



# **Foresight of New and Emerging Risks to Occupational Safety and Health Associated with New Technologies in Green Jobs by 2020**

Introduction to OSH issues

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# Common Themes

- Decentralisation
- New materials
- Conflict between Green and OSH
- Rate of innovation
- Increasing automation
- Need for new OSH knowledge and skills
- Skills shortage
- Polarisation of workforce high-skilled jobs vs. precarious works
- Diverse workforce – fewer job opportunities in (highly skilled) green jobs for vulnerable groups incl. female/older/migrant/disabled workers?

# Decentralisation

- Decentralisation of workplaces into smaller, dispersed units, incl. rise of sub-contracted work, self-employed and micro-enterprises: lower OSH awareness/culture and fewer resources for OSH
  - Small businesses, often with low OSH awareness, as provider of green services, e.g. cargo bikes for green delivery of people, goods and services
- Difficulty enforcing good OSH conditions and safe working practices in dispersed and difficult to reach workplaces with poorer access to OSH services (labour inspection, preventive services, training, etc.).

# Decentralisation - Manufacturing

## 3D-printing

- dispersed locations,
- mass customisation,
- difficulty to define and enforce standards for safe work as products are one-offs
- integrity of products,
- widespread storage and use of a variety of chemicals for a variety of one-offs products,
- inexperienced workforces.

## 'BONUS WORLD' - MANUFACTURING

"Hello - how may I help you??"

*(....I used to work just in retail...*

*Now I am expected to be a manufacturer as well. I just press the buttons and hope it is OK! )*



I'll have a Zpad4.2 ... in lime green and purple ... and a cup of coffee while I wait please

# Decentralisation – Renewable Energy

- Distributed, small scale installations
- Non-standard installations: risks to maintenance workers
- New entrants without necessary skills
- Sub-contracting
- Retrofitting
  - Dust, lead, asbestos, work at height, etc. – risks not new but in new situations
  - Re-insulation of buildings: exposure to insulation materials, e.g. MMMF
  - Roof spraying of polyurethane foam insulation: OEL for isocyanate exceeded

# 'DEEP GREEN' - ENERGY SYSTEMS

Local bio-gas with  
livestock  
management

bio-mass landscapes  
with community power  
generation



Autonomous housing  
with micro-  
generation

Integrated  
industrial ecology  
systems

# New Materials

- Nanomaterials
- Composites
- Biomaterials
- Ceramics
- Smart Materials
- Quantum Materials
- Metal organic frameworks
- Plastic electronics



# New Materials

- Manufacturing
- Biotechnology
- Waste handling
- Batteries
- Construction

⇒ *(New, long-latency) work-related diseases from new materials?*

- Difficulty to trace diseases back to jobs without exposure registers

# Green construction materials

- New materials: nanomaterials, phase change, heat storage chemicals, aerogels
  - ⇒ prior health impact assessment needed
- Renewables, e.g. wood, bamboo, straw, sheep wool, etc
  - ⇒ dust, allergens, moulds, endotoxins and possibly chemicals
    - Flakes or flax wool impregnated with Borax: fire retardant and antimicrobial but also reprotoxicant
- Recycled materials:
  - Fly ash (PAH, cadmium, mercury, nickel, chromium) and asphalt (PAH) as filler in concrete
  - Steel from recycled metals containing lead ⇒ need for better material quality control

## 'BONUS WORLD' - BIO-ENERGY



So - any idea  
what's in Silo  
number 2 today??

No idea... But we  
got to get it out  
of here before  
the morning shift.

## 'WIN-WIN' - WASTE

Our automated waste recovery extraction and intelligent re-use technology is the best available...



But how do we know if new kinds of hazardous waste are getting into new kinds of places ???

# Conflict between Green and OSH

- Political pressure – grants, subsidies
  - OSH risks from work rushed before subsidies' withdrawal
  - In-house waste treatment due to high waste disposal charges: risk shifting from professional waste operator to waste producer
- Hazardous materials and processes
  - Higher incident rate in green-certified construction projects
  - Re-furbishing: OSH risks from the re-use of old equipment
  - Sealed buildings
- Waste disposal
- End of life - Recycling
  - Green construction sites: 2 to 3x more manual work due to on-site waste separation

## 'DEEP GREEN' - WIND ENERGY



Look at that turbine - way beyond its design life !!  
We can only get refurbished spare parts these days...

It is exhausting to spend all day climbing up these old turbines without lifts... I wish we had new ones

## 'BONUS WORLD' - WASTE

Have you  
thought about  
investing in  
automated  
landfill resource  
extraction &  
recovery?



Who needs to  
invest in  
automation  
when you've  
got all these  
cheap  
workers??

