



MEMO

TO	Jennifer Messer, CIRDA
FROM	ERM
DATE	March 25, 2024
SUBJECT	Environmental Results - Co-Pollutant Table, References, and Methodology

This memo includes the following:

1. Co-pollutant table identifying CAPs and HAPs emissions associated with all 15 GHG reduction measures that are expected to be reduced in general and in LIDAC areas.
2. List of references used to develop the co-pollutant table for CIRDA's reference.
3. Overview of methodologies used to develop the co-pollutant table for CIRDA's reference.

CAPs & HAPs Methodologies Summary:

- To determine which CAPs and HAPs emissions would be reduced for each GHG reduction measure, various methodologies were used based on the type of GHG reduction measure.
- For all reduction measures that included a decrease in electricity usage, either through installation of solar or energy efficiency upgrades, EPA's AVOIDED Emissions and geneRation Tool (AVERT)¹ was used for each scenario, and IDEM permits of power plants within the MSA were reviewed for CAPs and HAPs.
- For measures that resulted in the reduction of natural gas combustion, EPA's documented emission factors for natural gas combustion² identified CAPs and HAPs reduced.
- For other reduction measures, including measures that decrease motor vehicle usage or fertilizer usage, EPA's published reports were used to determine the reduction of CAPs and HAPs. i-Tree Planting³ software provided estimates of CAPs and HAPs reductions for any tree planting and reforestation efforts.
- The following co-pollutant table was generated for all 15 GHG reduction measures based on the methodologies described in the sections to follow.

¹ US EPA. 9 January 2024. "Avoided Emissions Generated Tool (AVERT)." Accessed March 2024. Retrieved from: <https://www.epa.gov/avert>

² US EPA. 3 January 2024. "Natural Gas Combustion." Accessed March 2024. Retrieved from: <https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf>

³ i-Tree | US Forest Service Research and Development ([usda.gov](https://www.istree.org/))

