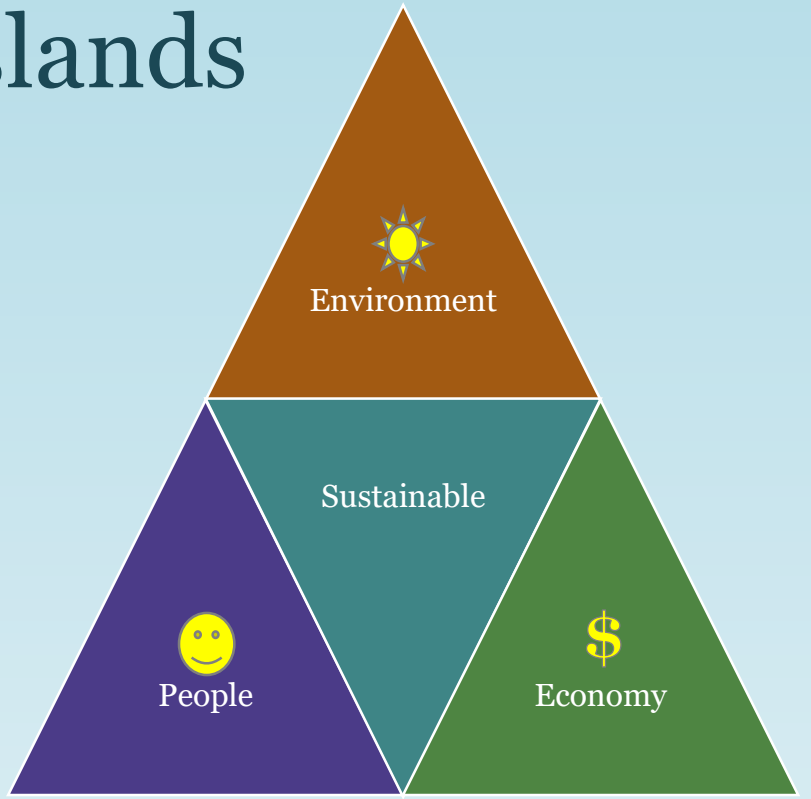
Modelling Renewable Energy for Islands

SUSTAINABLE ENERGY PLANNING, AALBORG UNIVERSITY

Hannah Marczinkowski

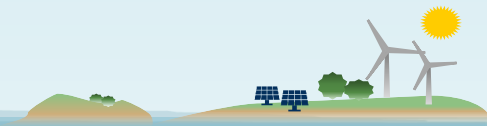
Sustainable Energy Planning for Islands

- **Sustainable** for environment, people and economically
- **Energy** for electricity, heat, industry and transport
- **Planning** through consideration of local oppotunities, limits and ideas
- **Islands** are especially effected by climate change and require support



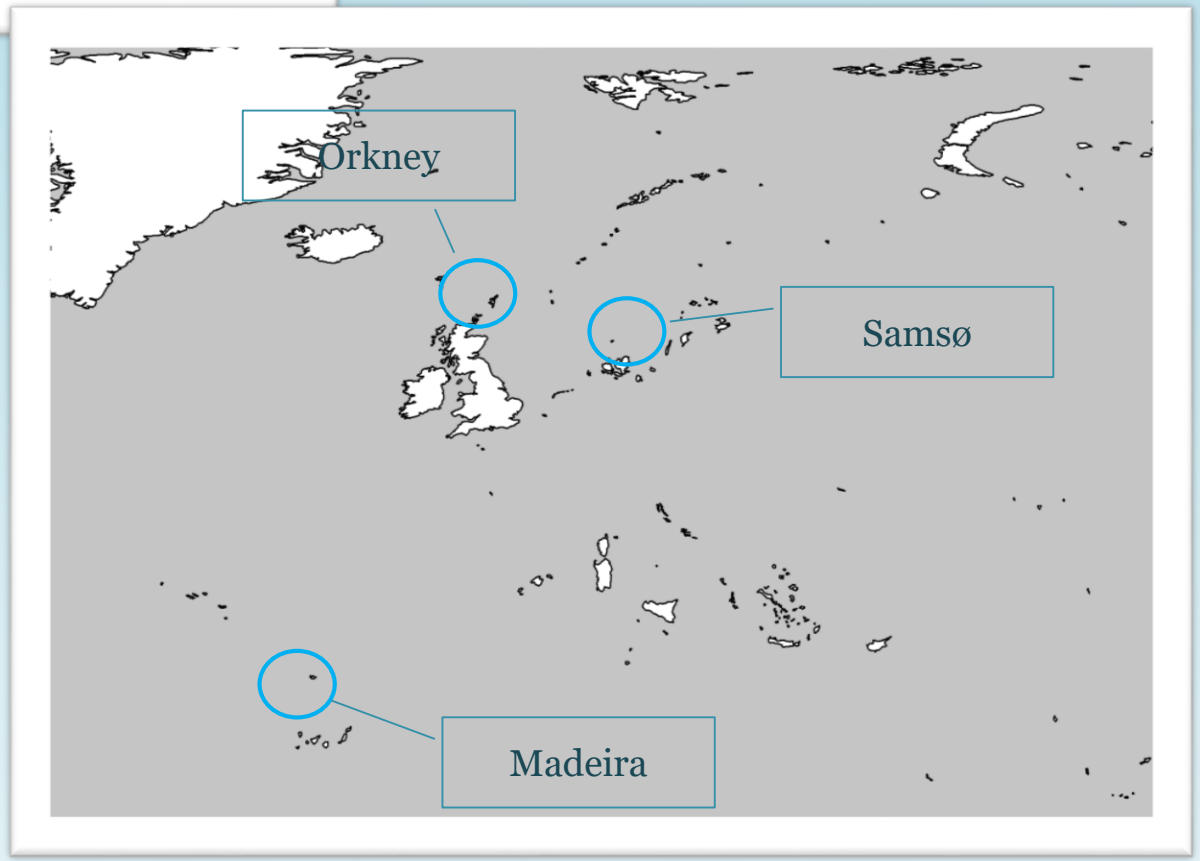
PhD Overview

- Small and/or secluded communities and islands
- Transition to sustainable, smart renewable energy systems
  - From challenges and opportunities
  - To strategies and recommendations
- Focus on Samsø, Orkney and Madeira (& explore further islands)
  - Test and integration of their energy systems
  - Observe and optimize electrification
  - Sustainable use of local resources
- Technical analyses and models of islands and their comparison
- Conclusions on Sustainable Energy Planning for Islands



Islands

- Remote
- Isolated
- Limited
- Complex
- Dependent
- Import
- Bottlenecks



- Potentials
- Weather
- Resources
- Dependency
- Small
- Test size
- Focus

How are the current situations, trends, challenges and opportunities for island energy systems?

How can the transition of islands towards smart renewable energy systems be assisted and replicated?

