ENERGY & THERMOFLUIDS ENGINEERING

Environmental Labelling of Manufactured Products – Our Opportunity to Catch Up With International Trade

Dr Steve Brown, CSIRO Air Quality Control Sciences

Petar Johnson, President, Australian Environmental Labelling Association

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

ENERGY & THERMOFLUIDS ENGINEERING

What is indoor air quality?

- Indoor air - the air within any non-industrial enclosed space where people spend more than 1 hour/day: Dwellings, offices, schools, hospitals, cars
- Urban populations spend 90% of time indoors, 7% in transit
- Indoor air quality - the attributes of indoor air that affect occupant health and well-being: air pollutants, heating/cooling, odours, stuffiness
- For many pollutants, average indoor conc^{n} >> outdoor conc^{n}
- Indoor air pollution is mostly driven by emissions from indoor materials/processes!!!

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

ENERGY & THERMOFLUIDS ENGINEERING

Why be concerned about indoor air quality?

Ill-health effects:

- building related illness (asbestos diseases, Legionnaires' disease, environmental tobacco smoke, respiratory and other illnesses from combustion gases and particles)
- sick building syndrome (reduced productivity ~6% from headache, nausea, lethargy and irritation effects from non-specific causes)
- illnesses from exposure to Air Toxics?

Costs due to illness and lost productivity:

- USA up to $170billion/year
- Australia estimate ~$10billion/year

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

ENERGY & THERMOFLUIDS ENGINEERING

Indoor Air Pollutants in Australia

NHMRC Indoor Air Goals

- Total VOCs (1h ave) 500 µg/m^3
- Any VOC (1h ave) 250 µg/m^3
- Formaldehyde (ceiling value) 130 µg/m^3
- Carbon monoxide (8h ave) 9 ppm
- Lead (3 month ave) 1.5 µg/m^3
- Total Susp. Part. (annual) 90 µg/m^3
- Ozone, Sulfur Dioxide, Radon

If goals exceeded, sources of the pollutants should be removed or the building ventilation rate should be increased

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

ENERGY & THERMOFLUIDS ENGINEERING

Indoor Air Pollution in Australia - Government Initiatives

- 1992 NHMRC Indoor Air Goals
- 1993 Consultant's Review for EPAV
- 1997 State of Environment Report on IAQ
- 1998 IAQ Guidelines for Sydney Olympics
- 1998 Built Environment Protocol - Qld Public Works
- 1999-2002 - Environment Australia's Air Toxics Program
- 2000 IAQ - Health Impacts and Management for Comm. Dept Health&Aged Care
- 2001 State of Environment Report on Human Settlement
- 2001 Report on Sick Building Syndrome - NSW Leg Ass
- 2002 FASTS paper on IAQ Strategy → govt. projects $350k(gas heaters, woodsmoke, schools)
- 2003 Healthy Homes guideline by enHealth Council

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

ENERGY & THERMOFLUIDS ENGINEERING

Indoor Air Pollution in Australia – CSIRO Research

- Pollutants in Buildings - new
  - established
  - occupant complaint
- Volatile Organics in new cars
- Pollutants emitted from building materials and appliances: paints, carpet, wood-based panels, furniture, office equipment, unflued gas heaters
- www.cmit.au

Implementation of Research – Emission Labelling

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

ENERGY & THERMOFLUIDS ENGINEERING

Typical Indoor Air Pollutant Concentrations

Formaldehyde (NHMRC goal 130 mg/m^3)

outdoor	<20
conventional house/office	10 - 120
mobile house/office	80 - 1200

Nitrogen Dioxide (WHO goal 230 mg/m^3)

outdoor	100 - 300 (highest)
house/school with:	
- unflued gas heater	60 -1600 (range)
- low emission unflued gas heater	600 (highest)

VOCs (NHMRC goal TVOC 500 mg/m^3, VOC 250 mg/m^3)

outdoor	TVOC 20 -100
indoor (established building)	TVOC 100 - 300
indoor (new building)	TVOC 5,000 – 20, 000
new car interior	TVOC 2,000 – 64,000

