US EPA ARCHIVE DOCUMENT
EPA Design for the Environment (DfE) Training:
Best Practices for Auto Refinishing

Presented by:
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  Jeff Aigeldinger
Overview of DfE Project, Goals, Findings, Outreach Efforts
Hazardous Air Pollutants and VOCs in Collision Repair
Key Chemicals of Concern
Health/Environmental Effects

Tour of Virtual Auto Body Shop
www.ccar-greenlink.org/cshops
Overview & Goals - DfE Project
www.epa.gov/dfe/pubs/projects/auto

- Partnership with collision repair industry
- Encourage best practices and technologies to reduce risk/pollution
- Focus on spray painting and other activities that release toxic chemicals
- Tools: site visits, workshops, outreach kit - binder/CD, self-evaluation checklist, DfE and virtual auto body shop websites
Findings - Best Practices Shop Visits: A Success

- Over 100 shop and school site visits; numerous workshops across country
- 81% of shops made changes
- Changes include:
  - improved use of HVLP spray guns
  - reduced shop emissions
  - better respiratory protection for painters
  - improved mixing room ventilation
  - all spraying in booth, including priming
Profile of Auto Refinish Industry

- 47,000 shops; >190,000 technicians
  - 14% small (<$300,000)
  - 49% large ($300,000 - $1 million)
  - 37% super ($>1 million)
  (Data from 2007 I-CAR Education Foundation Survey)

- Numerous high school and community college programs
- Shops/schools use & release harmful chemicals
- Emissions may pose risks to those in the shops/schools and nearby residents
Outreach Efforts

- Identify factors that motivate change
  - lower costs (less paint, less waste)
  - similar or better performance
  - cleaner, healthier work environment
  - easier to comply with new regulations
  - recognition as environmental leader

- Develop useful tools

- Build a network of support
New EPA Regulations

- Compliance date – 2011 (for existing shops)
- Includes a number of best practices
  - All paint spray application in a filtered booth or prep station
  - HVLP or equivalent spray guns
  - Painter training & certification
  - Gun cleaning requirements
- Record keeping and notification
HAPs, VOCs, and Other Chemicals of Concern in Collision Repair

- **HAPs =** hazardous air pollutants (188)
  - Heavy metals, organic solvents, HDI
- **VOCs =** volatile organic compounds
  - Organic solvents
- **Other chemicals of concern**
  - HDI polyisocyanates
Chemicals of Concern in Paint Products

**Activator (hardener)**
- ethyl acetate*
- toluene*
- aliphatic polyisocyanate
- hexamethylene diisocyanate

**Clearcoats**
- methyl ethyl ketone
- toluene*
- mixed dibasic esters*
- petroleum naphtha*

**Thinners (solvents)**
- butyl acetate*
- ethylbenzene*
- toluene/xylene*
- methyl ethyl ketone*

**Basecoats**
- methyl ethyl ketone*
- titanium dioxide
- metallic pigments
- xylene*

**Primers**
- barium sulfate
- resins and fillers
- toluene/xylene*
- isocyanates often added

Developed by the US EPA Design for the Environment Program and Eastern Research Group, Inc. under Contract # EP-W-05-014
Diisocyanates

- Diisocyanates
  - Hexamethylene diisocyanate (HDI)
  - HDI polyisocyanate
  - (also TDI, MDI, and other diisocyanates)

- Potential exposures
  - spray mist (primers, clear coats)
  - sanding dusts
  - welding and soldering fumes of urethane coatings
Diisocyanates – Why should we be concerned?

- Leading cause of work-related asthma
- Can cause allergic reactions
- Skin and lung sensitizers
- National Institute for Occupational Safety and Health (NIOSH) ALERTS
  - 2006 Spray-on truck bed lining operations
  - 1996 Warning on asthma & death with exposures
- New lower Canadian air standards (2006)
- Toluene diisocyanate (TDI) is a probable human carcinogen
Heavy Metals

- Chromium, Lead, Manganese, Nickel, Cadmium (target HAPs in new EPA regulation)

- Potential exposures
  - sanding dusts
  - spray mists (paint pigments, corrosion protection for metal surfaces)
  - undercoating
  - welding fumes
Heavy Metals - Why should we be concerned?

