

BIAYA TAK TERLIHAT LISTRIK DARI BATUBARA

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180227**

**STANDAR LINGKUNGAN TERKINI
VS. PENINGKATAN BEBAN
LINGKUNGAN & KESEHATAN**

EKSTERNALITAS #1: PENCEMARAN UDARA

Fokus 2017: Pencemaran udara dari PLTU

- [PLTU Bauh](#), Sarolangun, Jambi (debu batubara dari bongkar muat)
- [PLTU Rum](#), Tidore, Maluku Utara (debu batubara dari bongkar muat)
- [PLTU Pacitan](#), Jawa Timur (kerusakan mesin, debu bongkar muat)
- [PLTU Cilacap](#), Jawa Tengah (asap dari cerobong, debu bongkar muat)
- [PLTU Cirebon](#), Jawa Barat (gugatan Izin Lingkungan, prakiraan DPH udara)
- [PLTU Indramayu](#), Jawa Barat (gugatan Izin Lingkungan, prakiraan DPH udara)
- [PLTU Papua 2 Hotelkamp](#), Jayapura (debu dari cerobong, hujan kotor)
- [PLTU Pangkalan Susu](#), Langkat, Sumatera Utara (debu bongkar muat, sesak nafas dan ISPA)
- [PLTU-IO Indominco Mandiri](#), Kalimantan Timur (debu cerobong, fly ash bottom ash)

Namun, KLHK melaporkan ketaatan PLTU-B 100% pada tahun 2017!

MENGAPA?

Standar lingkungan yang masih rendah (PermenLH No. 21/2008)

| | PM | SO ₂ | | NO _x | | Mercury |
|-----------|---|---------------------|--|---------------------|---------------------------------------|-------------------|
| | | New plants | Existing plants | New plants | Existing plants | |
| EU | 50–100 | 200 | 400 | 200 (after 2015) | 500 (till 2015) | 0.03 (Germany) |
| US | 22.5 | 160 (after 2005) | 160 (1997–2005); | 117 | 117 (after 2005); 160 (1997–2005); | 0.001–0.006 |
| China | 30 | 100 | 200; 400* | 100 | 100 (2004–11); 200 (before 2004) | 0.03 |
| India | 100 (till 2003); 50 (2004–16); 30 | 100 | 600 (< 500 MW); 200 (> = 500 MW) | 100 | 600 (till 2003); 300 (2004–16) | 0.03 |
| Indonesia | 150–100 | 750 | 750 | 850 | 750 | None |

Unit: mg/Nm³

*SO₂ standards of 400 mg/m³ for four provinces with high sulphur coal

Source: World Resources Institute Asia. Environmental Science and Technology.

MENGAPA? (2)

Pengendalian terhadap emisi fugitif / debu larian lemah (i.e. dari bongkar muat batubara, kolam abu)