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY CSIRO

ENERGY & THERMOFLUIDS ENGINEERING

Indoor Air Quality in a New House

'healthy' house design

mechanical vent. (0.35ACH) with doors/windows closed

occupied, no smoking, no cleaning <24h sampling

concurrent air sampling in livingroom, child's BR & outdoor on days 2, 19, 72, 246 after construction

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY CSIRO

ENERGY & THERMOFLUIDS ENGINEERING

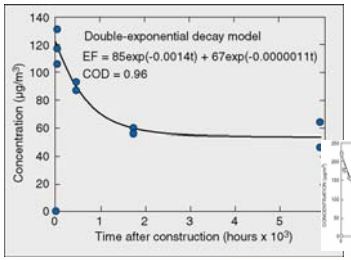
VOC Concentrations (µg/m^3)

VOC	Indoor on day 2	19	72	246	Out (ave)
Methanol	700*	780*	180	180	<5
n-Hexane	250*	18	3	<1	<1
Cyclohexane	360*	<1	<1	<1	<1
Toluene	160	100	15	10	2
Texanol®	390*	130	37	16	<1
Methyldibutyl succinate	290*	120	18	<1	<1
TVOC	4000*	1300*	500*	290	38

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY CSIRO

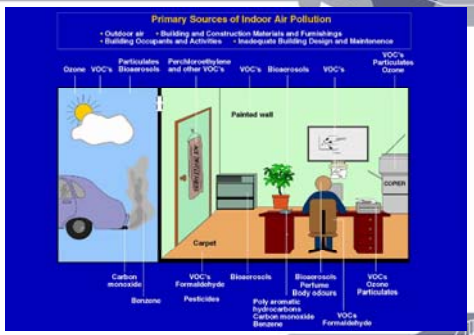
ENERGY & THERMOFLUIDS ENGINEERING

Formaldehyde Decay by Double-exponential Model



CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY CSIRO

ENERGY & THERMOFLUIDS ENGINEERING

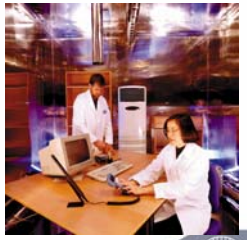


CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY CSIRO

ENERGY & THERMOFLUIDS ENGINEERING

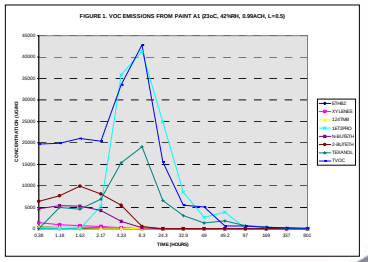
Measurement/modeling of Pollutant Emissions - Room Environmental Chamber

- T/RH ± 0.5^{o}C/ ± 5%RH
- Ventilation ± 0.05 h^{-1}
- Mixing - well-mixed
- Non-emitting/sinking construction materials
- Purified air supply
- *All pollutants in air must be from Test Materials*
- Paints, Carpets, Wood panels, Photocopiers, Gas heaters, Furniture



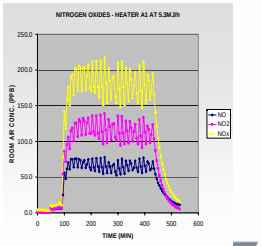
CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY CSIRO

VOC Emission from Interior Acrylic Paint



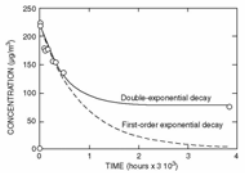
Unflued Gas Heater Emissions in Room Chamber

- Heater operated at constant heating rate
- Chamber operated at constant ventilation rate
- Purified air supply
- Chamber interior well-mixed
- Pollutants achieved steady-state concentration by 2 h
- Emissions of NO2, CO, VOCs, fine particles formaldehyde



Formaldehyde Emission from Wood-based Panels

- Chamber emission test: 23°C, 45%RH, 1 ACH, 1.0m²/m³ loading
- Low-emission goal (E1) is 130 µg/m³
- Emissions <2wks are first order, exceed E1, but predict no emission by 5mo
- Emissions >1 mo are double exponential, <E1 but persist at ~80 µg/m³



outdoor	**<20**
conventional house/office	**10 - 120**
mobile house/office	**80 - 1200**

