

The Environmental Impact of Digital Preservation : Research notes

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List of resources and notes compiled by Linda Tadic for her 2015 presentation *The Environmental Impact of Digital Preservation* (presented at SEAPAVAA April 2015, IASA September 2015, AMIA November 2015). Both the powerpoint and these notes will be updated from time to time.

Most resources last accessed November 30, 2015. Citations are not necessarily MLA or any other format.

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http://www.ipcc.ch/publications_and_data/ar4/syr/en/spm.html

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<http://gesi.org/SMARTer2020>

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<http://www.latimes.com/world/asia/la-et-ct-china-movie-theaters-smog-pollution-air-20160122-story.html>

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https://en.wikipedia.org/wiki/Air_quality_index#Computing_the_AQI

AirNow. (see real-time AQI and PM2.5 measurements). <http://airnow.gov/index.cfm?action=airnow.main>

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Banks, Roland. "Mobiles and the environment – can we be greener?" 10 December 2014. *Mobile Industry Review* <http://www.mobileindustryreview.com/2014/12/mobile-environment-impact.html>

Electronics Waste Management in the United States, Approach 2. April 2007. US Environmental Protection Agency. <http://www.epa.gov/epawaste/conservation/materials/ecycling/docs/app-2.pdf>

"Ethical shopping guide to Mobile Phone Handsets." Nov/Dec 2013. *Ethical Consumer*
<http://www.ethicalconsumer.org/buyersguides/phonebroadband/mobilephones.aspx>

Blacksmith Institute report. <http://www.blacksmithinstitute.org/> [org re-named "Pure Earth" : <http://www.pureearth.org/>]

Josh Lepawsky & Grace Akese. "Sweeping Away Agboglobloshie. Again." *Discard Studies: Social studies of waste, pollution & externalities*. 23 June 2015. <http://discardstudies.com/2015/06/23/sweeping-away-agboglobloshie-again/>

How products are made: Videotape. <http://www.madehow.com/Volume-7/Videotape.html>

Creative uses of video and audiotape:

- <http://www.myrecycledbags.com/category/cassette-tape-crafts/>
- Philip Ob Rey's "V" HS Project. <http://www.humantropy.com/v-hs-1/>

Recyclers:

- Sims Recycling Solutions <http://www.simsrecycling.com/>
- GreenDisk <http://greendisk.com/>

“Are There Ghosts in Your Closet? Saving Wasted Energy in Computer Server Rooms.” *National Resources Defense Council* (2012). <http://www.nrdc.org/energy/files/Saving-Energy-Server-Rooms-FS.pdf>

“Revisiting the Search for Long-Term Storage: a TCO Analysis of Tape and Disk.” *The Clipper Group Calculator*. (2013) <http://www.clipper.com/research/TCG2013009.pdf>

Clicking Green: a Guide to Building the Green Internet. Greenpeace, May 2015.
<http://www.greenpeace.org/usa/Global/usa/planet3/PDFs/2015ClickingClean.pdf>

Chai Jing's review: *Under the Dome – Investigating China's Smog* 柴静□□□□ : □□□□ [March 1, 2015] <https://www.youtube.com/watch?v=T6X2uwlQGQM#t=207> ;
<http://thinkprogress.org/climate/2015/03/02/3628458/chinese-air-pollution-documentary-clears-the-haze/>

Climate Interactive. <https://www.climateinteractive.org/>

Netherlands legal case: <http://www.theguardian.com/environment/2015/jun/24/dutch-government-ordered-cut-carbon-emissions-landmark-ruling> http://www.huffingtonpost.com/2015/06/24/dutch-climate-change-case_n_7653050.html

Kolbert, Elizabeth. “The Weight of the world.” *The New Yorker*, 24 Aug 2015

NDSA 2013 annual meeting: “Green Bytes: Sustainable Approaches to Digital Stewardship” plenary. (Josh Sternfeld, chair) <http://www.digitalpreservation.gov/meetings/ndiipp13.html>

NDSA 2015 National Agenda for Digital Stewardship: Section 5.3.2. Environmental Sustainability and Sustainability of Digital Collections.
<http://www.digitalpreservation.gov/ndsa/documents/2015NationalAgenda.pdf>

