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# CSIRO Energy Management & SKA

Energy Transformed Flagship

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National Research  
**FLAGSHIPS**

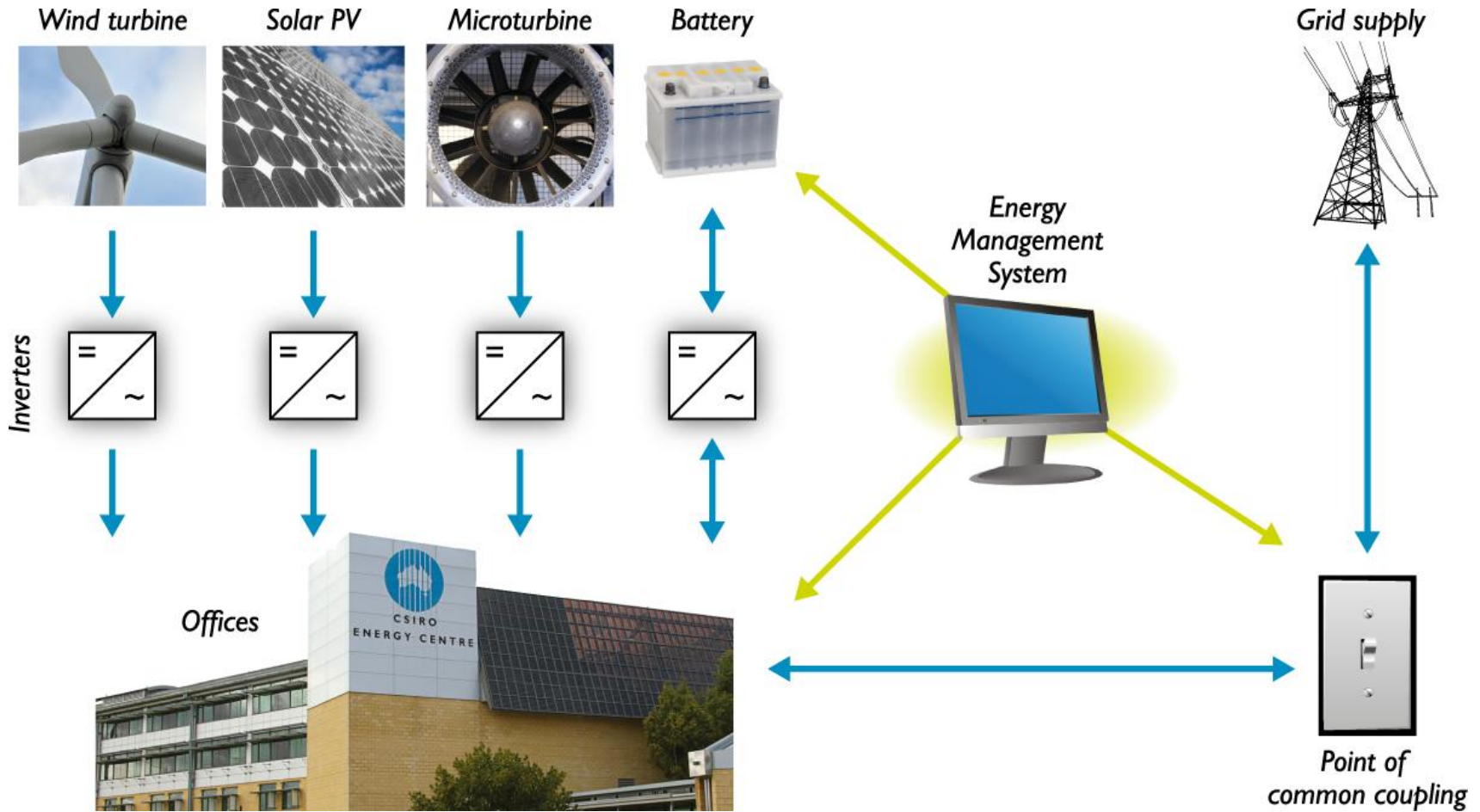