- Chromium VI (hexChrome)
  - lung cancer; irritation of eyes, nose, throat, lungs; skin & lung sensitization
  - new OSHA standard (lowered exposure limit from 50 ug/m³ to 5 ug/m³)

- Lead:
  - muscle and joint pain; irritability
  - memory and concentration problems
  - fertility problems; anemia; kidney damage
  - nerve, and brain damage
Organic Solvents

- Toluene, xylenes, methyl ethyl ketone, ethyl benzene, others

- Potential Exposures
  - thinners, solvent wipe-down
  - paint mixing
  - cleaning equipment
  - hazardous waste handling/disposal
Organic Solvents – Why should we be concerned?

- Health effects include:
  - irritation; headache, nausea
  - liver, kidney, blood effects
  - central nervous system damage
  - reproductive effects (recent Dutch study)
- Ethyl benzene is a probable human carcinogen
Methylene Chloride
CAS #75-09-2

- Also known as dichloromethane
- Hazardous air pollutant, volatile solvent
- Used for paint stripping
- EPA regulation – “6H” - paint stripping & miscellaneous surface coating operations
- Develop & implement written minimization plan if annual usage > 1 ton
- All sources must implement work practices to minimize emissions
- Consider switching to safer alternatives
- Health effects: central nervous system, other
- Possible inhalation and skin exposure
Virtual Auto Body Shop

www.ccar-greenlink.org/cshops
A Painter’s Perspective on Best Practices
Making Change: A Personal Decision

- 25 years experience in the industry
- Motivation to change as an individual
  - Personal health
  - Family
  - Monetary benefits (both as shop manager and painter)
  - Professional pride
- Motivation to improve the industry
  - Support the DfE team’s efforts to help the industry
  - Share experience on overcoming challenges
  - Industry offers great professional opportunity for young painters
Best Practices and Technologies that Reduce Exposures/Emissions
What is wrong with this picture?
Key Exposure & Release Points

- Spray Painting - exposure to paint mist containing solvents, diisocyanates, lead chromate, paint additives

- Paint Mixing - solvent exposure; inadequate ventilation

- Preparation & Clean Up - dust, solvent exposure
Key Best Practices That Reduce Emissions

- Perform all spray painting in spray booth
- Use HVLP spray guns or equivalent
- Use safer alternative paints and cleaning products
Key Best Practices (contd.)

- Properly ventilate paint mixing room
- Use appropriate respiratory protection
- Wear chemical-resistant gloves, clothing, eye protection
- Manage health & safety responsibly
DfE Site Visit Binder

The binder contains:

- Best practices checklist for each activity
- Best practices fact sheets and case studies for selected activities
- List of manufacturers and suppliers
- Information on isocyanates
- Video on working safely with polyurethane paints
Best Practices - Benefits

- Cleaner, more productive shop
- Healthier painter, fewer lost sick days
- Reduced paint & solvent emissions
- Paint cost savings
- Waste reduction
Spray Painting Best Practices

- Perform all spraying activities in a well-maintained ventilated spray booth. Booth types include:
  - Downdraft
  - Semi-downdraft
  - Crossdraft

- Spray booth filters are 98% efficient for particulates.
ILLUSTRATION OF AIR FLOW IN A DOWNDRAFT SPRAY BOOTH

Filtered air enters at ceiling of booth and exits through the floor.
ILLUSTRATION OF AIR FLOW IN A SEMI-DOWNDRAFT SPRAY BOOTH

Filtered air enters at ceiling of booth and exits through the right side.
ILLUSTRATION OF AIR FLOW IN A CROSSDRAFT VENTILATION SPRAY BOOTH

Filtered air enters at left side of booth and exits through right side.
## OSHA and EPA Spray Booth Requirements