Specific Islands

- Three case studies/islands
  - SMILE
  - Visits, cooperation, discussion ongoing
- Technical scenario analyses
  - Energyplan
  - Reference and future scenarios
- Comparison and study of further islands and experiences
  - Germany, Greece, Spain, …

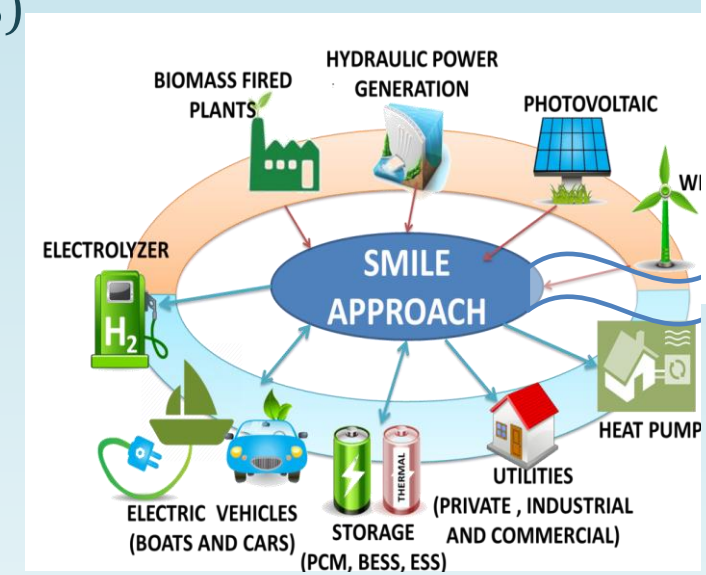
Island	Size	Population	RE share
Samsø, DK	114 km²	3,700	60%
Orkney islands, UK	975 km²	22,000	18%
Madeira, PT	741 km²	250,000	31%
Germany			
Föhr	82 km²	8,600	
Pellworm	37 km²	1,100	
Helgoland	4 km²	1,200	
Greece			?
?			
Spain			
?			

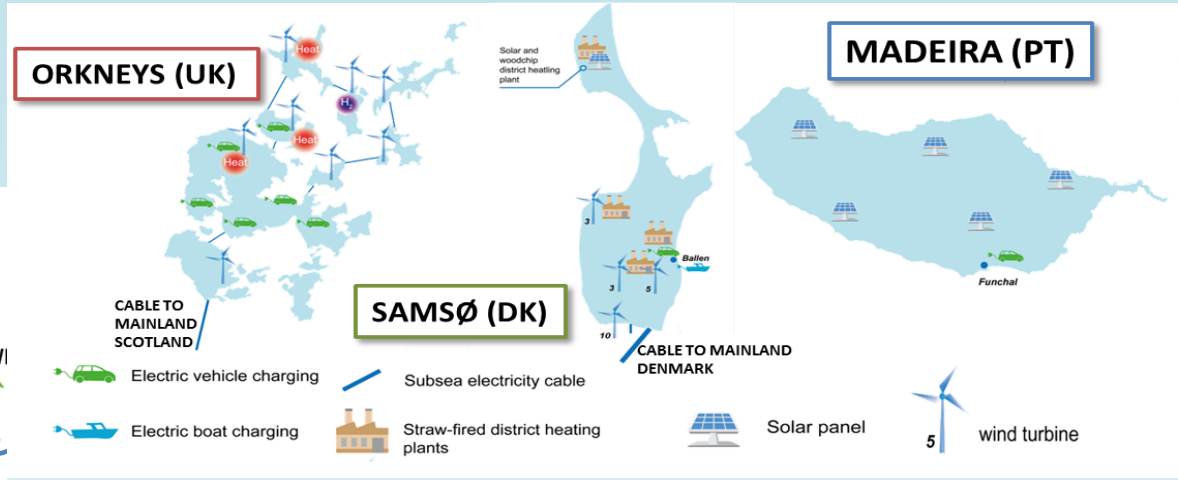




H2020 SMILE Project Involvement

- SMart IsLand Energy systems (SMILE Grant Agreement 731249)
- May 2017 – April 2021
- www.h2020smile.eu
- (Work package 8)





Aim

- Improve conditions, sustainable development
- Overcome challenges and barriers
- Coordination and cooperation of several islands
- Technical, market and policy evaluation
- Suggestions, strategies, guidelines
- = Understand and support transition towards 100% renewable energy systems

Specific research so far…

H2020-LCE-2016-2017

EUROPEAN COMMISSION

Innovation and Networks Executive

Grant agreement no. 731249

Smart Island Energy Sy

Deliverable D8.1

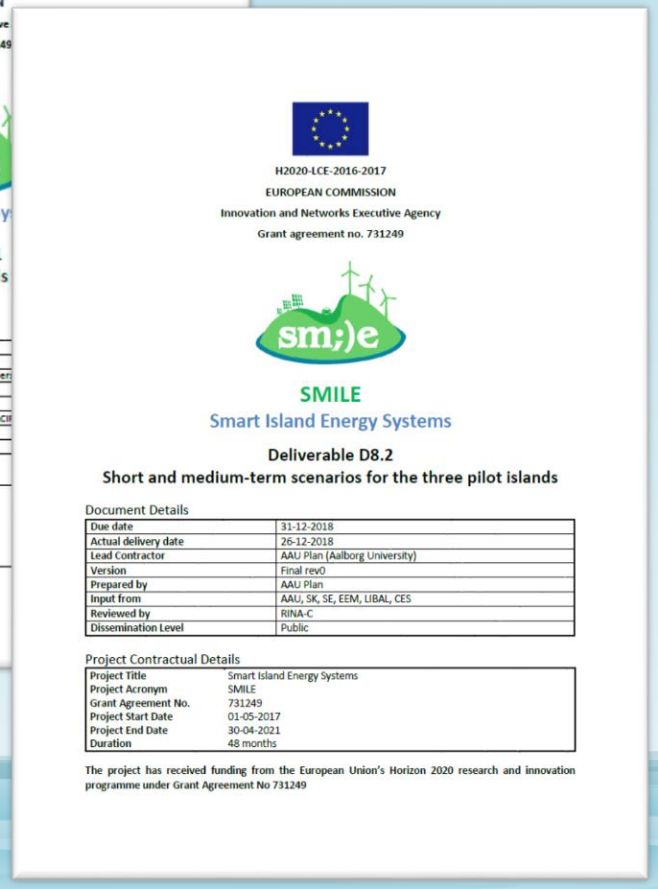
Reference energy simulation models islands

Document Details

Due date	31-01-2018
Actual delivery date	30-01-2018
Lead Contractor	AAU Plan (Aalborg Univer
Version	Final rev0
Prepared by	AAU Plan
Input from	AAU, SK, SE, SEL, CES, ACH
Reviewed by	RINA-C
Dissemination Level	Public

Project Contractual Details

Project Title	Smart Island Energy Systems
Project Acronym	SMILE
Grant Agreement No.	731249
Project Start Date	01-05-2017
Project End Date	30-04-2021
Duration	48 months