Controlling Indoor Air Pollution
Exposure = Concentration × Time

- We spend over 90% of time indoors
- Indoor air pollution is driven by emissions from indoor materials/processes
- Reduce indoor air pollutant concentrations by:
- increased building ventilation rate (limited increases possible; increased energy use→other environmental problems)
- inclusion of air cleaning devices (mech. ventilation system; maintenance; gases and particles)
- Reduced emissions from 'polluting' materials and appliances (100-fold ↓, energy neutral, passive control)

Establishing Pollutant Emission Criteria for Building Materials, Furnishings and Appliances

- Understand the emissions from individual products and their IAQ impact:
- What pollutants?
- What quantities are emitted?
- How do emissions change with time
  → exposure levels to occupants?
- Emission criteria based on acceptable exposure levels

Pollutant Emission Source Models

- **Emission Factor** EF = mass pollutant/m²/h
- **First order** emission decay:
  $EF_t = EF_o \exp(-kt)$
  (paints, VOC/wood panels, carpet)
- **Double exponential** emission decay:
  $EF_t = EF_{o1} \exp(-k_1 t) + EF_{o2} \exp(-k_2 t)$
  (formaldehyde/wood panels, carpet)
- **Constant** emission rate:
  C = EF.area/volume.ventln rate
  (gas heater, office equipment)

Selecting Low Polluting Building Materials

Non-Emitting/Low-Emitting

- glass, granite, tiles, bricks
- powder-coated metals
- wool insulation
- gypsumboard
- solid/precoated woods
- 'zero-VOC' paint
- polyolefin flooring

Voluntary Low-Emission Labels

- pollutant emission factor after manufacture - odorant, irritant, air toxic, repro-toxin, carcinogen
- Germany: Blue Angel (build. materials, office equip)
- Germany(2002): Committee on health-related evaluation of building materials
- USA - Greenguard
- Finland - 300 products as supplement to Building Code
- Voluntary but called up in codes as best practice

Emission Classification in Finland – 300 Low Emission Building Materials

The goal of the classification is to enhance the development and use of low-emitting building materials so that material emissions do not increase the requirement for ventilation in ordinary work spaces and residences. The Classification does not overrule official building codes.

M1 classified materials have to fulfil the criteria at the age of 4 weeks.

- The emission of total volatile organic compounds (TVOC) shall be below 0.2 mg/m²h. A minimum of 70% of the compounds shall be identified.
- The emission of formaldehyde shall be below 0.05 mg/m²h.
- The emission of ammonia (NH3) shall be below 0.03 mg/m²h.
- The emission of carcinogenic compounds belonging to category 1 of the IARC monographs (IARC 1987) shall be below 0.005 mg/m²h.
- The material is not odorous (dissatisfaction with odour shall be below 15 %).
- Plasters and tiling products, levelling agents, putty, mastics, fillers, screeds and renders shall not contain casein.

Finnish Classification Scheme

533.3 Rubber flooring
Freudenberg Building Systems Oy
Noraplan (stone, mega, plus, effect, viva, vario II, uni, mega elastic, stone elastic)
Pavimento Oy
Granito
534.1 Linoleum flooring
Forbo Linoleum Oy
Artoleum (Graphic, Piazza, Scala, Sierra)
Marmoleum (Decibel, Fresco, Mosaic, Ohmex, Real)
Walton
Tarkett Sommer Oy
Linosom
Upofloor Oy
DLW-Linoleumi
534.2 Cork flooring
Paloheimo Parquets
Wicander Cork Master
Wicanders Wood-O-Cork
Wicanders Wood-O-Cork
536.8 Flooring reinforcements and toppings
Pohjanmaan Tehdaspalvelu Oy
ARC 791 V kvartsikomposiittipinnoite
538.1 Carpet underlays
Tupler Oy
Tuplex
54 Wall finishes
Armstrong World Industries AB
Sliter Vägg 1,0 mm

Committee for Health-Related Evaluation of Building Materials (AGBB), Germany, 2002