Monitoring yang masih lemah – *continuous emission monitoring system*

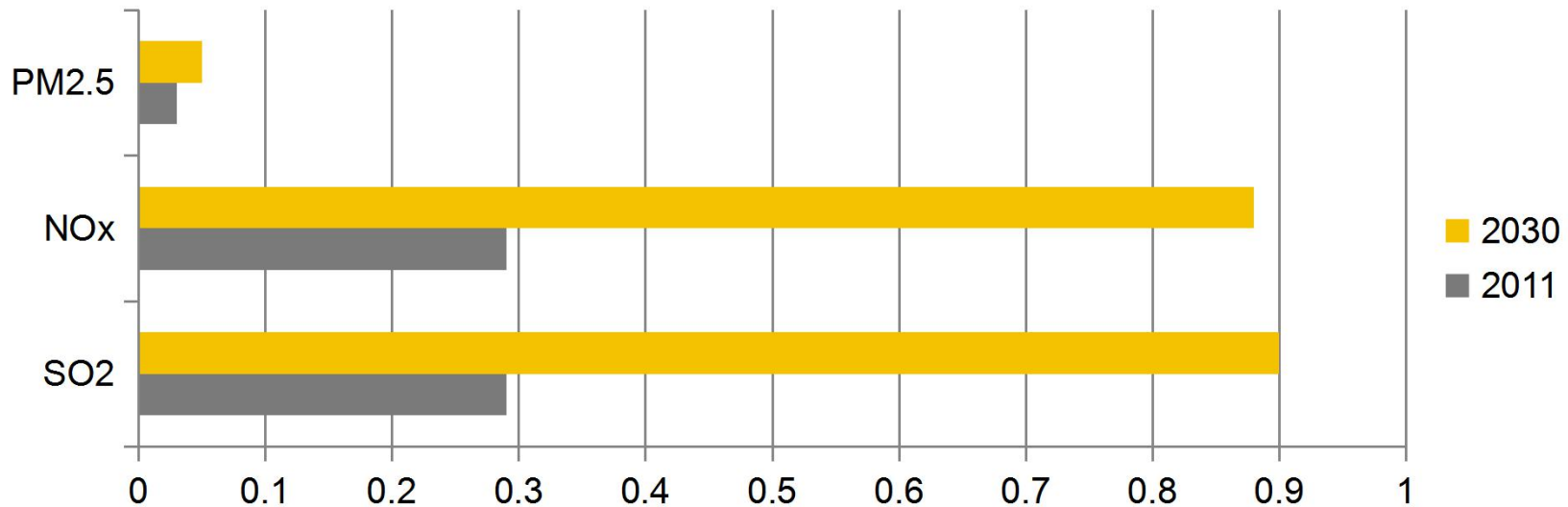
- Swapantau dilakukan secara manual, unit kecil (< 25MW) tidak memiliki CEMS
- CEMS tidak terkalibrasi
- CEMS rusak
- CEMS tidak terkoneksi dengan sistem pengawas (i.e. DLH)

| No. | Nama Perusahaan | Kapasitas Terpasang (MW) | Tahun operasi | Produksi 2015 (MWh) | Alat PPU | Konsentrasi Emisi 2014-2015 (mg/m3) | | | | | |
|-----|---|--------------------------|---------------|---------------------|--------------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | | | | | | Partikulat | | SO2 | | NO2 | |
| | | | | | | Emisi | Baku Mutu Emisi | Emisi | Baku Mutu Emisi | Emisi | Baku Mutu Emisi |
| 2 | PT. B (PLTU Paiton) | 800 | | 5,105,722 | | | | | | | |
| | Unit #1 | 400 | 1994 | 2,751,375 | ESP | 39,17 - 90,15 | 150 | 130,5 - 617,5 | 750 | 64,3 - 104,5 | 850 |
| | Unit #2 | 400 | 1995 | 2,354,347 | ESP | 62,92 - 111,25 | 150 | 95,35 - 576,5 | 750 | 68,15 - 114,75 | 850 |
| 3 | PT. C (PLTU Tanjung Jati B) | 2840 | | 18,349,824 | | | | | | | |
| | Unit #1 | 710 | 2006 | 4,266,767 | ESP; FGD; Low NOx burner | 1,03 - 5,08 | 150 | 97 - 523 | 750 | 215 - 456 | 850 |
| | Unit #2 | 710 | 2006 | 4,555,389 | | 0,77 - 6,10 | 150 | 100 - 467 | 750 | 246 - 486 | 850 |
| | Unit #3 | 710 | 2012 | 4,603,673 | | 18,7 - 58,2 | 150 | 3,13 - 131,4 | 750 | 66,1 - 280,5 | 850 |
| | Unit #4 | 710 | 2012 | 4,923,996 | | 12,94 - 56,6 | | 2,15 - 97,3 | 750 | 83,5 - 443,2 | |
| 4 | PT. D (PLTU 2 Jawa Tengah, Cilacap/Karang Kandri) | 600 | | | | | | | | | |
| | Unit #1 | 300 | 2006 | 1,902,195 | ESP; Low NOx burner | 78,35 - 149,09 | 150 | 123,08 - 228,97 | 750 | 168,3 - 473,58 | 850 |
| | Unit #2 | 300 | 2006 | 1,668,421 | | | | | | | |
| 5 | PT. E (PLTU Paiton 9) | 660 | 2012 | 4,138,488 | ESP | 51,3 - 63,7 | | 50,4 - 715,7 | 750 | 69,7 - 191,4 | |
| 6 | PT. I (PLTU Paiton 3) | 815 | 2012 | 5,121,242 | ESP | 0,8 - 37,23 | | 0,01 - 22,36 | | 111,45 - 215,58 | |

