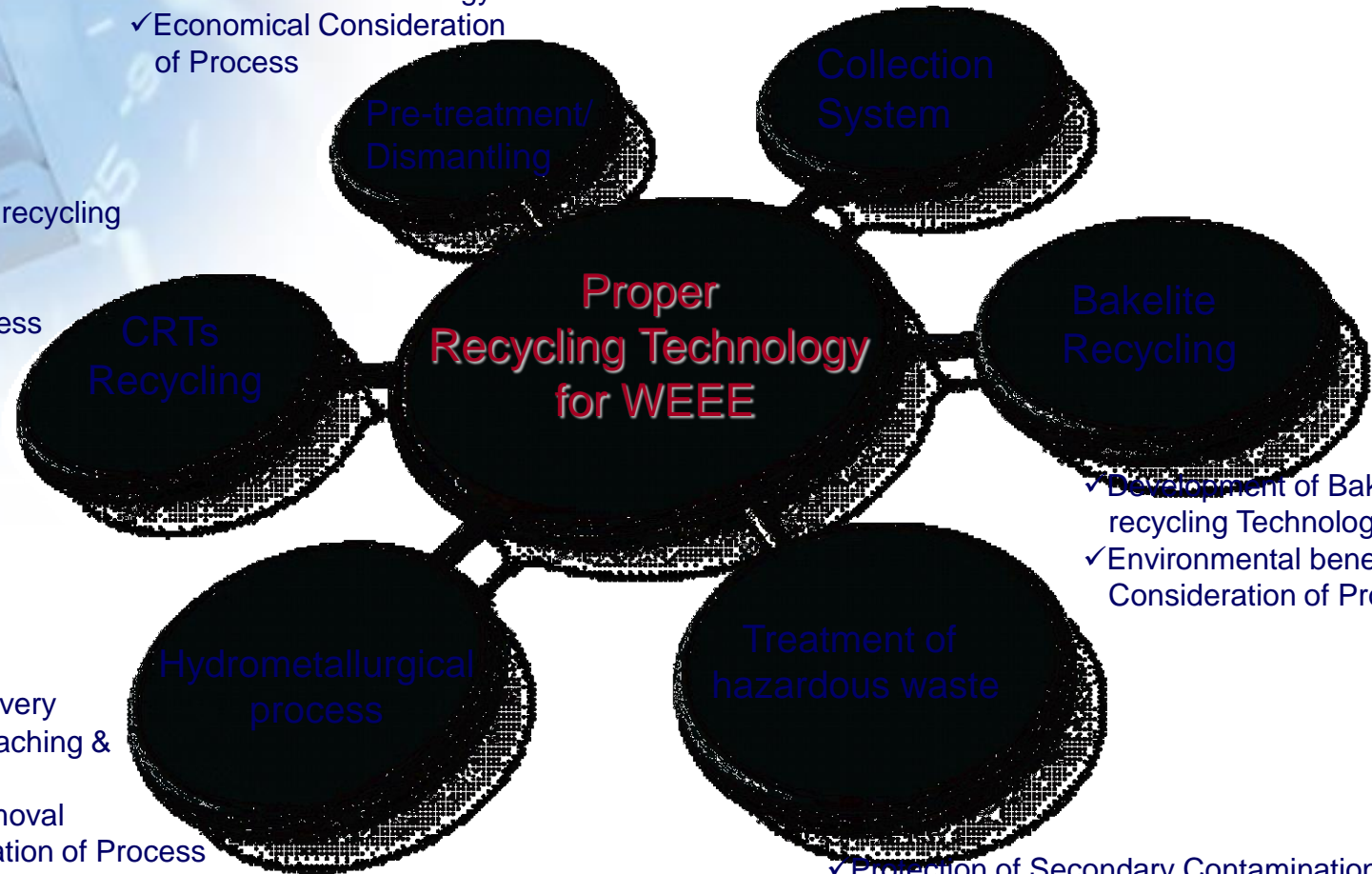
# III. PROPER RECYCLING TECHNOLOGY



# III. PROPER RECYCLING TECHNOLOGY

- ✓ Development of Effective Pretreatment Technology
- ✓ Economical Consideration of Process

