Model Documentation

Australian Stocks and Flows Framework version 4_1

18-Sep-17
Households

- State population [s,g,ts,a]
- Household formation rate [s,ha,ts]
- Mapping of a to ha [ha,a]
- Persons per household [s,ts]
- Households by state [s,ha,ts]
- Total households [s,ts]
Allocate Households to Settlements and Rural Areas

Allocate Households to Settlements and Rural Areas

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Allocate Households to Settlem
Allocate Core Households to SLA

Households in Core by SLA

(1)

planned core relative SLA density [stl->sla,ts]

planned core relative SLA density [stl->sla,ts]

actual core SLA density [stl->sla,ts]

core households in settlement detailed

settlement area base [stl->sla,brys]

settlement area base [stl->sla,brys]

settlement area base [stl->sla,brys]

households in settlement core [s->stl,ts]

households in settlement core [s->stl,ts]

households in settlement core [s->stl,ts]
Allocate Non-Core Households to SLA

1. Non-Core Area Designated for Expansion Development
2. Planned Marginal Greenfield Density By SLA
3. Effective Average SLA Density Greenfield Only
4. Planned Aggregate Non-core Density of Greenfield and Infill Detailed
5. Ensure Consistency with Overall Settlement Density
6. Allocate Non-Core Households in Settlements to SLA
Allocate Rural Households to SLA and Consolidate

1. Settlement Total SLA Area
   - [s->sla,ts]
2. Households in Rural Area
   - [s->sla,ts]
3. Settlement Total SLA Households
   - [s->sla,ts]
4. Consolidate All Households to SLA and SSD
   - [s->sd->ssd,ts]
5. Household geography shares
   - [c->ssd,ts]
6. Household state geography share
   - [s->sd->ssd,ts]
7. Household city geography share
   - [c->ssd,ts]
8. Settled non-core areas
   - [s->sla,ts]
9. Non settled area
   - [s->sla,ts]
Allocate population to Households

1. Located population
2. State population
3. City population
4. Person per household

- Person per urban household
- Person per rural household
- Located urban population
- Located rural population
- Person per household
- State population
- City population
- Person per household
- Population

- Roads
- ConQFacto
- CatchGoal
- UrbTranVeh
- ResH
- AllocRurHHSLACon
- AllocPopHH
Labour Force

population [g,ts,a]

defence force participation [g,ts,adp]

Labour Force (3)

labour force participation [g,ts,la]

mapping of a to la [la,a]

defence force (1) [g,ts,adp]

civilian population (2) [g,ts,a]

labour Force [ts]

Maximum labour Force [ts]

leisureQ urbTran leisureQ labTen

labour force participation [g,ts,la]
Agricultural Livestock

Animal Feed Required
1. Animal Feed Required (1)
   - Animal feed required
     - [s->sd,lvs,ts]

Animal Feed Supply
2. Animal Feed Supply (2)
   - Animal feed required
     - [s->sd,afc,ts]
   - Animal feed required from native pasture
     - [s->sd,ts]

Native Pasture Land
3. Native Pasture Land (3)
   - Native pasture land
     - [s->sd,ts]

Deconsolidate animal feed required
4. Deconsolidate animal feed required (4)
   - Deconsolidate animal feed required
     - [s->sd,ts]
   - Animal feed required net of sown pasture
     - [s->sd,afcxp,ts]

Aggregate to five year timestep
5. Aggregate to five year timestep (5)
   - Aggregate to five year timestep
     - [s->sd,lvs,ts5]
   - Animal feed required sown pasture 5-yearly
     - [s->sd,ts5]
   - Animal feed required net of sown pasture 5-yearly
     - [s->sd,afcxp,ts5]
   - Live stock annually
     - [s->sd,lvs,ts]
Livestock Products

Livestock exports and remaining stock

Animal Products Production

Separate Animals Products for Food and Non-food

Animal products production for human food

Animal products production not human food

Live stock

Livestock exports

Domestic live stock

Live export

Live export fraction

Animal products production rate

Animals Products Production

Food processing products

Primary material disposal

Agricultural livestock

Agricultural processing emissions

Agricultural livestock processing of animal products

Agricultural livestock rate of animal products production

LIV STOCK

[SD, LVS, TS]

LIV EXPORT

[SD, LVS, TS]

LIV EXPORT FRACTION

[SD, LVS, TS]

ANIMAL PRODUCTS PRODUCTION RATE

[SD, LVS, APT, TS]

ANIMAL PRODUCTS PRODUCTION

[SD, APT, TS]

ANIMAL PRODUCTS PRODUCTION FOR HUMAN FOOD

[APTHF, TS]

ANIMAL PRODUCTS PRODUCTION NOT HUMAN FOOD

[APTRHF, TS]

DOMESTIC LIV STOCK

[SD, LVS, TS]
Agriculture Land Amendments

Agriculture Amendment Requirements (1)

Animal Manure Production (2)

Net Amendment (3)
Evolve Agricultural Land State

- **base agriculture land**
  \[ s -> sd, lcbi -> alk, ybal, byrs \]

- **agriculture land**
  \[ s -> sd, lcbi -> alk, ybal, ts \]

- **base land state**
  \[ s -> sd, lcbi, lst, ybal, byrs \]

- **agriculture crop activity**
  \[ s -> sd, lcbi, art -> crp, ybal, ts \]

- **agriculture land state change rate due to cropping activity**
  \[ s -> sd, lcbi, art -> crp, ts5, lst \]

- **agriculture resting activity**
  \[ s -> sd, raat, ybal, ts5 \]

- **agriculture land state change due to resting activity**
  \[ s -> sd, raat, ts5, lst \]

- **agriculture conditioner**
  \[ s -> sd, lcbi, alt -> ala, acont, ybal, ts5 \]

- **agriculture land state change due to amendment**
  \[ s -> sd, lcbi, alt -> ala, acont, ts5 \]

- **Make Transfer Weights For Land States**
  \( (1) \)

- **Transfer weights**
  \[ s -> sd, lst, ybal, ts5, lcbi, lcbif \]

- **Evolve Agriculture Land State**
  \( (2) \)

- **land state**
  \[ s -> sd, lcbi, lst, ybal, ts5 \]
Crop Yield

Determine Actual Land State Response (1)

Choose Yield Method (2)

Determine Fertilizer Response (3)

Assemble Yield From Components (4)

\[ \text{land state yield factor endogenous } \]
\[ \text{land state yield factor exogenous } \]
\[ \text{yield method } \]
\[ \text{fertilizer response function } \]
\[ \text{fertilizer intensity } \]
\[ \text{fertilizer intensity asymptotic } \]
\[ \text{land state yield factor exogenous } \]
\[ \text{land state yield factor endogenous } \]
\[ \text{land state yield factor exogenous } \]
\[ \text{fertilizer factor } \]
\[ \text{irrigation yield factor } \]

\[ \text{land state } [s\rightarrow sd, lcbi, lst, ybal, ts5] \]
\[ \text{agriculture land state response functions } [lst, si] \]
\[ \text{land state yield factor exogenous } [s\rightarrow sd, lcbi, ybal, ts5] \]
\[ \text{yield method } [ym] \]
\[ \text{fertilizer response function } [s\rightarrow sd, lcbi, arc\rightarrow crp, f] \]
\[ \text{fertilizer intensity } [s\rightarrow sd, lcbi, arc\rightarrow crp, ts] \]
\[ \text{fertilizer intensity asymptotic } [s\rightarrow sd, lcbi, arc\rightarrow crp, ts] \]
\[ \text{land state yield factor exogenous } [s\rightarrow sd, lcbi, ybal, ts5] \]
\[ \text{land state yield factor endogenous } [s\rightarrow sd, lcbi, ybal, ts5] \]
\[ \text{basic yield factor } [s\rightarrow sd, arc\rightarrow crp] \]
\[ \text{weather and other exogenous yield factors } [s\rightarrow sd, arc\rightarrow crp, ts5] \]
\[ \text{genetics yield factor } [s\rightarrow sd, arc\rightarrow crp, ts] \]
\[ \text{fertilizer factor } [s\rightarrow sd, lcbi, arc\rightarrow crp, ts5] \]
\[ \text{irrigation yield factor } [s\rightarrow sd, lcbi, arc\rightarrow crp, ts5] \]

\[ \text{crop yield } [s\rightarrow sd, lcbi, art\rightarrow crp, ybal, ts] \]
Fish Stock and Catch

Evolve Fishery Stock (1)

Calculate Actual Catch and Domestic Commercial Effort (2)

Report domestic fish production by jurisdiction, fishery and family (3)

Consolidate Production (4)
**Fisheries Operations and Boat Stock**

**Consolidate Operations Requirement (3)**

- Fish production labour \([j,ts5]\)
- Energy for fish production \([j,se,ts5]\)
- Fish production operating material required \([j,ts]\)

**Commercial Domestic Boat Stock Operations (2)**

- Energy for wild fishin\([j,se,ts5]\)
- Boat operating material required \([j,ts5]\)

**Evolve Domestic Boat Stock (1)**

- Boat stock \([j,siz,ts,ba]\)
- Boat discards \([j,siz,ts,ba]\)
- New boats required \([j,siz,ts]\)

**Fish Stock ACatch**

- Base boats for fishing \([j,siz,byrs5,ba]\)
- Commercial domestic fishing boat requirements
- Sustained energy stock base \([j,siz,byrs5,ba]\)
- New boats required base \([j,siz,byrs5]\)

**Fish Op ABoatStock**

- Fish Op ABoatStock
- Fish Op ABoatStock
- Fish Op ABoatStock

**Farm Fish**

- Fish farm labour \([j,ts5]\)
- Energy for fish farm \([j,se,ts5]\)
- Fish farm operating material required \([j,ts5]\)

**Variables**

- Farm Fish
- Fish Op ABoatStock
- What if?

