



CIRCIE 2019

Challenges for the Islands in the era of the Circular Economy



Turn waste to resource through local supply chains of UCO to biodiesel. *The COMPOSE model towards positive energy communities*

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SMile 2019

6th Sustainable Mobility & Intelligent Transport conference





Biofuels for the EU's transport sector GHGs emissions reduction

- Renewable alternative fuels in the EU's transport sector (biodiesel & bioethanol), for the reduction of GH emissions & improvement of the EU's supply security:
 - ✓ By 2020, EU aims to 10% of the transport fuel of every EU country from RE, such as biofuels, (*Renewable Energy Directive 2009/28/EC*); aim for 2030 set up to at least 14% (*Political Agreement, 2018*)
 - ✓ Fuel suppliers are required to reduce the greenhouse gas intensity of the EU fuel mix by 6% by 2020 in comparison to 2010 (*Fuel Quality Directive 2009/30/EC*)



Biofuels for the EU's transport sector / Ethical Dilemma



➤ Food Security

«.....Yellow corn was used as a biofuel feedstock in the USA and animal feed in Mexico. Mexican government previously was importing yellow corn from the USA. But, as the US had a sudden increase in the bioethanol sector it had to decrease export. As a result, the Mexican government had to implement subsidies on white corn for tortilla to handle the situation (Nuffield Council on Bioethics, 2011)»



Source: Frits Ahlefeldt



UCO disposal and environmental concerns

- UCOs: oils & fats from food industry, restaurants & households (European Waste Catalogue - [code 20 01 25](#))

Most commonly met practice households' UCOs: throw it in the [sewage system](#)

- clogging of the sewage system;
- malfunctions in the filters & oil / water separators;
- increase wastewater treatment cost

Recycling UCO to biodiesel can be a sustainable alternative for the exploitation of [a problematic waste](#)

It does not compete other [edible feedstock](#) & it does not produce [land use change effects](#)





UCO to biodiesel in Rethymno Municipality

Aim: increase UCO recycling rate & enhance safe disposal by expanding & optimising the collection network with web-based monitoring





UCO collection best practices in EU

>40 different systems were studied;
 different types have been used in other EU countries





EU experience* in UCO household collection

Success factors:

- motivation of citizens through setting up a “citizens’ friendly” scheme
- focus on citizens’ awareness with regular, targeted activities
- support from local stakeholders

