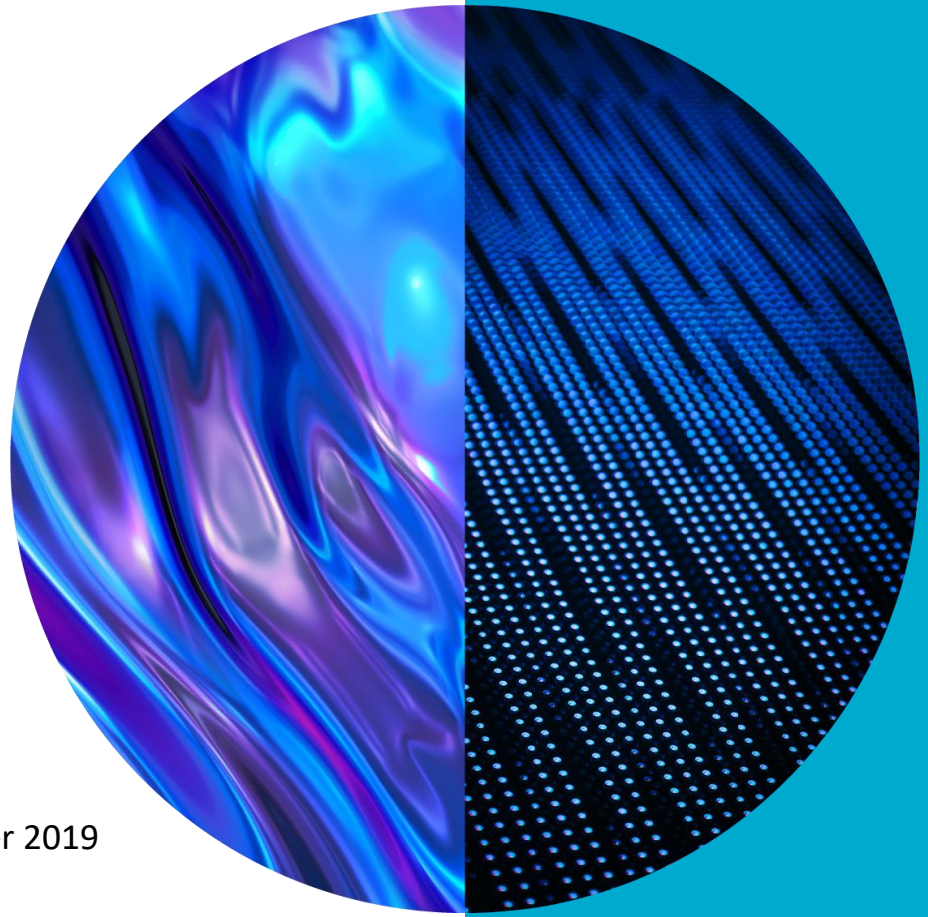
Update on Australian TIMES model



Luke Reedman | 9 December 2019

Overview

- Structure of AusTIMES
- Updates to inputs since last report
- Activities/Projects
- Where are we going (“Demand-pull”)
- Collaboration with ETSAP

Structure

AusTIMES structure

- Coverage of all states and territories (ACT, NSW, NT, QLD, SA, TAS, VIC, WA)
- AusTIMES has been calibrated to a base year of 2015 based on state/territory level energy balance (OCE, 2016), national inventory of greenhouse gas emissions (DoEE, 2017), existing stock of electricity generators (GHD, 2018) and vehicles in the transport sector (ABS, 2016).
- Time is represented in annual frequency (2015-2020) and then five-year time steps (2025, 2030,…, 2050)
- Demand sectors include agriculture (8 sub-sectors), mining (6 sub-sectors), manufacturing (19 sub-sectors), other industry (5 sub-sectors), commercial and services (11 building types), residential (3 building types), road transport (10 vehicle segments) and non-road transport (aviation, rail, shipping).