**Diagram Notes**

- FishOpABoatStock
- Calculator Diagram - fishOpABoatStock
- Base boats for fishing
- Commercial domestic fishing
- Boat stock
- Boat discards
- New boats required
- Sustained energy stock base
- New boats required base
No spatial disaggregation on the assumption that as mining effort in one area becomes less economic due to lower grades, then mining will continue elsewhere. Therefore the grade will diminish approximately homogenously. Spatial detail could be useful if the location is important for better freight calculations, or for location of inputs (labour, energy, materials, water). Labour - State level might be useful. Energy (& emissions) - State? Since mining is generally in isolated areas, energy production is independent of centralised system. Materials - Aust? Water - water management unit?
Water Use Account

1. Consolidate Non Agriculture Water Use
   - [s->sd->ssd,wusna,ts]

2. Consolidate Gross Water Use By Sector And Statistical Location
   - [s->sd->ssd,wus,ts]

3. Convert Sectoral Gross Water Use To Water Regions
   - [wr,wus,ts]

4. Sectoral Withdrawal From Water Stock Type
   - [wr,wus,wst,ts]
Water Resources

Precipitation Flows

(1)

Precipitation rate

[w,r,t]

Precipitation volume

[w,d,w,r,l,u,c,t]

Evapotranspiration fraction

[w,r,l,u,c,t]

Deep drainage fraction

[w,r,l,u,c,t]

Transmission loss fraction

[w,r,l,u,c,t]

Runoff and Groundwater Flows

(2)

Runoff Less Transmission Losses

(4)

Runoff to surface immediate

[w,d,w,r,l,u,c,t]

Transmission losses

[w,d,w,r,l,u,c,t]

Runoff to surface

[w,d,w,r,l,u,c,t]

Groundwater input

[w,d,w,r,l,u,c,t]

potranspiration to atmosphere

[w,d,w,r,l,u,c,t]

Region Area

[w,r]

land use in water region

[w,r,l,u,c,t]

land use

[w,s->d,l,u,c,t]

agricultural water use spatial share (sum wr = 1)

[w,s->d,w,r,l,u,c,t]

urban water use spatial share (sum wr = 1)

[w,s->d,w,r,l,u,c,t]

Evapotranspiration fraction

[w,r,l,u,c,t]

Deep drainage fraction

[w,r,l,u,c,t]

Transmission loss fraction

[w,r,l,u,c,t]

land use by Water Region

(1)

land use

[w,s->d,l,u,c,t]

Base land area

[w,r,l,u,c,t]

land use in water region

[w,r,l,u,c,t]
Surface Water Balance Account

- Gross flows to terrestrial environment
  - Net flows to environment
    - Water outflow destination
      - Cross-region water flow share
      - Water use region transfer fraction
      - Convergence Controls
    - Water discharged untreated
      - Water discharged treated
    - Water inflow cross-region
      - Water outflow cross-region
  - Water inflow to environment
    - Water use region transfer
  - Water outflow to sea
  - Water outflow cross-region
  - Water inflow cross-region
  - Water inflow to environment
- Negative water outflow tension
- Groundwater input
- Runoff to surface
- Water inflow to surface

Water Resources

Water Discharge Account

Water Use Account

Surf Water Balance Account
Interstock Water Balance

1. **Area Rainfall**
   - $[wr, ts]$ – Water region area

2. **Rainfall**
   - Determine Quantity Inputs to Water Stocks
   - $[wr, ts]$ – Volume rainfall

3. **Evaporation Rate**
   - Determined
   - $[wr, ts]$ – Evaporation rate

4. **Transfer Matrix**
   - Determined
   - Transfer rate
   - $[wr, wstf, wstt, ts]$ – Linear system transfer matrix

5. **Exogenous Transfers**
   - Net exogenous transfers
   - $[ts, wrefra, wrto]$ – Net exogenous transfers in
   - $[wr, wst, ts]$ – Net exogenous transfers out
   - $[wr, wst, ts]$ – Net input flow

6. **Net Input Flow**
   - Net input flow
   - $[wr, wst, ts]$ – Net input flow

**Equations and Terms**
- Water discharged untreated
- $[w, wus, wst, ts]$
- Water discharged treated
- $[w, wst, ts]$
- Water division outflow
- $[wr -> wrs, ts]$
- Rainfall direct destination share
- $[w, wst, ts]$
- Surface evaporation
- $[w, ts]$
- Average surface water depth
- $[w, ts]$
- Transpiration rate
- $[w, ts]$
- Transfer rate
- $[w, wstf, wstt, ts]$
- Non-transferred net input
- $[w, wst, ts]$
located vehicle emissions [s->sd->ssd,tvs,ek,emt,ts]

secondary heavy industry emissions [s->sd->ssd,mep,ek,emt,ts]

primary industry emissions [s,pis,ek,emt,ts]

waste emissions [s->sd->ssd,wt,ek,emt,ts]

buildings emissions [s->sd->ssd,bk,ek,emt,ts]

secondary light industry emissions [s->sd->ssd,ek,emt,ts]

emissionsConsol

on-primary industry emission detailed [s->sd->ssd,emsa->emsd,ek,emt,ts]

emission detailed [s,emsa->emsd,ek,emt,ts]

Consolidate Emissions (2) emission aggregate [s,emsa,ek,emt,ts]
Land Resources Base

- **Base Forest Land (fe, fr, byrs5)**
- **Base Open Clear Cut Land (fe, frcc, byrs5, al)**
- **Base Forest Land Share (s->sd, fe, byrs5)**
- **Base Agriculture Land Use (s->sd, lcbi->alk, byrs5)**
- **Base Grazing and Other Land (s->sd, gol, byrs)**
- **Base Urban Land (stl, ult, byrs)**

Flow Diagram:

1. **Base Forest Land Total (1)**
2. **Base Non Urban Land (2)**
3. **Base Land Use (3)**

**Land Resources (landRes)**

**Land Tenure (landTen)**

**Water Resources (waterResources)**

Date: 18-Sep-17
Building land use yearly

(1)

New building space constructed 5year base

Building space demolitions 5year base

[s->sd->ssd, bd, byrs5, ab5]

Building land use yearly

(2)

New building land

[stl, ts]

Demolished building land

[stl, ts]

Forest land change yearly

(3)

Total forest land deletions 5year base

[fe, byrs5, ab5]

Total forest land deletions

[fe, ts5]

New building space footprint

[stl, bd, ts5]

Historical new building space footprint

[stl, bd, ts5]

New building space constructed

[s->sd->ssd, bd, ts5]

Building space demolitions

[s->sd->ssd, bd, ts5, ab5]

New building space footprint

[stl, bd, ts5]

Actual agriculture land deletions 5year base

[s->sd, lcbl, alk, ybal, byrs]

Actual agriculture land deletions

[stl, ts]

Actual agriculture land

[stl, ts, ts5]

Actual new agriculture land

[stl, ts, ts5]

Land deletions

(3)

Land Res

Actual new agriculture land yearly

[stl, ts, ts5]

Actual agriculture land deletions yearly

[s->sd, lcbl, alk, ybal, ts]
new building land
[stl,ts]  
building land use
(1) 
building land use
[stl,ts]  

demolished
building land
[stl,ts]  
r

urban road
[s->stl,rc,rt,ts]  
urban land
(2) 
urban land
[stl,ult,ts]  
road footprint
[stl,rc,ts]  
other urban to
building land ratio
[stl,ts]  

base urban land
[stl,ult,byrs]  
urban land change
(3) 
urban land additions
[stl,td,ts]  
urban land deletions
[stl,td,ts]  

base forest land total
[s->sd,fe,byrs]  
forest land change
share (sum ssd=1)
[s->sd,fe,ts]  

total forest
land additions
[stl,td,fe,ts]  

total forest
land deletions
[stl,td,fe,ts]  

forLandUseProcE 
landRes 
forLandUseProcEm 
landRes 
forLandUseProc 
landRes
whatIf?

Potential: simulate waste heat capture for hot water heating
Residential White Appliances

1. Residential white appliance stock require (1)
   - Residential white appliance stock base
   - Residential white appliance ownership fraction
   - Residential white appliance life table
   - New residential white appliance share

2. Evolve white appliance stock (2)
   - Residential white appliance stock
   - Residential white appliances new
   - Residential white appliances discards

Dwelling units in use grand total
[s->sd->ssd,ts]

Residential white appliance stock require
[s->sd->ssd,wat,ts]

Residential white appliance stock
[s->sd->ssd,ftwa->wat,brys,awa]

New residential white appliance share
[s->sd->ssd,ftwa->wat,ts]
**Institutional Building Space Required**

**edServeReq**
- Student rate \([s,et,ts]\)
- Education class rooms \(1\)
- Education class rooms \([s,et,ts]\)

**serLabReq**
- Institutional labour service \([s,ts]\)
- Institutional building labour service intensity \([s,ts]\)

**class room load factor** \([s,et,ts]\)
- Space per class room \([s,et,ts]\)

**space per health care bed** \([s,hct,ts]\)
- Health care space \(5\)
- Health care space \([s,hct,ts]\)

**institutions**
- Intitutional building space \(6\)
- Intitutional building space \([s,ts]\)
commercial and institutional building space existing

non-dwelling building space conditioning energy intensity

commercial and institutional building space base

non-dwelling building space conditioning energy intensity history

commercial space conditioning energy requirement

(1)

commercial space conditioning net of CHP energy requirement

(2)

commercial space conditioning net of CHP energy requirement excess

(3)

commercial space conditioning net of decentralized energy energy requirement excess

(4)

commercial space conditioning capacity base

commercial space conditioning capacity new

commercial space conditioning capacity discard rate

commercial space conditioning capacity new share

commercial space conditioning net of decentralized energy energy requirement excess

commercial space conditioning capacity discards
commercial local electricity production capacity base [s->sd->ssd,ciet,byrs]

commercial local electricity production capacity new share [s->sd->ssd,ciet,ts]

commercial local electricity production capacity discard rate [s->sd->ssd,ciet,ts]

commercial local electricity production capacity new [s->sd->ssd,ciet,ts]

commercial local electricity production capacity discards [s->sd->ssd,ciet,ts]

commercial local electricity produced total [s->sd->ssd,ts]

commercial local electricity produced total [s->sd->ssd,ts]

commercial local electricity produced [s->sd->ssd,ciet,ts]

commercial local electricity produced total [s->sd->ssd,ts]

commercial local electricity produced total [s->sd->ssd,ts]

commercial local waste heat-electricity ratio [s->sd->ssd,cichpt,ts]

commercial local waste heat used fraction [s->sd->ssd,cichpt,ts]

commercial local waste heat for cooling fraction [s->sd->ssd,cichpt,ts]

commercial local waste heat for cooling efficiency [s->sd->ssd,cichpt,ts]

commercial local CHP heat produced [s->sd->ssd,sct,ts]

commercial local waste heat used [s->sd->ssd,cichpt,ts]
Consolidate Building Space

- **dwellung unit floor space in use** [s->sd->ssd,dut,ts5,ab5] → building space in use (1) → building space in use total [s->sd->ssd,bd,byrs5]
- **commercial and institutional building space existing** [s->sd->ssd,b,ts5,ab5] → building space in use total (2) → building space in use state total [s,bd,ts]
- **building space in use total history last year** [s->sd->ssd,bd,byrs5] → building space in use total state total [s,bd,ts]
- **new dwelling unit floor space in use** [s->sd->ssd,dut,ts5] → building space constructed (4) → new building space constructed [s->sd->ssd,bd,ts5]
- **commercial and institutional building space new construction** [s->sd->ssd,b,ts5] → building space constructed (4) → new building space constructed yearly [s->sd->ssd,bd,ts]
- **new building space constructed base** [s->sd->ssd,bd,byrs5] → new building space constructed yearly (5) → new building space constructed yearly total [s->sd->ssd,bd,ts]
- **building space in use total** [s->sd->ssd,bd,byrs5] → building space demolitions (6) → building space demolitions [s->sd->ssd,bd,ts5,ab5]
- **building space demolitions base** [s->sd->ssd,bd,byrs5] → building space demolitions yearly total (7) → building space demolitions yearly total [s->sd->ssd,bd,ts]
Building Operations

- Building space in use state total [s,bd,ts]
- Building space operations goods unit requirements [bd,ts]
- Building space operations material unit requirements [bd,mib,ts]
- Building Maintenance (1)
- Building operations goods required [s,bd,ts]
- Building operations material required [s,bd,mib,ts]

conBldSpc
conNHIMa
bdDiscFt
OpGood
OpGood
Personel Use Vehicle Stocks

Determine Required Vehicle Stock (1)
- required personal use vehicle stock [s,vtpua,ts]
- required motor cycle vehicle stock [s,ts]
- required personal use passenger vehicle stock [s,ts]
- personal use passenger vehicle survival rates [s,atk,byrs,av]
- personal use passenger vehicle base stock [s,atk,byrs,av]
- personal use passenger vehicle survival rates [s,atk,ts,av]
- new personal use passenger vehicle share [s,atk,ts]
- personal auto operating material intensi [atk,ts]
- personal auto vehicle operating material required [s,atk,ts]