H2020-LCE-2016-2017

EUROPEAN COMMISSION

Innovation and Networks Executive Agency

Grant agreement no. 731249

SMILE

Smart Island Energy Systems

Deliverable D8.2

Short and medium-term scenarios for the three pilot islands

Document Details

Due date	31-12-2018
Actual delivery date	26-12-2018
Lead Contractor	AAU Plan (Aalborg University)
Version	Final rev0
Prepared by	AAU Plan
Input from	AAU, SK, SE, EEM, LIBAL, CES
Reviewed by	RINA-C
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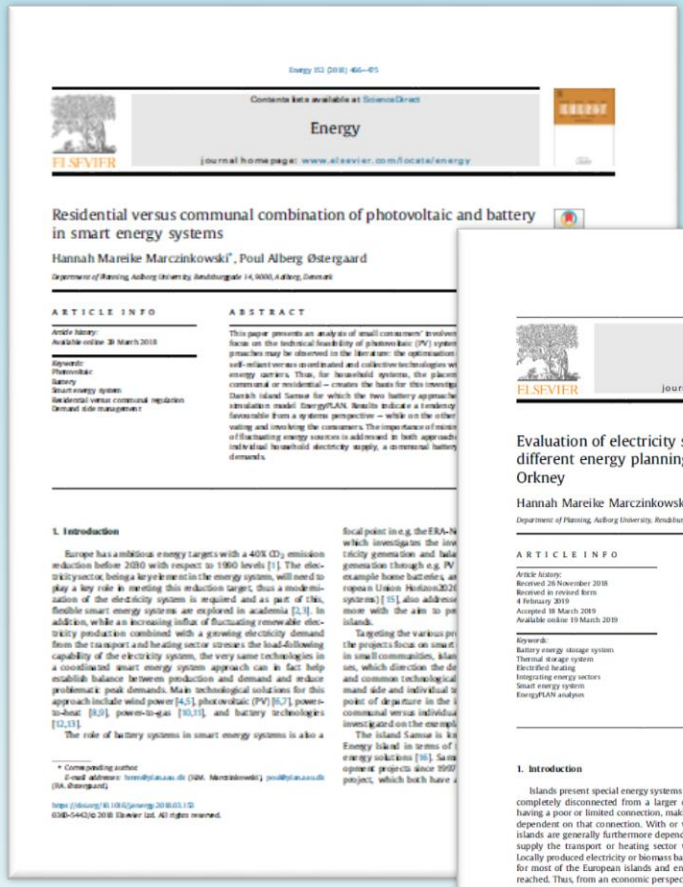
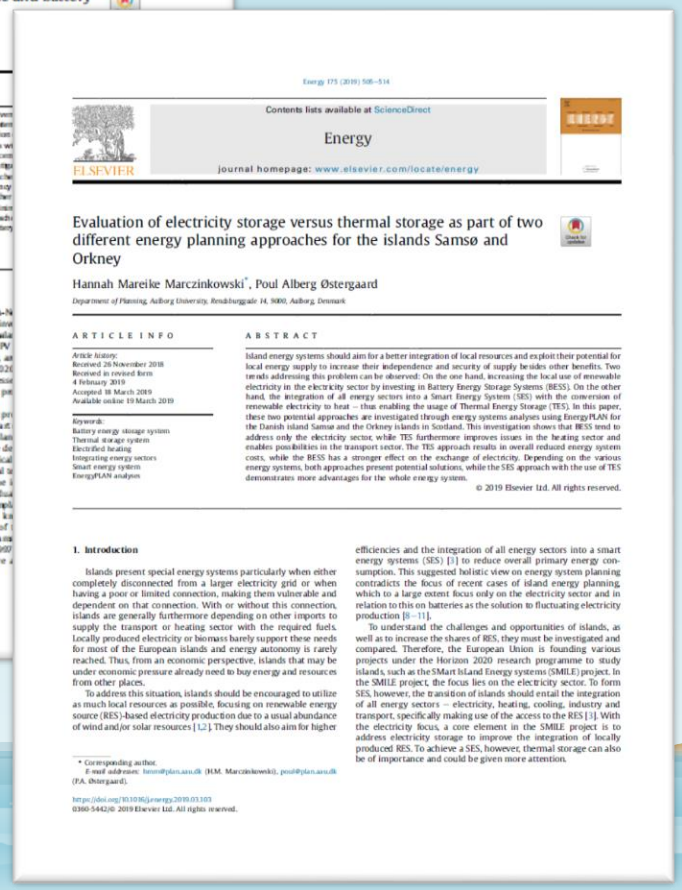


Energy

Residential versus communal combination of photovoltaic and battery in smart energy systems

Hannah Mareike Marczinkowski*, Poul Alberg Østergaard



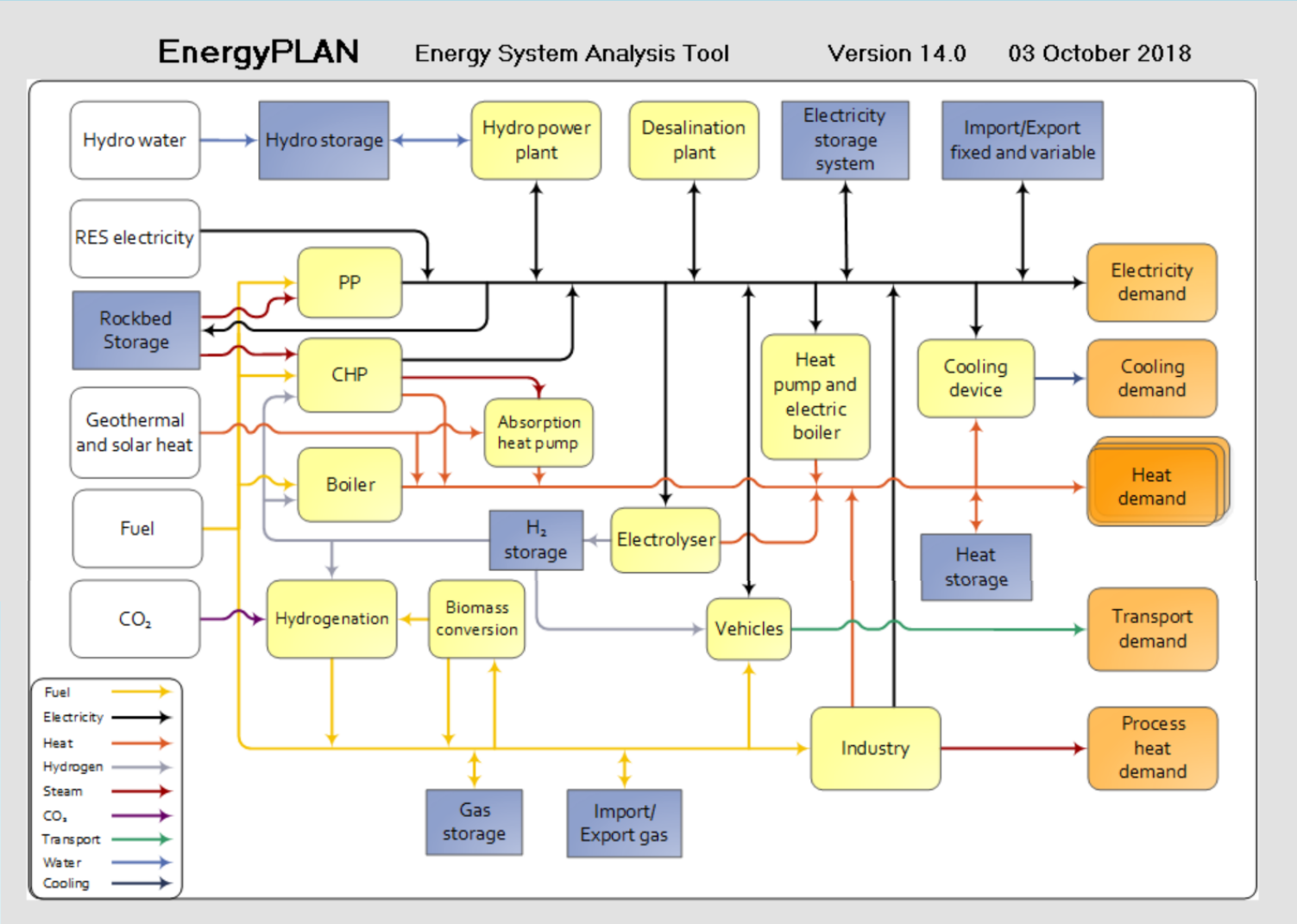
Energy

Evaluation of electricity storage versus thermal storage as part of two different energy planning approaches for the islands Samsø and Orkney

Hannah Mareike Marczinkowski*, Poul Alberg Østergaard

Research done:

- https://www.energyplan.eu/
- Energy system analysis
- Hourly for one year
- Holistic, aggregated, technical



Energy PLAN

Advanced energy system analysis computer model

Specific research so far

… on the RE transition (today & future) of Samsø, Orkney and Madeira


Smart Island Energy Systems

Deliverable D8.1

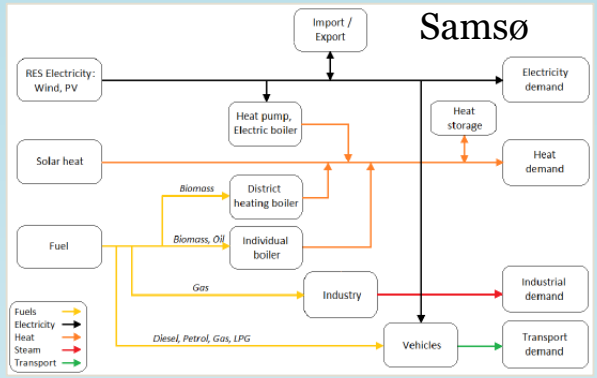
Reference energy simulation models for the three pilot islands