- ✓ Construction of Collecting System
- ✓ Informatics of Discarding Step



- ✓ Development of glass recycling Technology
- ✓ Environmental benefit Consideration of Process

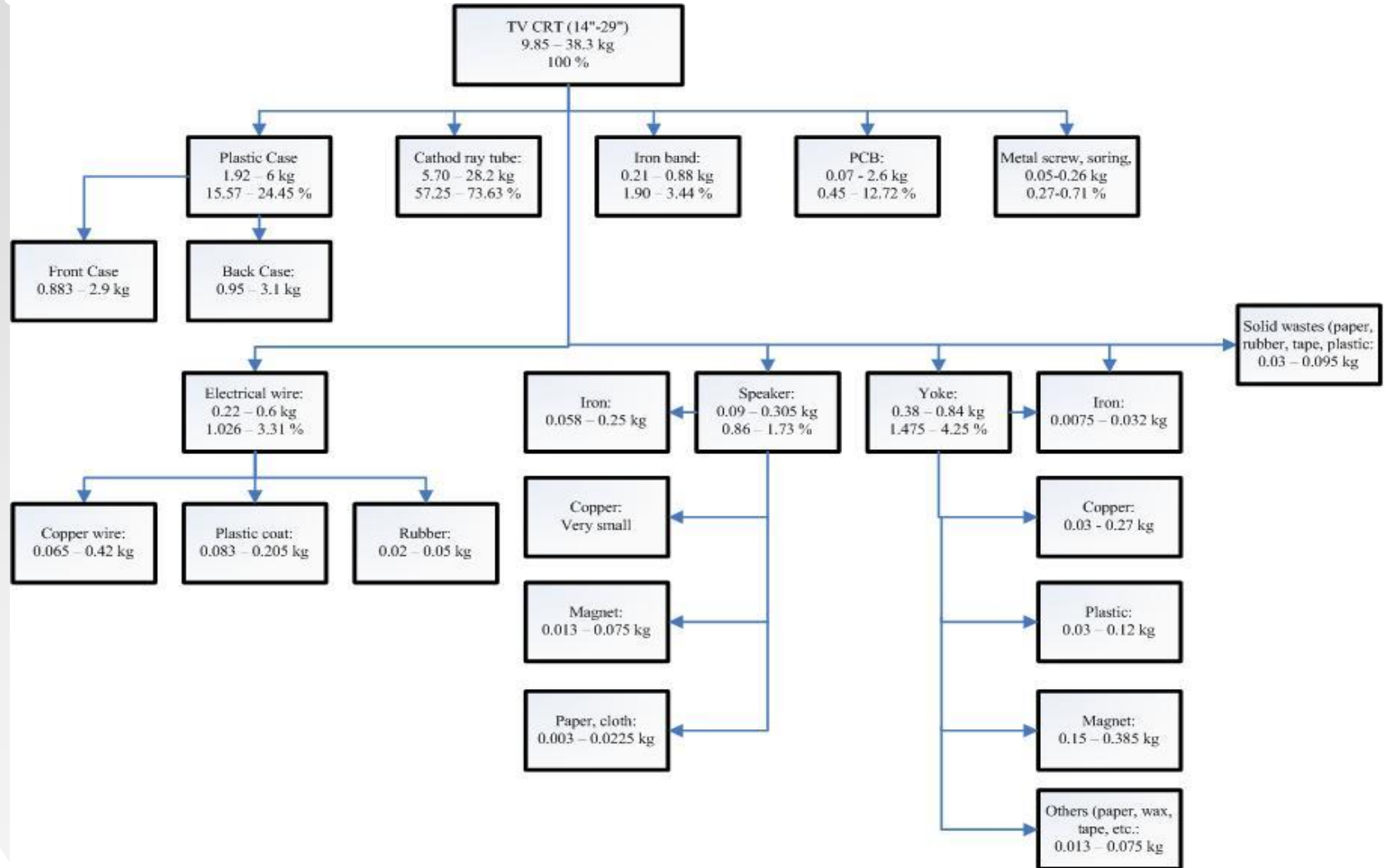
- ✓ Development of Bakelite recycling Technology
- ✓ Environmental benefit Consideration of Process