Deconsolidate personal use vehicle stock (2)
- required personal use vehicle stock [s,vtpua,ts]
- required motor cycle vehicle stock [s,ts]
- required personal use passenger vehicle stock [s,ts]
- personal use passenger vehicle survival rates [s,atk,byrs,av]
- personal use passenger vehicle base stock [s,atk,byrs,av]
- personal use passenger vehicle survival rates [s,atk,ts,av]
- new personal use passenger vehicle share [s,atk,ts]
- personal auto operating material intensi [atk,ts]
- personal auto vehicle operating material required [s,atk,ts]

Evolve Personal Use Vehicle Stock (3)
- existing personal use passenger vehicle stock [s,atk,ts,av]
- passenger vehicle discard [s,atk,ts,av]
- new passenger vehicles [s,atk,ts]
- personal use passenger vehicle survival rates [s,atk,byrs,av]
- personal use passenger vehicle base stock [s,atk,byrs,av]
- personal use passenger vehicle survival rates [s,atk,ts,av]
- new personal use passenger vehicle share [s,atk,ts]
- personal auto operating material intensi [atk,ts]
- personal auto vehicle operating material required [s,atk,ts]

Number of personal use vehicles per household [s,vtpua,ha,ts]
- households by state [s,ha,ts]
Personal Use Vehicle Kilometers

Allocate Vehicle KM

1. required motor cycle vehicle stock [s,ts]
2. motor cycle distance travelled [s,ttpuv,ts]
3. motor cycle load factor [s,ttpuv,ts]
4. passenger vehicle passenger kilometers [s,ttpuv,ts]
5. personal use vehicle passenger kilometers [s,ttpuv,ts]
6. personal use vehicle passenger kilometers [s,ttpuv,ts]

passTranSer

personal use vehicle passenger kilometers [s,ttpuv,ts]

existing personal use passenger vehicle stock [s,atk,ts,av]

passenger vehicle estimated distance travelled [s,rut,ttpuv,atk,ts,av]

Allocate Vehicle KM

Allocate Vehicle KM

existing personal use passenger vehicle stock [s,atk,ts,av]

passenger vehicle estimated distance travelled [s,rut,ttpuv,atk,ts,av]

passenger vehicle kilometers total [s,ttpuv,ts]
Light Commercial Vehicle Stock

- non-dwelling space required [s,b,ts]
- light commercial vehicle stock required (1)
- light commercial vehicle required [s,ts]
- light commercial vehicle stock required (2)
- Evolve Light Duty Commercial Vehicle Stock
- light commercial vehicle stock base [s,atk,byrs,av]
- light commercial vehicle intensity [s,b,ts]
- existing light commercial vehicle stock [s,atk,ts,av]
- new light commercial vehicles [s,atk,ts]
- light commercial vehicle discards [s,atk,ts,av]
- new light commercial vehicle shares [s,atk,ts]
- light commercial vehicle survival rates [s,atk,ts,av]
- newVehReqCons
- newVehReqCons
- newVehReqCons
- newVehReqCons
- newVehReqCons
- newVehReqCons
- commercial auto vehicle operating material required (3)
- commercial auto vehicle operating material required [s,atk,ts]
- commercial auto operating material required [atk,ts]
- vehBSV
- vehDiscFt
- OpGoodRec
- CAIBldSpc
- LCVehKM
Light Commercial Vehicle Kilometers

- Light commercial vehicle stock required [s, ts]
- Light commercial yearly distance per vehicle [s, ts]
- Light commercial VKM road use class share [s, rut, ts]
- Light commercial vehicle stock [s, atk, ts, av]
- Light commercial vehicle relative distance travelled [s, rut, atk, ts, av]
- Light commercial vehicle total distance (1)
- Light commercial vehicle kilometers (2)
- Light commercial vehicle total distance [s, rut, ts]
- Light commercial vehicle kilometers [s, rut, atk, ts, av]
labour Force [ts]
non-commuting fraction [ts]
commuting auto share [ts]
transit commuter share [c,ts]

Commuters by Mode (1)

auto commuters [ts]
urban transit commuters [c,ts]

city population [c,ts]
average work year [ts]
average daily commute distance [c,ts]
non commuting transit passenger kilometer intensity [c,ts]

Required Vehicles (4)

urban transit commuters [c,ts]

total passenger kilometers [c,ts]

passenger kilometers [c,tvc,ts]

load factor transit vehicles [c,tvc,ts]
transit vehicle yearly vehicle distance [c,tvc,ts]
transit vehicle capacity [tvc,ts]
Evolve Freight

Motive Stock

(3)

base motive freight vehicle stocks

[fvc->ftv,byrs,av]

motive freight vehicle life table

[fvc->ftv,ts,av]

ew new motive freight vehicle share

[fvc->ftv,ts]

mapping of fvc->ftv to fvt

[fvt,fvc->ftv]

base freight rail car stock

[byrs,av]

freight rail car life table

[ts,av]

Evolve Freight Rail Rolling Stock

(4)

freight rail car stock

[ts,av]

ew freight rail car required

[ts]

freight rail car discards

[ts,av]

Evolve Freight Stock Required

(2)

freight tonne kilometer state distribution

[fvc,ts]

new motive freight vehicles required

[fvt,ts]

new motive freight vehicles required

[fvt,ts]

motive freight vehicle stock

[fvc->ftv,ts,av]

freight rail car stock required total

[ts]

motive freight vehicle required

[fvc,ts]

motive freight vehicle required

[fvc,ts]

ratio of engines to rolling stock

[ts]

freight vehicle load factor

[fvc,ts]

freight vehicle capacity

[fvc,ts]

freight tonne kilometers exogenous

[s,lf,fvc,ts]

freight tonne kilometer state distribution

[s,fvc,ts]

rail car stock required total

[ts]

freight tonne kilometer state distribution

[1]

freight tonne kilometers exogenous

[s,lf,fvc,ts]

mapping of fvc->ftv to fvt

[fvt,fvc->ftv]

Evolve Freight

Rail Rolling Stock

(4)

base motive freight vehicle stocks

[fvc->ftv,byrs,av]

motive freight vehicle life table

[fvc->ftv,ts,av]

ew new motive

freight vehicle share

[fvc->ftv,ts]

mapping of fvc->ftv to fvt

[fvt,fvc->ftv]

base freight rail car stock

[byrs,av]

freight rail car life table

[ts,av]

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Evolve Freight

Stock Required

(2)

freight tonne kilometer state distribution

[fvc,ts]

new motive freight vehicles required

[fvt,ts]

motive freight vehicle stock

[fvc->ftv,ts,av]

freight rail car stock required total

[ts]

motive freight vehicle required

[fvc,ts]

motive freight vehicle required

[fvc,ts]

ratio of engines to rolling stock

[ts]

freight vehicle load factor

[fvc,ts]

freight vehicle capacity

[fvc,ts]

freight tonne kilometers exogenous

[s,lf,fvc,ts]

freight tonne kilometer state distribution

[s,fvc,ts]

rail car stock required total

[ts]

freight tonne kilometer state distribution

[1]
Roads

located urban population
[stl->sla,ts]

urban road per capita
[s->stl,rc,rt,ts]

base urban road
[s->stl,rc,rt,byrs]

urban road
[s->stl,rc,rt,ts]

Road Materials Required
(6)

road reconstructed
[s,rk,rc,rt,ts]

new rural road
[s,rc,rt,ts]

new road
[s,rk,rc,rt,ts]

existing road
[s,rk,rc,rt,ts]

existing road
[s,rk,rc,rt,ts]

urban road
[s->stl,rc,rt,ts]

new urban road
[s->stl,rc,rt,ts]

new road
(3)

new road
(2)

rural road required
[s,rc,rt,ts]

road reconstruction rate
[rk,rc,rt,ts]

road reconstructed
(5)

materials per unit road
[s,rca,rk,rc,rt,mrd,ts]

located urban population
[stl->sla,ts]

base rural road
[s,rc,rt,byrs]

road
reconstruction rate
[rk,rc,rt,ts]

per capita
[s->stl,rc,rt,ts]

urban road
[s->stl,rc,rt,ts]
Freight Rail Lines

- Freight rail line base [s, byrs]
- Freight rail line required [s, ts]
- Freight rail line new material intensity [s, mrl, ts]
- Freight rail line new material required (1)
- Freight rail line maintenance material intensity [s, mrl, ts]
- Freight rail line maintenance material required (2)
- Freight rail line material required (3)
- Freight rail line material required (4)
- Freight rail line new [s, ts]
- freight rail line aw material required [s, mrl, ts]
- Freight rail line material required [s, mrl, ts]
transmission line base [s,byrs]

transmission line require [s,ts]

transmission line material intensity [s,mls,ts]

transmission line maintainence material intensity [s,mls,ts]

transmission line new (1)

transmission line new material required [s,mls,ts]

transmission line new material required (2)

transmission line maintainence material required (3)

transmission line material required (4)

transmission line maintainence material required (3)

transmission line material required (4)
Electricity Distribution Capacity

decentralised electricity potential use  
*s-*sd-*ssd,ts*

centralised electricity required available at use  
*s-*sd-*ssd,ts*

hours per year  

electricity distribution peak hour to yearly average  
*ts*

electricity distribution capacity required  
(1)

electricity distribution required yearly capacity required  
*s-*sd-*ssd,ts*

electricity distribution capacity required  
(2)

electricity distribution capacity required  
*s-*sd-*ssd,ts*

electricity distribution capacity existing  
*s-*sd-*ssd,ts*

electricity distribution capacity new  
*s-*sd-*ssd,ts*

electricity distribution capacity discard rate  
*s-*sd-*ssd,ts*

Evolve Electricity Distribution Capacity  
(3)

cenElecFinDmd  

decEnPrd  

comFdbkV
freight tonne kilometers ship Australia internal [s,ts]

freight tonnes ship Australia internal origin [s,ts]

average freight distance ship [s,ts]

freight tonnes ship throughput internal Australia [s,ts]

freight tonnes ship throughput [s,ts]

Australia internal shipping origin destination share [sfr,sto,ts]

freight tonnes ship throughput internal Australia [s,ts]

freight tonnes ship throughput [s,ts]

freight tonnes ship throughput [s,ts]

freight tonnes ship throughput internal Australia [s,ts]

freight tonnes ship throughput [s,ts]

ship port capacity required [s,ts]

ship port capacity required base [s,ts]

ship port capacity new [s,ts]

ship port capacity required new [s,ts]

ship port capacity new material required [s,msp,ts]

ship port capacity maintenance material required [s,msp,ts]

ship port capacity material required [s,ts]

ship port capacity material required [s,ts]
Australian resident air trip rate [s,ts]

international foreign air traveller departures [s,ts]

airport throughput (1)

airport throughput [s,ts]

airport capacity required (2)

port capacity required [s,ts]

airport capacity new (3)

air port capacity new [s,ts]

air port capacity new material required (4)

air port capacity new material required [s,map,ts]

air port capacity maintenance material required (5)

air port capacity maintenance material required [s,map,ts]

air port capacity maintenance material required (6)

air port capacity maintenance material required [s,map,ts]

air port capacity new goods required (7)

air port capacity new goods required [s,gfdap,ts]

air port capacity maintenance goods required (8)

air port capacity maintenance goods required [s,gfdap,ts]
On Site Construction

construction equipment required [s,bca,bd,ts]

building space demolitions yearly total [s->sd->ssd,bd,ts]

building activity (1)

road construction activity [s,rca,rk,rc,rt,ts]

road reconstruction [s,rk,rc,rt,ts]

road activity (2)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]

building space construction machine intensity [s,bca,bd,ce,ts]

construction activity [s,bca,bd,ts]

building space constructed year [s->sd->ssd,bd,ts]

construction activity (1)

construction equipment required [s,cs,ce]

construction equipment stock base [s,ce,byrs,av]

construction equipment life table [s,ce,ts,av]