# The Traditional Approach

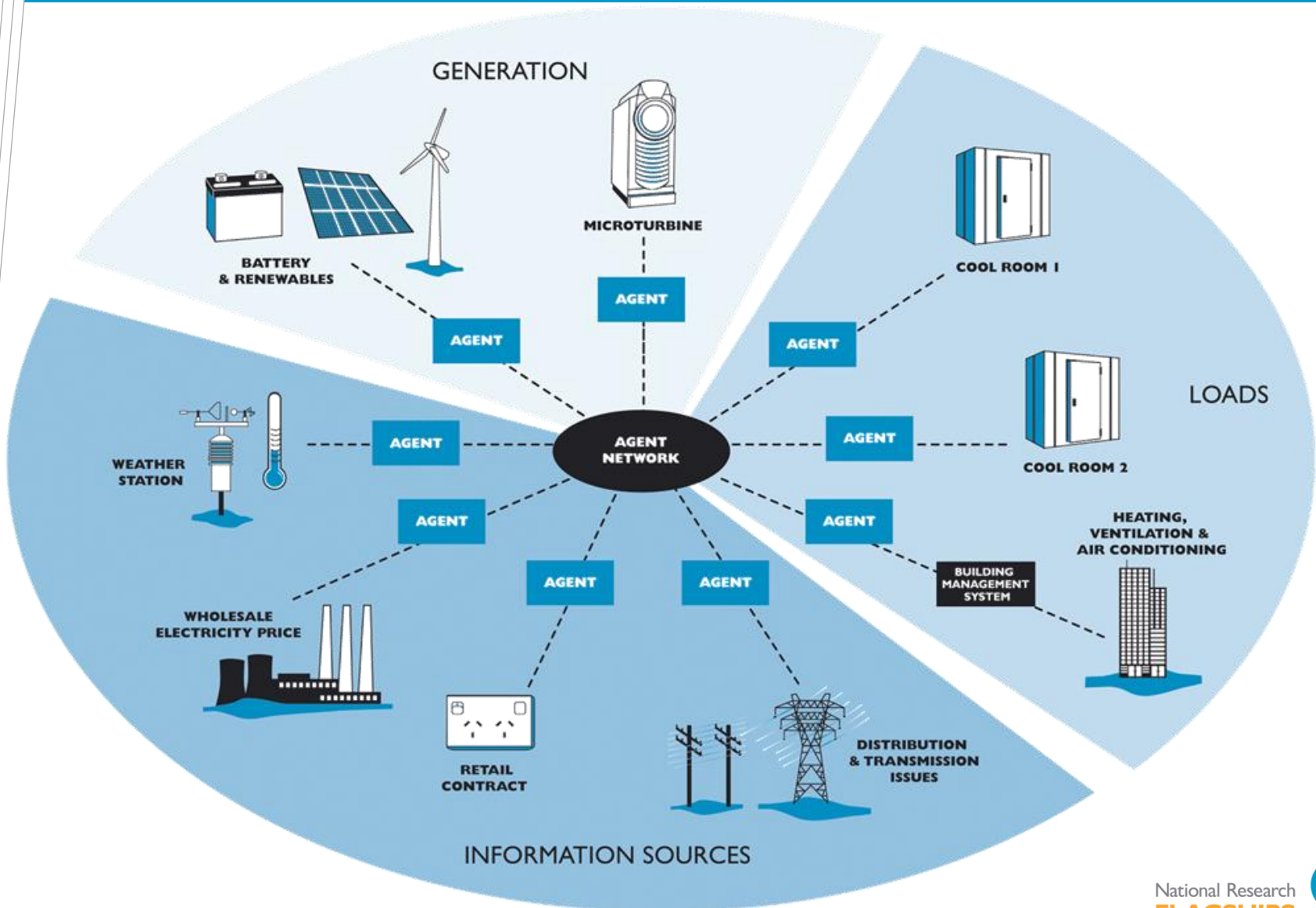
- Poor utilisation of assets
- No incentive for efficient operation
- Single point of failure
- Poorly matched to renewable generation characteristics