Thermal Guidelines for Data Processing Environments. 3rd ed. (2012)

Project ARCC. <http://projectarcc.org/>

Background Research

PM2.5 and health risks

Google Street View adding air pollution data: http://cleantechnica.com/2015/07/29/google-street-view-now-monitors-urban-air-pollution/?utm_source=CleanTechnica+News&utm_medium=email&utm_campaign=f5a538486d-RSS_EMAIL_CAMPAIGN&utm_term=0_b9b83ee7eb-f5a538486d-332044413

EU study: risk of heart attack. “The new findings are the result of researchers investigating the effect of short-term exposure to common levels of air pollution on the risk of ST-segment elevation myocardial infarction (STEMI) — which is, for some background here, a particularly dangerous type of heart attack triggered by prolonged blockage of blood supply within the heart. Of all heart attack types, this one features largely the worst prognosis.

Most common air pollution is a mix of particulate matter and pollutant gases (sulfur dioxide, nitric dioxide, and ozone). Particularly small particulate air pollution (PM2.5) has the ability to be absorbed deeply into the lower respiratory tract — it’s a common product of fossil fuel combustion.”

http://cleantechnica.com/2015/09/06/safe-levels-air-pollution-still-associated-increased-risk-severe-heart-attacks-research-finds/?utm_source=CleanTechnica+News&utm_medium=email&utm_campaign=0f32ea0f9a-RSS_EMAIL_CAMPAIGN&utm_term=0_b9b83ee7eb-0f32ea0f9a-332044413

Makinen, Julie. “Air is main feature in this cinema.” *Los Angeles Times*, January 27, 2016. <http://www.latimes.com/world/asia/la-et-ct-china-movie-theaters-smog-pollution-air-20160122-story.html>

PM2.5 real-time monitoring:

- Paris: <http://aqicn.org/city/france/paris/paris-centre/>
- US: <http://www.airnow.gov/index.cfm?action=airnow.main#tabs-1>
http://www3.epa.gov/airnow/air-quality-guide_pm_2015.pdf

ARTICLES/NEWS

Collapse of civilization by 2040 if no action (UK modeling project). http://cleantechnica.com/2015/06/25/climate-change-impacts-collapse-civilization-2040-states-uk-govt-report/?utm_source=CleanTechnica+News&utm_medium=email&utm_campaign=97580a212a-RSS_EMAIL_CAMPAIGN&utm_term=0_b9b83ee7eb-97580a212a-332044413

Methane: <http://www.latimes.com/science/la-me-methane-emissions-20150114-story.html> In Los Angeles, elevated methane levels over landfills. Report: <http://www.atmos-chem-phys.net/15/241/2015/acp-15-241-2015.pdf>

Article on 2° C change, carbon budget for century: <http://grist.org/climate-change/2011-12-05-the-brutal-logic-of-climate-change/>

CO2 global average (not just isolated areas) reaches new high (400 ppm): http://cleantechnica.com/2015/05/07/new-atmospheric-carbon-dioxide-level-record-says-noaa/?utm_source=CleanTechnica+News&utm_medium=email&utm_campaign=f26bbc78f6-RSS_EMAIL_CAMPAIGN&utm_term=0_b9b83ee7eb-f26bbc78f6-332044413

Legos going green: <http://money.cnn.com/2015/06/23/news/companies/lego-sustainable-material/index.html> lego pieces are backwards compatible – pieces from 1950s work with pieces today.

Netherlands Court ordered the government to cut greenhouse gas emissions by at least 25% by 2020, in a case environmentalists hope will set a precedent for other countries. 6/24/2015. Found it a tort; the govt has responsibility to take care of its citizens. Low-lying Netherlands is especially vulnerable, and must now cut its emissions by a quarter compared with 1990 levels.

Coal and gas provide much of the Netherlands' energy needs, with the country lagging behind neighbours Denmark and Germany in the use of renewables. The Dutch government can appeal to a higher court and it is not clear yet how the ruling will be enforced.

The European Union recently set a target of reducing emissions by 40% by 2030.