| A | B | C | D | E | F | G | H | |
|-----|----|------------------|-----------------------------|--------|----|-----|--------|----------------------|
| 107 | 2 | Triwulan IV 2012 | Tuesday, October 2, 2012 | 265.69 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 108 | 3 | Triwulan IV 2012 | Wednesday, October 3, 2012 | 220.29 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 109 | 4 | Triwulan IV 2012 | Thursday, October 4, 2012 | 323.44 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 110 | 5 | Triwulan IV 2012 | Friday, October 5, 2012 | 232.25 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 111 | 6 | Triwulan IV 2012 | Saturday, October 6, 2012 | 170.57 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 112 | 7 | Triwulan IV 2012 | Sunday, October 7, 2012 | 166.71 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 113 | 8 | Triwulan IV 2012 | Monday, October 8, 2012 | 130.43 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 114 | 9 | Triwulan IV 2012 | Tuesday, October 9, 2012 | 119.29 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 115 | 10 | Triwulan IV 2012 | Wednesday, October 10, 2012 | 137.86 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 116 | 11 | Triwulan IV 2012 | Thursday, October 11, 2012 | 270.74 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 117 | 12 | Triwulan IV 2012 | Friday, October 12, 2012 | 591.59 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 118 | 13 | Triwulan IV 2012 | Saturday, October 13, 2012 | 320.48 | 24 | 150 | mg/Nm3 | PerMen LH No.21 2008 |
| 119 | 14 | Triwulan IV 2012 | Sunday, October 14, 2012 | | | | | |
| 120 | 15 | Triwulan IV 2012 | Monday, October 15, 2012 | | | | | |
| 121 | 16 | Triwulan IV 2012 | Tuesday, October 16, 2012 | | | | | |
| 122 | 17 | Triwulan IV 2012 | Wednesday, October 17, 2012 | | | | | |
| 123 | 18 | Triwulan IV 2012 | Thursday, October 18, 2012 | | | | | |
| 124 | 19 | Triwulan IV 2012 | Friday, October 19, 2012 | | | | | |
| 125 | 20 | Triwulan IV 2012 | Saturday, October 20, 2012 | | | | | |
| 126 | 21 | Triwulan IV 2012 | Sunday, October 21, 2012 | | | | | |
| 127 | 22 | Triwulan IV 2012 | Monday, October 22, 2012 | | | | | |
| 128 | 23 | Triwulan IV 2012 | Tuesday, October 23, 2012 | | | | | |
| 129 | 24 | Triwulan IV 2012 | Wednesday, October 24, 2012 | | | | | |
| 130 | 25 | Triwulan IV 2012 | Thursday, October 25, 2012 | | | | | |
| 131 | 26 | Triwulan IV 2012 | Friday, October 26, 2012 | | | | | |
| 132 | 27 | Triwulan IV 2012 | Saturday, October 27, 2012 | | | | | |
| 133 | 28 | Triwulan IV 2012 | Sunday, October 28, 2012 | | | | | |
| 134 | 29 | Triwulan IV 2012 | Monday, October 29, 2012 | | | | | |

REDUKSI EMISI PERLU BME BARU!

- **Perkiraan kontribusi emisi dari PLTU-B pada 2011:** 30.000 ton PM 2,5 dan 290.000 ton SO₂ dan NO_x.
- **Dengan standar ini, pertumbuhan emisi tinggi:** penambahan 3x lipat untuk SO₂, 2x lipat PM 2,5 pada 2030



Source: Koplitz, Shannon N., et al. "Burden of Disease from Rising Coal-Fired Power Plant Emissions in Southeast Asia." *Environmental Science & Technology* (2017).