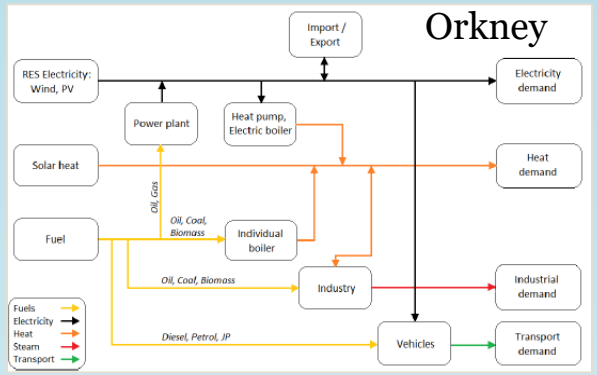

SMILE

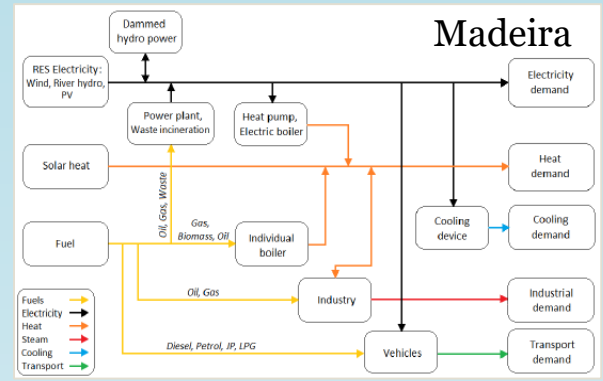
Smart Island Energy Systems

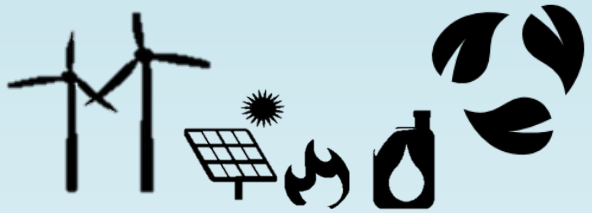
Deliverable D8.2

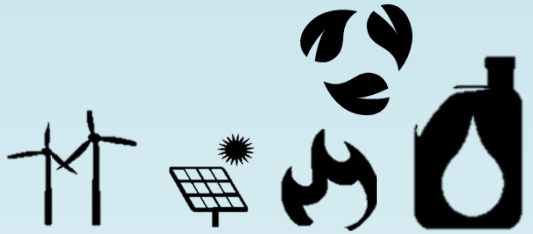
Short and medium-term scenarios for the three pilot islands