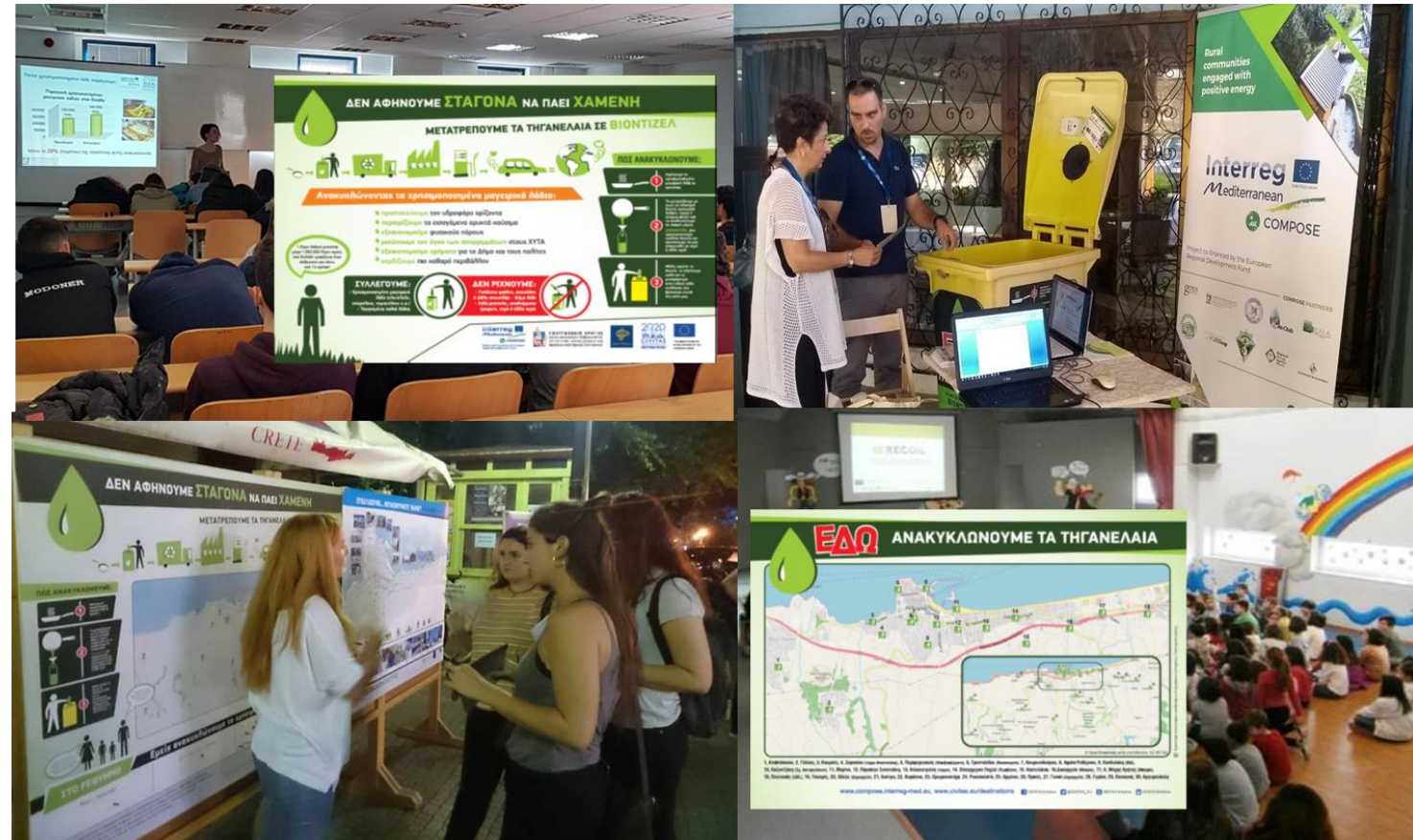
System	Advantages	Disadvantages
Door-to-door collection	<ul style="list-style-type: none"> • UCO collector direct contact with citizens; Potential to deliver biodiesel to consumers 	<ul style="list-style-type: none"> • Expensive & time-consuming collection process • Difficult to define a rewarding benefit
Public collection points	<ul style="list-style-type: none"> • Lower logistics costs • Citizens become more familiarized & motivated 	<ul style="list-style-type: none"> • No direct control over the quality • Risk of UCO theft events • Limited hygiene of bins; linked to spills

**RecOil Project - Promotion of used cooking oil recycling for sustainable biodiesel production*



UCO recovery potential in the Rethymno Municipality

- UCO potential from households estimated > 120 m³/year
- Can be increased through awareness campaigns & recycling rewards schemes





UCO 'public collection points system' considerations

- **Problems of UCO theft**, due to rising UCO price
- **Large variations** in the UCO produced per household:
 - ✓ Difficulty for the UCO collector to predict the fill level of the UCO bins
 - ✓ UCO collection routes are in most cases predefined regardless the fill level of the UCO bins
- Risk of **UCO contamination** with other kind of substances, especially when collected in bulk



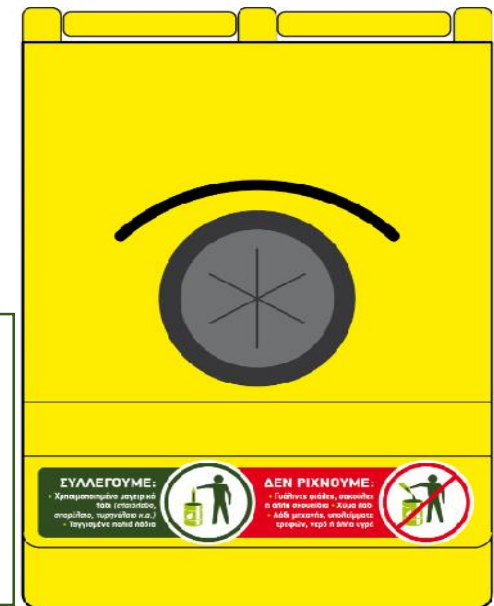
Smart UCO collection system – recycling

RECYCLING TIPS



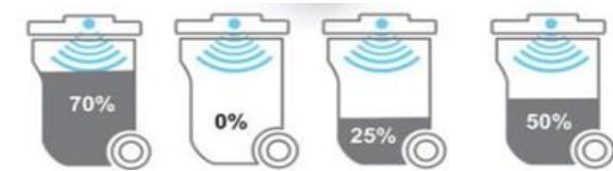
Bottled UCO vs bulk collection → minimize:

- ✓ risk of contamination with other wastes
- ✓ aesthetic degradation of bin & surroundings





Smart UCO collection system – smart sensors



Data recorded by the
sensors are
transferred wirelessly
through GSM, in real
time

A software application allows:

- ✓ Monitoring of a bin's fill level 0 - 100%
- ✓ Tracking its location in the city (GPS) with 2.5 m accuracy

Alert message:

- ✓ when moving the bin
- ✓ to selected fill rate
- ✓ for unexpectedly temperature raise





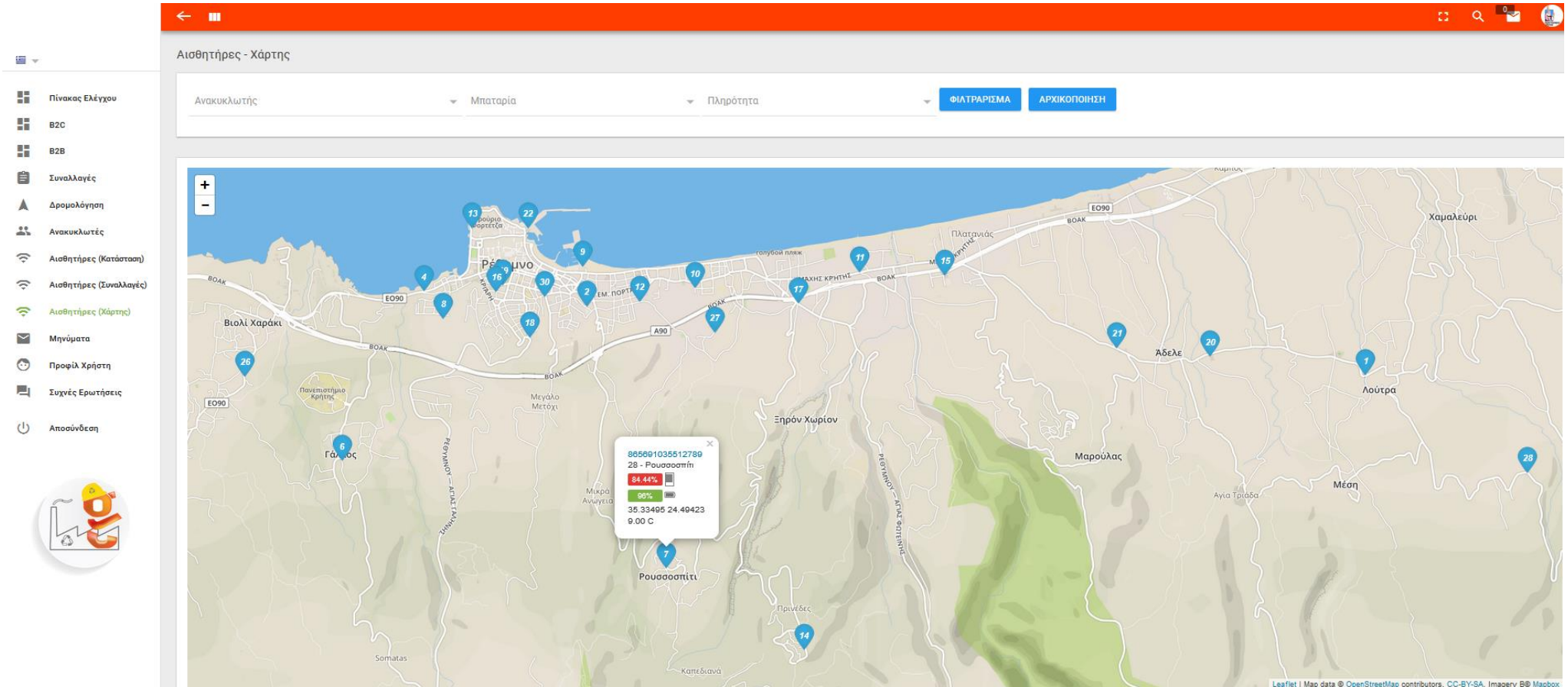
UCO bins siting optimization criteria

- ✓ **locations easily accessible to a large number of citizens**
- ✓ neighbourhoods where families **with kids** live
- ✓ close **to other waste** bins
- ✓ in adequately illuminated roads
- ✓ **in spaces that will not cause problems to**
- ✓ locations that will **not hinder citizens walking** or **vehicles' circulation**
- ✓ **at locations easily accessed by UCO collector's vehicle**