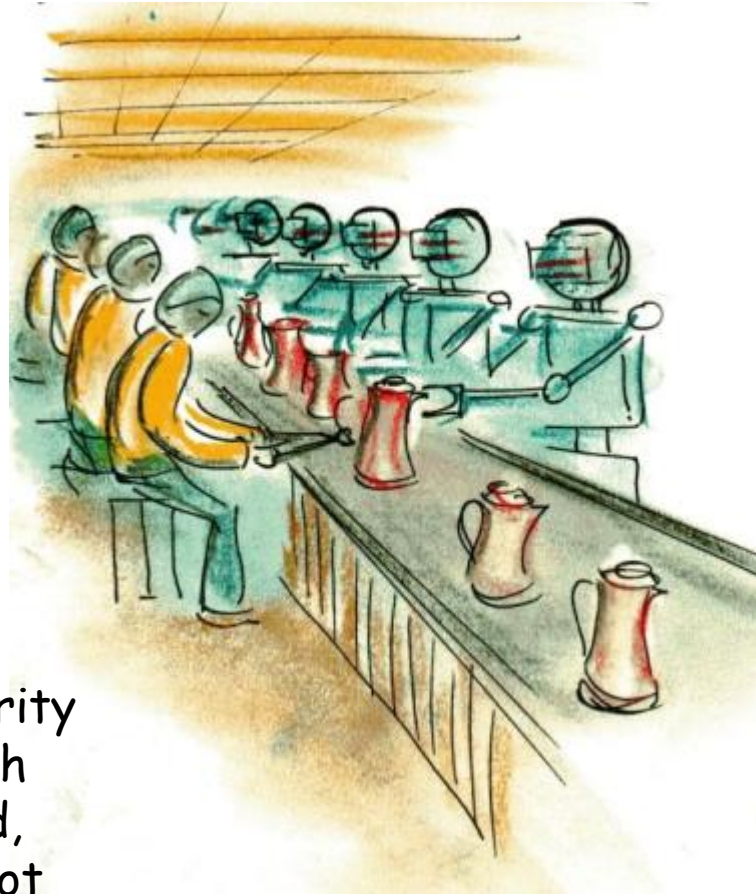
# Innovation and Automation

- Increasing rate of innovation
- Increasing levels of automation in all sectors
- Increasing complexity
- Human machine interface
- Cobots
- Over-reliance on computers



# 'WIN-WIN' - MANUFACTURING

now that robots  
or "co-bots" do  
most of the  
work.... What's  
there to worry  
about ???



**+++ THIS  
HUMAN HAS A  
POOR  
TRAINING  
RECORD+++  
KEEP HER  
UNDER ACTIVE  
SURVEILLANCE  
+++**

Boredom ... insecurity  
... Keeping up with  
innovation ... And,  
what if they do not  
keep out of our way...

## 'WIN-WIN' - TRANSPORT

Do you think this new  
"platoon" technology is  
going to be totally safe ??

How safe is safe ?? ...  
At least I can catch up  
on my e-mails whenever  
I want



# Automated construction

- Offsite manufacturing of building modules has improved safety on construction sites
- New risks from use of new substances and materials
- Issues on construction site from mixing automated activities with manual ones

Construction ?? -  
it's all  
'prefabrication'  
these days. Much  
less manual work.



Yeah - look at this one -  
"carbon epoxy fibre  
laminated cement  
extrusion, with all  
services installed. Just  
hope the 'plug and play'  
water and electricity  
connections are clearly  
labelled.

# Increasing reliance on electricity

- Electric vehicles
  - Risks in maintenance
    - Workers unaware of high voltages (360-500V)
  - Risks to emergency services
  - Risks not confined to the vehicle
    - End-of-life batteries for vehicle service re-used to store electricity in buildings
  - Risks from fuel cells
- Electricity for heating of buildings
  - PV risks to installers
  - PV risks to fire services



## 'BONUS WORLD' - TRANSPORT

*"Yes these ex-car batteries should be fine, no service record but never had any problem..."*



*"No need for guarantees... I just need 20 units for the home system"*



Author: David Tijero Osorio

- “Construction” hazards combined with electrical hazards
- Manufacturing - involves large quantities of chemicals - many highly toxic
- Leaching hazard, including at the waste treatment stage
- PV remains live even when the mains supply is cut - risks for emergency workers

Material	DOT Hazard Classification*
Arsenic	Poison
Arsine	Highly Toxic Gas
Cadmium	Poison
Diborane	Flammable Gas
Diethyl Silane	Flammable Liquid
Diethyl Zinc	Pyrophoric Liquid
Dimethyl Zinc	Spontaneously Combustible
Hydrochloric Acid	Corrosive Material
Hydrofluoric Acid	Corrosive Material
Hydrogen	Flammable Gas
Hydrogen Selenide	Highly Toxic Gas
Hydrogen Sulfide	Flammable Gas
Indium	Not Regulated
Methane	Flammable Gas
Molybdenum Hexafluoride	Toxic and Corrosive Gas
Oxygen	Gaseous Oxidizer
Phosphine	Highly Toxic and Pyrophoric Gas
Phosphorus Oxychloride	Corrosive Material
Selenium	Poison
Silane	Pyrophoric Gas
Silicon Tetrafluoride	Toxic and Corrosive Gas
Tellurium	Not Regulated
Tertiarybutyl Arsine	Pyrophoric and Highly Toxic Liquid
Tertiarybutyl Phosphine	Pyrophoric Liquid
Tetramethyl Tin	Pyrophoric and Highly Toxic Liquid
Trimethyl Indium	Pyrophoric Solid
Trimethyl Aluminum	Pyrophoric Liquid
Trimethyl Gallium	Pyrophoric Liquid
Tungsten Hexafluoride	Toxic and Corrosive Gas

# Picture and cartoon credits

- **Picture on slide 20:**
  - Felix Kramer (CalCars)
- **Picture on slide 22:**
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- **Cartoon artist:**
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