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UNIVERSITY OF TECHNOLOGY, SYDNEY

ADAA INTERNATIONAL SYMPOSIUM – 8-9 October 2024
Exploring Coal Combustion Product Harvesting Opportunities

ROLES OF FLY ASH IN SUSTAINABILITY
A concrete engineering viewpoint

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Professor of Concrete Engineering

Innovation in practice
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PIONEERING THE USE OF FLY ASH

1950 **Keepit Dam**
Lowering the heat of hydration

1955

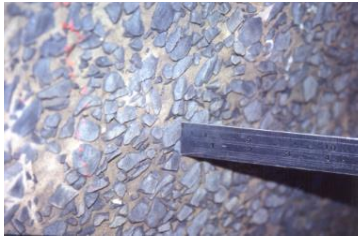
The grand experiment
1960 Mummorah Power Station 1967-2012

1965

1970 **Pump or not to pump**
Value of fly ash in improving workability

1975 **UNSW Round House**
Methods of fly ash mix design

1980



Sirivivatnanon, V., Marsh, P. and Nelson, P., 'Comparative Field Performance of Portland-Cement and Fly-Ash Concrete' Proceedings of Concrete Institute of Australia Concrete 97 Conference, Adelaide, Australia, 14-16 May 1997, pp. 131-139.

DECADES OF RAPID DEVELOPMENTS

1980
RTA Specifications
"No fly ash shall be used"

1982

1984

CSIRO Building Construction & Engineering
Concrete durability research & AS3600

1986

1988
Concrete for the Nineties
Advancement in Australian Concrete Tech

1990

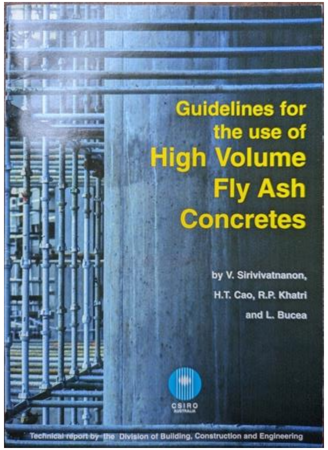
1992
High Volume Fly Ash Concrete
Electricity Commission of NSW – Peter Nelson

1994
CANMET promotes 56% HVFA concrete

1996
RTA B80 Specifications
"Fly ash and slag shall be used"

1998

2000



Sirivivatnanon, V., Cao, H.T., Khatri, R. and Bucea, L., 'Guidelines for the Use of High Volume Fly Ash Concretes, CSIRO DBCE Technical Report TR95/2, August 1995

SCMs & ALTERNATIVE CONCRETE

2000

Sydney Harbour Tunnel
Fly ash concrete in marine environment

2005

CSIRO
Development of Geopolymer Concrete

Green Building Council
Use of 40% fly ash in concrete

2010

2015

SmartCrete CRC
Use of CCP in Low Carbon Concrete

2020

SA Technical Specification TS199

2025

“Geopolymer and Alkali Activated Binder”

2030

Sirivivatnanon, V., Xue, C. and Khatri, R., ‘Service-Life Design of Low-Carbon Concrete Containing Fly Ash and Slag under Marine Tidal Conditions’, ACI Materials Journal, November 2022.

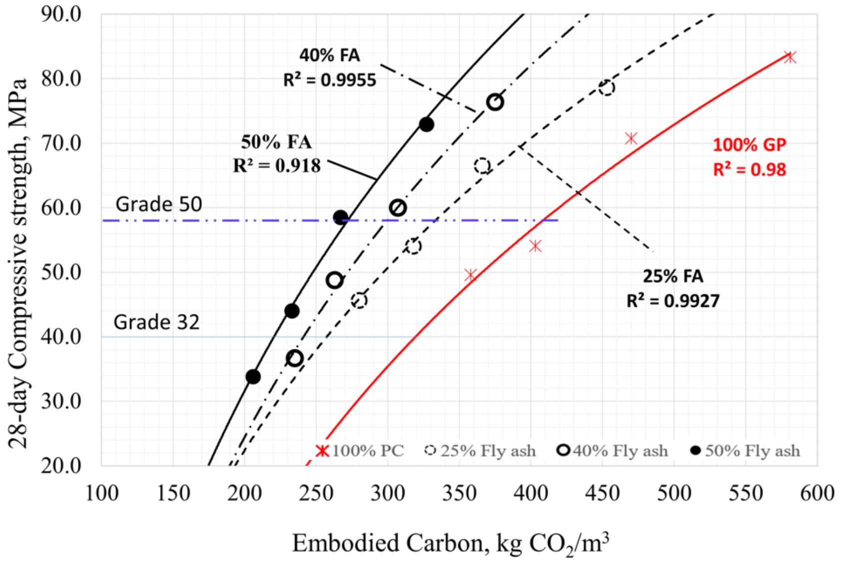
EMBODIED CARBON OF CONCRETING MATERIALS

Kg CO_2-e per kg

Materials	GP cement	Slag	Fly Ash	Coarse Agg	Fine Agg	Admixtures	Water
Aus LCI	0.905	0.195	0.020	0.011	0.004	4.253	0.0004
ICE version 2*	0.930	0.083	0.008	0.005	0.005	0.380	0.001