- **Measure VOC emissions in chamber at 0.5ACH and 0.5m²/m³**
- **After 3 days:**
- TVOC ≤ 10mg/m³
- Sum of all detected carcinogenic VOCs ≤ 0.01mg/m³
- **After 28 days:**
- TVOC ≤ 1.0mg/m³
- Sum of slightly volatile (C_{16-22}) organic compounds ≤ 0.1mg/m³
- Sum of all detected carcinogenic VOCs ≤ 0.001mg/m³
- For 122 VOCs with a Lowest Conc of Interest, ∑C/LCI ≤ 1
- For VOCs with unknown LCI, ∑VOC < 0.1mg/m³
- **Products rejected if any of these criteria are not met**
- **Scheme proposed to European Union regulators**

Mandatory Low Polluting Building Materials 2004

- Netherlands Building Decree 2001- occupational exposure standards and the pollutant emission properties of materials form the basis of the approach. Using the area of source materials, their emission behaviours and a ventilation rate 1/6th of that required, an estimate is made of pollutant concentrations in the building and these must not exceed the standards.
- Japan Building Standard Law 2003 - restricts use of formaldehyde-emitting building materials as interior finishing materials. Materials causing a formaldehyde concentration above 100 μg/m³ prohibited. Other formaldehyde-based materials restricted according to the type of habitable room and the level of ventilation.
- China Indoor Air Quality Standard 2002 - application to dwellings, offices and other buildings; specified pollutant concentrations for acceptable indoor air at occupancy, and the pollutant emission limits for building materials so that the acceptable indoor air concentrations can be achieved.

Pollutant Emissions Impacting Australian Exports – CSIRO Interactions to Date

- **China**
- **Australian carpet imports to meet USA Carpet & Rug Institute criteria**
- **low-VOC and zero-VOC paints being developed (Aust. & China-Aust. Venture)**
- **Japan**
- **zero formaldehyde wood-based panels**
- **use powder coating on panels (esp. furniture items)**

Product Labelling in Australia

- Manufacturers of unflued gas heaters: NO_2, CO, formaldehyde
- Manufacturers of wood-based panels: formaldehyde (E1, E0, super-E0)
- Australian Environmental Labelling Association started Nov 2001 (NZ ~1999)
  - an independent environmental scientific research and assessment organisation that operates on a non-profit basis
  - Australian Ecolabel Program – "an independent and credible environmental labelling system to international best practice standards."
  - draft standards – adhesives, recycled plastics and rubber, paints, wool carpet, paper gypsumboard, photocopiers,
  - broad focus on sustainability (resource use, waste minimisation, energy, air and water pollution etc)
  - www.aela.org.au

HEALTHY INDOOR AIR IS A PART OF SUSTAINABILITY

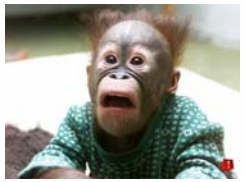
World Health Org - 9 Statements of rights derived from fundamental principles:

- Everyone has the right to breathe healthy indoor air
- Everyone has the right to adequate information about potentially harmful exposures
- All individuals, groups and organisations associated with a building bear responsibility to work for acceptable air quality for the occupants
- The socio-economic status of occupants should have no bearing on their access to healthy indoor air, BUT health status may determine special needs for some groups
- All relevant organisations should establish explicit criteria for assessing building air quality
- The presence of uncertainty shall not be used as a reason for postponing cost effective measures to prevent harmful exposure
- The polluter is accountable for any harm to health and for welfare resulting from unhealthy indoor air exposures
- Under principles of sustainability, health and environmental concerns cannot be separated.

How do we reduce indoor air emissions? (No surprise)

Establish criteria and product database for manufactured products:

- Large area surfaces (paints, carpet, wood-based panels)
- 'Wet' materials/products (adhesives, lacquers)
- Products exhausting indoors (heaters, office equipment)



Implement criteria through a reputable, independent product labelling organisation – Australian Environmental Labelling Organization

WWW.AELA.ORG.AU

Australians' Ecological Footprint

Top five consuming nations in the world.