CO-POLLUTANT TABLE

GHG Reduction Measure	CAPs - General & LIDAC		HAPs - General & LIDAC				LIDAC Description
CIRDA Regional Building & Asset Modernization Program	Fine Particulate Matter (PM2.5) Nitrogen Oxides (NOx) Sulfur Dioxide (SO2)	Carbon Monoxide (CO) Volatile Organic Compound (VOC)	1,1,2-Trichloroethane 1,2-Dibromoethane 1,3-Butadiene 1,4-Dichlorobenzene 2,2,4-Trimethylpentane 2,3,7,8-Tetrachlorodibenzo-p-dioxin 2,4-Dinitrophenol 2-Methylphenol (o-cresol) 4-Methylphenol (p-cresol) Acetaldehyde Acetophenone Acrolein Antimony Arsenic	Benzene Beryllium Biphenyl Bromomethane Cadmium Carbon disulfide Carbon tetrachloride Cobalt Chlorine Chlorobenzene Chloroform Chromium (III and VI) Cumene Di(2-ethylhexyl)phthalate (DEHP)	Dibutylphthalate Dichloromethane Ethyl benzene Formaldehyde Hexane Hydrogen cyanide Lead Manganese Mercury Methanol Methyl ethyl ketone Methyl tert-butyl ether Methylchloride Naphthalene	Nickel N-Nitrosodimethylamine Pentachlorophenol Phenol Phosphorus Phthalic anhydride Polycyclic organic matter (POM) Propionaldehyde Propylene oxide Selenium Styrene Tetrachloroethylene Toluene Xylenes	Program will fund clean energy and energy efficiency upgrades to buildings and infrastructure located in or near LIDAC census tracts. Power plants within the MSA that have reduced emissions from this program are also located within LIDAC census tracts.
City of Indianapolis Solar Upgrades	PM2.5 NOx VOC		1,3-Butadiene 1,4-Dichlorobenzene Acetaldehyde Acrolein Arsenic Benzene	Beryllium Cadmium Chromium Cobalt Ethylbenzene Formaldehyde	Hexane Lead Manganese Mercury Naphthalene Nickel	POM Propylene Oxide Selenium Toluene Xylene	All buildings that are part of this project are located in a LIDAC census tract. Power plants within the MSA that have reduced emissions from this project are also located within LIDAC census tracts.
McCordsville Town Hall Energy Efficiency Updates	NOx		Same as HAPs listed for "City of Indianapolis Solar Upgrades"				LIDAC residents visiting the building will experience reduced air pollution. Power plants within the MSA that have reduced emissions from this project are also located within LIDAC census tracts.
Energy Insights Program	PM2.5 NOx SO2	CO VOC	Same as HAPs listed for "City of Indianapolis Solar Upgrades"				Participating facilities that are in or near LIDAC areas will benefit LIDAC residents. Power plants within the MSA that have reduced emissions from this project are also located within LIDAC census tracts.
Rolls Royce HVAC Optimization & Submetering	NOx		Same as HAPs listed for "City of Indianapolis Solar Upgrades"				This project is located in a LIDAC census tract. Power plants within the MSA that have reduced emissions from this project are also located within LIDAC census tracts.
Rolls Royce PV Solar	PM2.5 NOx VOC		Same as HAPs listed for "City of Indianapolis Solar Upgrades"				This project is located in a LIDAC census tract. Power plants within the MSA that have reduced emissions from this project are also located within LIDAC census tracts.
Crispus Attucks High School Energy Efficiency Renovations	PM2.5 NOx SO2	CO VOC	Same as HAPs listed for "City of Indianapolis Solar Upgrades"				LIDAC residents attending the school will experience reduced air pollution due to the efficiency improvements of this project.
Indianapolis Arts Center Upgrades	PM2.5 NOx SO2	CO VOC	Same as HAPs listed for "City of Indianapolis Solar Upgrades"				LIDAC residents visiting the building will experience reduced air pollution. Power plants within the MSA that have reduced emissions from this project are also located within LIDAC census tracts.
CIRDA Regional Open Space Revitalization & Connectivity Program	PM2.5 NOx SO2	CO VOC	1,1,2-Trichloroethane 1,2-Dibromoethane 1,3-Butadiene 1,4-Dichlorobenzene 2,2,4-Trimethylpentane 2,3,7,8-Tetrachlorodibenzo-p-dioxin 2,4-Dinitrophenol 2-Methylphenol (o-cresol) 4-Methylphenol (p-cresol) Acetaldehyde Acetophenone Acrolein Antimony	Arsenic Benzene Beryllium Biphenyl Bromomethane Cadmium Carbon disulfide Carbon tetrachloride Cobalt Chlorine Chlorobenzene Chloroform Chromium (III and VI) Cumene DEHP	Dibutylphthalate Dichloromethane Ethyl benzene Formaldehyde Hexane Hydrogen cyanide Lead Manganese Mercury Methanol Methyl ethyl ketone Methyl tert-butyl ether Methylchloride Naphthalene	Nickel N-Nitrosodimethylamine Pentachlorophenol Phenol Phosphorus Phthalic anhydride POM Propionaldehyde Propylene oxide Selenium Styrene Tetrachloroethylene Toluene Xylenes	This program will fund a variety of projects targeting degraded lands located in or near LIDAC areas.
Nickel Plate Pedestrian Bridge	PM2.5 NOx	CO VOC	Same as HAPs listed for "CIRDA Regional Open Space Revitalization & Connectivity Program"				LIDAC residents located near the project will experience reduced air pollution from the reduction of the usage of motor vehicles in the area.
Conner Prairie Wetland Enhancement and Fertilizer Education Program	PM2.5 NOx	CO VOC	Same as HAPs listed for "CIRDA Regional Open Space Revitalization & Connectivity Program"				LIDAC residents, including those attending surrounding area public schools in LIDAC areas, routinely visit Connor Prairie.
Grassy Creek Trail	PM2.5 NOx	CO VOC	Same as HAPs listed for "CIRDA Regional Open Space Revitalization & Connectivity Program"				The project runs through LIDAC census tracts and will reduce the amount of motor vehicle usage in these LIDAC areas.
City of Indianapolis Brownfield Julietta Landfill	PM2.5 NOx VOC		1,3-Butadiene 1,4-Dichlorobenzene Acetaldehyde Acrolein Arsenic Benzene	Beryllium Cadmium Chromium Cobalt Ethylbenzene Formaldehyde	Hexane Lead Manganese Mercury Naphthalene Nickel	POM Propylene Oxide Selenium Toluene Xylene	Power plants within the MSA that have reduced emissions from this project are also located within LIDAC census tracts.
Conner Prairie Reforestation	PM2.5 NOx SO2	CO VOC	Same as HAPs listed for "City of Indianapolis Brownfield Julietta Landfill"				LIDAC residents, including those attending surrounding area public schools in LIDAC areas, routinely visit Connor Prairie. Power plants within the MSA that have reduced emissions from this project are also located within LIDAC census tracts.
Indianapolis Area Renewable Energy and Waste Reduction Operation	PM2.5 NOx SO2	CO VOC	Same as HAPs listed for "City of Indianapolis Brownfield Julietta Landfill"				This project has the potential to be located within or near a LIDAC census tract.