<table>
<thead>
<tr>
<th>EPA</th>
<th>OSHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Booth filters at least 98-percent efficient in capturing overspray. [40 CFR Part 63.11173(e)(2)(i)]</td>
<td>Perform all spray applications in a spray booth or spray room. [29 CFR 1910.94(c)(2)]</td>
</tr>
<tr>
<td>Complete motor vehicles in a fully enclosed booth or prep station (4 walls or side curtains). [40 CFR Part 63.11173(e)(2)(ii)]</td>
<td></td>
</tr>
<tr>
<td>Perform spray painting of parts or sub assemblies in a booth or prep station with at least 3 walls or side curtains. [40 CFR Part 63.11173(e)(2)(iii)]</td>
<td></td>
</tr>
</tbody>
</table>

Standards and regulations that address the design/construction/location of spray booths:
2. OSHA: Ventilation, 29 CFR 1910.94(c)(3)
Reduction in Auto Body Shop Emissions with Best Practices

% Reduction in Emissions

- Conventional spray gun without booth
- HVLP spray gun without booth
- Booth + Conventional spray gun
- Booth + HVLP spray gun

Diisocyanates - Lead, Chromium - Organic Solvents

Best Practice
Spray Painting Best Practices
Safer Alternative Paints/Products

- Use safer alternative paints and cleaning products
  - Consider switching to waterborne paints
  - Substitute topcoats and undercoats with chrome- and lead-free alternatives
  - Use low VOC, zero HAPs cleaning solvents
Waterborne Paint Systems
Prep, Storage and Mixing Notes

- Surface prep similar - cleaning more critical
- Mixing more straight forward – no guess work with reducers
- Storage
  - Temperatures between 36° F and 95° F (more of an issue for distributors)
  - No agitation needed in storage
Waterborne Paint Systems

Application Notes

- Improved coverage (fewer coats needed)
- Good color matching / improved blending
- Air accelerators needed to achieve comparable dry times
- Increased air movement makes it more important to keep the booth clean
- Dedicated waterborne gun recommended
Waterborne Paint Systems
Gun Cleaning Notes

- Separate cleaning systems from guns for solvent borne coatings
- Disposable gun cup systems help with cleaning
- Rinse inside of gun with water before use
- Coordinate with state/local authorities to ensure proper waste disposal
Spray Painting Best Practices

HVLP Spray Guns

- Use High Volume Low Pressure (HVLP) spray guns
  - Increase transfer efficiency (up to 65%) and reduce overspray
- Transfer efficiency is the measurement of how much paint sprayed is actually applied to the part being painted.
Why is Increased Transfer Efficiency Important?

- Reduce shop emissions
- Reduce worker exposure
- Reduce paint volume needed for each job, resulting in savings for shops

<table>
<thead>
<tr>
<th>Gun Type</th>
<th>TE</th>
<th>Sprayed</th>
<th>On part</th>
<th>Overspray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>30%</td>
<td>10 oz.</td>
<td>3 oz.</td>
<td>7 oz.</td>
</tr>
<tr>
<td>HVLP</td>
<td>65%</td>
<td>4.6 oz.</td>
<td>3 oz.</td>
<td>1.6 oz.</td>
</tr>
</tbody>
</table>
Paint Cost Savings with HVLP Spray Guns

- Conventional: Cost
- HVLP Spray Guns: $6,900 Savings
- HVLP Spray Guns with Proper Technique: $13,000 Savings

*Estimated annual savings, based on 420 gal/yr
Courtesy of the STAR Program, IWRC

Developed by the US EPA Design for the Environment Program and Eastern Research Group, Inc. under Contract # EP-W-05-014
Tips for Effective Use of HVLP Spray Guns

- Use a larger diameter air hose
- Use the right gun tip for the job
- Ensure that shop compressor is capable of delivering sufficient air
- Set up each gun to ensure proper pressure at the gun tip
- Use proper spraying techniques
Spray Techniques

- Spray gun distance to part
- Perpendicular to surface
- Spray angle
- Consistent 50% overlap
- Reduce lead and lag
- Spray pattern size and shape
Prep Work Best Practices