Evolve Construction Equipment (4)

construction equipment stock new [s,ce,ts]

construction equipment stock discarded [s,ce,ts,av]

road construction intensity [s,rca,rk,rc,rt,ce,ts]

existing road [s,rk,rc,rt,ts]

new road [s,rk,rc,rt,ts]
Secondary Light Industry Combined Heat and Power

1. Secondary light industrial CHP heat capacity existing total [s,lik,ts]
2. Secondary light industrial CHP heat capacity base [s,lik,ftichp,byrs]
3. Secondary light industrial CHP heat capacity discard rate [s,lik,ftichp,ts]
4. Secondary light industrial CHP heat capacity new share [s,lik,ftichp,ts]

Secondary light industrial CHP heat capacity load factor [s,lik,ftichp,ts]

Secondary light industrial CHP electricity to heat ratio [s,lik,ftichp,ts]

Secondary light industrial CHP heat production energy intensity [s,lik,ftichp,ts]

Light Industry Combined Heat and Power Fuel Use (4)

Secondary light industrial CHP heat produced (1)

Secondary light industrial CHP heat produced (2)

Secondary light industrial CHP electricity produced (3)

Secondary light industry CHP non byproduct fuel use [s,lik,ftine,ts]

Secondary light industry CHP heat byproduct fuel use [s,lik,ftibpchp,ts]

Secondary light industrial CHP heat capacity existing [s,lik,ftichp,ts]

Secondary light industrial CHP heat capacity new [s,lik,ftichp,ts]

Secondary light industrial CHP heat capacity discards [s,lik,ftichp,ts]
crop production net of seed and feed yearly for human food \([\text{crop hf ts}]\)

food production fraction for food \([\text{fc, ts}]\)

food processing waste fraction \([\text{fc, ts}]\)

animal products production for human food \([\text{apthf, ts}]\)

fish production \([\text{fk, ts}]\)

fish production for human food \([\text{fk, ts}]\)

animal products production for human food \([\text{apthf, ts}]\)

crop production for human food \([\text{crphf, ts}]\)

fish production for human food \([\text{fk, ts}]\)

crop production for human food \([\text{crphf, ts}]\)
Currently all the elements of deteo have solar as their heat source so no fuel is required:
If we add in electricity only technologies that have a fuel use then we must add in a procedure
to calculate that fuel use and pass it on to conFuelUse and secLightIndEm calculators
Material and Energy Input-Output Process Coefficients

- **Input-Output Co-efficients for Materials Used in Material Processes (1)**
  - material use per unit material plant used [mbi->mp,mbi,ts]

- **Co-efficients for Energy Used in Material Processes (2)**
  - secondary energy use per unit material plant used [mbi->mp,fti,ts]

- **Co-efficients for Converting Fuel-based Energy for Material or Electricity Processes to Fuel (3)**
  - material use per unit energy plant used [fti->seaeep,mbi,ts]

- **Co-efficients for Electricity Generation (4)**
  - secondary energy use per unit energy plant used [fti->seaeep,fti,ts]

- **Transmission Losses (5)**
  - secondary energy use per unit energy plant used [fti->seaeep,fti,ts]

- **Convert Co-efficients to Five Yearly Steps (6)**
  - material use per unit material plant used [ts5,mbi->mp,mbi]
  - secondary energy use per unit material plant used [ts5,mbi->mp,fti]
  - material use per unit energy plant used [fti->seaeep,mbi,ts]
  - secondary energy use per unit energy plant used [ts5,fti->seaeep,mbi]
Heavy Industry Combined Heat and Power Production

Heavy Industry Combined Heat and Power Fuel Use

Distribute to heat and electricity

Cumulate to 5-year steps
Material and Energy Transformations

Specify plant characteristics for material and energy processes

- plant life table parameters [mep,ts5,ap5]
- planned energy plant decommissioning [s->sd->ssd,siegp,byrs5,ap5]
- planned material plant decommissioning [s->sd->ssd,mp,ts5,ap5]
- load factor [mep,ts5]
- new material plant share [s->sd->ssd,mbi->mp,ts5]
- new energy plant share [s->sd->ssd,siegp,ts5]
- material capacity use priority [mbi->mp,ts5]
- energy capacity use priority [siegp,ts5]
- energy throughput ratio [siegp,ts5]
- material throughput ratio [mp,ts5]
- plant material composition [mep,mbi,ts5]
- material use per unit material plant used five yearly [ts5,mbi->mp,mbi]
- secondary energy use per unit material plant used five yearly [ts5,mbi->mp,mbi]
- material use per unit energy plant used five yearly [ts5,fti->seaep,mbi]
- secondary energy use per unit energy plant used five yearly [ts5,fti->seaep,mbi]

Evolv Materials and Energy Transformation Process (1)

- planned energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]
- planned material plant capacity [s->sd->ssd,mp,byrs5,ap5]
- energy plant capacity [s->sd->ssd,siegp,ts5]
- materials plant capacity [s->sd->ssd,mp,ts5]

iterations take [ts5]

- new materials in domestic production [mep,mbi,ts5]
- intermediate material import [mep,mbi,ts5]
- intermediate energy production [fte,ts5]

new materials in domestic production [mep,mbi,ts5]

heavy industry CHP electricity produced [ts5]

energy plant capacity [s->sd->ssd,siegp,ts5]

energy plant capacity [s->sd->ssd,mp,ts5]

materials plant capacity [s->sd->ssd,mp,byrs5,ap5]

heavy industry CHP heat produced [s->sd->ssd,mp,ts5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

heavy industry CHP electricity produced [ts5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,ts5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]

energy plant capacity [s->sd->ssd,mp,byrs5,ap5]

energy plant capacity [s->sd->ssd,siegp,byrs5,ap5]
Material and Energy Plant Capacity

- Base energy plant capacity used [s→sd→ssd,siegp,byrs5,ap5]
- Base materials plant capacity used [s→sd→ssd,mp,byrs5,ap5]
- Energy plant capacity used [s→sd→ssd,siegp,ts5,ap5]
- Energy plant capacity used total [s→sd→ssd,siegp,ts]
- Materials plant capacity used [s→sd→ssd,mp,ts]
- Materials plant capacity used total [s→sd→ssd,mp,ts]

**Diagram Elements:**
- matEnrTran
- secHIEmp
- secIndW
- secHeavy
- secHeavyInd
- energyTen
- secHIEmp
- secIndW
- secHeavyInd

**Diagram Edges:**
- From base materials plant capacity used [s→sd→ssd,mp,byrs5,ap5] to materials plant capacity used total (1)
- From base materials plant capacity used [s→sd→ssd,mp,byrs5,ap5] to materials plant capacity used total (2)
- From energy plant capacity used [s→sd→ssd,siegp,ts5,ap5] to energy plant capacity used total (2)
- From energy plant capacity used [s→sd→ssd,siegp,ts5,ap5] to energy plant capacity used total (2)
Materials and Energy Imports Required

- New materials in plants imported [mep, mbi, ts5]
- Intermediate material imported [mbi, ts5]
- Material imports yearly (1)
- Material imports [mbi, ts]

- Material imports direct [mbi, ts5]
- Material imports base [mbi, byrs5]

- Energy imports direct [fte, ts5]
- Intermediate energy production imported [fte, ts5]
- Energy imports yearly (2)
- Energy imports [fte, ts]

- Energy import base [fte, byrs5]
Check that all primary materials (for material processes) have non-zero inputs (e.g., fertilizerK).
Work at Home Employment

- dwelling units in use grand total [s->sd->ssd,ts]
- work at home employment intensity [ts]
- work at home employment (1)
- work at home employment [etwh,ts]

resBidReq
conEmp
check asic this data in ASFF version 3 has zero for retail and wholesae?
Commercial and Institutional Employment

- Population based occupational service workers [s,olc,ts]
- Retail service workers [s,ts]
- Wholesale service workers [s,ts]
- Healthcare workers [s,hct,ts]
- Teachers [s,et,ts]
- Institutional service workers [s,ts]

Commercial and institutional employment [s,b,ts]
Transport Driver Employment

intercity vehicle distance travelled [itt->ftv,ts,av] → intercity vehicle driver employment (1) → intercity vehicle driver employment [itt,ts]

freight vehicle distance travelled [fvc->ftv,ts,av] → freight vehicle driver employment (2) → freight vehicle driver employment [fvc,ts]

light commercial vehicle total distance [s,rut,ts] → light commercial driver employment (3) → delivery vehicle driver employment [ts]

transit vehicle distance travelled [c,tvc,ftv,ts,av] → transit vehicle driver employment (4) → transit vehicle driver employment [tvc,ts]

vehicle driver employment (5) → vehicle driver employment [etvd,ts]
Secondary Heavy Industry Employment

- materials plant capacity used total [s->sd->ssd, mp, ts]
- materials plant employment intensity [mp, ts]
- energy plant capacity used total [s->sd->ssd, siegp, ts]
- energy plant employment intensity [siegp, ts]

Secondary heavy industry employment (1)

- secondary heavy industry employment [mep, ts]

conEmp

matEnrPlCap

matEnrPlCap
Consolidate Employment

Consolidate Employment

commercial and institutional employment [s,b,ts]

work at home employment [etwh,ts]

primary industry employment [pis,ts]

secondary heavy industry employment [mep,ts]

secondary light industry employment [etsli,ts]

nicle driver employment [etvd,ts]

labour demand total (2)

labour demand share [ls,ts]

labour demand detailed [ls->lac,ts]

employment [ls,ts]

labTen

comFdbkVar

labInc

comInstEmp

secLiEmp

secHiEmp

transDrvEmp

workAtHomeEmp
Food Consumables

1. Foreign Traveler Food based Equivalent Population
   - inbound traveler rate [s,co,trl,atr,ts]
   - international traveler food per person day ratio [co,trl,atr,fc,ts]

2. total population [ts]
   - human food eaten (2)

3. food consumption waste fraction [fc,ts]
   - human food consumption (3)

- food per capita [fc,ts]
- food consumption waste fraction [fc,ts]
- human food consumption [fc,ts]
Other Consumables

- Other Consumables per capita
  - [moc, ts]
- Other Consumables
  - (1)
- Her consumables require
  - [s, moc, ts]

conQLFactors

population

state
population total
[s, ts]

conNHIMatUse

othConDiscFt
morbidity [s,mt,ts,a] → morbidity rate (1) → morbidity rate [s,mt,ts]

state population [s,g,ts,a] → long term health care fraction [s,g,ts,a] → long term health care population (2) → long term health care population [s,ts]
Commercial Service Required