ONGKOS KESEHATAN (PM 2.5)

| CURRENT IMPACTS | PM2.5 exposure to adults | | | | | | PM2.5 exposure to children | Ozone exposure to adults | TOTAL | Confidence interval (95%) | |
|---|--------------------------|------------------------|---------------------------------------|-------------|---|-------|------------------------------|--------------------------|-------|---------------------------|-------|
| | Stroke | Ischemic Heart Disease | Chronic Obstructive Pulmonary Disease | Lung Cancer | Other cardiovascular and respiratory diseases | Total | Lower Respiratory Infections | Respiratory diseases | | LOWER | UPPER |
| Within Indonesia | 2681 | 2315 | 380 | 323 | 179 | 5878 | 115 | 480 | 6473 | 3700 | 9500 |
| Total including impacts outside Indonesia | 2761 | 2459 | 427 | 347 | 185 | 6180 | 118 | 801 | 7099 | 3900 | 10500 |

Table 1.1 Estimated Current Impacts of Indonesia's Coal-Fired Power Plants

| PROJECTED IMPACTS | PM2.5 exposure to adults | | | | | | PM2.5 exposure to children | Ozone exposure to adults | TOTAL | Confidence interval (95%) | |
|---|--------------------------|------------------------|---------------------------------------|-------------|---|-------|------------------------------|--------------------------|-------|---------------------------|-------|
| | Stroke | Ischemic Heart Disease | Chronic Obstructive Pulmonary Disease | Lung Cancer | Other cardiovascular and respiratory diseases | Total | Lower Respiratory Infections | Respiratory diseases | | LOWER | UPPER |
| Within Indonesia | 6590 | 5632 | 935 | 792 | 440 | 14388 | 282 | 1050 | 15719 | 8900 | 23100 |
| Total including impacts outside Indonesia | 7581 | 7812 | 1801 | 1057 | 545 | 18796 | 407 | 2027 | 21231 | 11800 | 31300 |

Table 1.2 Projected Impacts of New Projects

STUDI KASUS: INDRAMAYU

2 X 1.000 MW

| | Health effects | Operating units | | New units | |
|-------------------------|--|-----------------|--------------------|------------|-------------------|
| | | units | 95% CI | units | 95% CI |
| PM2.5, premature deaths | Lower Respiratory Infections (infants) | 40 | (10-100) | 10 | (0-20) |
| | Lung cancer | 60 | (20-90) | 30 | (10-50) |
| | Other cardiovascular diseases | 170 | (110-240) | 60 | (40-80) |
| | Ischemic heart disease | 490 | (320-670) | 160 | (100-210) |
| | Stroke | 560 | (350-780) | 190 | (120-270) |
| | Other respiratory disease | 60 | (40-90) | 20 | (10-30) |
| | Chronic obstructive pulmonary disease | 80 | (50-110) | 30 | (20-40) |
| | PM2.5 Total | 1470 | (900-2080) | 500 | (300-700) |
| NO2, premature deaths | All causes | 1210 | (470-1740) | 330 | (130-470) |
| Premature deaths | Total | 2280 | (1210-3240) | 720 | (390-1010) |
| PM2.5 | Low birth weight births | 750 | (230-1300) | 160 | (50-280) |

Sumber: Millyvirta & Chuwah (2017) Keterangan Ahli dalam Gugatan SK Izin Lingkungan PLTU-B Indramayu