Sanding
- Use Vacuum sanding system (dry sanding)
- Use a well ventilated area, such as a prep station (dry sanding)

Solvent Wipe Down
- Use spray booth, or prep station, or other source of ventilation; consider substitute solvent
Spray Gun Cleaning
Best Practices

- Use an automatic gun cleaning unit
- Pre-clean guns to remove gross contamination
- Cover gun cleaning unit when possible
- Ensure that gun cleaning unit is in good working order
- Consider substitute cleaning compounds
Spray Gun Cleaners

Enclosed Automatic Paint Gun Washer

Recirculating Paint Gun Cleaning System
Minimizing Hazardous Waste

- Solvent recyclers
- Spray gun cleaners that reuse cleaning solvents
  - Proper cleaning techniques
- Computerized mixing system
- Mix only what is needed
- Store and reuse remaining mixed paint
Paint Mixing Best Practices

- Provide adequate ventilation in paint mixing area. Local exhaust vents should be located near sources of emissions.
- Keep all containers shut when not in use. Use gasket-sealed, spring-loaded covers on solvent storage containers and waste drums.
Poor Ventilation Design

Make-up air inlet

Paint/solvent vapors drawn through worker's breathing zone

Mixing Bench

Exhaust vent

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Draw vapors away from breathing zone

Make-up air inlet

Paint/solvent vapors drawn away from worker's breathing zone

Exhaust vent
Top view of room—Locate make-up air inlet opposite from exhaust vent
Top view of room—
Locate exhaust vent near vapor sources
Local exhaust ventilation
Virtual Auto Body Shop
Paint Mixing Room

www.ccar-greenlink.org/cshops
Health and Safety Management in the Collision Repair Shop/School
## Personal Protective Equipment (PPE)

<table>
<thead>
<tr>
<th>Task</th>
<th>PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spray Painting</td>
<td>A loose-fitting SAR or better (APF of at least 25).</td>
</tr>
<tr>
<td></td>
<td>Protective gloves (nitrile or manufacturer suggested gloves).</td>
</tr>
<tr>
<td></td>
<td>Protective eyewear.</td>
</tr>
<tr>
<td></td>
<td>Coveralls and headsock.</td>
</tr>
<tr>
<td>Paint Mixing, Solvent Wipe Down,</td>
<td>A half-mask APR with organic vapor cartridges or better.</td>
</tr>
<tr>
<td>Spray Gun Cleaning</td>
<td>Protective gloves (nitrile or manufacturer suggested gloves).</td>
</tr>
<tr>
<td></td>
<td>Protective eyewear.</td>
</tr>
<tr>
<td>Sanding</td>
<td>A loose-fitting SAR or better (APF of at least 25).</td>
</tr>
<tr>
<td></td>
<td>A half-mask APR with N95 particulate filter or better (dry sanding).</td>
</tr>
</tbody>
</table>
User-Friendly Respirators

- **Loose-fitting hood supplied-air respirators**
  - Light-weight, low-maintenance
  - Do not need a fit test to use
  - Can even have a beard and wear eyeglasses
  - Often provide the greatest cooling effect

- **Tight-fitting facepiece supplied-air respirators**
  - Typically provide the highest level of protection
  - Rear-mount model helps prevent contact with the paint job
  - Painters need a fit-test and cannot have beard/facial hair
  - Eyeglass mounts available with most models

- **Select the type of respirator that works best for the shop and its painters**
Grade D Breathing Air

Grade D breathing air is required for supplied air respirators (OSHA requirement):

- Oxygen content (v/v) of 19.5-23.5%;
- Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less
- Carbon monoxide content of 10 ppm or less
- Carbon dioxide content of 1,000 ppm or less
- Lack of noticeable odor

Grade D breathing air can be provided by:

- Supplied air respirator fresh air pump
- The shop air compressor equipped with an appropriate filter and regulator for breathing air and with a carbon monoxide alarm
Health and Safety Management

- Respiratory Protection Program
- Hazard Communication Program
Respiratory Protection Program