- **population**
  - population based occupational service work
    - [s,olc,ts]

- **office building worker yearly service**
  - [s,olc,ts]

- **internal traveler rate**
  - [s,ts]

- **mapping of a to tap**
  - [tap,a]

- **bed rate for internal travelers**
  - [ts]

- **internal travel propensity**
  - [s,tap,ts]

- **state population**
  - [s,g,ts,a]

- **internal traveler rate**
  - (2)

- **traveler bed days**
  - (3)

- **bed rate for international travelers**
  - [co,trt,atr,ts]

- **inbound traveler rate**
  - [s,co,trt,atr,ts]

- **bed rate for state population**
  - [s,ts]

- **restaurant use rate**
  - [s,ts]

- **internal traveler restaurant use rate**
  - [s,ts]

- **inbound traveler rate**
  - [s,co,trt,atr,ts]

- **international traveler restaurant use rate**
  - [co,trt,atr,ts]

- **non-traveller restaurant use rate**
  - [ts]

- **restauran seat day requirement**
  - (4)

- **hospital worker yearly service**
  - [s,olc,ts]

- **restauran seat day requirement**
  - [s,ts]

- **population**
  - [s,olc,ts]

- **office building space labour service required**
  - [s,olc,ts]
null
residential space conditioning net of decentralized energy energy requirement \([s->sd->ssd,sct,ts]\)

residential space conditioning capacity \([s->sd->ssd,sct->rsct,ts,asp]\)

new residential space conditioning capacity fuel conversion efficiency \([s->sd->ssd,ftrsc->rsct,ts]\)

residential space conditioning capacity used (1)

residential space cooling fuel required (2)

residential space conditioning capacity used \([s->sd->ssd,rsc,ts]\)

residential space conditioning fuel required \([s->sd->ssd,ftrsc,ts]\)
residential hot water heater stock
[s->sd->ssd,hwht,ts,ahwh]

residential hot water heater energy required total
[s->sd->ssd,ts]

hot water heater heat load share
[s->sd->ssd,hwht->hwhft,ts]

new residential hot water heater fuel conversion efficiency
[s,hwht,ts]

new residential hot water heater fuel conversion efficiency history
[s,hwht,119872006]

mapping of hwht to ftrhw
[ftrhw,hwht]

residential hot water heater stock
[s->sd->ssd,hwht,ts,ahwh]

residential hot water heater energy required total
[s->sd->ssd,hwht,ts,ahwh]

residential hot water heater energy required total
[s->sd->ssd,ts]

residential hot water heater fuel required total
[s->sd->ssd,hwht,ts,ahwh]

residential hot water heater fuel required total
[s->sd->ssd,ts]

residential hot water heater fuel required total
[s->sd->ssd,ftrhw,ts]
Residential White Appliances Fuel Use

resWhiteAppl

residential white appliance stock
[s->sd->ssd,ftwa->wat,ts,awa]

new residential white appliance fuel intensity
[s->sd->ssd,ftwa->wat,ts]

residential white appliance fuel required
(1)

residential white appliance fuel required
[s->sd->ssd,ftwa,ts]
Residential Plug Load And Lighting Fuel Use

- Residential plug load and lighting electricity required
- Residential plug load and lighting electricity intensity
- Dwelling unit floor space in use grand total

\[ \text{resBldReq} \]

\[ \text{resPLLightFU} \]

\[ \text{conResFU} \]

\[ \text{18-Sep-17} \]
Residential local electricity produced from vehicles [s->sd->ssd,atkneb,ts]

Fuel use to auto electricity ratio [atkneb,ts]

Auto use in building electricity share [s->sd->ssd,atkneb->ftab,ts]

Residential local electricity produced from vehicles fuel required from vehicles fuel required (1) [s->sd->ssd,ftab,ts]

Residential local CHP fuel required (2) [s->sd->ssd,ftrchp,ts]

Residential local CHP fuel intensity [s->sd->ssd,ftrchp->reptch,ts]

Residential local electricity produced from fuels [s->sd->ssd,reptchp,ts]

Residential electricity produced from vehicles fuel required [s->sd->ssd,ftab,ts]
Consolidate Residential Fuel Use

residential hot water heater fuel required total
\[ s -> sd -> ssd, ft hw, ts \]

mapping of \( ftrhw \) to \( ftr \) for fuels
\[ ftr, ftrhw \]

residential white appliance fuel required
\[ s -> sd -> ssd, ftwa, ts \]

mapping of \( ftwa \) to \( ftr \) for fuels
\[ ftr, ftwa \]

residential plug load lighting electricity required
\[ s -> sd -> ssd, eoeut, ts \]

residential local fuel required
\( 1 \)

mapping of \( ftrchp \) to \( ftr \) for fuels
\[ ftr, ftrchp \]

residential local CHP fuel required
\[ s -> sd -> ssd, ftchp, ts \]

residential energy enduse fuel use
\[ s -> sd -> ssd, reet, ftr, ts \]

residential non electricity fuel use
\[ s -> sd -> ssd, ftns, ts \]

residential potential electricity use
\[ s -> sd -> ssd, ts \]

mapping of \( ftrhw \) to \( ftr \) for fuels
\[ ftr, ftrhw \]

mapping of \( ftwa \) to \( ftr \) for fuels
\[ ftr, ftwa \]

mapping of \( ftrchp \) to \( ftr \) for fuels
\[ ftr, ftrchp \]

mapping of \( ftrsc \) to \( ftr \) for fuels
\[ ftr, ftrsc \]

mapping of \( ftab \) to \( ftr \) for fuels
\[ ftr, ftab \]

residential space conditioning fuel required
\[ s -> sd -> ssd, ftrsc, ts \]

residential electricity produced from vehicles fuel required
\[ s -> sd -> ssd, ftab, ts \]
residential potential electricity use
[s->sd->ssd,ts]

residential electricity required hourly share
[s->sd->ssd,hod,moy,ts]

residential local electricity required hourly
(1)

residential local electricity produced potential
[s->sd->ssd,hod,moy,ts]

residential local electricity produced potential hourly
(2)

residential local electricity production used directly
(3)

residential local electricity production excess potential hourly
(4)

residential local electricity production excess potential hourly
[s->sd->ssd,hod,moy,ts]

residential local electricity production used directly
[rept,hod,moy,ts]

residential local electricity production
[rept,ts]

residential electricity charge and discharge loss fraction
[ts]

residential electricity stored and retrieved
[rept,ts]

residential electricity stored and retrieved
[rept,ts]

residential local electricity required hourly share
[s->sd->ssd,hod,moy,ts]

residential electricity required hourly
(1)

residential electricity produced potential
[s->sd->ssd,hod,moy,ts]

residential local electricity produced potential
(2)

residential local electricity production used directly
(3)

residential local electricity production excess potential hourly
(4)

residential local electricity production excess potential hourly
[rept,hod,moy,ts]

residential local electricity production used directly
[rept,hod,moy,ts]

residential local electricity production
[rept,ts]

residential local electricity produced potential
[rept,ts]

residential electricity use
(6)

residential electricity use
(6)
Commercial and Institutional Space Conditioning Fuel Use

(new commercial space conditioning capacity) [s->sd->ssd,ftcsc->csct,ts] → commercial space conditioning fuel required (2) [s->sd->ssd,ftcsc,ts]

commercial space conditioning capacity used (1) [s->sd->ssd,csct,ts] → commercial space conditioning capacity used [s->sd->ssd,csct,ts]

commercial space conditioning capacity [s->sd->ssd,sct->csct,ts] → commercial space conditioning net of decentralized energy energy requirement [s->sd->ssd,sct,ts]

cAISpcCon

cAISpcCon

commercial space conditioning capacity used [s->sd->ssd,sct,ts] → commercial space conditioning capacity used [s->sd->ssd,csct,ts]
commercial floor space total
\([s->sd->ssd,b,ts]\)

commercial plug load and lighting electricity required
\([s->sd->ssd,b,ts]\)

commercial plug load and lighting electricity required
\([s->sd->ssd,oeut,ts]\)
Commercial and Institutional Local Electricity Production Fuel Use

- Commercial local electricity produced
  \[s\rightarrow sd\rightarrow ssd, ciet, ts\]

- Commercial local CHP fuel required
  \[s\rightarrow sd\rightarrow ssd, ftbne, ts\]

conCAIFU

CILocElecPrd

whatIf?

18-Sep-17
(1) commercial local fuel required
commercial local CHP
[s->sd->ssd,ftbne,ts]

(1) commercial local fuel required
commercial local CHP
[s->sd->ssd,ftbne,ts]

(2) commercial electricity required
commercial electricity use
[s->sd->ssd,ts]

(2) commercial electricity required
commercial electricity use
[s->sd->ssd,ts]

(2) commercial electricity required
commercial electricity use
[s->sd->ssd,ts]

(1) commercial local fuel required
commercial local CHP
[s->sd->ssd,ftbne,ts]

(1) commercial local fuel required
commercial local CHP
[s->sd->ssd,ftbne,ts]

(2) commercial electricity required
commercial electricity use
[s->sd->ssd,ts]

(2) commercial electricity required
commercial electricity use
[s->sd->ssd,ts]
Vehicles Fuel Use

passenger vehicle stock total annual distance travelled [s,rut,atk,ts,av]

passenger vehicle distance travelled multi fueled vehicle share [s,atkmf->ftv,ts]

passenger vehicle actual fuel intensity history [s,rut,atk->ftv,1967_2006]

passenger vehicle actual fuel intensity [s,rut,atk->ftv,ts]

motor cycle kilometers [s,ttpuv,ts]

motor cycle fuel intensity [s,ts]

light commercial vehicle kilometers [s,rut,atk,ts,av]

light commercial vehicle distance travelled multi fueled vehicles share [s,atkmf->ftv,ts]

light commercial vehicle actual fuel intensity history [s,rut,atk->ftv,1967_2006]

light commercial passenger vehicle actual fuel intensity [s,rut,atk->ftv,ts]

agri commercial vehicle kilometer [s,rut,atk,ts,av]

light commercial vehicle stock total annual distance travelled [s,rut,atk->ftv,ts,av]

light commercial vehicle stock total annual distance travelled by vehicle fuel [s,rut,atk->ftv,ts,av]

light commercial vehicle energy demand by vehicle fuel type [s,ftv,ts]

light commercial vehicle energy demand by vehicle fuel type total [s,ftv,ts]

person use vehicle energy demand by vehicle fuel type total [s,ftv,ts]

personal use vehicle energy demand by vehicle fuel type [s,ftv,ts]

light commercial vehicle kilometers [s,rut,atk->ftv,ts,av]

light commercial vehicle energy demand by vehicle fuel type [s,ftv,ts]

light commercial vehicle energy demand by vehicle fuel type total [s,ftv,ts]
Secondary Light Industry Fuel Use

- construction equipment stock [s,ce,ts,av]
- construction energy end use intensity [ce,ieeu,ts]
- construction energy end use required total (1)
  - construction energy end use required total [ce,ieeu,ts]

- goods manufacture capacity used total [gms,ts]
- goods production energy end use intensity [gms,ieeu,ts]
- goods production energy end use required total (2)
  - goods production energy end use required total [gms,ieeu,ts]