REFERENCES LIST

- Indiana Department of Environmental Management (IDEM). 21 June 2019. "Part 70 Operating Permit Renewal, Office of Air Quality, Citizens Thermal CC Perry K Steam Plant." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/40132f.pdf>
- IDEM. 10 August 2021. "Part 70 Operating Permit Renewal, Office of Air Quality, Indianapolis Power & Light, Company d/b/a AES Indiana – Harding Street Station." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/43644f.pdf>
- IDEM. 10 May 2023. "Part 70 Operating Permit Renewal, Office of Air Quality, Duke Energy Indiana LLC Noblesville Generating Station." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/45900f.pdf>
- IDEM. 15 November 2023. "Part 70 Operating Permit Renewal, Office of Air Quality, AES Indiana – Georgetown Substation Generating Plant." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/46304f.pdf>
- IDEM. 21 November 2023. "Part 70 Operating Permit Renewal, Office of Air Quality, AES Indiana – Eagle Valley Generating Station." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/46136f.pdf>
- IDEM. February 2024. "Indiana Brownfields Program Site List." Accessed March 2024. Retrieved from: <https://www.in.gov/ifa/brownfields/files/3.11.24-MS.pdf>
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- US Department of Energy. "Alternative Fuels Data Center: Pollutants and Health." Accessed March 2024. Retrieved from: https://afdc.energy.gov/vehicles/emissions_pollutants.html
- US Energy Information Administration (EIA). 11 October 2023. "Frequently Asked Questions." Accessed March 2024. Retrieved from: <https://www.eia.gov/tools/faqs/faq.php?id=45&t=5#:~:text=In%202022%2C%20the%20U.S.%20annual,1.038%20MMBtu%2C%20or%2010.38%20therms.>
- US Environmental Protection Agency (US EPA) Office of Transportation and Air Quality. February 2007. "Control of Hazardous Air Pollutants from Mobile Sources: Regulatory Impact Analysis." Accessed March 2024. Retrieved from: <https://nepis.epa.gov/Exe/ZyPdf.cgi?Dockkey=P1004LNN.PDF>
- US EPA. 29 November 2023. "Sources and Solutions: Agriculture." Accessed March 2024. Retrieved from: <https://www.epa.gov/nutrientpollution/sources-and-solutions-agriculture>
- US EPA. 3 January 2024. "Natural Gas Combustion." Accessed March 2024. Retrieved from: <https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf>
- US EPA. 9 January 2024. "Avoided Emissions Generated Tool (AVERT)." Accessed March 2024. Retrieved from: <https://www.epa.gov/avert>

CRITERIA AIR POLLUTANTS (CAPs) METHODOLOGY AND REFERENCES

ELECTRICITY REDUCTIONS

For all electricity related projects, US EPA's AVOIDed Emissions and geneRation Tool (AVERT)⁴ was run for each scenario based on solar installation capacity or reduction in electricity usage. The below table shows all the data entered into AVERT for each project. Entries were based on total solar capacity or total electricity reductions expected from 2025–2030.