AusTIMES structure

- End-use services
  - Residential (heating, cooling, hot water, lighting, cooking, appliances/other)
  - Services (heating, cooling, hot water, lighting, cooking, appliances/other)
  - Industry sectors (process, equipment)
  - Transport (10 road vehicle classes, aviation, rail, shipping)
- Electricity sector
  - NEM (16 zones), SWIS, NWIS, DKIS, MIIS
  - 16 time slices per year (seasonal, time of day)
  - Existing generation fleet – unit level data for thermal and hydro
  - Renewable resource availability/potential by zone
  - Many technologies

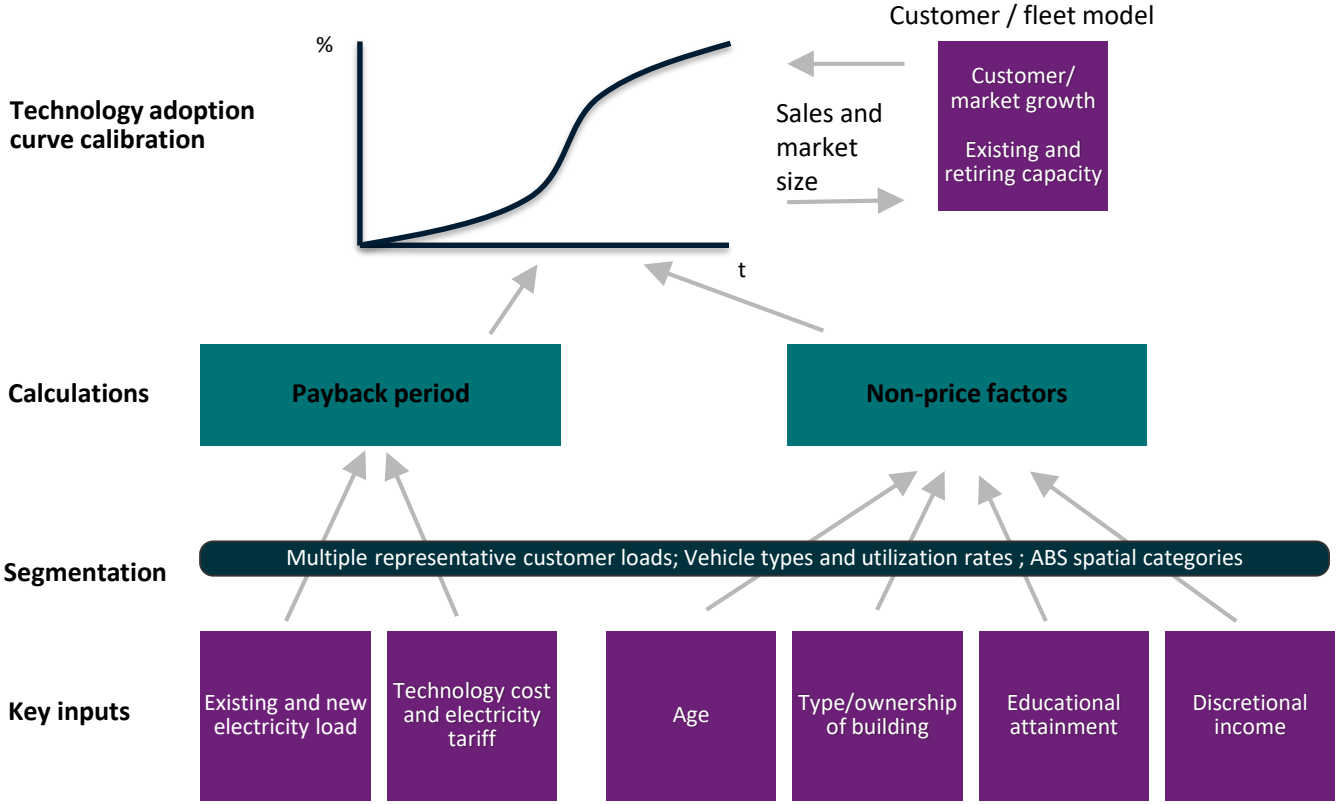
Updates since last report

Team effort

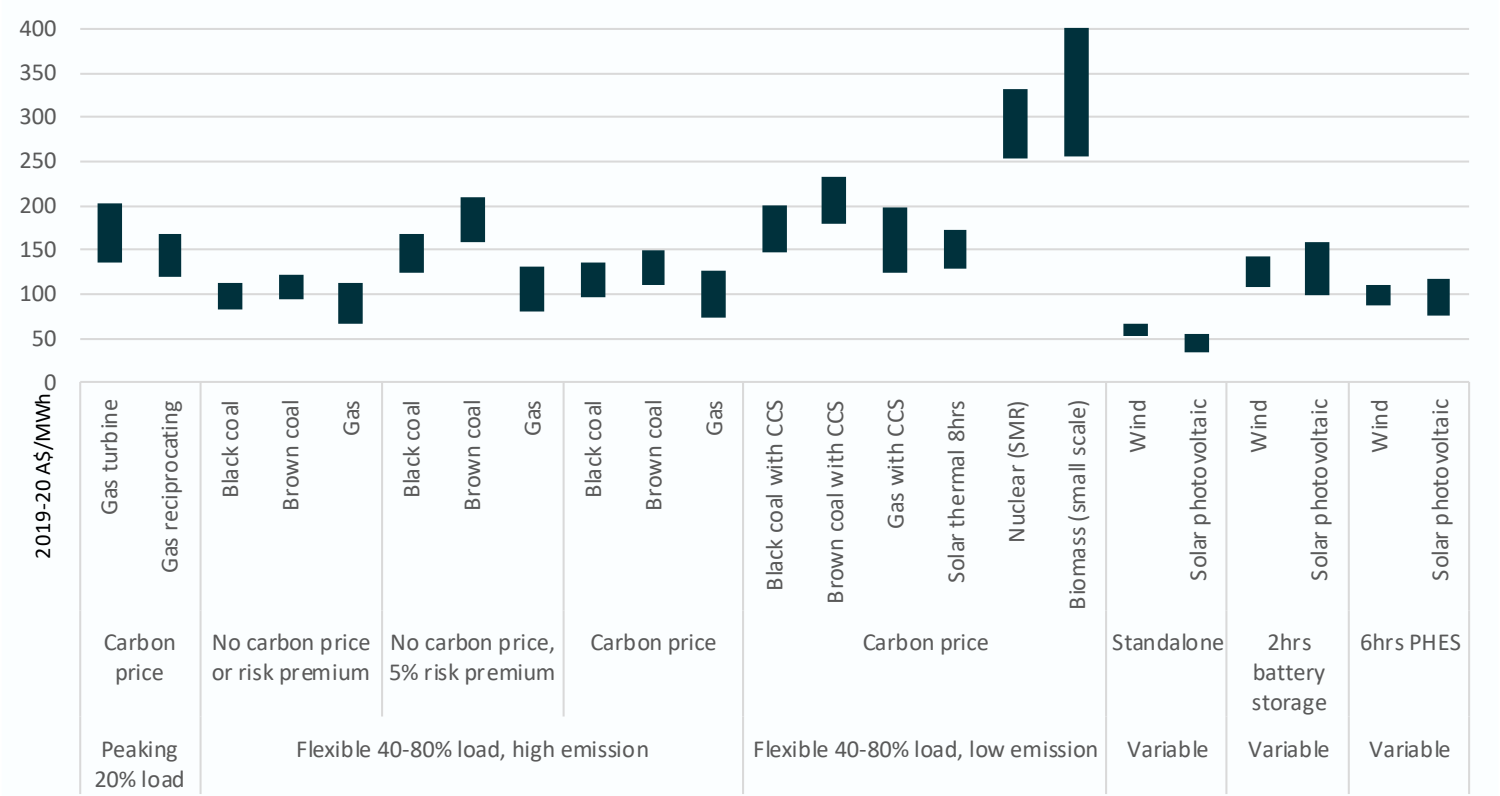
Demand sectors – Industry, services, residential