Campaigners brought the case on behalf of almost 900 Dutch citizens. They argued the government had a legal obligation to protect its citizens from the dangers of climate change.

<http://www.bbc.com/news/world-europe-33253772>

Also on the Dutch case: http://cleantechnica.com/2015/07/23/dutch-courts-climate-ruling-may-force-other-states-to-cut-emissions-or-else/?utm_source=CleanTechnica+News&utm_medium=email&utm_campaign=549e416fc6-RSS_EMAIL_CAMPAIGN&utm_term=0_b9b83ee7eb-549e416fc6-33204441_3

United Nations Environment Program (UNEP) <http://www.unep.org/>

<http://www.unep.org/roap/Portals/96/UNEP-Post-2015-Note-3.pdf>

A Conversation with Mary Robinson (UCLA Luskin Series). January 12, 2016. Video:

<https://vimeo.com/151832880>

e-WASTE

Wood, Molly. "Recycling Electronic Waste Responsibly: Excuses Dwindle." 31 December 2014. *New York Times*. <http://www.nytimes.com/2015/01/01/technology/personaltech/recycling-electronic-waste-responsibly-excuses-dwindle.html?hpw&ref=technology&action=click&pgtype=Homepage&module=well-region®ion=bottom-well&WT.nav=bottom-well&r=0>

Moskvitch, Katia. "Unused e-waste discarded in China raises questions." 20 April 2012. *BBC News*. <http://www.bbc.com/news/technology-17782718> Chinese city dumping e-waste; toxic (2012)

Agboblshie e-waste site. Ghana is large e-waste importer. <http://www.bbc.com/news/science-environment-24994209> Agboblshie update (July 2015): Approx 20,000 people living in slum around site forced to move and homes, schools, businesses demolished No place for them to move to. "Land grab" using toxic environment as an excuse.

<http://goodelectronics.org/news-en/agboblshie-portrayed-as-largest-electrical-wasteland-in-truth-its-a-functional-profit-making-recycling-network> <https://medium.com/@AfricanSolarLLP/demolition-exercise-forced-evictions-fire-outbreak-and-rainfall-399541864075>

Blacksmith report: <http://www.blacksmithinstitute.org/>

Basel Convention: e-waste can't be exported to developing countries. US hasn't ratified (signed but Congress hasn't ratified). <http://e-stewards.org/learn-more/for-enterprises/learn-more/the-basel-convention/>

Basel Action Network: <http://www.ban.org/>

Fresh Air show on BAN: <http://www.npr.org/templates/transcript/transcript.php?storyId=132204954>

Children smash the equipment. Guest mentions computers had asset tags from EPA, US Army, school systems. Many computer hard drives had retrievable data. “We found a hard drive from the World Bank with all of the internal documents.”

DATA CENTERS

Data centers create pollution from the back-up diesel generators. Even if they aren’t on at all times, they must be run occasionally to test that they’re operational.

Clicking Green: a Guide to Building the Green Internet. Greenpeace, May 2015.
<http://www.greenpeace.org/usa/Global/usa/planet3/PDFs/2015ClickingClean.pdf>

Environmental Protection Agency. Int’l conference with e-waste reports from around the world (2014):
<http://www2.epa.gov/international-cooperation/e-waste-around-world>

Apple and solar-powered facilities: <http://www.wired.com/2014/04/green-apple>

Google going clean: <http://www.datacenterdynamics.com/focus/archive/2014/11/google-data-center-chief-go-green-because-your-customers-care>

http://cleantechnica.com/2015/02/13/google-signs-repower-iconic-bay-area-wind-farm/?utm_source=Cleantechnica+News&utm_medium=email&utm_campaign=3026b541e6-RSS_EMAIL_CAMPAIGN&utm_term=0_b9b83ee7eb-3026b541e6-332044413

Facebook: Built 100% renewable energy data center in Altoona, Iowa (opened November 2014).

“Altoona will be powered by 100% renewable energy, thanks to the new wind project we worked with Mid American Energy to develop in nearby Wellsburg, Iowa. In addition to bringing more jobs and investment to the area, Wellsburg adds 140 MW of new renewable energy to the grid in Iowa — more than what our data center will require for the foreseeable future.”