Project	GHG Analysis Sheet:	5 year total:	AVERT entry:
City of Indianapolis Solar	Solar Size: 2,222 kW	5-year total: 11,110 kW	Rooftop PV Solar: 11.11 MW
McCordsville Town Hall	Reduction in Usage: 22,215 kWh/yr	5-year total: 111,075 kWh	Reduce Annual Generation: 0.111075 GWh
Energy Insights Program	Reduction in Usage: 24,000 MWh	5-year total: 120,000 MWh	Reduce Annual Generation: 120 GWh
Rolls Royce HVAC	Reduction in Usage: 900 MWh	5-year total: 4,500 MWh	Reduce Annual Generation: 4.5 GWh
Rolls Royce Solar	Solar Size: 10.5 MW	5-year total: 21 MW (starts in 2029)	Rooftop PV Solar: 21 MW
Crispus Attucks: LED Lighting	Reduction in Usage: 59.3 MW	5-year total: 296.5 MW	Reduce Annual Generation: 0.2965 GWh
Indianapolis Arts Center	Solar Size: 0.169 MW	5-year total: 0.845 MW	Rooftop PV Solar: 0.845 MW
Julietta Landfill	Solar Size: 10 MW	5-year total: 40 MW	Rooftop PV Solar: 40 MW

AVERT provided information on the emissions reductions by county for a specific electricity grid region. AVERT's "Midwest" region grid was chosen for the CIRDA MSA. Once the AVERT runs were completed, the results were reviewed to determine emissions reductions of CAPs in MSA counties where there are fossil fuel power plants located (Hamilton, Marion, and Morgan). If any of the three counties showed a reduction in emissions of a CAP in AVERT due to the energy efficiency or solar installations for each project, that CAP was included on the list of CAP emissions reduced in the MSA for that project.

All three counties with power plants contain LIDAC census tracts, so it was assumed that if the county had emissions reductions in CAPs, the LIDAC tracts would also experience the same

⁴ US EPA. 9 January 2024. "Avoided Emissions Generated Tool (AVERT)." Accessed March 2024. Retrieved from: <https://www.epa.gov/avert>

CAP reductions. In addition, two power plants in Marion county are located within LIDAC census tracts.

NATURAL GAS COMBUSTION REDUCTIONS

For all projects related to the reduction of natural gas combustion, emissions factors from Chapter 1.4 Natural Gas Combustion of EPA's "AP-42: Compilation of Air Emissions Factors from Stationary Sources"⁵ were used to identify emissions reductions based on the amount of natural gas combustion reduced. The table below shows the natural gas usage reductions that were used to identify CAP reductions.

GHG Reduction Measure	GHG Analysis Sheet:	5 year total:
Energy Insights Program	Reduction in Usage: 89,303 MMBtu	4-year total: (assumes 2027 implementation) 357,212 MMBtu
Rolls Royce HVAC	Reduction in Usage: 6,977 MMBtu	5-year total: 34,885 MMBtu
Crispus Attucks: HVAC	Reduction in Usage: 125 MMBtu	5-year total: 625 MMBtu
Crispus Attucks: Windows	Reduction in Usage: 86 MMBtu	5-year total: 430 MMBtu
Indy Arts Center	Reduction in Usage: 108.8 MMBtu	5-year total: 544 MMBtu
IMS Digester: Farm 1	Reduction in Usage: 137,000 MMBtu	5-year total: 411,000 MMBtu
IMS Digester: Farm 2	Reduction in Usage: 45,600 MMBtu	5-year total: 136,800 MMBtu

For the calculations, a heating value of 1,038 BTU/scf is assumed for all natural gas combustion, based on EIA.⁶

The LIDAC CAPs list was determined based on location of the project, as well as if LIDAC residents would visit the site of a project location (e.g., Crispus Attucks) and benefit from decreased natural gas usage.

MOTOR VEHICLE REDUCTIONS

For projects that reduce internal combustion engine motor vehicle usages, such as increased public transportation, a list of CAPs reduced was determined based on a list of CAPs emitted

⁵ US EPA. 3 January 2024. "Natural Gas Combustion." Accessed March 2024. Retrieved from: <https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf>

⁶ US Energy Information Administration (EIA). 11 October 2023. "Frequently Asked Questions." Accessed March 2024. Retrieved from: <https://www.eia.gov/tools/faqs/faq.php?id=45&t=5#:~:text=In%202022%2C%20the%20U.S.%20annual,1.038%20MMBtu%2C%20or%2010.38%20therms.>

from mobile combustion provided by the US Department of Energy (DOE).⁷ If the project occurred within a LIDAC area, the CAPs from the DOE website were also listed in LIDAC.