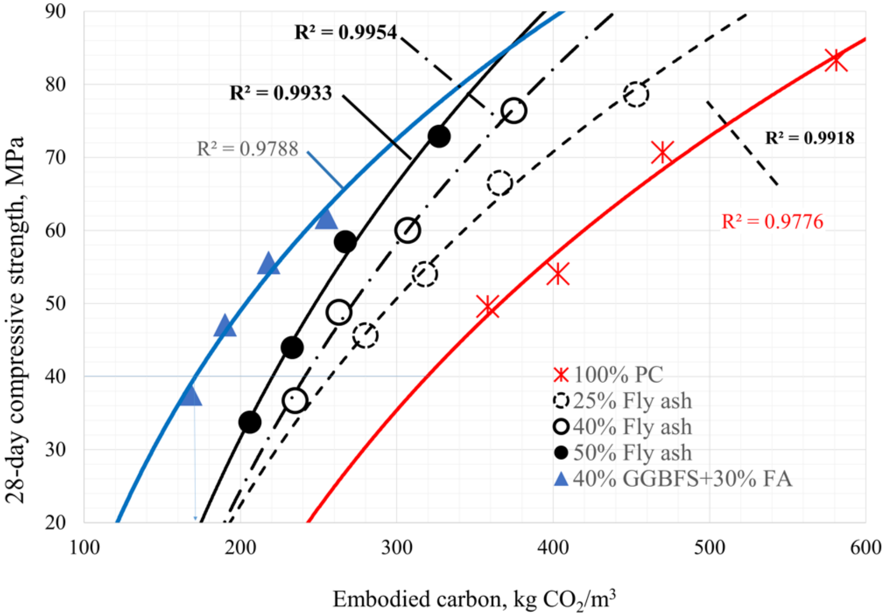
**Inventory of Carbon & Energy (ICE) Version 2.0 developed by Hammond & Jones 2011*

Effect of FA on 28-day compressive strength and Embodied Carbon



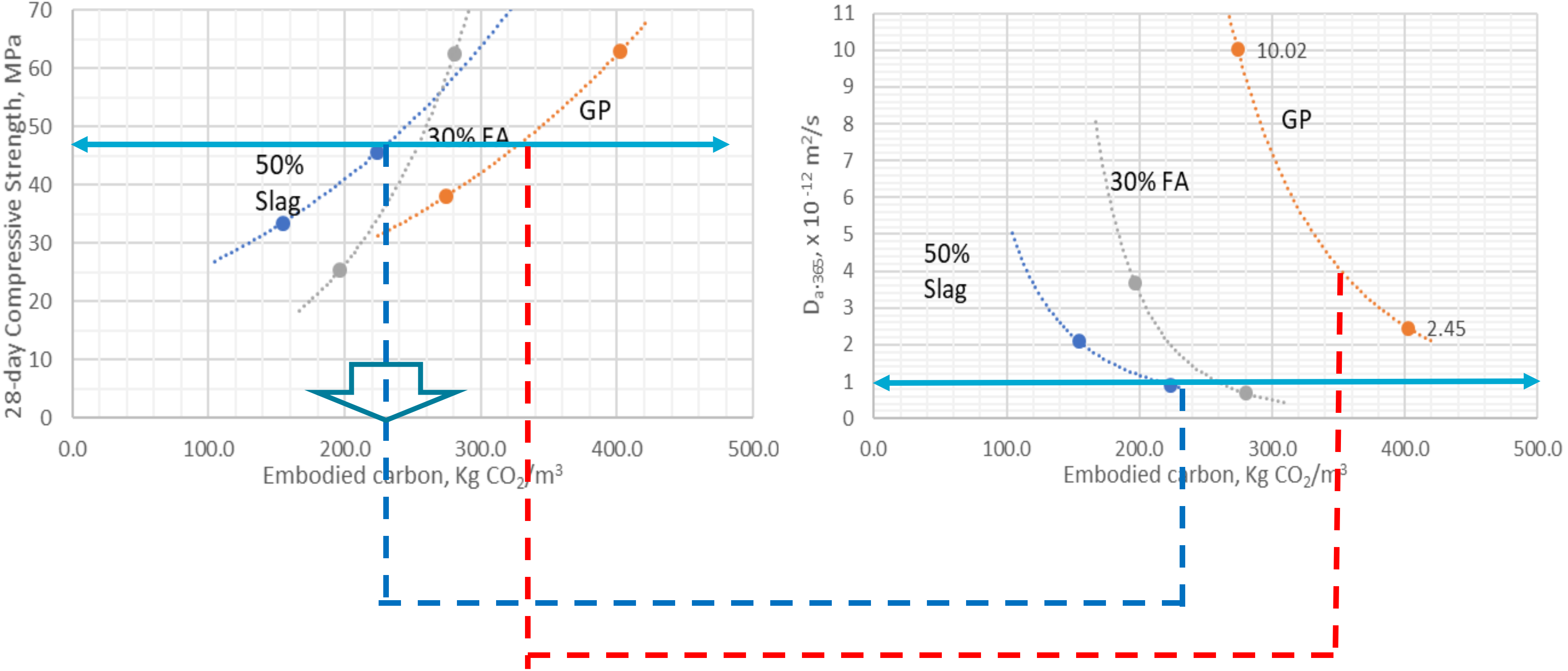
Binder	Grade 32		Grade 50	
	EC kg CO_2-e per kg	%	EC kg CO_2-e per kg	%
GP	320	100	410	100
25FA	260	81	330	80
50FA	220	69	270	66