<https://www.facebook.com/notes/altoona-data-center/altoona-online-facebooks-fourth-data-center-now-serving-traffic/731265633630692> “We are committed to reaching 25% clean and renewable energy in our global data center mix in 2015, and we will continue to work with utilities and other partners on supply options for our other data centers.”

“In 2013 our energy mix was 14% clean and renewable, 34% coal, 17% natural gas, 23% nuclear, and 12% uncategorized (power bought on the spot market). The percentage of clean and renewable energy in our mix has declined over the past two years, as we expected it would. The percentage of clean energy powering our data center operations will steadily rise as our Lulea, Sweden, data center (which runs entirely on hydro electric power) and our Altoona, Iowa, data center (which runs entirely on wind power) start serving more traffic. We are on course to meet our goal of 25% clean and renewable energy in our mix by the end of 2015.” <https://www.facebook.com/notes/green-on-facebook/our-carbon-footprint-for-2013/888969404451650>

Amazon. Glanz, James. “Power, Pollution and the Internet.” 22 September 2012. New York Times.
<http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html?pagewanted=5&r=0>

Jones, Penny. “DCD industry census 2013: Data center power.” 31 January 2014. *Data Center Dynamics*.
<http://www.datacenterdynamics.com/focus/archive/2014/01/dcd-industry-census-2013-data-center-power>
<http://www.greendatacenternews.org/articles/787136/pue-is-for-colos-too-by-peter-judge/>

http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html?_r=0

<http://searchdatacenter.techtarget.com/podcast/Trends-in-data-center-power-usage>

lower temp (ASHRAE guidelines, 3rd ed. 2012): <http://info.rfcodes.com/data-driven-data-center/bid/237825/2012-ASHRAE-Thermal-Guidelines-for-Data-Processing-Environments>

Green Grid: <http://www.thegreengrid.org/>

David Rosenthal's paper at Green Bytes plenary (NDSA 2013): <http://blog.dshr.org/2013/07/talk-at-digital-preservation-2013.html>

POWER

1. Coal-burning: China burns half the coal on the planet, even though it has tripled its solar energy and increased wind and hydropower. (2012) <http://www.theguardian.com/environment/2012/jan/12/china-renewable-energy-coal-consumption>

2. Deutsche Bank report (3/4/2015): Solar will be 30% of the global energy source by 2030 and generates \$5 trillion in revenue over the next 15 years, and displaces large amounts of fossil fuels. In India, will be 25% by 2022. [California required to be 33% renewable energy by 2020].

“Even today, (with about) 20% of the world's population does not have access to grid electricity,” it notes. “Due to declining costs and ability to deploy the technology without really developing the grid, we expect policy makers in developing countries to proactively promote solar.”

http://cleantechnica.com/2015/03/04/deutsche-bank-solar-will-be-dominant-global-electricity-source-by-2030/?utm_source=Cleantechnica+News&utm_medium=email&utm_campaign=54d4f63113-RSS_EMAIL_CAMPAIGN&utm_term=0_b9b83ee7eb-54d4f63113-332044413

3. Ivanpah Solar Power: Mojave desert. Powers 140,000 homes. Generates electricity by generating steam that runs turbines - water is heated by sun rather than fossil fuels. Water is recycled back into system (closed-loop). But, no energy storage.

4. US Electricity generation report ((2014): Coal is biggest, but NEW energy is mostly generated by renewable sources.

http://cleantechnica.com/2015/03/10/renewable-energy-13-4-of-us-electricity-generation-in-2014-exclusive/?utm_source=Cleantechnica+News&utm_medium=email&utm_campaign=a43065f534-RSS_EMAIL_CAMPAIGN&utm_term=0_b9b83ee7eb-a43065f534-332044413

DEVICES

<http://www.epa.gov/smm/electronics/prticipnts.htm>

<http://www.mnn.com/green-tech/gadgets-electronics/stories/what-happens-to-the-electronics-we-recycle>

Dell recycling program: <http://www.dell.com/learn/us/en/uscorp1/dell-environment-recycling?dgc=BA&cid=283092&lid=5379376&acd=12309207097294293>