STUDI KASUS: INDRAMAYU

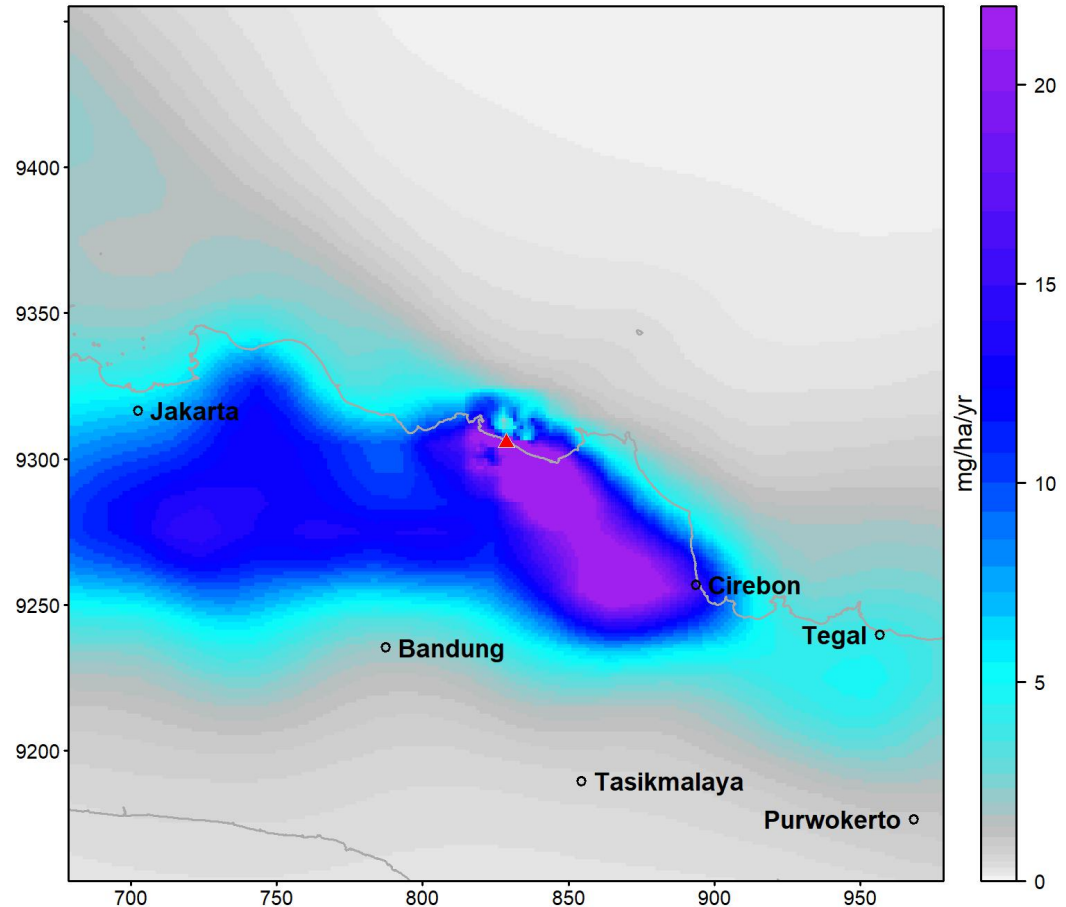
2 X 1.000 MW

*“Most intense acid and fly ash deposition would take place to the south of the plant, **with deposition in the most affected areas exceeding 15kg of SO₂-equivalent per hectare and 3kg of fly ash per hectare per year** (Figure 9 and Figure 10).*

*Also, total mercury deposition on land from the existing plant **exceed 18 kg per year** Southwest of Indramayu (Figure 11). [...] Mercury deposition rates as low as 125mg/ha/year can lead to accumulation of unsafe levels of mercury in fish (Swain et al 1992). The predicted deposition from the existing and new plants exceed this rate in the most affected regions highlighted above.”*

Sumber: Millyvirta & Chuwah (2017)
Keterangan Ahli dalam Gugatan SK Izin Lingkungan PLTU-B Indramayu

Annual total mercury deposition from Indramayu old and new units



REVISI PERMENLH 21/2008

Usulan nilai BME PLTU-B Pasca KP ESDM (Februari 2018)

| No. | Parameter | Kategori I (Perencanaan dan/atau operasi setelah Permen ini disahkan) | Kategori II (Beroperasi setelah Permen ini disahkan) |
|-----|-----------------|---|--|
| 1. | SO ₂ | 550 | 200 |
| 2. | NO _x | 550 | 200 |
| 3. | PM | 100 | 75 |
| 4. | Hg | 0,03 | 0,03 |

Usulan nilai BME PLTU-B Pasca KP Industri (Desember 2017)

| No. | Parameter | Kategori I (Operasi sebelum 1 Des 2008) | Kategori II (Operasi setelah 1 Januari 2009 s.d. 31 Desember 2020) | Kategori III (Operasi setelah 1 Januari 2021) |
|-----|-----------------|---|---|---|
| 1. | SO ₂ | 550 | 400 | 100 |
| 2. | NO _x | 550 | 300 | 100 |
| 3. | PM | 75 | 50 | 30 |
| 4. | Hg | 0,03 | 0,03 | 0,03 |

PERKIRAAN BIAYA INSTALASI APC

Bergantung pada analisis armada & informasi detail mengenai teknologi PPU yang sudah terpasang

Pengurangan armada (0 investasi)

- **PLTU-B berumur > 25 tahun** (Total armada 1,7 GW): Biaya investasi APC (esp. SO_x dan NO_x) > benefit penurunan emisi selama sisa masa hidup
- **Unit < 100 MW (Total armada 2,1 GW)**: Biaya investasi APC > benefit penurunan emisi karena beban emisi relatif kecil