- Industry (36 sub-sectors)
  - Some autonomous energy efficiency improvement
  - Costed EE technologies (process improvements, small and large equipment upgrades)
  - Costed electrification options (e.g., industrial heat pumps, electric furnaces)
  - Costed fuel switching options (e.g., fossil fuels to low carbon fuels)
- Buildings (14 building types)
  - Commercial/services: Hospital, hotel, law court, offices, public, retail, supermarkets, schools, tertiary, data centres, aged care)
  - Residential: Detached, semi-detached (townhouses, terraces), apartments
  - End-uses represented (space heating, space cooling, lighting, hot water, appliances, cooking, equipment)
  - EE options for existing, retrofits, new buildings

DER/LZEV Adoption model



Electricity, storage costs



https://doi.org/10.25919/5c587da8cafe7

Activities/projects

Project
Decarbonisation Futures (2019)

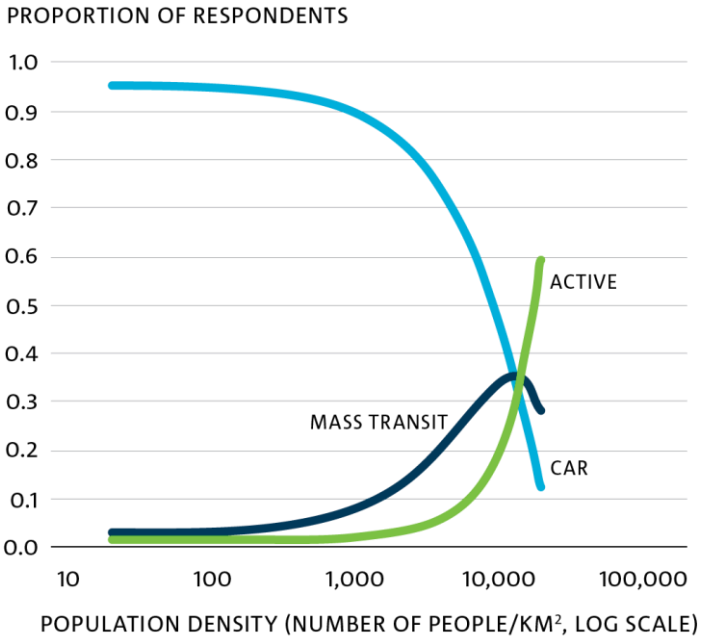
Climate Works Australia

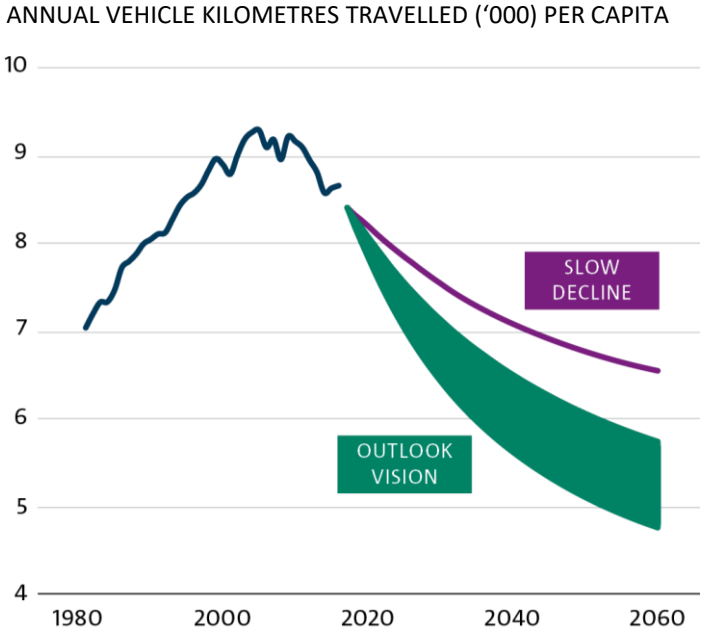
Stakeholders: VIC DEWLP, QLD Govt, CEFC

Project
Australian National Outlook (2018)