Iceland 10.1
New Zealand 9.8
United States 8.4
Australia 8.1
Canada 7.0
World average 2.3

Ha of land per capita required to produce materials for consumption and assimilate waste.

Reference: Australians and their Environment [ABS 2001, p12)

Australian Environmental Labelling Association Inc.

"A commitment to credible product information for sustainable development"

Sustain-able Living | Environmental Choice Label | Corporate Website | Green Procure-ment

Australian Environmental Labelling Association

- Established in December 2000 as a non-profit research organisation
- For delivery of a national environmental labelling program - Good Environmental Choice
- Conformance to the requirements of ISO (1999): independence, scientific credibility, transparency, the requirements of the Trade Practices Act and the Rules for Standard Setting Bodies of the World Trade Organisation

GOALS

- Delivery of a national full product life cycle environmental labelling program in general conformance to ISO 14 024 as a Third Party Independent Program
- To improve the quality of the environment by promoting sustainable consumption in Australia

ENERGY & THERMOFLUIDS ENGINEERING

Objectives of AELA Program

- To provide market incentives through the supply chain to reduce the environmental impacts of products sold in Australia
- To provide a clear, credible and independent guide to consumers wishing to take account of environmental impacts in their purchasing decisions
- To encourage consumers to purchase products which have lower environmental impacts
- To recognise and reward activities by organisations to reduce the adverse environmental impacts of the life cycle of their products and services, and
- To provide guidance to companies seeking to reduce their environmental impacts.

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY CSIRO

ENERGY & THERMOFLUIDS ENGINEERING

AELA Infrastructure

- Offices in Canberra with 5 management staff
- AELA Board advised by Stakeholders Council (18 industry, environmental and scientific experts in sustainability: air, water, waste, recycling, design, manufacture, biodiversity…)
- Mutual recognition agreement with 7 key ecolabelling programs: Blue Angel (Germany), Nordic Swan, Green Seal (USA), Terra Choice (Canada)….
- only Australian full member of the Global Eco-labelling Network which is comprised of over 38 national government and non-government eco-labelling programs in Europe, N. America and Asia

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY CSIRO

Global Ecolabelling Network – Member Countries

Global Ecolabelling Network

THE STRUCTURE OF THE ECOLABELLING PROGRAM

The Australian Eco Label Board – 2002
8 Members – 2 MC, 2 Industry, 2 Env. 2 Tech.

The Management Committee of AELA Inc.

Advisory Committee of Stakeholders and Technical Experts. 30 – Broad membership.

The Operational Setting:

Head Office:
Business Managers
Marketing and PR
Research Center
LCI – LCA Data Warehouse

Assessors:
30 Assessors
Trained – Resourced

Using the LCA Methodology to Identify Relevant Environmental Criteria.

Feasibility → **W.G. Stakeholders** → **Submissions & Data**

Data Analysis

Goal Definition and Scope :

Inventory Analysis:

Impact Assessment:

Draft Standard

Final Standard

Overall Requirements for the Good Environmental Choice Program

Each standard of the "Good Environmental Choice" Label deals covers four key components of a products performance:

Fitness for Purpose.

Environmental Performance against key environmental benchmark criteria.

Manufacturers compliance to environmental regulations.

Manufacturers compliance or demonstration of corrective action to OH&S, employee entitlements and anti-discrimination legislation.

ENERGY & THERMOFLUIDS ENGINEERING

Some Good Environment Choice Standards

- Adhesives
- Publishing & industrial paper
- Architectural Coatings
- Recycled plastic products
- Computers
- Recycled rubber products
- General Purpose Cleaners
- Recycled paper products
- Gypsum plasterboard
- Sanitary paper products
- Office paper
- Textiles
- Photocopiers
- Spray toiletry products
- Printers & printed matter
- Wool pile carpets
- Printers/Faxes/Multi-function devices
- Furniture
- Printing inks

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

CSIRO

ECOLABELLING IS A SIMPLE MARKET MACHANISM

Environmental labels and declarations provide information typically at the point of sale.

Purchasers and potential purchasers can use this information in choosing the products or services they desire based on environmental, as well as other, considerations.