Unit ukuran menengah 1990-2005 / unit sedang pasca 2006

- Total armada 8,4 GW
- PM (ESP) 105-315 juta/MW;
- SO₂ (FGD) 525-630 juta / MW;
- NO_x (low NO_x burner, SCR) 210-315 juta / MW.
- **Total: 735-1.260 juta/MW** (asumsi penambahan FGD)

Unit baru besar (> 300 MW, pasca 2006)

- Armada 12 GW
- PM: 0 (sudah punya ESP)
- SO₂: 735-840 juta/MW (untuk yang belum punya FGD)
- NO_x: 21 juta/MW (upgrade low NO_x burner)
- **Total: 546-861 juta** (asumsi penambahan/upgrade FGD)

PERKIRAAN BIAYA RETROFIT EKSISTING

Total biaya retrofit untuk PLTU eksisting dengan asumsi instalasi ESP, FGD dan SCR (Greenpeace, 2017):

Rp 8,8 Triliun

Cat: Dengan instalasi FGD + SCR + ESP, performa yang dapat dicapai jauh di bawah standar norma usulan KLHK pasca KP dengan ESDM

EKSTERNALITAS #2: EKOSISTEM LAUT

Standar BMAL ke laut belum memperhitungkan logam berat dari FGD

- Arsenik, selenium, merkuri, nitrat mungkin muncul dalam air bahang, namun belum diatur dalam PermenLH 8/2009

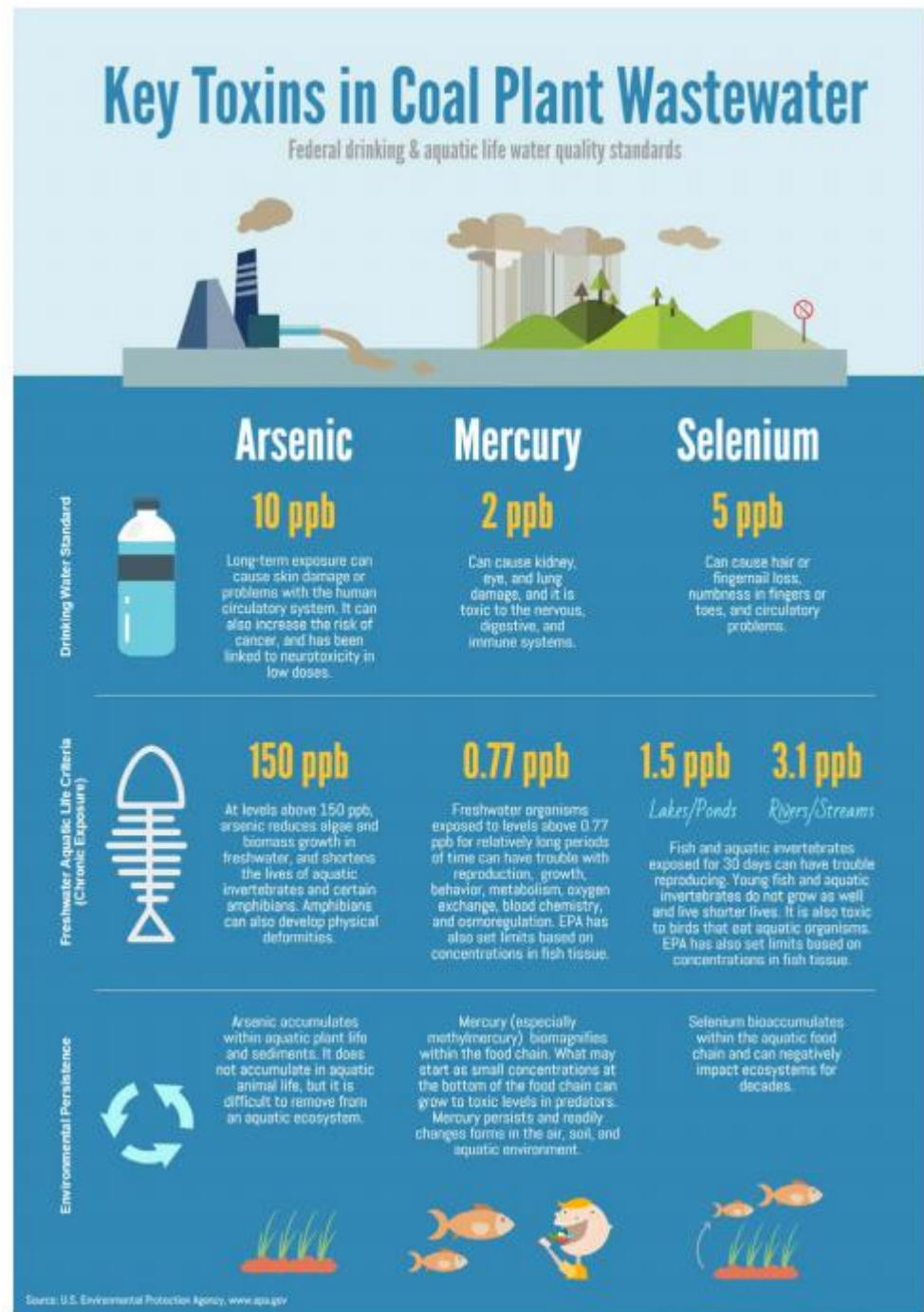
Teknologi pengambilan air pendingin menjebak dan menghancurkan jutaan biota laut