CSIRO, National Australia Bank

Urban Shift – Transport





www.csiro.au/en/Showcase/ANO

Project

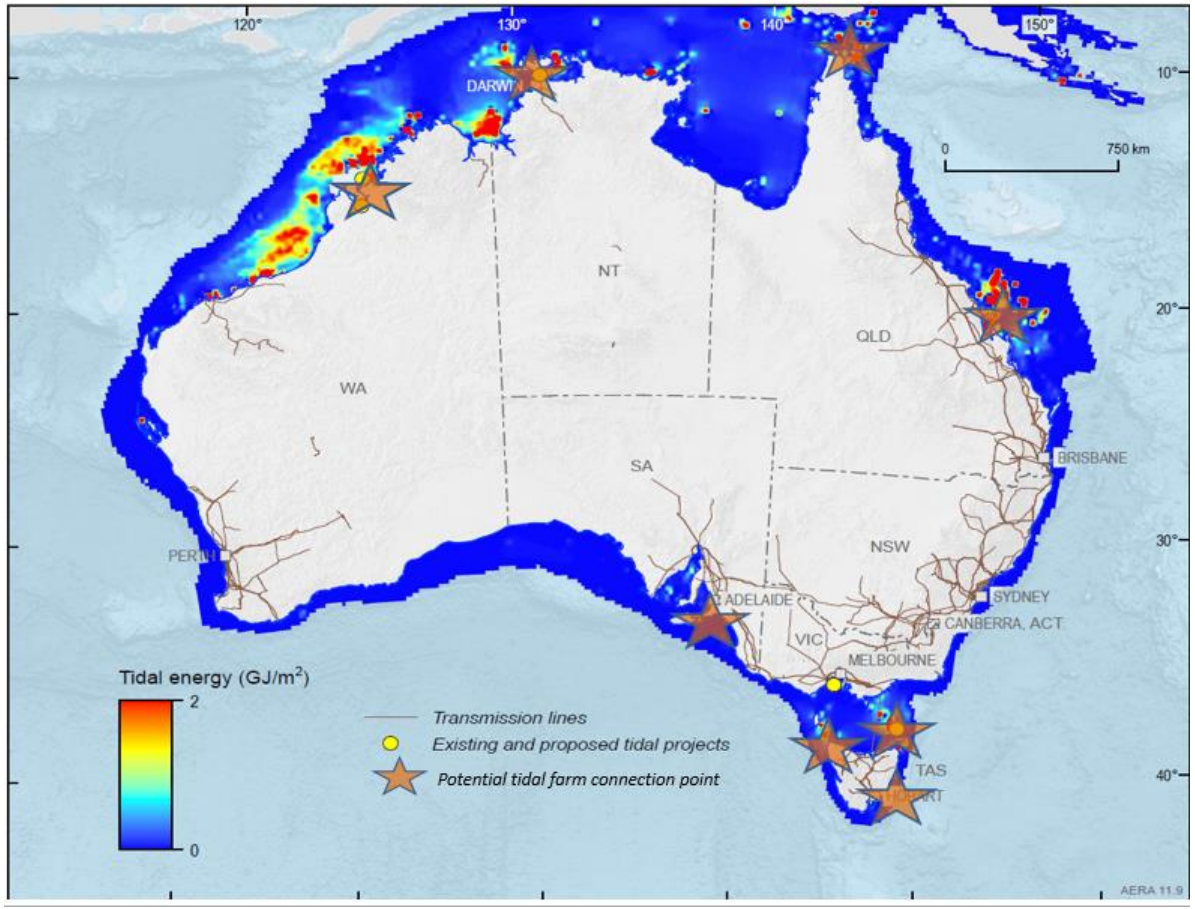
AusTEN (2017-2020)

Australian Renewable Energy Agency (ARENA)

Partners: University of Tasmania, University of Queensland

http://austen.org.au/

Revised tidal resource mapping



Project

COMMIT: Climate pOlicy assessment and Mitigation Modeling to Integrate national and global Transition pathways (2018-2020)