- ✓ Precious metals recovery
- ✓ Nonferrous metal Leaching & recovery
- ✓ Harmful Element Removal
- ✓ Economical Consideration of Process

- ✓ Protection of Secondary Contamination
- ✓ Economical Consideration of Process

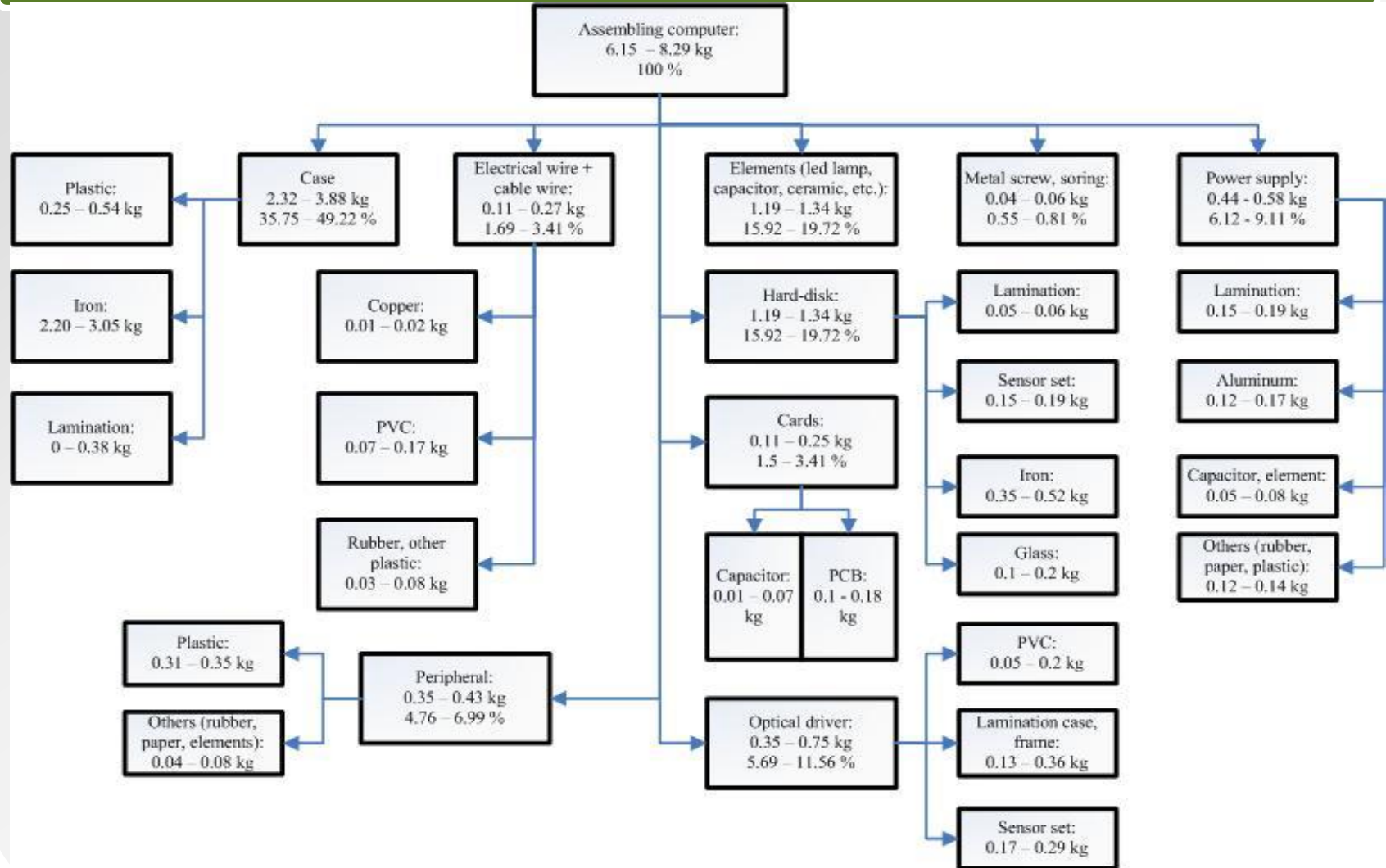
# III. PROPER RECYCLING TECHNOLOGY

## Pre-treatment / Dismantling of TV