# An Integrated Approach



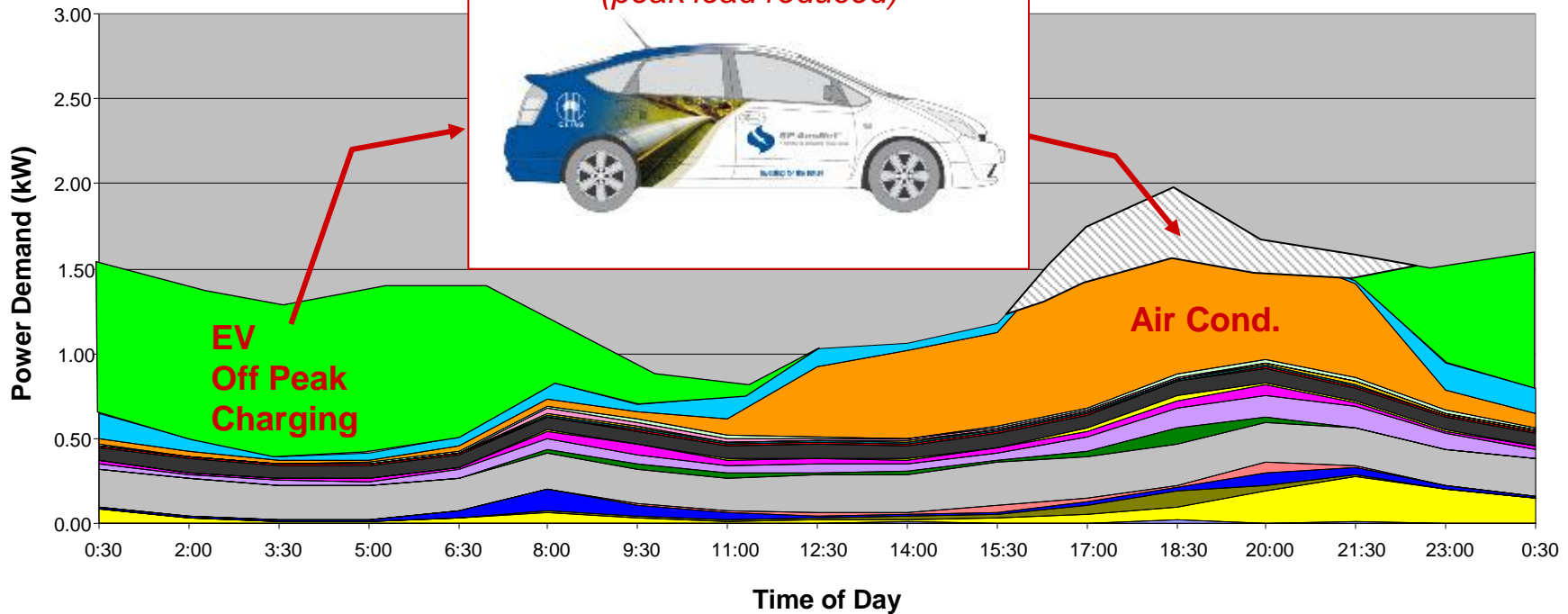
# Intelligent Controllers



# Energy Management

Thermal storage  