- recycle plant capacity used total [s,rcs,ts]
- recycling energy end use intensity [rcs,ieeu,ts]
- recycling energy end use required total (3)
  - recycling energy end use required total [rcs,ieeu,ts]

- food processing capacity total use total [fps,ts]
- food production energy end use intensity [fps,ieeu,ts]
- food production energy end use required total (4)
  - food production energy end use required total [fps,ieeu,ts]
Secondary Heavy Industry Fuel Use

- Energy plant capacity used total
  - Secondary energy use per unit energy plant used
    - Materials plant capacity used total
      - Secondary energy use per unit material plant used
        - Secondary heavy industry fuel use
          - Secondary heavy industry fuel use
            - Energy plant fuel use
              - Materials plant fuel use
                - Secondary energy use per unit material plant used
                  - Secondary energy use per unit energy plant used
                    - Energy plant capacity used total
                      - Secondary energy use per unit energy plant used
                        - Materials plant capacity used total
                          - Secondary energy use per unit material plant used
                            - Secondary heavy industry fuel use
                              - Secondary heavy industry fuel use
                                - Energy plant fuel use
                                  - Materials plant fuel use
                                    - Secondary energy use per unit material plant used
                                      - Secondary energy use per unit energy plant used
                                        - Energy plant capacity used total
Primary Industry Fuel Use

agriculture crop activity total
[s->sd,lcbi,art->crp,ts]

cropping energy intensity
[fti,art,ts]

agriculture fuel use
(1)

agriculture machine requirements
[s->sd,am,ts]

animal machine energy intensity
[lsm,ts]

agriculture fuel use
[primIndFU]

forestry fuel use
(2)

forestry machine stock
[fm,ts,av]

forestry energy intensity
[fm,ts]

forestry machine energy share
[fm,fti,ts]

forest machine energy conversion coefficient
[fm,fti,ts]

land use
[s->sd,luc,ts]

landRes
Centralised Electricity Final Demand

1. Vehicle electricity use
   - use geography
2. Second light industry net electricity use
   - use geography
3. Decentralised electricity potential use
4. Secondary light industry excess electricity produced
5. Secondary light industry excess electricity available at use
6. Decentralised electricity potential available
7. Centralised electricity required available at use

allocRurHHSACon

vehFU

resEnrStorage

secLightIndFU

decEnrPrd

conCAIFU

decEnrPrd
Consolidate Final Demand Fuel Use

Diagram - conFinDemFU

primary industry fuel use [s,pis,fti,ts]

Diaggregate primary sector fuel use (1)

primary industry electricity fuel use [s,pist,ts]

final demand non electricity fuel use [erfds,ftine,ts]

centralised electricity required available at use [s->sd->ssd,ts]

final demand electricity fuel use total (2)

residential non electricity fuel use [s->sd->ssd,ftbne,ts]

final demand non electricity fuel use total (3)

commercial non electricity fuel use [s->sd->ssd,ftbne,ts]

decentralised electricity production fuel use [s->sd->ssd,ftchp,ts]

material use per unit energy plant used [fti->seaep,mbi,ts]

Convert Fuel Energy Required to Fuel Mass (4)

vehicle non electricity fuel use [s,tvs,ftvne,ts]

mapping of ftbne to ftine [ftine,ftbne]

mapping of ftchp to ftine [ftine,ftchp]

mapping of ftvne to ftine [ftine,ftvne]

secondary light industry non electricity fuel use [lik->lis,ftine,ts]

heavy industry CHP produced fuel fuel use [ftine,ts]

primary industry non electricity fuel use [s,pist,ftine,ts]

material fuels final consumption [mbi,ts]
Consolidate Fuel Use

1. Final demand total fuel use (1)
2. Heavy industry total fuel use (2)
3. Total fuel use (3)
4. Separate secondary heavy industry fuel use (4)
5. Sector spatially detailed electricity use (5)
6. State sector electricity use (6)

Secondary heavy industry fuel use [s->sd->ssd, mep, fti, ts]

Electricity use decentralized serviceable [s->sd->ssd, ers, ts]

Primary industry electricity fuel use [s, pilst, ts]
Buildings Emissions

conResFU

residential non electricity fuel use
[s->sd->ssd,ftbne,ts]

conCAIFU

commercial non electricity fuel use
[s->sd->ssd,ftbne,ts]

fuel use emissions buildings
[ftbne,bk,emt,ts]

fuel use emissions buildings
[ss->sd->ssd,bk,emt,ts]

emissionsCons
Consolidate Transport Sector Vehicle Use Emissions

Vehicle Use Emissions

- Personal Use Vehicle
  - [s->sd->ssd,emtfd,ts]
- Intercity Vehicle
  - [s->sd->ssd,emtfd,ts]
- Transit Vehicles
  - [s->sd->ssd,emtfd,ts]
- Light Duty Vehicle
  - [s->sd->ssd,emtfd,ts]
- Freight Vehicles
  - [s->sd->ssd,emtfd,ts]
- International Air Travel
  - [s->sd->ssd,emtfd,ts]
Industry Fuel-Based Emissions

- Secondary light industry non-electricity fuel use
  - fuel use emission intensity secondary light industry
  - (1) fuel use emissions

- Secondary light industry fuel use
  - fuel use emission intensity secondary light industry
  - (2) fuel use emissions

- Secondary heavy industry fuel use
  - fuel use emission intensity secondary heavy industry
  - (3) fuel use emissions

- Primary industry fuel use
  - fuel use emission intensity primary industry
  - (4) fuel use emissions
Vehicles Emissions Distance Dependent

- **intercity vehicle**
  - distance travelled
  - distance dependent emissions intensity
  - distance dependent emissions intensity history

- **transit vehicle**
  - distance travelled
  - distance dependent emissions intensity
  - distance dependent emissions intensity history

- **freight vehicle**
  - distance travelled
  - distance dependent emissions intensity
  - distance dependent emissions intensity history

- **commercial floor space**
  - geography share
Secondary Light Industry Process Emissions

- procAssem
  - goods manufacture capacity used total geo [s->sd->ssd,gms,ts]
- recycling
  - recycle plant capacity used total state [s,rcs,ts]
- foodProc
  - food processing capacity total use total [fps,ts]
- process emission intensity light industry kind processing [likp->lis,emt,ts]
- process emissions light industry kind processing [likp->lis,emt,ts]
- secondary light industry kind processing activity (1)
- secondary light industry kind processing activity [likp->lis,ts]
Secondary Heavy Industry Process Emissions

- Energy plant process emission intensity [siegp, emt, ts]
- Secondary heavy industry process emissions (2)
- Secondary heavy industry process emissions [s->sd->ssd, mep, emt, ts]
- Materials plant process emission intensity [mp, emt, ts]
- Materials plant capacity used total [s->sd->ssd, mp, ts]
- Energy plant capacity used total [s->sd->ssd, siegp, ts]
Agriculture Process Emissions

1. Manure production emissions
   \[ \text{manure production } [s->sd,lvs,ts5] \]

2. Anure production history emissions
   \[ \text{anure production history } [s->sd,lvs,byrs5] \]

3. Global GHG Emission emissions
   \[ \text{global GHG Emission } \]

4. Animal emissions emissions
   \[ \text{animal emissions } [s->sd,lvs,emt,ts] \]

5. Agriculture amendments emissions
   \[ \text{agriculture amendments emissions } [s->sd,emt,ts] \]

6. Livestock emissions
   \[ \text{livestock emissions } [s->sd,lvst,ts] \]

7. Greenhouse gas emissions intensity animal manure
   \[ \text{greenhouse gas emissions intensity animal manure } [s->sd,lvst,ts] \]

8. Greenhouse gas emissions intensity animal product
   \[ \text{greenhouse gas emissions intensity animal product } [s->sd,lvst,ts] \]

9. Greenhouse gas emissions intensity crop operation
   \[ \text{greenhouse gas emissions intensity crop operation } [s->sd,art->crp,ts] \]

10. Agriculture amendments emissions
    \[ \text{agriculture amendments emissions } [s->sd,emt,ts] \]

11. Agriculture land-use emissions
    \[ \text{agriculture land-use emissions } [s->sd,emt,ts] \]

12. Agriculture land-use emissions
    \[ \text{agriculture land-use emissions } [s->sd,emt,ts] \]

13. Land use emissions
    \[ \text{land use emissions } [s->sd,luc,ts] \]

14. Greenhouse gas emissions intensity land-use operation
    \[ \text{greenhouse gas emissions intensity land-use operation } [s->sd,luc,ts] \]

15. Agriculture crop activity total emissions
    \[ \text{agriculture crop activity total } [s->sd,lcbi,art->crp,ts] \]

16. Greenhouse gas emissions intensity crop operation
    \[ \text{greenhouse gas emissions intensity crop operation } [s->sd,art->crp,ts] \]
Forestry Land Use Process Emissions

Forestry Burning GHG Emissions (1)
- Forestry burning emissions
  - [s->sd, emt, ts]

Forestry Aging and Clearing GHG Emission (2)
- Forestry process emissions
  - [s->sd, emt, ts]

Forestry Sequestering GHG (3)
- Forestry process emissions
  - [s->sd, emt, ts]

Forestry burning greenhouse gas emissions intensity calibrated
- [fe, fr, emt, ts]

Base tree inventory
- [fe, fr, byrs5, fa]

Tree inventory
- [fe, fr, ts5, fa]

Volume per tree
- [fe, frg, ts5, fa]

Forest land total
- [s->sd, fe, ts]

Tree life table
- [fe, frg, ts5, fa]

Windfall from forest land reduction total
- [fe, ts5]

Windfall use share
- [fe, ts5]

Forestry clearing greenhouse gas emissions intensity calibrated
- [fe, emt, ts]

Forest land deletions
- [s->sd, fe, ts]

Forest land total
- [s->sd, fe, ts]

Total forest land additions
- [s->sd, fe, ts]

Forest growth greenhouse gas sequestration intensity calibrated
- [fe, emt, ts]

Forest land total
- [s->sd, fe, ts]

Total forest land additions
- [s->sd, fe, ts]
Mining process emissions

mining capacity use
[s,pmie,emt,amc]

mining process emission intensity
[s,pmie,emt,ts]
Waste Process Emissions

1. Landfill GHG Emissions (1)
   - Landfill emissions [s,emt,ts]
   - Inflow: landfill material stock [s,m,ts]
   - Waste greenhouse gas emission intens [m,emt,ts]

2. Wastewater GHG Emissions (2)
   - Wastewater emissions [wr,emt,ts]
   - Inflow: Water discharged [wr,wus,ts]
   - Wastewater greenhouse gas emission intens [wus,emt,ts]
- fuel use emissions
  - primary industry
  - [s, pis, emt, ts]

- mining process emissions
  - [s, pmie, emt, ts]

- forestry process emissions
  - [s->sd, eft, emt, ts]

- forestry process 
  - greenhouse gas sequestration
  - [s->sd, emt, ts]

- agriculture amendments emissions
  - [s->sd, emt, ts]

- animal emissions
  - [s->sd, lvs, emt, ts]

- agriculture land-use emissions
  - [s->sd, emt, ts]

primary industry emissions
- [s, pis, ek, emt, ts]

airRes
New Vehicles Required Consolidation

- new passenger vehicles [s, atk, ts]
- new light commercial vehicles [s, atk, ts]
- new transit vehicles required [c, vtt, ts]
- new intercity vehicles required [vtic, ts]
- construction equipment new [s, ce, ts]
- agriculture machines new [s->sd, am, ts]
- new forestry machines required [fm, ts]
- new boats required [j, siz, ts]
- new motive freight vehicles required [fvt, ts]
- new freight rail car required [ts]
- vehicle unit mass [gfdvt, ts]