REGULASI US-EPA

"The most stringent options proposed, if finalized, would benefit our nation health, environment and economy.

- 1. These options would eliminate between 3.3 and 5.3 billion pounds of pollution per year*
- 2. Reduce the number of receiving waters that exceed water quality, wildlife, or human health criteria by 66 to 93 percent.*
- 3. Create millions of dollars in benefits every year in the form of improved health and recreational opportunities for all Americans, in addition to the incalculable benefits of clean and healthy watersheds.*
- 4. Cost less than one percent of annual revenue for most coal plants and at most about two pennies a day in expenses for ordinary Americans, if the utilities passed some of the treatment costs on to consumers."*

Sumber: Sierra Club (2013)



EKSTERNALITAS #3: LIMBAH B3 (FABA)

Abu batubara mengandung arsenik (As), barium (Ba), Berilium (Be), Cobalt (Co), Timbal (Pb) dan Mangan (Mn)

Termasuk Limbah B3 dalam PP No. 101/2014

- Dapat dimanfaatkan dengan Izin Pemanfaatan LB3 apabila lolos uji TCLP
- Pemanfaatan harus mengikuti PermenLH No. 2 Tahun 2008 tentang Pemanfaatan LB3, a.l. campuran semen, aspal, geopolimer, stabilisator tanah, batu bata, dll
- Penampungan FABA harus mengikuti standard teknis (i.e. *composite liners*)
 - Clay lines; landfills dimungkinkan; surface impoundments seharusnya tidak boleh untuk LB3

The CCW risk assessment suggests that the management of CCW in unlined landfills and unlined surface impoundments may present risks to human health and the environment.

Selenium in certain types of WMUs managing certain types of CCW may present a risk of clinical selenosis to highly exposed groundwater users or fish consumers, or a risk of adverse effects to highly exposed aquatic receptors.

Arsenic in certain types of WMUs managing certain types of CCW may present lifetime cancer risks above EPA's range of concern to highly exposed groundwater users.

Sumber: EPA (2010) Human & Ecological Risk Assessment of CCW

Table 3-5. Screening Analysis Results: Selection and Prioritization of CCW Constituents for Further Analysis^a