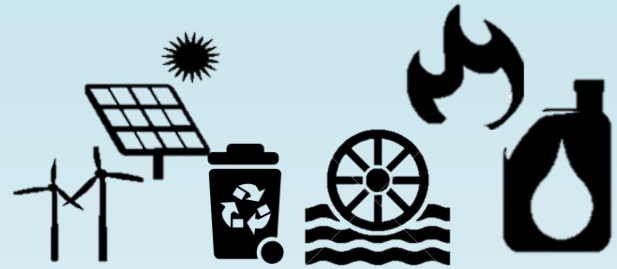


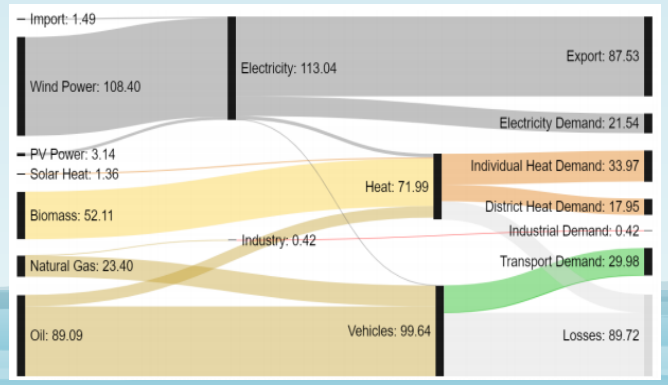


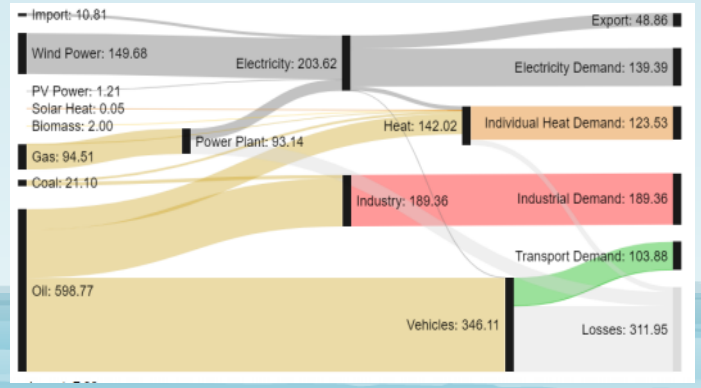


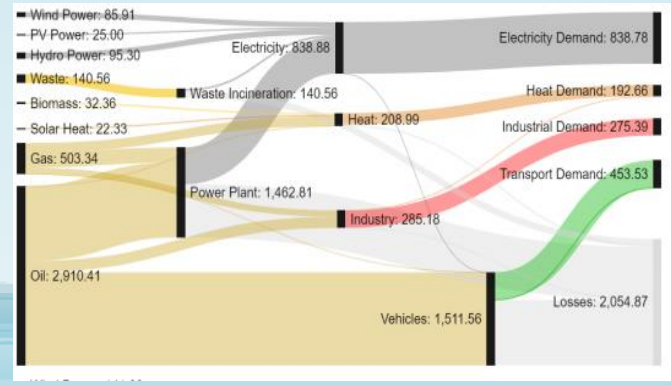








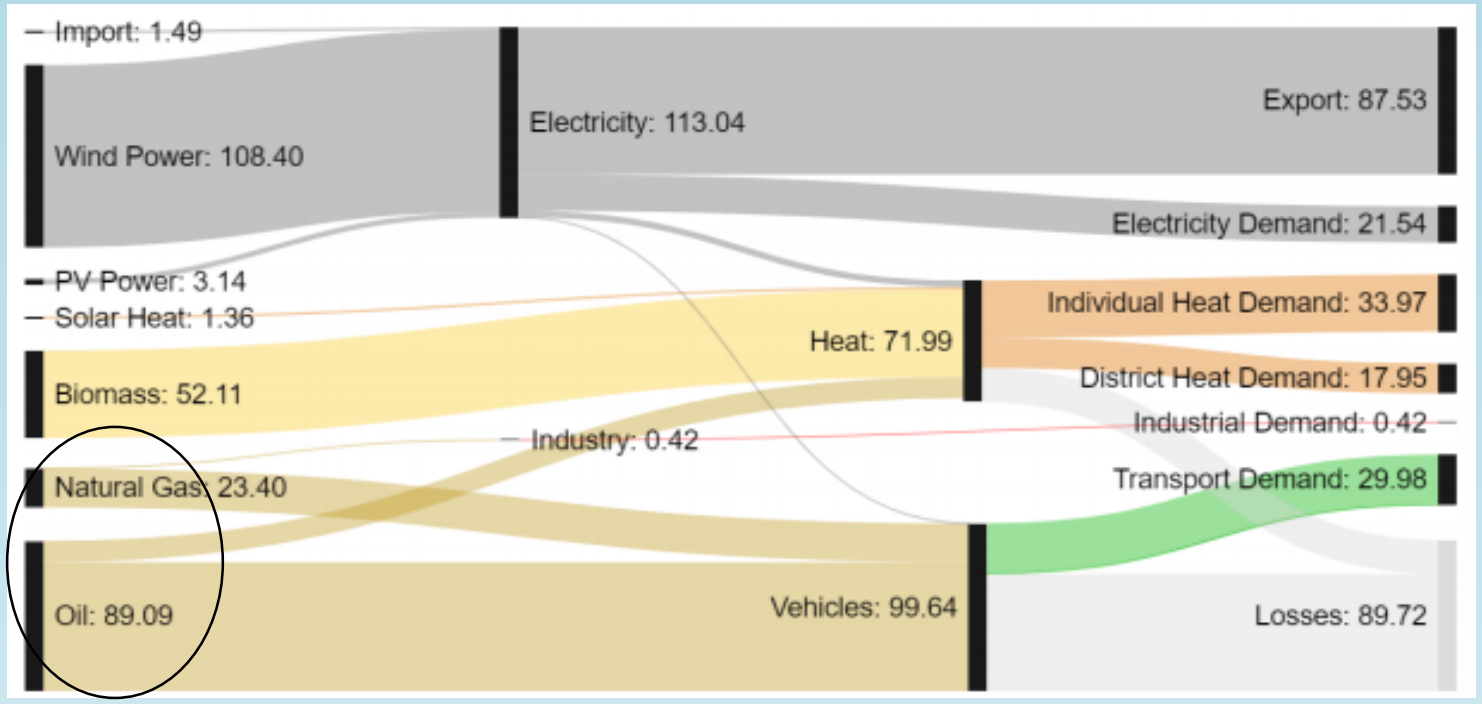




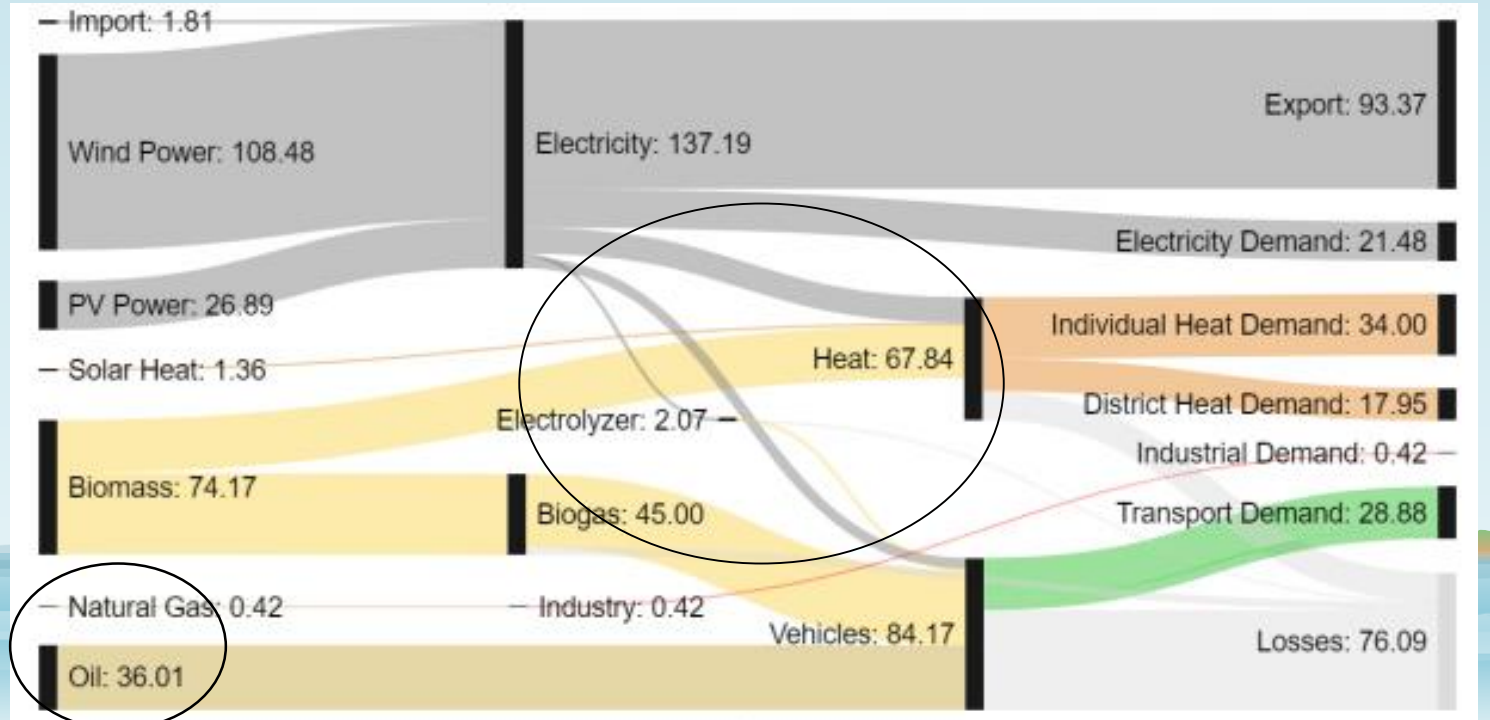
… the RE transition:

Samsø

2015 &



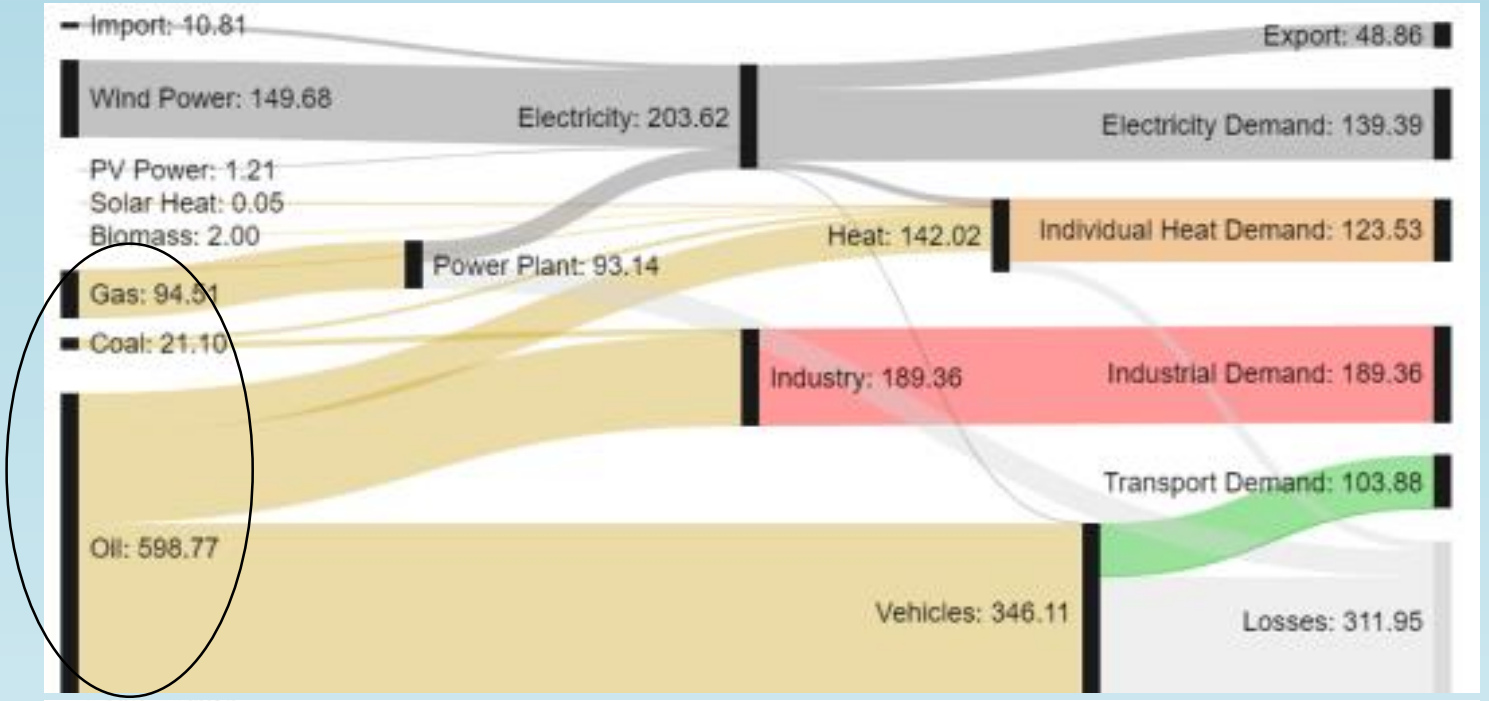
2030?