Computation task  
Mechanical load

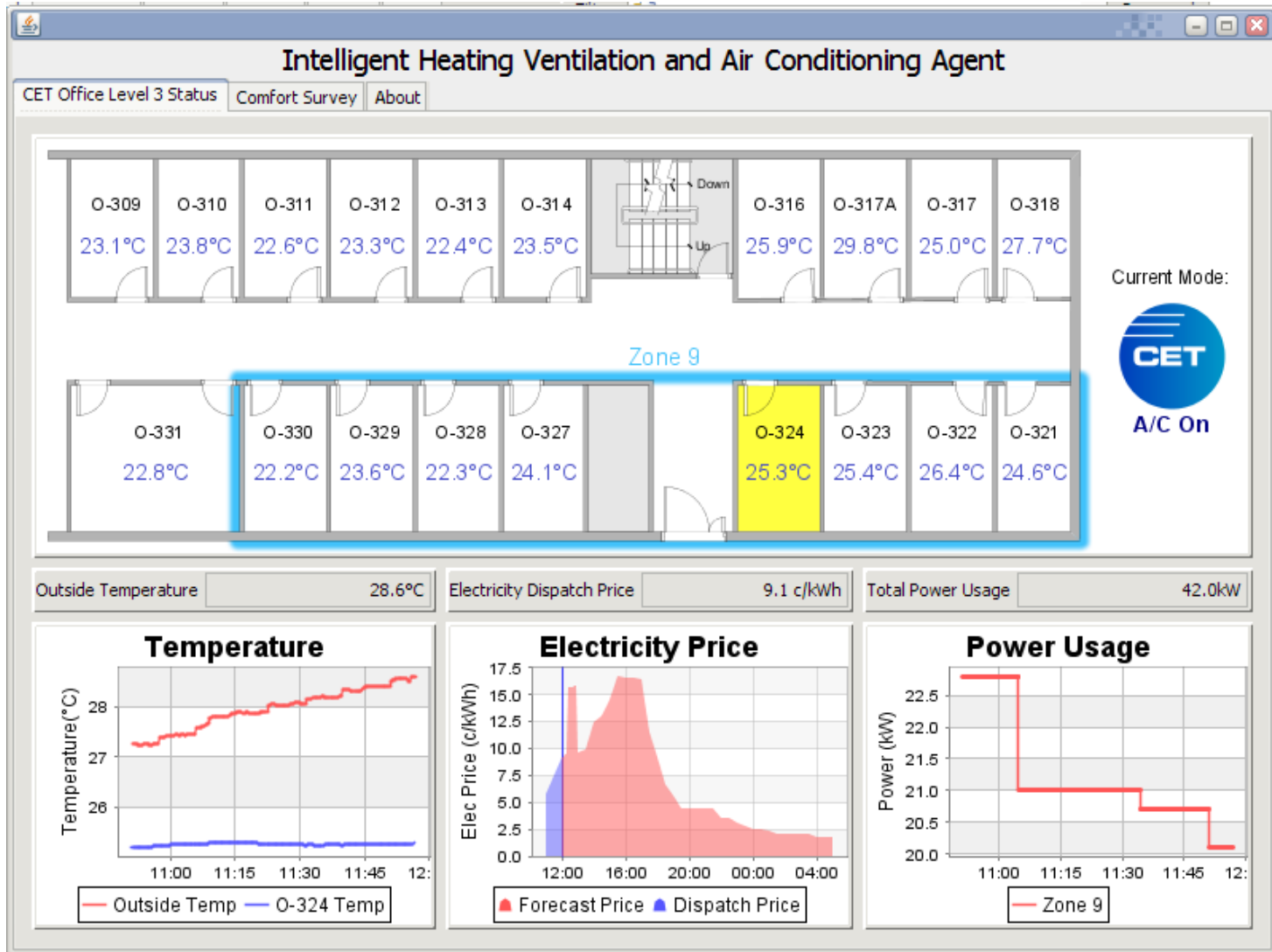
**Vehicle to House  
demand management  
(peak load reduced)**