The program (required by OSHA) assures that:

- Shop selects appropriate respirator for the job
- Respirators are used properly and provide the intended level of protection
- Workers are physically capable of wearing selected respirators
Respiratory Protection Program

The program should include:

- A written program
- Use of NIOSH approved respirators
- Medical surveillance
- Annual fit testing
- Training
- Filter change out schedule for APRs
Respirator Fit Test
Hazard Communication Program

This program helps convey information to the shop workers about workplace chemical hazards and how to protect themselves from these hazards.
Hazard Communication Program

The program (required by OSHA) must include:

- A written program
- Copies of MSDS for all chemicals in the shop
- Proper labeling of chemicals.
- Training
What is a MSDS?

- A document prepared by the product manufacturer that provides important health and safety information on working with the product.
MSDS Sections

A MSDS consists of 16 sections (in the commonly used ANSI format):

- **Section 1**: Chemical Product and Company Identification
- **Section 2**: Composition, Information on Ingredients
- **Section 3**: Hazards Identification
- **Section 4**: First Aid Measures
- **Section 5**: Fire Fighting Measures
- **Section 6**: Accidental Release Measures
- **Section 7**: Handling and Storage
- **Section 8**: Exposure Controls, Personal Protection
- **Section 9**: Physical and Chemical Properties
- **Section 10**: Stability and Reactivity
- **Section 11**: Toxicological Information
- **Section 12**: Ecological Information
- **Section 13**: Disposal Considerations
- **Section 14**: Transport Information
- **Section 15**: Regulatory Information
- **Section 16**: Other Information

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How to Read a MSDS

Section 1: Chemical Product and Company Identification. Names the material and provides a mailing address and telephone number for the manufacturer/distributor (useful in case of an emergency).

Section 3: Hazards Identification. How the chemical enters the body (such as inhaling, swallowing or through the skin) and what health problems it could cause.
Section 4: First Aid Measures. Includes emergency and first aid procedures.

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### Material Safety Data Sheet

**Burdick & Jackson**

**Material:** o-Xylene

**Ingredient Name:**

<table>
<thead>
<tr>
<th>Ingredient Name</th>
<th>NTP Status</th>
<th>IARC Status</th>
<th>OSHA List</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ingredients listed in this section.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 4. First Aid Measures

**Skin:** Wash with soap and water and flush with water. Remove contaminated clothing and wash before reuse. Get medical attention.

**Eyes:** Immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

**Inhalation:** Remove from exposure area to fresh air. If victim is not breathing administer artificial respiration according to your level of training and obtain professional medical assistance immediately.

**Ingestion:** Do not induce vomiting. Contact physician immediately.

**Advice to Physician:** Treat symptomatically.

#### 5. Fire Fighting Measures

**Flammable Properties**

- **Flash Point:** 63°F (17°C)
- **Flash Point Method:** Closed Cup
- **Autoignition Temperature:** 667°F
- **Upper Flame Limit (volume % in air):** 6.7%
- **Lower Flame Limit (volume % in air):** 0.9%
- **Flame Propagation Rate (ladle):** Not applicable
- **OSHA Flammability Class:** IB

**Extinguishing Media:**

- Dry Chemical, Foam, or Carbon Dioxide

**Unusual Fire and Explosion Hazards:**

Vapors are heavier than air and may migrate to a low area and flashback in a fire or remote ignition condition.

**Special Fire Fighting Precautions/Instructions:**

- Do not release runoff from fire control measures into waterways or sewers.
- Water will not be effective in extinguishing a fire. Use water spray to cool fire-exposed container and to reduce rate of burning, taking care not to spread the fire. Heat will build pressure and rupture closed storage containers. Wear NIOSH approved self-contained breathing apparatus and full protective clothing.

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How to Read a MSDS (cont'd.)