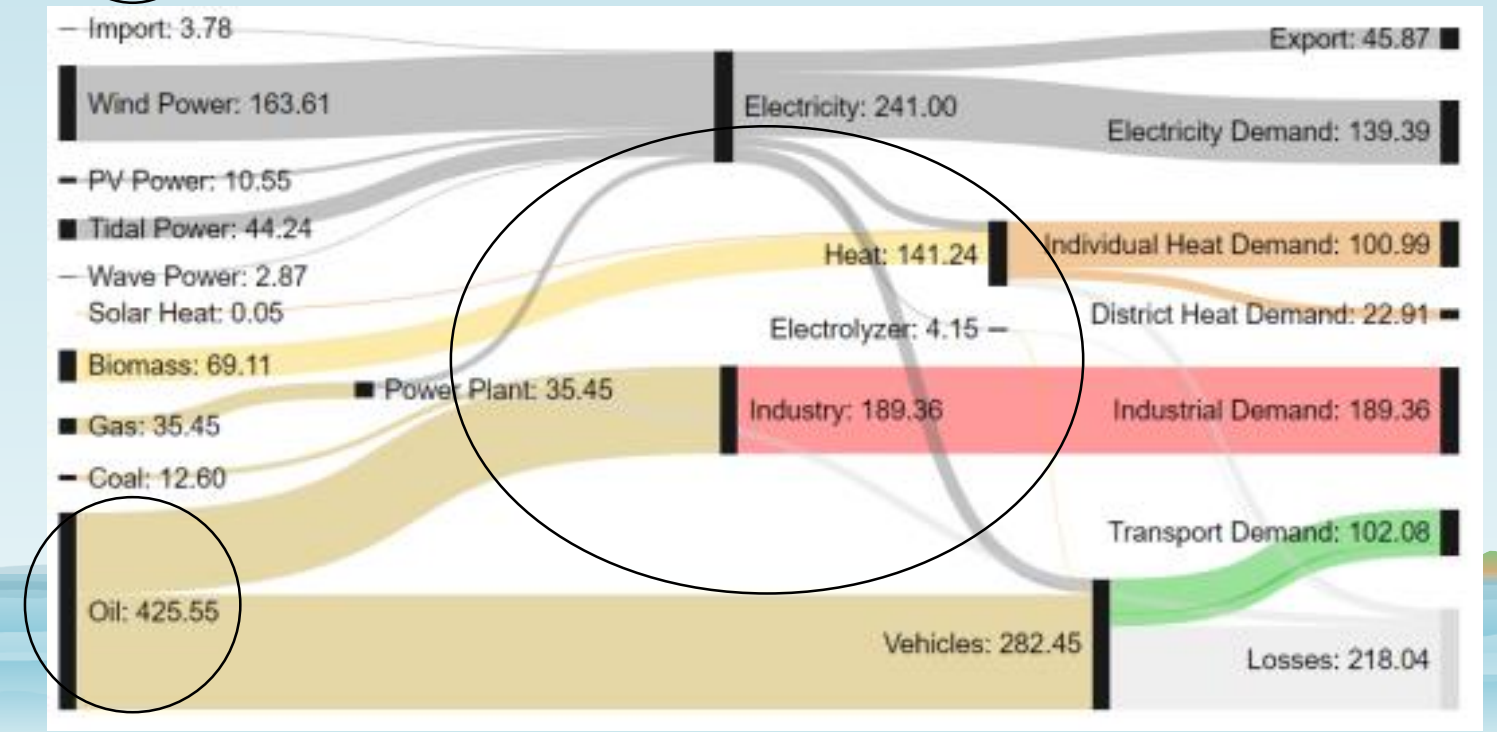
… the RE transition:

Orkney

2015 &



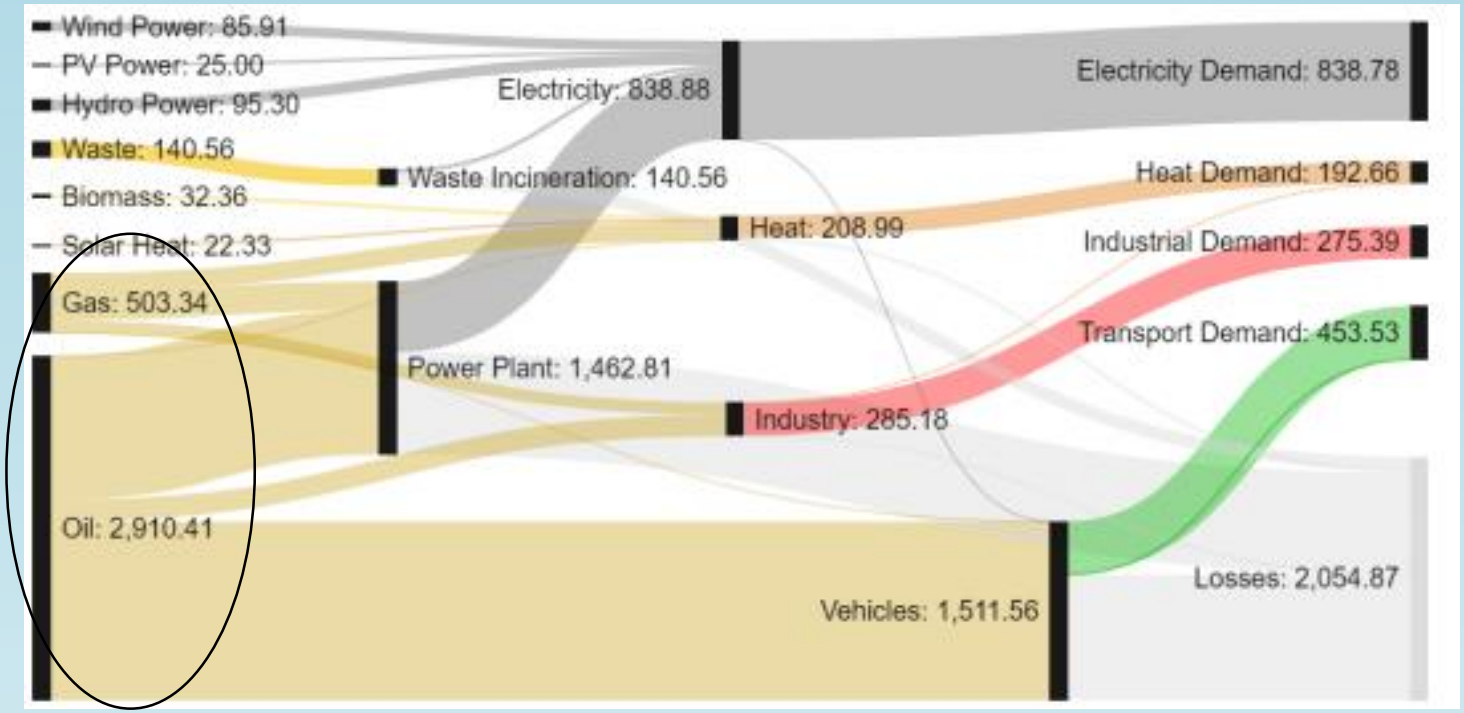
2030?