# III. PROPER RECYCLING TECHNOLOGY

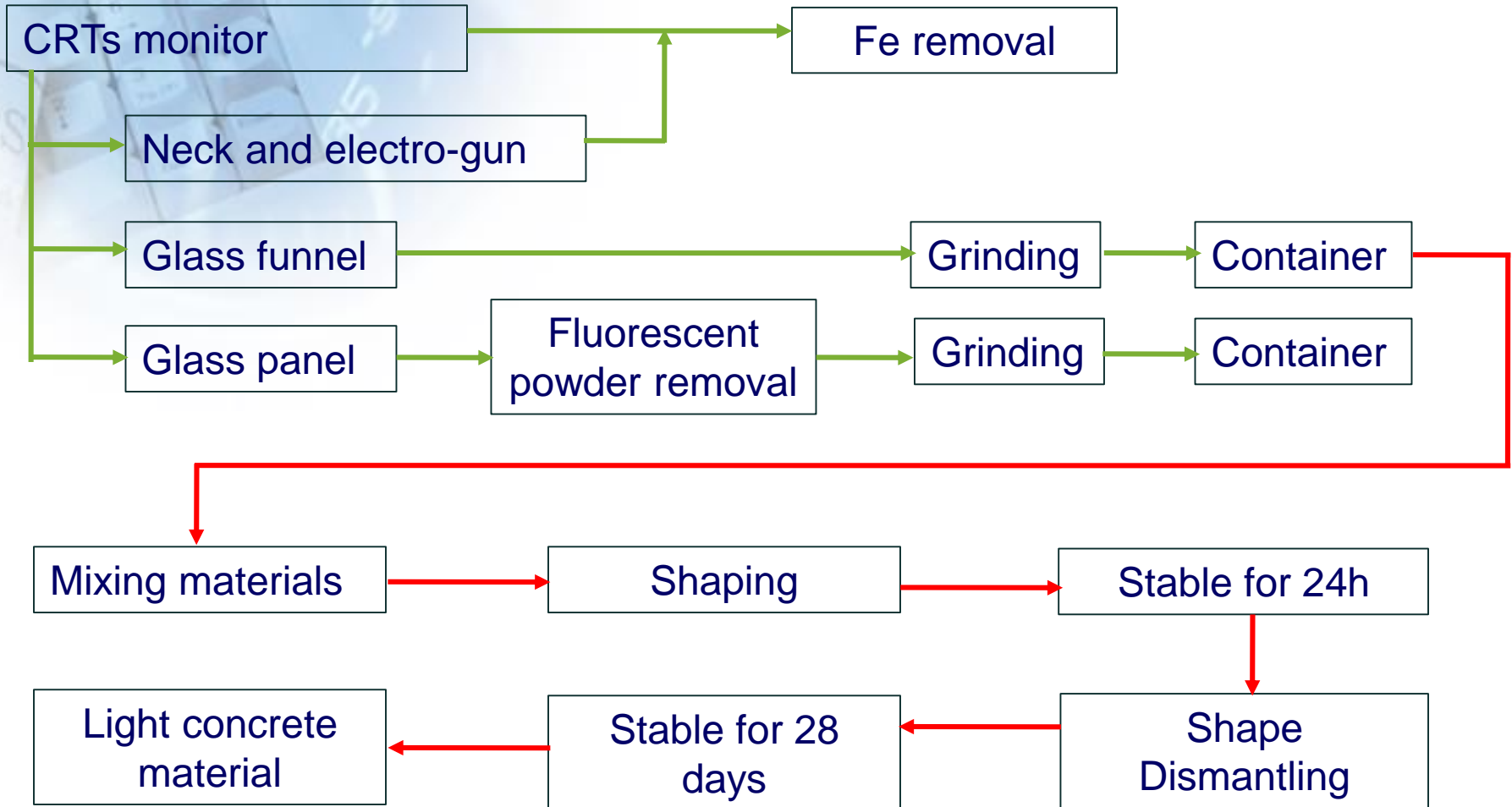
## Pre-treatment / Dismantling of PC





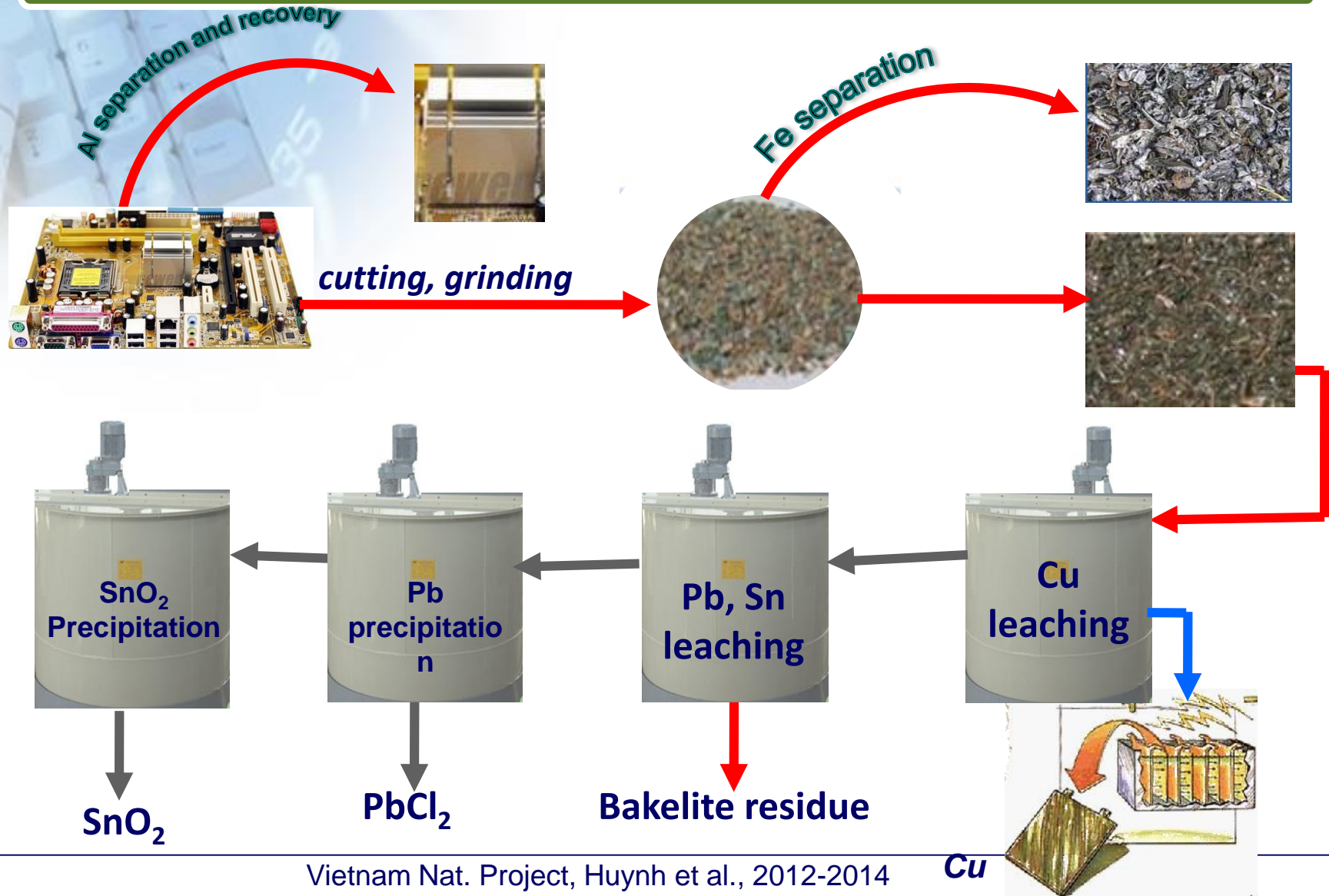
# III. PROPER RECYCLING TECHNOLOGY

## CRTs Recycling



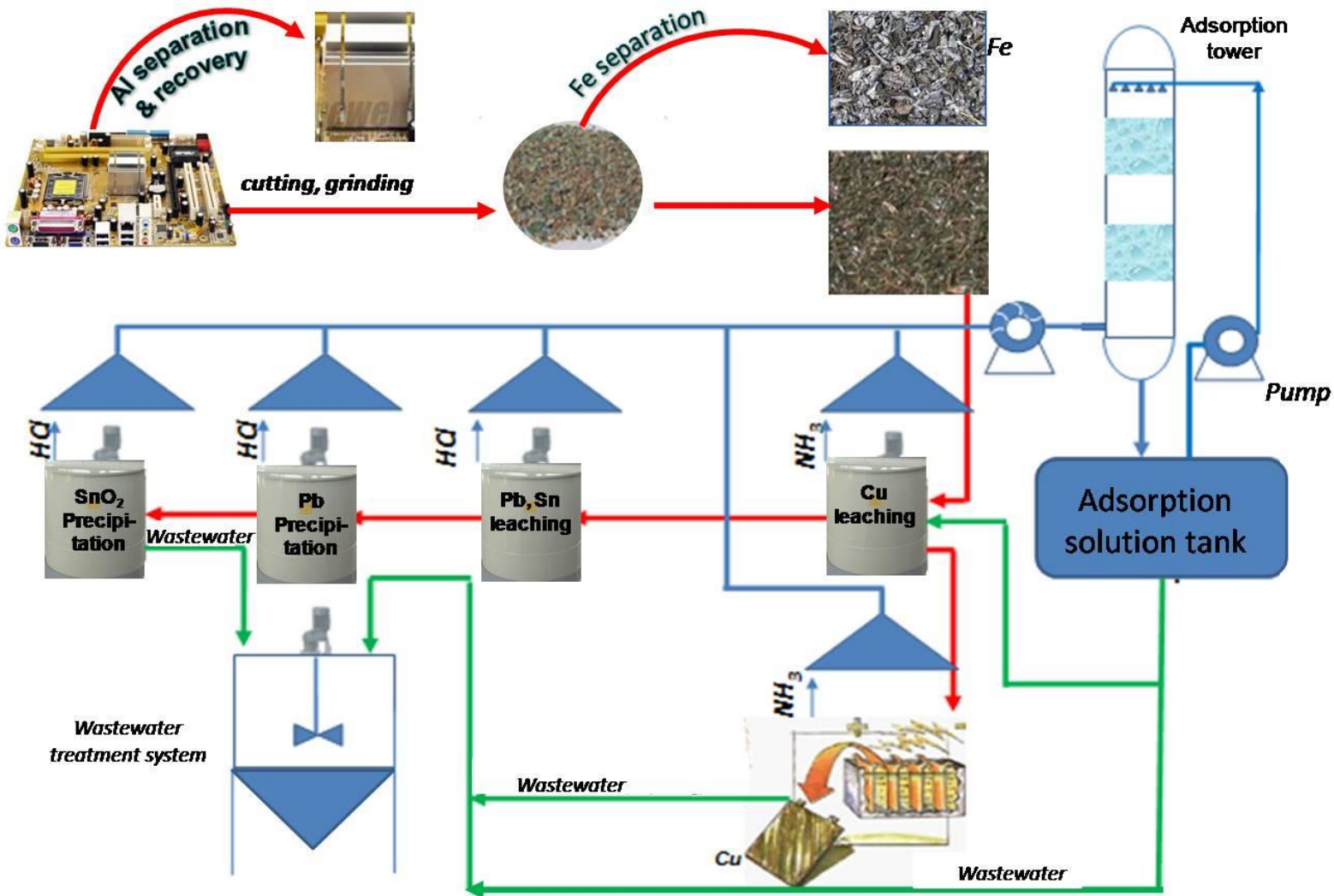
# III. PROPER RECYCLING TECHNOLOGY

## Hydrometallurgical process



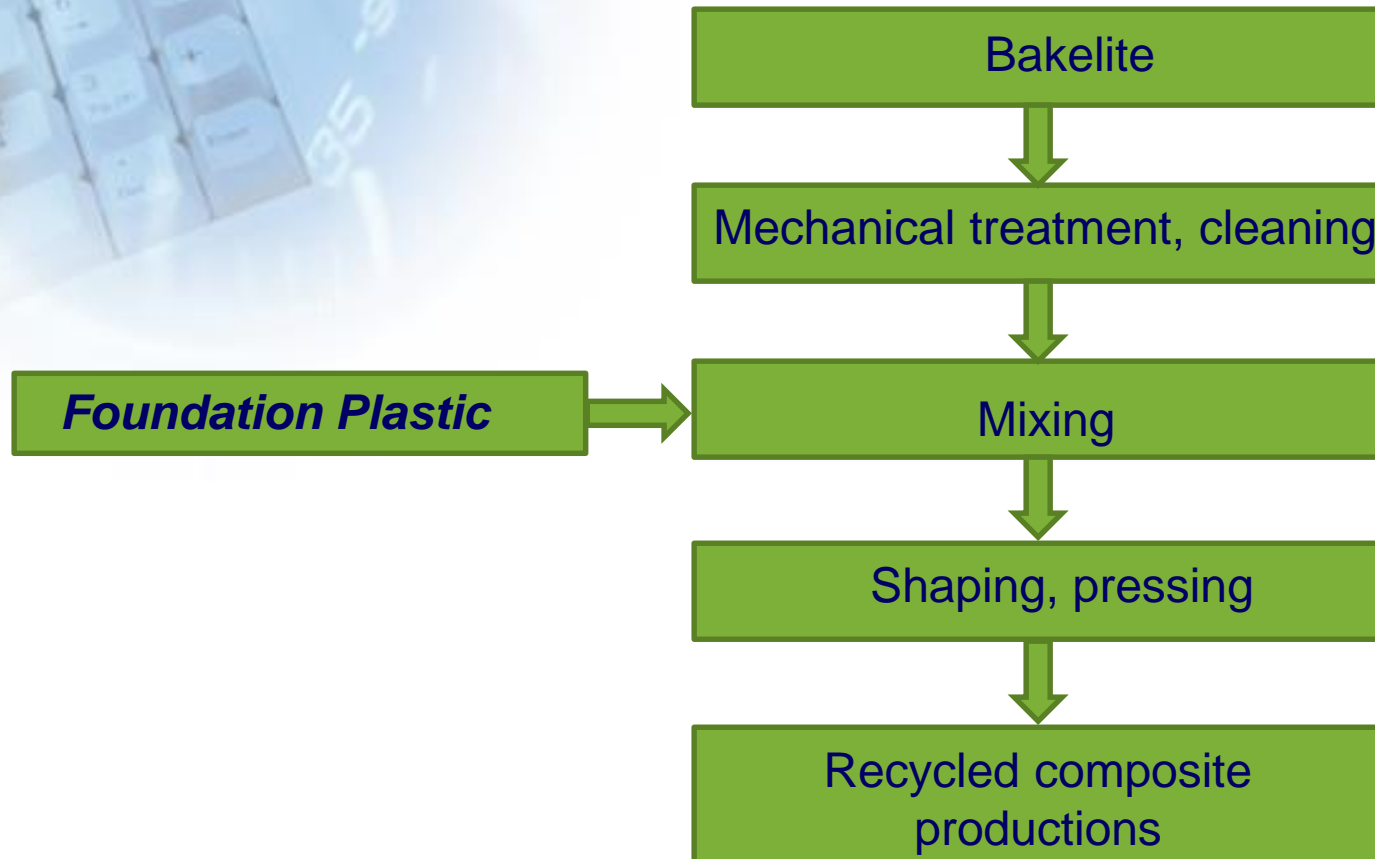
# III. PROPER RECYCLING TECHNOLOGY

## Treatment process of hazardous waste



# III. PROPER RECYCLING TECHNOLOGY

## Bakelite Recycling



# IV. CONCLUSION REMARKS

- E-waste is rising as emerge issue in Vietnam, due to its increasing rate and environmental impacts, and the co-benefits obtained from its treatment;
- Dismantling is major activities: based on the private sector; the use of backward technology and rudimentary equipment; only treat the ordinary material; harmful effect on environment and public health.
- Existing recycling process is ineffective, lost of natural resources;
- It is needed to develop the proper recycling technology.



The background of the slide features a blurred image of a computer keyboard on the left and a clock face in the center. The overall color scheme is light blue and white. On the right side, there are three overlapping blue arrow shapes pointing to the right. A thin blue horizontal line is located at the bottom of the slide.

Thank you for your attention !!