**Section 7: Handling and Storage.** Explains how to properly handle and store the chemical.

**Section 8: Exposure Controls, Personal Protection.** Describes how to maintain proper ventilation and recommends appropriate personal protective equipment, such as respirators, safety eye gear, gloves, and other protective clothing.
What is wrong with this picture?
Hockey players wear protective gear – so can you!
DfE Best Practices
Self Evaluation Checklist
Self Evaluation Checklist - Purpose

- Provide shop owners a tool to:
  - Assess protection of workers and community
  - Focus improvement efforts
  - Ensure ongoing implementation of best practices
Self Evaluation Checklist - Use

- Checklist assesses key refinish activities:
  - Surface preparation
  - Paint mixing
  - Spray painting
  - Spray gun cleaning
  - Health and safety management
**SELF-EVALUATION CHECKLIST**

<table>
<thead>
<tr>
<th></th>
<th>Baseline Evaluation</th>
<th>Follow-Up Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date:</td>
<td>Date:</td>
</tr>
<tr>
<td></td>
<td>Check Yes or No</td>
<td>Points</td>
</tr>
<tr>
<td>1.</td>
<td><strong>SURFACE PREPARATION</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sanding</td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>Does the shop consistently use vacuum sanding, a ventilated prep deck, and/or wet sanding methods?</td>
<td>Yes=3 No=0</td>
</tr>
<tr>
<td>1b</td>
<td>If you answered &quot;No&quot; to question 1a above – Do workers performing dry sanding tasks consistently use a half-mask air purifying respirator (APR) with an appropriate particulate filter (N95 or better)?</td>
<td>Yes=1 No=0</td>
</tr>
</tbody>
</table>

*The best protection to the person performing sanding and to all others in the workplace is provided by using one of the methods listed in item 1.a above. If such methods are not used, the person performing dry sanding tasks should use appropriate respiratory protection to prevent inhalation of hazardous dusts.*

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Are vacuum sanders and/or prep decks well maintained?</td>
<td>Yes=1 No=0</td>
<td>Yes=1 No=0</td>
</tr>
</tbody>
</table>

*Well maintained equipment will ensure proper capture of sanding dusts.*

<p>| | | | |</p>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Workers wear nitrile (or other impermeable gloves) when performing wet sanding tasks?</td>
<td>Yes=1 No=0</td>
<td>Yes=1 No=0</td>
</tr>
</tbody>
</table>

*Many abrasive compounds used for wet sanding are potential skin irritants. Refer to the product's MSDS for more information on hazards and required protective equipment.*
# Best Practices - Benefits

**EVALUATION TABLE**

<table>
<thead>
<tr>
<th>POINTS</th>
<th>EVALUATION OF OVERALL TOTAL POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>The shop has taken little if any positive steps to minimize emissions of isocyanates and other hazardous materials (or to protect workers and the surrounding community from such emissions) generated during refinishing tasks.</td>
</tr>
<tr>
<td>21-60</td>
<td>The shop has taken some positive steps to minimize emissions of isocyanates and other hazardous materials (or to protect workers and the surrounding community from such emissions) generated during refinishing tasks but much work is still needed.</td>
</tr>
<tr>
<td>61-85</td>
<td>While the basics are in place, some critical best practices still need work to ensure effective emission reduction and worker and community protection.</td>
</tr>
<tr>
<td>86-107</td>
<td>Congratulations. It appears that the shop has implemented most if not all of the key best practices. Keep up the good work and continue efforts to implement all best practices to ensure a healthy and safe environment for your workers and the surrounding community.</td>
</tr>
</tbody>
</table>
On-line Resources

- DfE Auto Refinish Project
  http://www.epa.gov/dfe/pubs/projects/auto

- Virtual Auto Body Shop
  http://www.ccar-greenlink.org/cshops

- STAR® (Spray Technique & Research)
  http://www.iwrc.org/STAR/STARschools.htm

- OSHA Auto Body Repair and Refinishing
  http://www.osha-slc.gov/SLTC/autobody

- NIOSH Alert on Diisocyanates
  http://www.cdc.gov/niosh/asthma.html
Contacts

DfE Auto Refinish Project
www.epa.gov/dfe/pubs/projects/auto

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