| Constituent | Human Health – Drinking Water | | Human Health – Surface Water ^b | | Ecological Risk – Surface Water | |
|--|-------------------------------|-------------------------|---|-------------------------|---------------------------------|--------|
| | LF HQ (Cancer Risk) | SI HQ (Cancer Risk) | LF HQ (Cancer Risk) | SI HQ (Cancer Risk) | LF HQ | SI HQ |
| <i>Constituents Modeled in Full-scale Assessment</i> | | | | | | |
| Carcinogen | | | | | | |
| Arsenic ^c | (1.4x10 ⁻³) | (1.8x10 ⁻²) | (2.2x10 ⁻⁴) | (1.7x10 ⁻³) | 49 | 640 |
| Noncarcinogens | | | | | | |
| Boron | 4.0 | 28 | - | - | 6,600 | 47,000 |
| Cadmium | 3.4 | 8.9 | 1.4 | 3.7 | 20 | 52 |
| Lead | 16 | 12 | - | - | 790 | 590 |
| Selenium | 1.2 | 2.4 | 4.7 | 9.5 | 35 | 71 |
| Thallium | 21 | 19 | 6.3 | 5.7 | - | - |
| Aluminum | - | - | - | - | 120 | 270 |
| Antimony | 22 | 5.5 | - | - | - | - |
| Barium | - | - | - | - | 400 | 75 |
| Cobalt | - | 11 | - | - | - | 270 |
| Molybdenum | 4.2 | 6.8 | - | - | - | - |
| Nitrate/ Nitrite | - /1.2 | 60/1.2 | - | - | - | - |
| <i>Constituents Not Modeled in Full-scale Assessment^d</i> | | | | | | |
| Noncarcinogens | | | | | | |
| Chromium VI | 2.3 | 4.2 | - | - | 18 | 33 |
| Fluoride | 1.8 | 5.2 | - | - | - | - |
| Manganese | 1 | 5.6 | - | - | - | - |
| Vanadium | 2.2 | 2.3 | - | - | 23 | 24 |
| Beryllium | - | - | - | - | 24 | - |
| Copper | - | - | - | - | 16 | 31 |
| Nickel | - | 1.3 | - | - | - | 14 |
| Silver | - | - | - | - | 110 | 14 |
| Zinc | - | - | - | - | 16 | - |

HQ = screening hazard quotient.

LF = landfill.

SI = surface impoundment.

^a A dash in a cell indicates that the screening HQ was less than 1 (or 10 for ecological risk), so the risk did not exceed the screening criteria for the indicated pathway.

^b Fish consumption pathway.

^c Although arsenic can act as both a carcinogen and a noncarcinogen, the cancer risk exceeds the noncancer risk at any concentration, so the more protective cancer benchmark for human health was used throughout this assessment.

^d These constituents were addressed using risk attenuation factors developed from full-scale results from modeled constituents (see Section 4.1.5).

FABA (CT'D)



Di Indonesia:

- Izin Pemanfaatan LB3 masih sedikit (i.e. PPLI)
- Banyak pembangkit menimbun LB3-nya, secara teknis rasional (?)

Kesepakatan pemanfaatan FABA untuk infrastruktur

- Perlu minimalisir gap teknis
- Perlu pengawasan atas pemanfaatan ilegal
- Tetap harus sesuai PP 21/2008

KESEPAKATAN BERSAMA

ANTARA

DIREKTORAT JENDERAL KETENAGALISTRIKAN
KEMENTERIAN ENERGI DAN SUMBER DAYA MINERAL

DENGAN

DIREKTORAT JENDERAL PENGELOLAAN SAMPAH, LIMBAH DAN
BAHAN BERACUN BERBAHAYA
KEMENTERIAN LINGKUNGAN HIDUP DAN KEHUTANAN

DAN

BADAN PENELITIAN DAN PENGEMBANGAN
KEMENTERIAN PEKERJAAN UMUM DAN PERUMAHAN RAKYAT

NOMOR. 4 Pj/05/DJL.4/2015

NOMOR. KB.02/PSLB3 – VPLB3/2015

NOMOR. 07/PKS/KL/2015

TENTANG

KERJA SAMA PENELITIAN PENGEMBANGAN DAN PENERAPAN TEKNOLOGI
SERTA PERCEPATAN PEMANFAATAN ABU TERBANG (*FLY ASH*) DAN ABU
DASAR (*BOTTOM ASH*) DARI PLTU BATUBARA UNTUK PEMBANGUNAN
INFRASTRUKTUR PEKERJAAN UMUM DAN PERUMAHAN RAKYAT (PUPR)

INSTRUMEN INTERNALISASI BIAYA

Penetapan standar lingkungan hidup (BMUA, BME, BMAL, BEP dalam pengelolaan LB3)

PP Instrumen Ekonomi

- Pajak lingkungan (i.e. carbon tax)
- Dana penanggulangan dan pemulihan LH; dana jaminan pemulihan LH
- Emission trading / pertukaran beban emisi (rev PP 41/1999)

Pertanggungjawaban (*liability*)

- *Strict liability* untuk LB3 – terutama jika ketidakpastian tinggi

TERIMA KASIH!

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