CONNER PRAIRIE PROJECTS

For the reforestation project, the USDA Forest Service tool “i-Tree Planting”⁸ was used to identify CAPs that would be reduced from the tree canopy.

For the fertilizer and wetland project, CAPs (NOx and PM) reduced from reduced fertilizer usage were pulled from EPA.⁹

Additionally, the wetland project indicated that farmland would be converted into wetlands, so it was assumed that this would reduce mobile combustion from farming equipment. The same list of CAPs used for motor vehicles from the Dept of Energy¹⁰ was also used for this project.

For LIDAC benefits, while Conner Prairie is not in a LIDAC census tract, it is a large tourist attraction in Central Indiana and would include visitors from LIDAC census tracts, who would experience CAP reductions while visiting.

HAZARDOUS AIR POLLUTANTS (HAPs) METHODOLOGY AND REFERENCES

ELECTRICITY REDUCTIONS

EPA’s AVERT does not calculate HAP reductions; however, since the tool provides data on fossil fuel power plants located in the MSA, it was assumed that any county in the MSA that showed CAP reductions would also show HAP reductions.

To determine the list of HAPs for electricity reductions, the permit of each power plant within the MSA was pulled from IDEM to see which HAPs were calculated to be emitted by the facility. See the table below with the list of HAPs for each power plant.

County	Power Plants from eGGRT	Power Plants Located in LIDAC Census Tract (Yes/No)	HAPs from Permits
Hamilton	Noblesville - Duke (NG) (Title V Permit No. 45900 ¹¹ , pg 240)	No	1,3-Butadiene Acetaldehyde Acrolein Benzene Ethylbenzene

⁷ US Department of Energy. “Alternative Fuels Data Center: Pollutants and Health.” Accessed March 2024. Retrieved from: https://afdc.energy.gov/vehicles/emissions_pollutants.html

⁸ i-Tree | US Forest Service Research and Development ([usda.gov](https://www.usda.gov))

⁹ US EPA. 29 November 2023. “Sources and Solutions: Agriculture.” Accessed March 2024. Retrieved from: <https://www.epa.gov/nutrientpollution/sources-and-solutions-agriculture>

¹⁰ US Department of Energy. “Alternative Fuels Data Center: Pollutants and Health.” Accessed March 2024. Retrieved from: https://afdc.energy.gov/vehicles/emissions_pollutants.html

¹¹ IDEM. 10 May 2023. “Part 70 Operating Permit Renewal, Office of Air Quality, Duke Energy Indiana LLC Noblesville Generating Station.” Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/45900f.pdf>

			Formaldehyde Naphthalene Polycyclic Organic Matter (POM) Propylene Oxide Toluene Xylene
Marion	Georgetown – AES (NG) (Title V Permit No. 46304 ¹² , pg 105)	No	Formaldehyde
	Perry Steam Plant – Citizens (NG) (Title V Permit No. 46998 ¹³ , pg 188)	Yes	1,3-Butadiene 1,4-Dichlorobenzene Arsenic Compounds Benzene Beryllium Compounds Cadmium Compounds Chromium Compounds Cobalt Compounds Formaldehyde Hexane Lead Compounds Manganese Compounds Mercury Compounds Naphthalene Nickel Compounds POM Selenium Compounds Toluene
	Harding St – AES (NG) (Title V Permit No. 43644 ¹⁴ , page 344)	Yes	1-3,Butadiene Acetaldehyde Acrolein Arsenic Compounds Benzene Beryllium Compounds Cadmium Compounds Chromium Compounds Ethylbenzene Formaldehyde Lead Compounds Manganese Compounds

¹² IDEM. 15 November 2023. "Part 70 Operating Permit Renewal, Office of Air Quality, AES Indiana – Georgetown Substation Generating Plant." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/46304f.pdf>