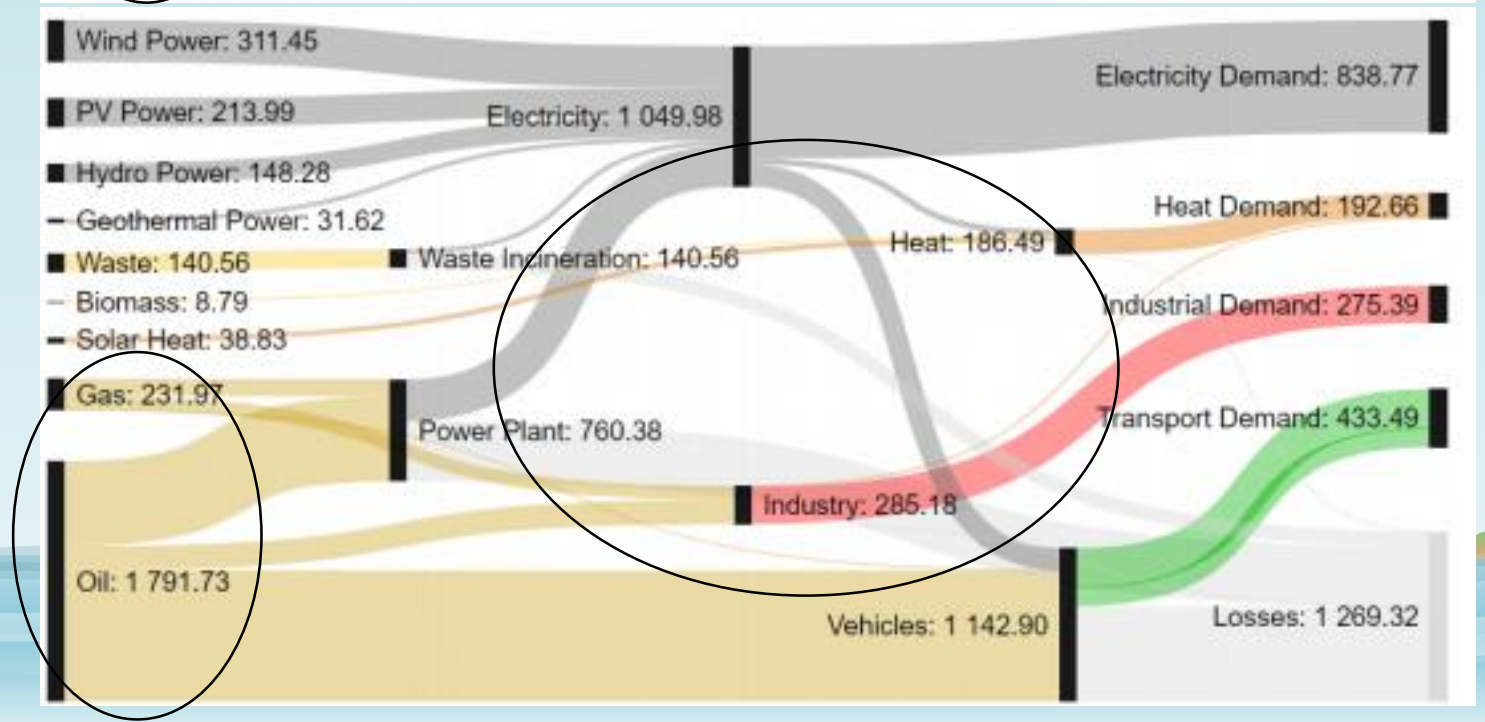
… the RE transition:

Madeira

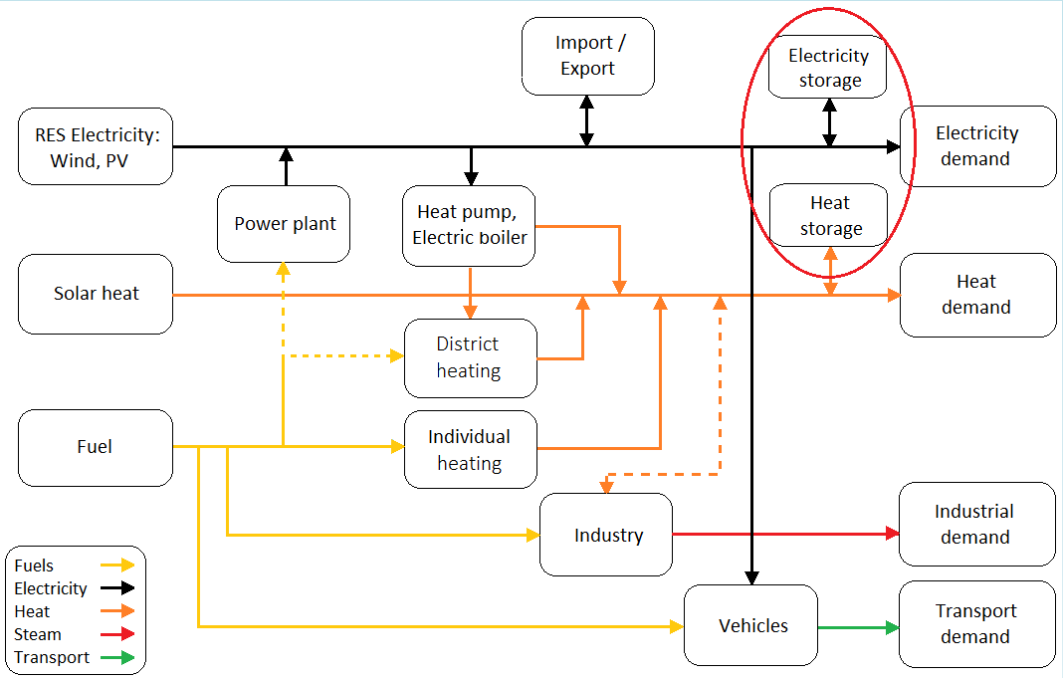
2015 &



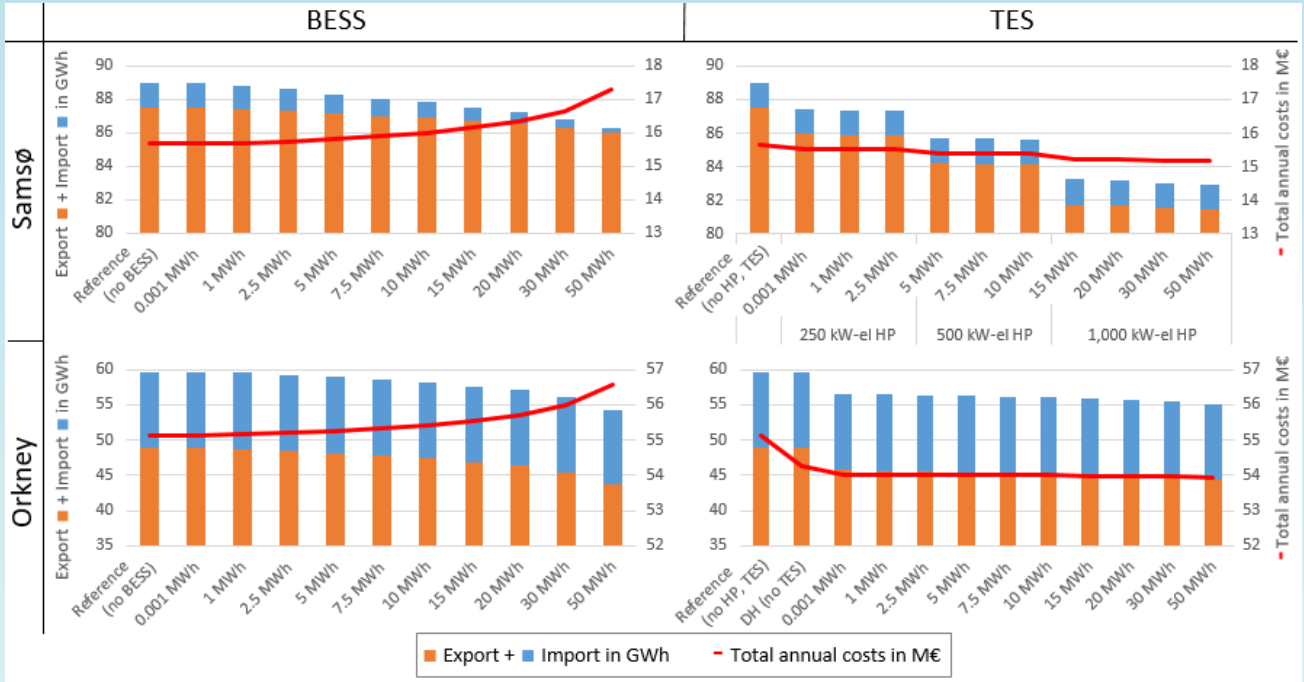
2030?