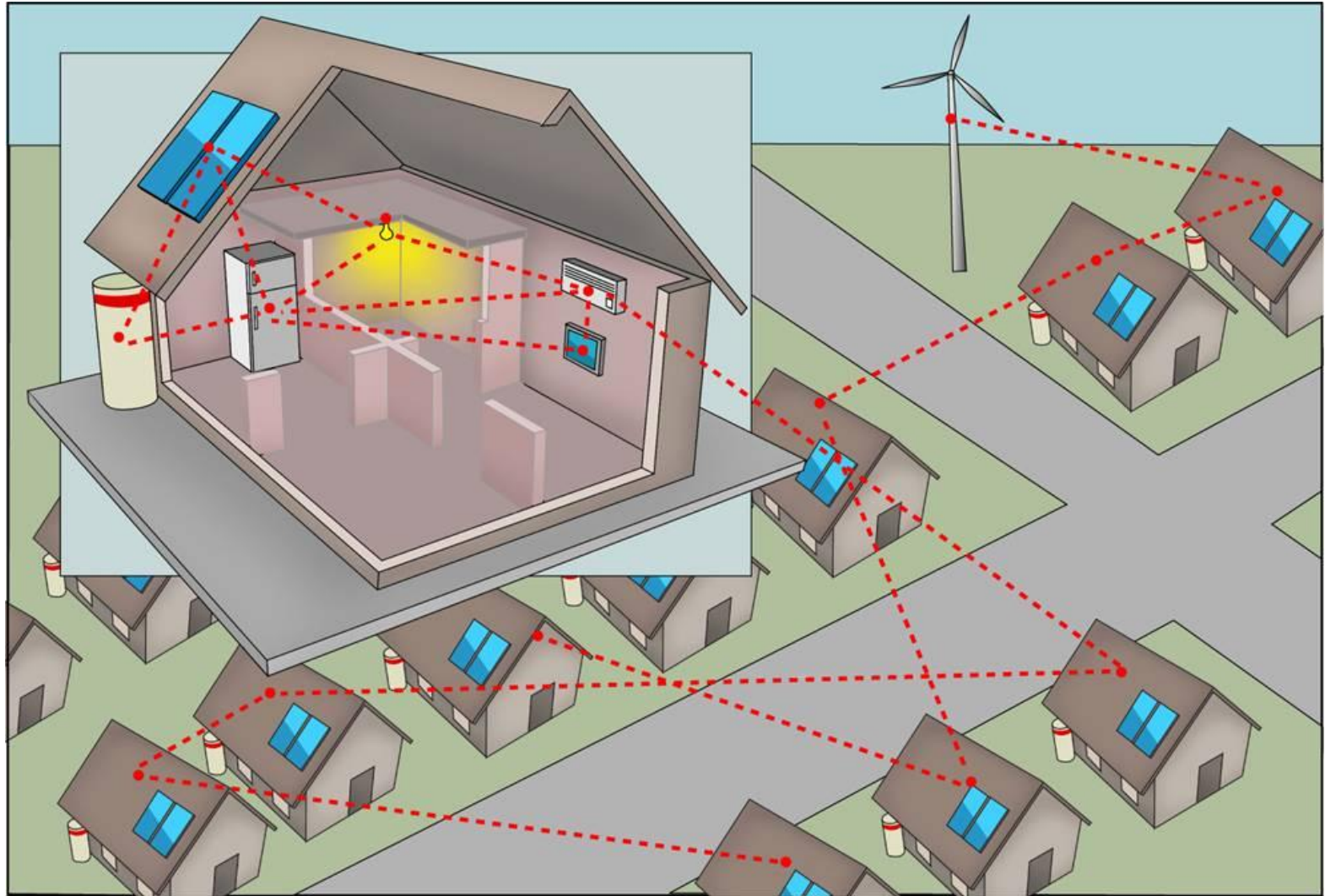
- |               |                  |                  |            |                 |
|---------------|------------------|------------------|------------|-----------------|
| Room heater   | Light            | Stove            | Peak WH    | Oven            |
| Refrigeration | Cooktop          | Video/TV         | Pool       | Microwave       |
| Freezer       | Water Bed        | Clothes Dryer    | Dishwasher | Washing Machine |
| Misc          | Air Conditioners | Off Peak 2 Water | PHEV       |                 |