Lenovo: http://www.lenovo.com/social_responsibility/us/en/climate.html

<http://www.pbs.org/mediashift/2010/03/is-digital-media-worse-for-the-environment-than-print090/> (2010)

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1551981/> (2006 book)

<http://www.un.org/apps/news/story.asp?NewsID=33845&Cr=waste&Cr1#.VlkYntQh0c> UN e-waste report (2009-2010) download report: http://www.unep.org/PDF/PressReleases/E-Waste_publication_screen_FINALVERSION-sml.pdf

EPA program: <http://www.epa.gov/smm/electronics/prticipnts.htm>

Monitors: LCD/LED displays – what is the impact? In India, about 10 million LCD/LED TVs were purchased in 2014, compared to 3.5 million CRTs. http://www.business-standard.com/article/companies/flat-panel-tv-sales-to-overtake-crt-sets-115062700716_1.html

DATA TAPE

“Recycling” = re-using the tape (wiping data clean), not physical recycling. Tape is not biodegradable. Destroy: (1) physically cut and pulverize the media. (2) End result is solid waste that is either disposed of in a landfill, or incinerated. Burning tape releases toxic gases; must develop safe means so gases aren’t released into the air.

Outer plastic cassette shells can be recycled, but how? PET recycling is largely focused on bottles. Can be recycled into carpet fiber and other products.

http://en.wikipedia.org/wiki/Polyethylene_terephthalate#Degradation

Brief process for plastic recycling: <http://www.epa.gov/osw/conservematerials/plastics.htm>

Plastics recycling: Since 2013, China only accepting bottle plastics for recycling (Green Fence Policy).

Mylar tape is more difficult. Have to extract the magnetic and iron particles from the tape.

Read more: http://www.ehow.com/how_6470940_recycle-mylar.html

“ The only real way to break down plastic is through photodegradation. This kind of decomposition requires sunlight, not bacteria. When UV rays strike plastic, they break the bonds holding the long molecular chain together. Over time, this can turn a big piece of plastic into lots of little pieces...Of course, plastic buried in a landfill rarely sees the light of day. But in the ocean, which is where a lot of discarded grocery bags, soft drink bottles and six-pack rings end up, plastic is bathed in as much light as water. In 2009, researchers from Nihon University in Chiba, Japan, found that plastic in warm ocean water can degrade in as little as a year. This doesn't sound so bad until you realize those small bits of plastic are toxic chemicals such as bisphenol A (BPA) and PS oligomer. These end up in the guts of animals or wash up on shorelines, where humans are most likely to come into direct contact with the toxins.” -- <http://science.howstuffworks.com/science-vs-myth/everyday-myths/how-long-does-it-take-for-plastics-to-biodegrade.htm>

Video recycling efforts:

Article on R&D to separate usable polyester (Portugal):

http://www.academia.edu/312793/VIDEOTAPE_RECYCLING_PROJECT

<http://www.earth911.com/eco-tech/the-vhs-and-cassette-tape-recycling-dilemma/>

Videotape magnetic particles: Iron oxide: <http://www.cdc.gov/niosh/pel88/1309-37.html>

RECYCLING STANDARDS

Resource Recycling (plastics, e-waste) <http://www.resource-recycling.com/>

National Association for Information Destruction (NAID). <http://www.naidonline.org/> Certification org for vendors that destroy data, but not involved with recycling efforts.

Sustainable Electronics Recycling International (SERI) R2 standard:

<http://www.sustainableelectronics.org/>

Website has list of certified R2 facilities: <http://www.sustainableelectronics.org/find-a-recycler/>

Includes locations in Shanghai, Singapore (3 locations), Thailand, Australia, India (one). None in Africa. Europe: only one in Netherlands.

eStewards <http://e-stewards.org/>

“The e-Stewards Initiative is a program started by the **Basel Action Network**, aka, BAN, in 2010 in response to a need for stricter, cleaner standards governing e-waste recycling. The e-Stewards Initiative states in part that no hazardous, illegal e-waste will be exported to developing nations, be disposed into solid waste landfills or recycled using forced or child labor.”