European Commission

Partners: PBL, PIK, IIASA, Imperial College London, PNNL, COPPETEC, E3 Modelling, NIES, ECCC, NCSC, ERI, TERI, BAU, CREP-ITB, IGES, UOS, HSE

https://themasites.pbl.nl/commit/

Bridging scenarios

		veloped countri		veloping countri		Comment													
Variable	Unit	Value	Year	Value	Year	General	PBL	Brazil	Austral	Japan	Global	India	EU	Canada	China (	China (	Indone	Indone	Korea	Russia	Global
1a. Manure from livestock sector treated with anaerobic digesters	%	55	2030	25	2030	Differentiatio	In Fekete et a	Changes	Impossit	Same co	In some	No	No	No		OK			OK, but (	No	No
1b. Manure from livestock sector treated with anaerobic digesters	%			55	2050																No
2. N use efficiency increase	% relative to 2015	10	2030	10	2050	with the same yield		It is not c	Impossit	Same co	OK	No	No	OK		Yes, with	amount of N fertili		OK, but (	No	No
3a. Final energy efficiency improvement appliances compared to base year (=autonomous improvemer	% (starting in 2018 for deve	-82.413	2018-2030	-91.722	2025-2030		In Roelfsema	OK	OK	It would (	OK	OK	Needs s	OK. Crrently, the (		OK				OK	OK
3b. Final energy efficiency improvement appliances compared to base year (=autonomous improvemer	% (second period, with slo	-67.406	2030-2050	-72.407	2030-2050																OK
4. New buildings final energy intensity for residential/commercial building	kWh/m2	22/30		2025	22/30	2035		Our mod	OK	As AIMI	OK	Yes, for (	Does this	The model curren		OK			As AIMI	OK	OK
4a. (different interpretation of 4) New buildings final energy intensity for residential/commercial buildin	% (relative to conventional	60	2025	60	2035																OK
5a. New fossil boiler capacity in new and existing commercial buildings	GW	0	2030	0	2040	Boilers can also be used f		Space h	Impossit	They are	OK	No	OK	OK. Based on the		What is	new fossil fuel boil		What is .	No	Also gas
5b. New fossil boiler capacity in new and existing residential buildings	GW	0	2030	0	2040	Boilers can also be used f		Space h	Impossit	They are	OK	No	OK	OK. Based on the		What is	new fossil fuel boil		What is .	No	Also gas
6. Renovation rate existing buildings	% (starting in 2018)	61.2419	2050	58.2934	2050	Mark?	Retrofit is 45	What en	OK	It is diffi	OK	Yes, for (	OK (con	The model curren		OK			It is diffi	OK	OK
7a. C-tax average (*0.5 for AFOLU)	$/t CO2	10	2020	10	2030	OK, not to include for 202		OK	OK	OK	OK	Can be i	This refe	OK. The C-tax in t		OK			OK	OK	OK
7b. C-tax average (*0.5 for AFOLU)	$/t CO2	25	2025	15	2035			OK	OK	OK	OK	Can be i	OK	OK. The C-tax in t		OK			OK	OK	OK
7c. C-tax average (*0.5 for AFOLU)	$/t CO2	75	2050	75	2055			OK	OK	OK	OK	Can be i	OK	OK. The C-tax in t		OK			OK	OK	OK
8. Newly installed non-CCS coal-fired capacity	GW	0	2025	0	2030			OK	OK	OK	OK	OK	OK	OK		OK	OK		OK	OK	OK
9. Renewable electricity share increase (including hydropower and biomass)	%-point per year	1.35	2050	1.35	2050			Not relev	OK	OK	OK	OK	OK. Low	Possible with diffe		OK	OK		OK	OK	feasible
Upto a level of		50%		50%		Differentiation is possible		Not relev	OK	OK	This see	OK	OK. Low	for the EU		OK	Seems too high, s		OK		
10. F-gas emission reduction	% relative to 2010	85	2035	85	2045			We do n	Impossit	OK	OK	No	?	Possible with diffe		OK	No, not now. We j		OK	No	OK
11. Coal mine CH4 emission recovery (underground mining only)	%	30	2030	30	2030	OK if open mines are exc		We unde	Impossit	Not relev	OK	No	?	Coal mining secto		OK	No, mostly open n		Not relev	No	OK
12. Venting and flaring total CH4 and CO2 (added with GWP) emission reduction	% relative to 2018	-55.12	2030	-55.12	2030	Mark?		It is not	Impossit	Not relev	OK	No	?	Not precisely tract		OK	OK		Not relev	OK	OK
13. Carbon captured and stored	% of country's emissions	0.5	2030	0.5	2040	If CCS is allowed in the m		We sugg	Impossit	Same co	Global ta	No	Seems r	Since model does		OK	OK only in upstre		Same co	OK	feasible
14. Final energy efficiency improvement compared to base year (autonomous improvement + due to pol	% relative to 2018	-95.552	2025	-90.832	2035			OK	Impossit	It would (	OK	OK	OK (con	OK		we have	OK		It would (	OK	OK
15. N2O emissions from adipic/acid production	% reduction relative to 201	99	2030	99	2030	Mark?		Not clear	Impossit	OK	OK	No	No	Possible with diffe		OK	OK, we have start		OK	No	99% very
16. Natural forest afforestation + reforestation rate	million ha/year	10	2025	10	2025	**Mark? --> check 10 mi**		Please c	Impossit	Impossit	10 ha per	No	No	The GCAM model		OK	Too low. 275,000 h		Impossit	No	No
17. Natural forest deforestation rate	ha/year	0	2030	0	2030								No			OK	Indonesia just iss		OK	No	No
18. Aviation energy efficiency improvement	% relative to 2018	-98.6	2020	-98.6	2020			Ok. Will	OK	OK	OK	OK	OK (con	OK		OK	OK		OK	OK	OK
19a. New passenger car average fuel efficiency (fossil)	km/l	38	2030	27	2030			For the c	OK	OK	OK	OK	OK. They	Possible with diffe		OK	OK		OK	OK	OK
19b. (different interpretation of 19a) New passenger car average fuel efficiency (fossil) (same as the km	gCO2/km	61	2030	86	2030			This see	OK	It is a res	OK	OK	OK. (to b	Possible with diffe		OK	OK		OK	OK	OK