Consolidate New Non-Freight Vehicles Required

- new vehicles required non freight [vtnf, ts]
- new vehicles required non freight [vtnf, ts]
- new vehicles required [gfdvt, ts]
- new vehicles required mass [gfdvt, ts]
- new vehicles required non freight [vtnf, ts]
- new vehicles required non freight [vtnf, ts]
- new vehicles required mass [gfdvt, ts]
Consolidate Non Heavy Industry Material Use

- otherConsum: other consumables required [s,moc,ts]
- procAssem: materials embodied in goods [meg,ts]
- procAssem: goods packaging materials [mgp,ts]
- foodProc: food packaging material required [s,mgp,ts]
- NSGMBlContent: new building contents required direct materials [s,bccd,m,ts]
- bidOp: building operations material required [s,bd,mi,b,ts]
- bidMat: new building materials yearly [s,mb,ts]
- roads: road material required [s,mrd,ts]
- frtRailLines: freight rail line material required [s,mrl,ts]
- pipeLines: pipe line material required [s,mpl,ts]
- transLines: transmission material required [s,mli,ts]
- seaPorts: ship port capacity material required [s,msp,ts]
- airPorts: air port capacity material required [s,map,ts]

Material required in goods (1) -> material required in goods [mrs,m,ts]
Material required in building (2) -> material required in building [mrsb,m,ts]
Material required in transport infrastructure (3) -> material required in transport infrastructure [mrsti,m,ts]
material required in new assembly capacity [mic, ts]

new food processing plant material required [mic, ts]

mine capacity new materials required [mic, ts]

new recycle plant material required [mic, ts]

agriculture external amendments required [s->sd, aac->aat, ts5]

agriculture external amendments required history [s->sd, aac->aat, byrs5]

material required in agriculture (4)

material required in agriculture (5)

material required in goods [mrs, m, ts]

material required in buildings [mrsb, m, ts]

material required transport infrastructure [mrsti, m, ts]

material required endogenous switch []

material required exogenous switch []

material required (6)

material required (7)

material required endogenous [mrs, m, ts]

material required exogenous [mrs, m, ts]
The mapping from m to mbi is to convert from the more aggregate materials currently used throughout most of ASFF, to the more detailed materials used in the IO structure of basic industry transformations. As more detail becomes available on the materials used in other sectors, then the material set \('m' can be progressively moved toward mbi.

The 'mrs' sectoral breakout of the mapping is to allow for sector specific details to be used, if available.
building space in use total
\[s->sd->ssd,bd,ts\]

building water unit requirements
\[s->sd->ssd,bd,ts\]

building water required
(1)

building water required
\[s->sd->ssd,bd,ts\]

waterUseAccount
Secondary Industry Water Use

1. Goods production water required
   - Goods manufacture capacity used total geo
   - Goods production water intensity
2. Recycle water required
   - Recycle plant capacity used total
   - Recycle water intensity recycling
3. Food processing water required
   - Food processing capacity total use
   - Food processing water intensity
4. Material and energy plant water required
   - Materials plant capacity used total
   - Materials plant water intensity
   - Energy plant capacity used total
   - Energy plant water intensity
Primary Industry Water Use

- Agriculture crop activity total
  - [s->sd,lcbl,art->crp,ts]
- Irrigation intensity
  - [s->sd,art->crp,ts]
- Live stock yearly
  - [s->sd,lvs,ts]
- Animal water use intensity
  - [s->sd,lvs,ts]

Agriculture water use

- Water intensity
  - [s,pmie,ts]

Mining capacity use

- Water intensity
  - [s,pmie,ts]

Mining water use

- Water use account

AgriLndAct

AgriLiveStock

MiningCap

waterUseAccount

whatIf?

18-Sep-17
Disposal of Recycled Building Contents Material Mass

- Base Recyclable Building Contents Material Mass [s, bccdm, byrs]
- Planned Recycled Building Contents Material Mass [s, bccdm, ts]
- Discarded Building Contents Material Mass to Land Fill [s, bccdm, ts]
- Potential Recycled Building Contents Material Mass [s, bccdm, ts]
- Recyclable Building Contents Material Mass [s, bccdm, ts]
- Actual Recycled Building Contents Material Mass [s, bccdm, ts]
Calculate Packaging Discard Fate

1. Packaging materials used:
   - Packaging materials [s,mgp,ts]

2. Distribute Other Consumables Discard Mass [s,mgp,ts]

3. Recycle Disposition of Packaging Mass:
   - Recyclable packaging mass [s,mgp,ts]
   - Actual recycled packaging mass [s,mgp,ts]
   - Potential recycled packaging mass [s,mgp,ts]

4. Disposition of Recycled Packaging Mass:
   - Recyclable packaging mass [s,mgp,ts]
   - Actual recycled packaging mass [s,mgp,ts]

- Food packaging material required [s,mgp,ts]
- Packaging state share [s,ts]
- Packaging landfill fraction [s,mgp,ts]
- Base landfill packaging mass [s,mgp,byrs]
- Base recyclable packaging mass [s,mgp,byrs]
- Planned recycled packaging mass [s,mgp,ts]
materials in discarded assembly capacity [s,mic,ts]

discarded food capacity materials [s,mic,ts]

capacity materials land fill fraction [s,mic,ts]

base land fill capacity mass [s,mic,byrs]

base recyclable capacity mass [s,mic,byrs]

planned recyclable capacity mass [s,mic,byrs]

Distribute materials in discarded capacity (1)

materials in discarded capacity [s,mic,ts]

discarded capacity materials to land fill [s,mic,ts]

potential recycled capacity mass [s,mic,ts]

land fill capacity mass (2)

land fill capacity mass [s,mic,ts]

recycling

Recycled Capacity Material Mass (4)

recycling

recycling

actual recycled capacity mass [s,mic,ts]

planned recyclable capacity mass [s,mic,byrs]

mine capacity material discards [s,mic,ts]
Primary Material Disposition

production primary material (1) → production primary material [pm,ts]

production primary material (2) → consumption primary material non human food [pm,ts]

crop production for human food [crphf,ts]

animal products production for human food [apthf,ts]

fish production human food [fk,ts]

crop production for non human food [crpnhf,ts]

animal products production not human food [pmthfe,ts]

windfall from forest land reduction [fe,rwt,ts5]

wood volume production [fe,fc,rwt,ts]

actual primary material and energy material production [pmie,ts]

construction material shares [cmst,ts]

primary materials embodied in human food [pmthfe,ts]

map pmthi to pm [pm,pmthi]

material and energy transformation primary material required yearly [s->sd->ssd,pmthi,ts]

other primary materials required [pm,ts]

crop production for non human food [crpnhf,ts]

animal products production not human food [pmthfe,ts]

windfall from forest land reduction [fe,rwt,ts5]

wood volume production [fe,fc,rwt,ts]

actual primary material and energy material production [pmie,ts]

construction material shares [cmst,ts]

primary materials embodied in human food [pmthfe,ts]

map pmthi to pm [pm,pmthi]

material and energy transformation primary material required yearly [s->sd->ssd,pmthi,ts]

other primary materials required [pm,ts]
Recycled Material Disposition

Recycled material import share [mr,ts]

material and energy transformation recycled material required yearly [s->sd->ssd,mr,ts]

Recycled material imports (1)

Imports recycled material plan [mr,ts]

Exports recycled material [mr,ts]

Imports recycled material [mr,ts]

Recycled material exports (2)

Recycled material [s,mr,ts]

Recycled material import share [mr,ts]
new vehicles imported

new vehicles import share
[gfdvt,ts]

new vehicles required
[gfdvt,ts]

new vehicles exported
[gfdvt,ts]

vehicle unit mass
[gfdvt,ts]

new vehicle mass
domestic production
(3)

new vehicle mass
domestic production
(2)

new vehicles domestic production
(1)

new vehicles imports
gfdvt,ts

new vehicles imports
gfdvt,ts

new vehicles imports
gfdvt,ts

new vehicles required
[gfdvt,ts]
other final demand goods consumption [gfdo,ts]

final demand goods import share [gfdo,ts]

other final demand goods imports (1)

other final demand goods imports [gfdo,ts]

other final demand goods exports [gfdo,ts]

other final demand goods production (2)

other final demand goods production [gfdo,ts]

comTrdBal

procAssem

ftTranSer

OthFinDmdGoodReqCons

OthFinDmdGoodDisp
operating goods required [s,gfdi,ts]
operating import share [gfdi,ts]
intermediate goods imports [gfdi,ts]
intermediate goods required [s,gfdi,ts]
intermediate goods exports [gfdi,ts]
operating goods domestic production (1)
intermediate goods domestic production [gfdi,ts]
intermediate goods exports [gfdi,ts]
intermediate goods domestic production (2)
operating goods domestic production [gfdi,ts]
Tourist Trade Balance (1)

- **inbound traveler rate** [s,co,trt,atr,ts]
- **inbound traveler spending rate** [co,trt,atr,ts]
- **outbound traveler stay length** [ts]
- **outbound traveler spending rate** [ts]

- **tourist spending** [pt,ts]
- **tourist trade balance** [ts]
- **Australian international travel person rate** [s,ts]

**Note:**
- **intTravel**
- **passTranSer**
- **intDebt**
international surplus (debt) [ts]

increment to international surplus [ts]

interest rate (per year) [ts]

tourist trade balance [ts]

current real goods trade balance [ts]

current invisibles trade balance [ts]

Evolve International Debt

(1)

international surplus (debt) [ts]
Scenario Theme Builder

demographic theme parameters [sts->vtp,dtpk]

life style theme parameters [lsc->lsp,istpk]

energy use intensity theme parameters [eus,eutpk]

energy use share asymptote theme parameters [eus->eut,euspm]

energy use share method [eus,euspt]

energy efficiency share theme parameters [eus->eut,eutpk]

energy efficiency method [eus->eut]

energy efficiency asymptote multiplier [eus->eut,eumpt]

energy use asymptote year [eus,euvl]

electricity generation share asymptote [l,e]

electricity generation share projection parameters [egapt]

electricity generation fuel use asymptote percent change [sepwf]

electricity generation fuel use projection parameters [egapt]

electricity generation line loss asymptote percent change []

electricity generation line loss projection parameters [egapt]

material intensity change parameters [micpt,micpk]

Life Style

Energy Use

Electricity Generation Share

Electricity Generation Fuel Use

Material Intensity
Does Labour Tension Exists (2)

labour tension ratio tolerance [ts]

labour Force [ts]

labour demand tension [ra,ts]

Labour Tension (1)

employment total [ts]
Land Tension

Does Land Tension Exist
(s->sd,ts)

Land tension exists
(s->sd,ts)

Any land tension exists total
(ts)

Base land use
[s->sd,luc,byrs]

Land use
[s->sd,luc,ts]

Land tension ratio tolerance
[]
Does Water Tension Exists (1)

Water Tension

water tension exists [wr,ts]

water tension exists total [ts]
Does Trade Surplus (debt) Tension Exists (2)