“In 2006, BAN set aside efforts to transition the Pledge program into an independently audited certification program to focus on bigger, more holistic solutions. BAN wanted to create a voluntary e-waste recycling standard and partnered with the U.S. EPA-funded “Responsible Recycling” (R2) multi-stakeholder process.

After contributing significantly to this process for two and a half years, **the environmental community ceased collaboration with R2 multi-stakeholder process. They could not in good conscience agree with the group and vote to field test a draft of the standard that would violate laws in importing countries, as well as allow toxic substances in solid waste disposal facilities.**

Soon after R2 standard was tested, thirteen recyclers, the e-Stewards Founders, approached BAN offering to fund a new standard. They wanted a standard that would differentiate them and ban any export of toxic e-waste to developing nations. BAN took up the challenge.”

e-waste calculator: <https://itunes.apple.com/us/app/ewaste-calculator/id917967751?mt=8>

EPA: map of R2 and eStewards-certified centers:

<http://www.epa.gov/osw/conserve/materials/ecycling/certmap.htm>

<http://www.epa.gov/osw/conserve/materials/ecycling/certification.htm>

RECYCLING VENDORS

1. Green Disk: <http://www.greendisk.com/> How do they recycle or destroy the media? Stays in US. (1/14/2015: left message for owner David Beschen to call. Spoke with April, who said they work with Library of Congress.)

<http://www.greendisk.com/pdf/What%20Happens%20to%20my%20Technotrash.pdf>

2. Australia: <http://businessrecycling.com.au/recycle/video> From the website: “All types of audio and video cassette tapes can be recycled. This allows the recovery of valuable resources such as polycarbonate (a type of plastic) for reuse in the manufacture of new plastics products. It also diverts e-waste from landfill where it will persist indefinitely. -- Recycling: The recycling process involves separating the various plastic components of these media, which is then granulated and recycled. The plastic cases are recycled with other plastics and the paper are given to paper recyclers for processing. The recovered plastics are used for manufacturing a wide variety of products.”

3. GreenChip: <http://www.greenchiprecycling.com/> Since 2012, required in NY State. They are an R2 certified recycler. Member of NAID.

4. eRecycling of California: <http://www.erecyclingofca.com/> In Hayward and Irvine. What they recycle (tech waste only): http://www.erecyclingofca.com/?page_id=5

5. Sims Metal management: <http://www.simsmm.com/> “World’s largest listed metals and electronics recycler.” Used by Green Citizen for videotape recycling. ?? Based in Hayward. [Sims Recycling Solutions is a Canadian company. Member of eStewards leadership council. Their website doesn’t mention videotape, only electronics. <http://www.simsrecycling.com/Business/Products-We-Recycle>]

6. Green Citizen: <http://www.greencitizen.com/how-to-recycle-vhs-tapes/>

7. Data Vista. In NJ. They shred tape in the cassette and send to 3rd party vendors. He did research and found that their partners dump the waste into a landfill. They offer a Certificate of Data Destruction -- they are legally liable if any data is released. They need to prove that that they destroyed the data and weren’t at fault. <http://datavista.com/services/datadestruction>

8. IT Asset Disposal (ITAD):
<http://datavista.com/pdf/Data%20Vista%20ITAD%20Assessment%20Service.pdf>

9. TES-AMM : on R2 facilities list with locations around the world.

10. Electronics Recycling Directory: <http://www.electronicrecyclingdirectory.com/>

Includes links to press (China, patents, etc.)

11. Vintage Tech Recyclers: <http://www.vintagetechnrecyclers.com/about-us/>

12. Environmental Media Solutions Limited (EMS) (UK)

Videotape: This article refers to a UK company “Environmental Media Solutions Limited” that works with broadcasters: <http://myzerowaste.com/2013/07/how-to-recycle-vhs-tapes-and-audio-cassettes/>

<http://www.ems-europe.co.uk/> <http://www.ems-europe.co.uk/services/recordable-media-rec/>

They separate video parts. See website for details. “The magnetic tape is not recyclable but is sent to waste to energy plants. The metals and polymers that remain, around 78% are reprocessed through other recycling partners and re-introduced back into UK manufacturing. We price our secure media destruction by weight. All charges include collection, waste transfer documentation and certificates of destruction.”

They don’t ship to other countries.