The power of triple blend



Binder	Grade 32		Grade 50	
	EC kg CO_2-e per kg	%	EC kg CO_2-e per kg	%
GP	320	100	410	100
50FA	220	69	270	66
30FA40S	**170**	**53**	**230**	**56**

LCC that meet both performance requirements



Benefits of SCM as precursors in geopolymer concrete

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	EC kg CO_2-e per kg	%	EC kg CO_2-e per kg	%
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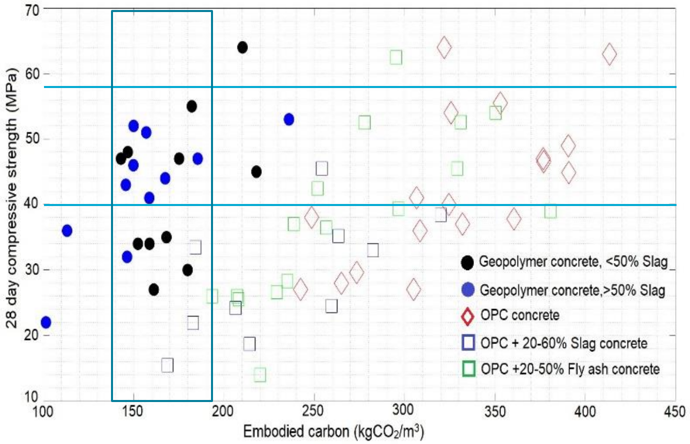
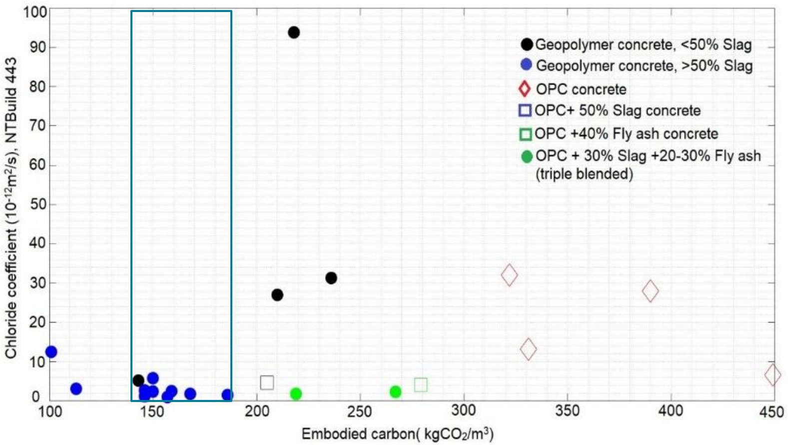
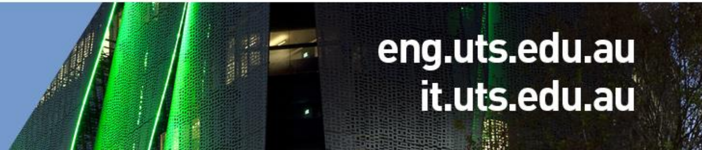




LOOKING FORWARD

SCMs and in particular fly ash are critical to sustainable concrete construction, and the pathway to net zero. We need to

1. Understand the future supply of fly ash, slag and new SCMs
2. The best use of individual SCM or their combinations for LCC
3. Important to combine structural efficiency with LCC to achieve most sustainable concrete structures



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THANK YOU