¹³ Indiana Department of Environmental Management (IDEM). 21 June 2019. "Part 70 Operating Permit Renewal, Office of Air Quality, Citizens Thermal CC Perry K Steam Plant." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/40132f.pdf>

¹⁴ IDEM. 10 August 2021. "Part 70 Operating Permit Renewal, Office of Air Quality, Indianapolis Power & Light, Company d/b/a AES Indiana – Harding Street Station." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/43644f.pdf>

			Mercury Compounds Naphthalene Nickel Compounds POM Propylene Oxide Selenium Compounds Toluene Xylene
Morgan	IPL Eagle Valley – NG (Title V Permit No. 46136 ¹⁵ , pg 341)	No	1,3-Butadiene Acetaldehyde Acrolein Arsenic Compounds Benzene Beryllium Compounds Cadmium Compounds Chromium Compounds Cobalt Compounds Dichlorobenzene Ethylbenzene Formaldehyde Hexane Manganese Compounds Mercury Compounds Naphthalene Nickel Compounds POM Selenium Compounds Toluene Xylene

This table was then consolidated into a list for each county, so it could be easily entered into the HAPs table.

County	HAPs from Permits
Hamilton	1,3-Butadiene Acetaldehyde Acrolein Benzene Ethylbenzene Formaldehyde Naphthalene POM Propylene Oxide Toluene

¹⁵ IDEM. 21 November 2023. "Part 70 Operating Permit Renewal, Office of Air Quality, AES Indiana – Eagle Valley Generating Station." Accessed March 2024. Retrieved from: <https://permits.air.idem.in.gov/46136f.pdf>

	Xylene
Marion	1,3-Butadiene 1,4-Dichlorobenzene Acetaldehyde Acrolein Arsenic Compounds Benzene Beryllium Compounds Cadmium Compounds Chromium Compounds Cobalt Compounds Ethylbenzene Formaldehyde Hexane Lead Compounds Manganese Compounds Mercury Compounds Naphthalene Nickel Compounds POM Propylene Oxide Selenium Compounds Toluene Xylene
Morgan	1,3-Butadiene Acetaldehyde Acrolein Arsenic Compounds Benzene Beryllium Compounds Cadmium Compounds Chromium Compounds Cobalt Compounds Dichlorobenzene Ethylbenzene Formaldehyde Hexane Manganese Compounds Mercury Compounds Naphthalene Nickel Compounds POM Selenium Compounds Toluene Xylene

NATURAL GAS COMBUSTION REDUCTIONS

Similar to the CAP emissions, HAPs from natural gas combustion on-site were taken from AP-42, Chapter 1.4, Table 1.4-3 and Table 1.4-4. Emissions included the following:

- Arsenic Compounds
- Benzene
- Beryllium Compounds
- Cadmium Compounds
- Chromium Compounds
- Cobalt Compounds
- Dichlorobenzene
- Formaldehyde
- Hexane
- Manganese Compounds
- Mercury Compounds
- Naphthalene
- Nickel Compounds
- Selenium Compounds
- Toluene
- POM

MOTOR VEHICLE REDUCTIONS

HAPs reduced from mobile combustion due to walking and biking trails were taken from Table 1.1-2 in the EPA report, Control of Hazardous Air Pollutants from Mobile Sources: Regulatory Impact Analysis (EPA420-R-07-002).¹⁶

BROWNFIELDS

IDEM's list of brownfields¹⁷ was reviewed to determine any additional HAPs that would be reduced attributable to the CIRDA Open Space Program.

¹⁶ US Environmental Protection Agency (US EPA) Office of Transportation and Air Quality. February 2007. "Control of Hazardous Air Pollutants from Mobile Sources: Regulatory Impact Analysis." Accessed March 2024. Retrieved from: <https://nepis.epa.gov/Exe/ZyPdf.cgi?Dockkey=P1004LNN.PDF>

¹⁷ IDEM. February 2024. "Indiana Brownfields Program Site List." Accessed March 2024. Retrieved from: <https://www.in.gov/ifa/brownfields/files/3.11.24-MS.pdf>