Specific research so far
… on storages on Samsø and Orkney



Battery Electricity (BESS) vs. Thermal Energy Storage (TES)



Dissemination

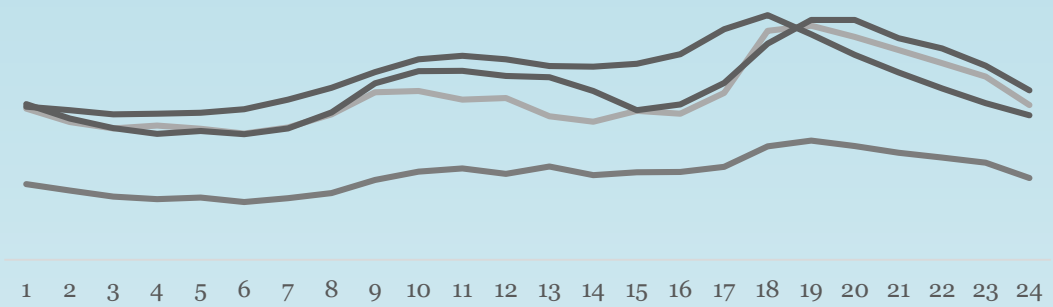
- SDEWES conferences 2017, 2018 (2019 invitation to special session on smart islands)
  - http://www.sdewes.org/
- AAU conference on 4GDH and Smart Energy Systems
  - https://smartenergysystems.eu/
- Green Island Conference Germany
  - http://greenicon.de/
- International Hybrid Power Systems workshop
  - http://hybridpowersystems.org/

Towards a sustainable future for islands

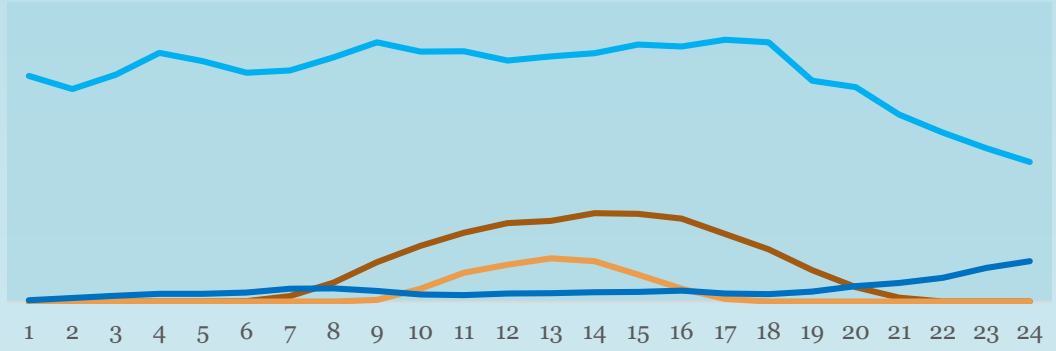
- Study and compare more islands
- Evaluate trends and solutions
  - Marine Energy!?
- Assess energy markets and policies
- Analyse, consult and guide interested people
- Listen, learn and repeat
- Ask questions

Towards a sustainable future for islands: electricity

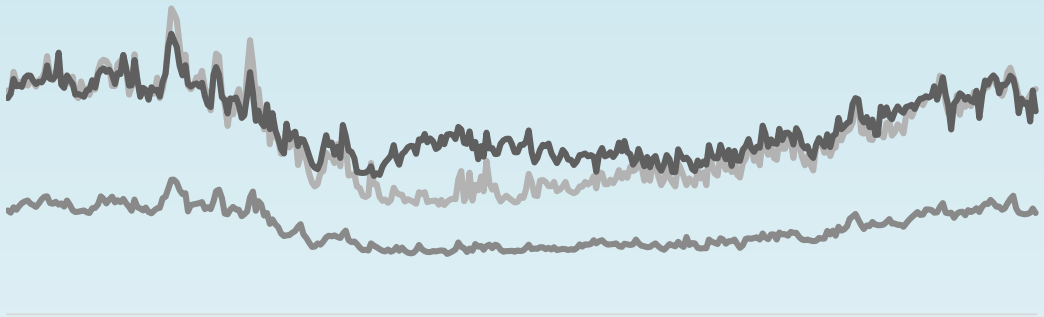
Electricity demand 24 hours



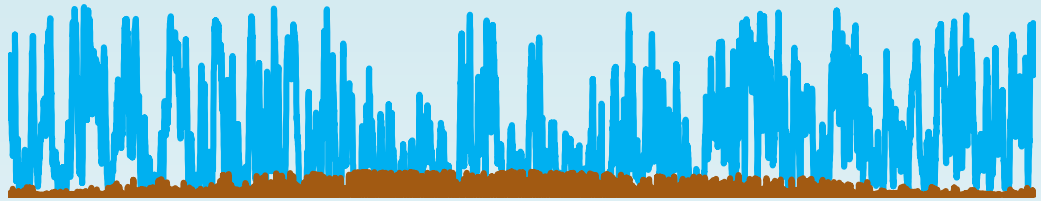
Electricity production 24 hours (wind and solar)



Electricity demand 365 days



Electricity production 365 days (wind and solar



Towards a sustainable future for islands: heating

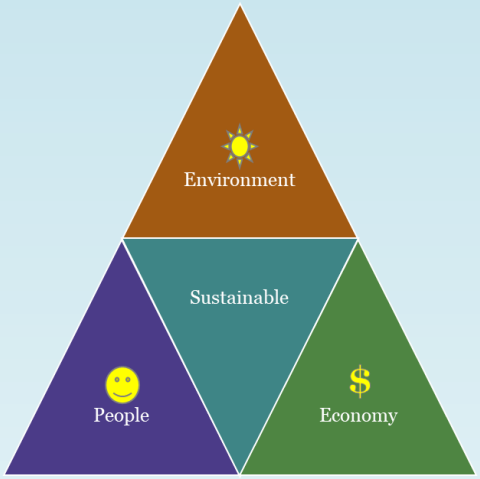
- Demand reductions, efficiency increase, insulation, etc.
- District heating
- https://heatroadmap.eu/peta4/
- Solar heat
- Heat pumps
- …

Towards a sustainable future for islands: transport

- Reductions
- Electric vehicles
- Biofuels
- …

Sustainable Energy Planning for Islands

- Combining/Coupling electricity, heating, industry and transport
- Education and information
- Step by step suggestions to solutions
- Support, participation (both ways)
- Sustainable



Thank you for listening!

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