Per Capita International Trade Surplus (1)

total population
[ts]

international surplus (debt)
[ts]

maximum trade surplus per capita []

trade surplus tension exists [ts]

trade debt tension exists [ts]

Does Trade Surplus (debt) Tension Exists (2)

Per Capita International Trade Surplus (1)

total population
[ts]

international surplus (debt)
[ts]

maximum trade surplus per capita []
Energy Tension
Calculator Diagram - energyTen

final demand non electricity fuel use [erfds, fine, ts]

final demand electricity fuel use total [ts]

secondary heavy industry fuel use [s->sd->ssd, mep, fti, ts]

energy plant capacity used total [s->sd->ssd, siegp, ts]

energy imports [fte, ts]

energy exports [fte, ts]

energy dependence ratio acceptable []

Primary Energy Use (1) → primary energy use total [ts]

Primary Energy Import Total (2) → energy imports total [ts]

Energy Dependence Ratio (3) → energy dependence ratio [ts]

Energy Tension (4) → energy tension exists [ts]

energy dependence ratio acceptable []
Animal Feed Tension

Grazing Land Tension

Does Grazing Land Tension Exists

Grazing land tension exists total [ts]

Grazing land tension exists [s->sd,ts]

Grazing land tension ratio [s->sd,ra,ts]

Does Grazing Land Tension Exists

Grazing land tension ratio [s->sd,ts]

Grazing land tension exists [s->sd,ts]

Native pasture land [s->sd,ts]

Land use [s->sd,luc,ts]
catchGoal

catch requested [fs,fun,ts] → Total Fish Required (1) → total fish required [fam,ts]

actual catch [fs,fun,ts] → FishTension (2) → fish tension [fam,ra,ts]

Does Fish Tension Exists (3) → fish tension exists [fam,ts]

fish tension exists total [ts]

cCatchGoal

catch requested [fs,fun,ts] → Total Fish Required (1) → total fish required [fam,ts]

actual catch [fs,fun,ts] → FishTension (2) → fish tension [fam,ra,ts]

Does Fish Tension Exists (3) → fish tension exists [fam,ts]

fish tension exists total [ts]
Tensions Overview

- Labour tension exists [ts]
- Any land tension exists total [ts]
- Water tension exists total [ts]
- Grazing land tension exists total [ts]
- Fish tension exists total [ts]
- Energy tension exists [ts]
- Trade surplus tension exists [ts]
- Trade debt tension exists [ts]

Consolidate Tensions (1)

- Tension exists reported [tent.ts]
Population Based Quality of Life Factors

**Population Based Quality of Life Factor Goods (1)**
- Average life expectancy from birth [ts]

**Population Based Quality of Life Factor Bads (2)**
- Average morbidity rate [ts]
- Fraction of population in long term care [ts]

**Populations**
- Deaths [s,g,ts,a]
- Population [g,ts,a]
- Total population [ts]
- Morbidity rate [s,mt,ts]
- Long term health care population [s,ts]
Consumables Based Quality of Life Factors

- **food per capita** \([fc, ts]\)
- **other consumables per capita** \([moc, ts]\)
- **located population** \([s->sd->ssd, ts]\)
- **average daily commute distance** \([c, ts]\)
- **Consumables Based Quality of Life Factor Goods** (1)
- **Consumables Based Quality of Life Factor Bads** (2)
- **total per capita food factor** \([ts]\)
- **fraction meat in diet factor** \([ts]\)
- **fraction fish in diet factor** \([ts]\)
- **aggregate average daily commute distance** \([ts]\)

**QLIndex**
Ownership Based Quality of Life Factors

- Total population
- Dwelling unit floor space in use grand total
- Building contents required
- Residential white appliances new unit mass
- Residential white appliances new unit mass history
- Existing personal use passenger vehicle stock
- Average dwelling space per capita
- Average dwelling contents per capita
- Average auto ownership per capita

QLIndex
QLInde
resBldReq
NSGMBlContent
resWhiteAppl
OthFinLnddGoodReqCons
goodsDiscFI
PUVehStk
resBldReq
NSGMBlContent
resWhiteAppl
OthFinLnddGoodReqCons
goodsDiscFI
PUVehStk
Leisure Quality of Life Factor

- Labour Force
- Defence Force
- Maximum Labour Force

Leisure Quality of Life Factor (1)

Inverse population dependency ratio [ts]

QLIndex
Quality of Life Indicator

average life expectancy from birth

average life expectancy from birth base year

total per capita food factor

total per capita food factor base year

fraction meat in diet factor

fraction meat in diet factor base year

fraction fish in diet factor

fraction fish in diet factor base year

domestic passenger kilometer yield

domestic passenger kilometer yield intercity

Australian international travel rate

Australian international travel rate

average dwelling space per capita

average dwelling space per capita base year

average dwelling contents per capita

average dwelling contents per capita base year

average auto ownership per capita

average auto ownership per capita base year

inverse population dependency ratio

inverse population dependency ratio base year

quality of life weights for goods

Quality of Life Goods Factor

quality of life for goods
average morbidity rate [ts]

aggregate average daily commute distance [ts]

average morbidity rate base year [byrs]

fraction of population in long term care [ts]

fraction of population in long term care base year [byrs]

Consolidate Bads Factors (3)

quality of life for goods [gqlt,ts]

Quality of Life Index in base year [byrs]

Quality of Life Index (5)

Quality of Life Bads Factor (4)

quality of life weights for bads [bqlt]

quality of life index for bads [bqlt,ts]

quality of life index [qlt,ts]
Building Based Stock Value

- new building space constructed year [s->sd->ssd,bd,ts]
- fraction of building space commercial
- commercial building space price [cbt,ts]
- commercial building based stock base
- commercial building based stock depreciation rate
- building based activities new building space (1)
- building based activities new building value (2)
- Commercial Building Based Stock Value (3)
- building based activities new building space [cbt,ts]
- building based activities new building value [cbt,ts]
- commercial building based stock value [cbt,ts]
Vehicle Based Stock Value

Consolidate New Vehicles (1)

new vehicles commercial based activity [cvt,ts]

new intercity vehicles required [vtic,ts]
new motive freight vehicles required [fvt,ts]
new transit vehicles required [c,vtt,ts]

vehicle prices Australian dollars (2)
vehicle prices Australian [cvt,ts]

new light commercial vehicles [s,atk,ts]

vehicle based stock value base [cvt,ts]
vehicle based stock depreciation rate [cvt,ts]

capInc.

vehicle prices [gfdvt,ts]
mapping of gfdvt to cvt [cvt,gfdvt]

New Vehicle Investment (3)

new vehicle commercial sed activity investment [cvt,ts]

Vehicle Based Stock Value (4)

vehicle base stock value [cvt,ts]
Process Based Stock Value

New Capacity for Materials and Energy Transformations (1)

New Capacity Investment in Energy and Material Production Process Based Stock (2)

New Capacity Investment in Goods Manufacture (5)

New Construction Equipment Investment (3)

New Construction Equipment Price (4)

Vehicle Prices (3)

Construction Equipment New (4)

New Goods Manufacture Capacity Investment (5)
new recycle plant investment (6)
new food processing plant investment (7)
Consolidate Investment (8)
new process based investment (9)
process based stock value base (10)
process based stock depreciation rate (11)
Resource Based Stock Value

Equipment Prices
1. Agriculture Machines
2. Forest Machines
3. Fishing Boats
4. Fish Farming

New Investment
5. Agriculture Machines
6. Forest Machines
7. Fishing Boats
8. Fish Farming

Consolidate Investment

Resource Based Stock Value

Vehicle Prices
- Forestry Machines
- Fishing Boat Price
- Agriculture Machines

New Investment
- Agriculture Machines
- Forest Machines
- Fishing Boats
- Fish Farming

New Investment in Mining

New Investment in Agriculture Machines

New Investment in Forest Machines

New Investment in Fishing Boats

New Investment in Fish Farming

Consolidate Investment

Resource Based Stock Value

Resource Based Stock Value Base

Resource Based Stock Depreciation Rate

Equipment Prices

Vehicle Prices

New Investment

Resource Based Stock Value

New Investment in Mining

New Investment in Agriculture Machines

New Investment in Forest Machines

New Investment in Fishing Boats

New Investment in Fish Farming

Consolidate Investment

Resource Based Stock Value

Resource Based Stock Value Base

Resource Based Stock Depreciation Rate

New Investment in Agriculture Machines

New Investment in Forest Machines

New Investment in Fishing Boats

New Investment in Fish Farming

Consolidate Investment

Resource Based Stock Value

Resource Based Stock Value Base

Resource Based Stock Depreciation Rate

New Investment in Agriculture Machines

New Investment in Forest Machines

New Investment in Fishing Boats

New Investment in Fish Farming

Consolidate Investment

Resource Based Stock Value

Resource Based Stock Value Base

Resource Based Stock Depreciation Rate

New Investment in Agriculture Machines

New Investment in Forest Machines

New Investment in Fishing Boats

New Investment in Fish Farming

Consolidate Investment

Resource Based Stock Value

Resource Based Stock Value Base

Resource Based Stock Depreciation Rate

New Investment in Agriculture Machines

New Investment in Forest Machines

New Investment in Fishing Boats

New Investment in Fish Farming

Consolidate Investment

Resource Based Stock Value

Resource Based Stock Value Base

Resource Based Stock Depreciation Rate

New Investment in Agriculture Machines

New Investment in Forest Machines

New Investment in Fishing Boats

New Investment in Fish Farming

Consolidate Investment

Resource Based Stock Value

Resource Based Stock Value Base

Resource Based Stock Depreciation Rate

New Investment in Agriculture Machines

New Investment in Forest Machines

New Investment in Fishing Boats

New Investment in Fish Farming

Consolidate Investment

Resource Based Stock Value

Resource Based Stock Value Base

Resource Based Stock Depreciation Rate
Labour Income

- Employment \([ls,ts]\)
- Wage rate \([ls,ts]\)
- Ratio of benefits to wages \([ts]\)

Labour Income \((1)\) → Labour income \([ls,emct,ts]\) → GDP
Capital Income

commercial building based stock value [cbt,ts]
return on investment rate for commercial building

vehicle base stock value [cvt,ts]
return on investment rate for vehicle based stock

process based stock value [pbst,ts]
return on investment rate for process based stock

resource based stock value [rst,ts]
return on investment rate for resource based stock

Return on Investment Building Based Stock (1)

Return on Investment Vehicle Based Stock (2)

Return on Investment Process Based Stock (3)

Return on Investment Resource Based Stock (4)

Consolidate Return on Investment (5)

return on investment commercial building based stock [cbt,ts]
return on investment for vehicle based stock [cvt,ts]
return on investment for process based stock [pbst,ts]
return on investment for resource based stock [rst,ts]
return on investment [cis,ts]

GDP

return on investment

rate for commercial building
rate for vehicle based stock
rate for process based stock
rate for resource based stock

return on investment commercial building based stock

Consolidate Return on Investment (5)
Gross Domestic Product

labinc: labour income [ts,emct,ts]

capinc: return on investment [cis,ts]

implic price deflatc [ts]

population: total population [ts]

Gross Domestic Product Current Prices (1)

gross domestic product current [gdps,ts]

Gross Domestic Product Total Real Prices (2)

gross domestic product total real [ts]

Gross Domestic Product Per Capita (3)

gross domestic product per capita [ts]