Source: UTS Sustainable Futures

# Single-Site Energy Management



# Distributed Energy Management



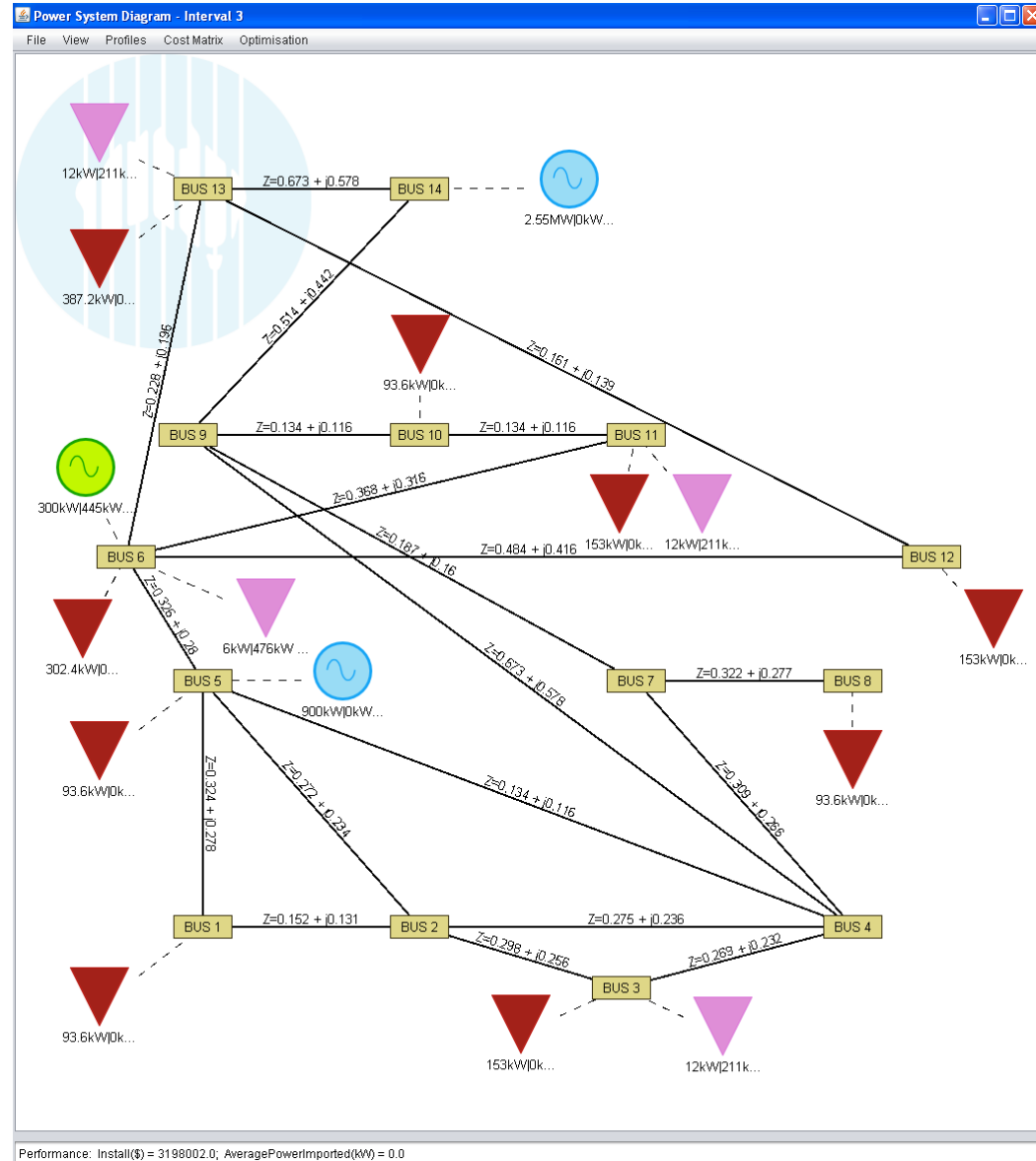
# Planning- what's optimal?

- **Issues:**

- What generation?
- Where?
- Batteries?
- Use of heat?

- **Optimisation:**

- Installation cost
- Maintenance cost
- CO<sub>2</sub> emission
- Electrical losses