Other projects

Applications

- GHG emission reduction pathways
- Transport
  - Road v. Non-road abatement potential
  - Electric vehicle adoption
  - Incentives for LZEVs
  - Disruption from autonomous vehicles
  - Bans on ICE vehicles
  - Revenue implications
- Electricity
  - CSP configurations
  - New Renewable Energy Zones, HVDC links

“Demand-pull”

Hydrogen pathways

Hydrogen production

- Electrolysis
- Fossil fuel conversion
- Biomass and waste conversion
- Direct hydrogen carrier production
- Thermal water splitting
- Biological hydrogen production
- Photochemical and photocatalytic processes

Storage and distribution

- Compression and liquefaction
  - Compressed hydrogen
  - Liquid hydrogen
  - Underground storage
  - Pipeline storage
- Chemical storage
  - Ammonia
  - Synthetic fuels
  - LOHCs
  - Hydrides
  - Proton batteries
  - Physisorption

Hydrogen utilisation

- Hydrogen Utilisation
- Direct hydrogen carrier utilisation

Cross-cutting RD&D

- Environment
- Social licence, safety and standards
- Modelling
- Policy and regulation
- Ancillary technology and services

ETSAP Collaboration

Collaborative activities

- Kanors-EMR

- ETSAP projects:
  - Excel technology database for energy system models integrated with a TIMES SubRES
  - Modelling of hydrogen & Joint workshops with Hydrogen TCP

- Visits
  - Kiti Suomolainen (U. Auckland) – August 2019
  - Wenying Chen (Tsinghua University) – 2020 TBC

Thank you

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