The provider of the product or service hopes the environmental label or declaration will be effective in influencing the purchasing decision in favour of its product or service.

HOW SERIOUS IS THE AUSTRALIAN CONSUMER?

The Environmental Monitor: Global Public Opinion on the Environment. 2000 International Report. Environs International Ltd, (Global survey of 1000 citizens in 34 countries - resulting in a total of 34,000 people).

The Most or an Important National Problem: Environment 39%

Personal Concern A Great Deal About The Environment: 35%

Own Health Affected By Environment Problems - A Great Deal: 21%

Willingness to Pay 10% More for Green Cleaning Product: Strongly Agree: 34%

Willingness to Pay 10% More for Green Cleaning Product: Somewhat Agree: 44%

HOW SERIOUS IS THE AUSTRALIAN CONSUMER?

Have Avoided A Damaging Brand: 61%

Willingness to Pay 10% More for Green Electricity: Strongly Agree: 39%

Willingness to Pay 10% More for Gasoline to Reduce Air Pollution: Strongly Agree: 21%

Willingness to Pay More for a Green Car: 31%

Environmental Protection Contributes to Economic Growth: Strongly Agree: 29%

HOW SERIOUS IS THE AUSTRALIAN CONSUMER?

Consumer environmental preference is a known and demonstrated attribute of the Australian market when the right and credible information is made available.

The problem is that we have not had such a program established on the national stage until now.

The Australian Ecolabel Program is ready now to service Australian Industry !

Companies are currently carrying legal liabilities regarding their environmental claims. Others are avoiding making them because of the uncertainty.

The environmental procurement markets are growing at an unprecedented rate.

Ecolabelling is an efficient and proactive management approach delivering significant market growth opportunities – We are confident that 10% of consumers are responding.

Ecolabelling offers recognition as best practice which in some cases and industries will allow for a price premium.

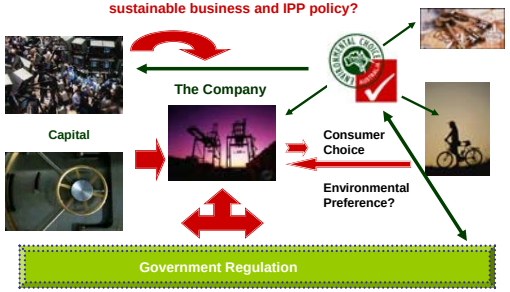
Some are currently trying to win over consumer environmental preference, but are risking problems with the ACCC and consumer perception.

SOME DANGEROUS TRENDS THAT A NATIONAL ECO-LABELING PRORAM CAN AVOID

1) Private Company Ventures - Not trusted by consumers
2) Single Issue Labels - Ozone Free
   - Energy Use - OK in some cases.
3) Self Declared Labels - Must have independent and credible verification
   - Consumer skepticism
4) Misleading - Product Names
5) Industry Programs - At best, lack independence

AND YOU THOUGHT ENVIRONMENT AND BUSINESS DON'T MIX??
WELCOME TO THE 21ST CENTURY

Why is ecolabelling such a significant driver for more sustainable business and IPP policy?



ENERGY & THERMOFLUIDS ENGINEERING

Environmental Labelling Catch-Up

- Clear that indoor air pollution is driven by the materials, appliances and processes that we place in our buildings
- Controlling indoor air (several million spaces) is different from controlling outdoor air (5-10 monitoring stations per city)
- Manufactured products are the emission sources so control is optimised at manufacture to limit indoor air pollution in 10s to 100s thousands buildings → emission labels (now used in most developed countries)

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

ENERGY & THERMOFLUIDS ENGINEERING

Environmental Labelling Catch-Up

- A total environmental approach → balance of global/local/indoor environments: Good Environmental Choice will deliver this
- Research & Labelling Infrastructure are here NOW: CSIRO & AELA
- Benefits flow to: manufacturers (local & international trade); consumers (healthy & sustainable consumption); government (growth in economy & productivity; regulatory frameworks; international trade)

CSIRO MANUFACTURING & INFRASTRUCTURE TECHNOLOGY

THANKYOU!