# Design-a-microgrid

**NSGA-II Power System Optimisation**

Run Settings

Save Name	Population Size	Evaluations	Number of Runs
My_Test_Run.rcf	50	5000	1

Objectives Examined

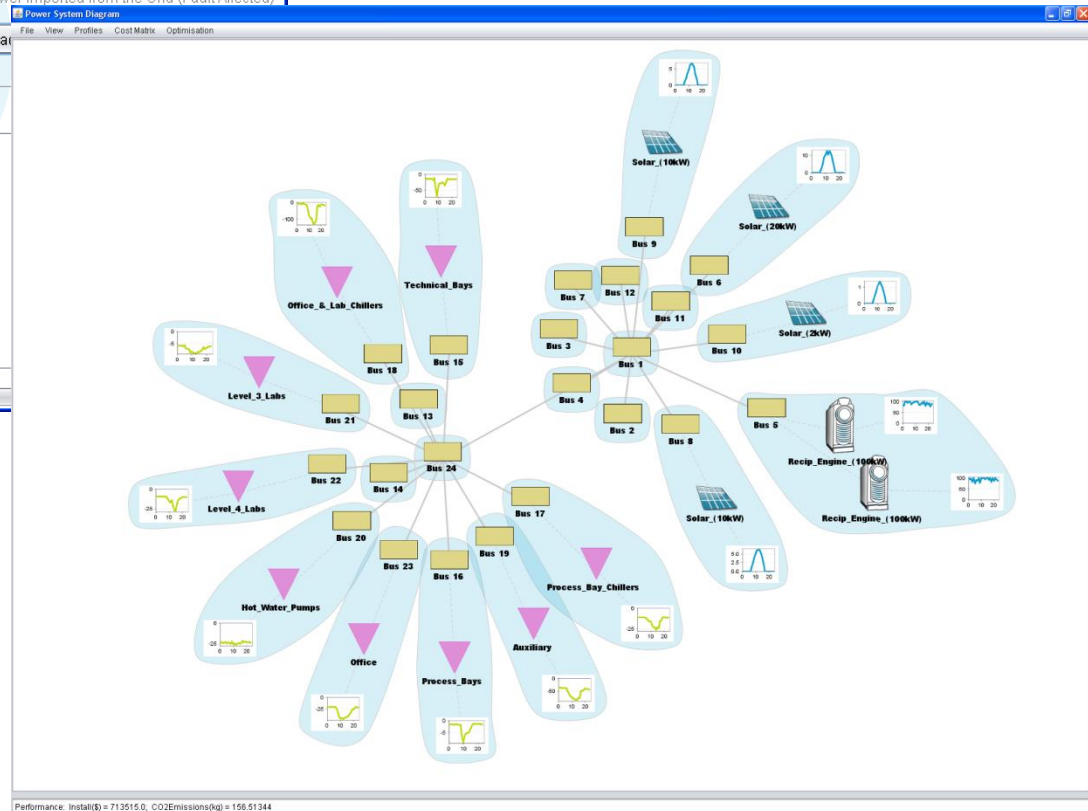
- Cost of Servicing Heat
- Installation Cost
- Power Imported from the Grid (Fault Free)
- Fuel Usage
- CO2 Emissions
- Combined Heat and Energy Costs
- EIR Total Load Reliability
- Total Load Loss in Island Mode
- Critical Load Loss in Island Mode
- Particulate Emissions
- EIR Critical Load Reliability
- DG Usage
- Redundancy
- Import Cost
- Line Loss
- Power Imported from the Grid (Fault Affected)

Run NSGA-II for Placement    Run NSGA-II for Placement

Run Output

Initialising Parent Population...  
 Generating Child Population...  
 Entering Main Execution Cycle...  
 Performed 150 evaluations  
     Current front size: 9  
 Performed 400 evaluations  
     Current front size: 83  
 Performed 650 evaluations  
     Current front size: 89

21 minutes



# Conclusion- Integrated Energy Management

Treat the telescopes, computation and power supply as a *system*..

- Better use of assets
- Dramatically improved reliability
- From 20% to 90% renewables
- Happening now in conventional networks

For the SKA:

- *Integrated* design
- Energy usage patterns? Earlier the better..
- What might be discretionary?
- Need a sophisticated design approach

*“It wasn't that long ago that microgrids were commonly thought of in the utility industry as negatives: They were supposedly unsafe. And worse, they were competition. But it looks like more utilities and other industry players see them as critical building blocks that will help ensure the efficiency and reliability of the Smart Grid.”*

- Are We Taking Microgrids Seriously — Finally? [www.smartgridnews.com](http://www.smartgridnews.com) Feb 18, 2010

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