Smart UCO bins locations monitored through the web platform



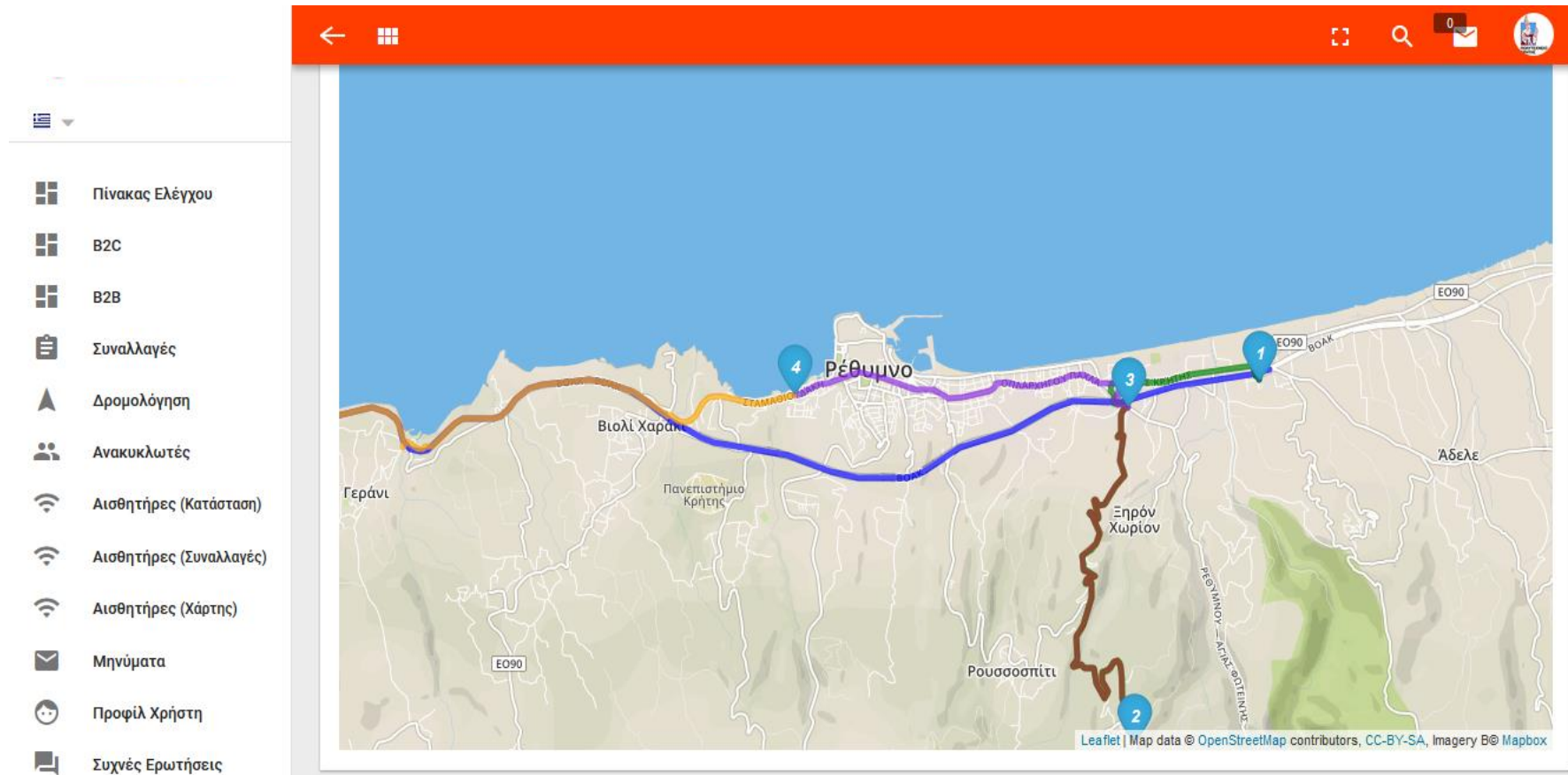


Smart UCO bins monitored through the web platform

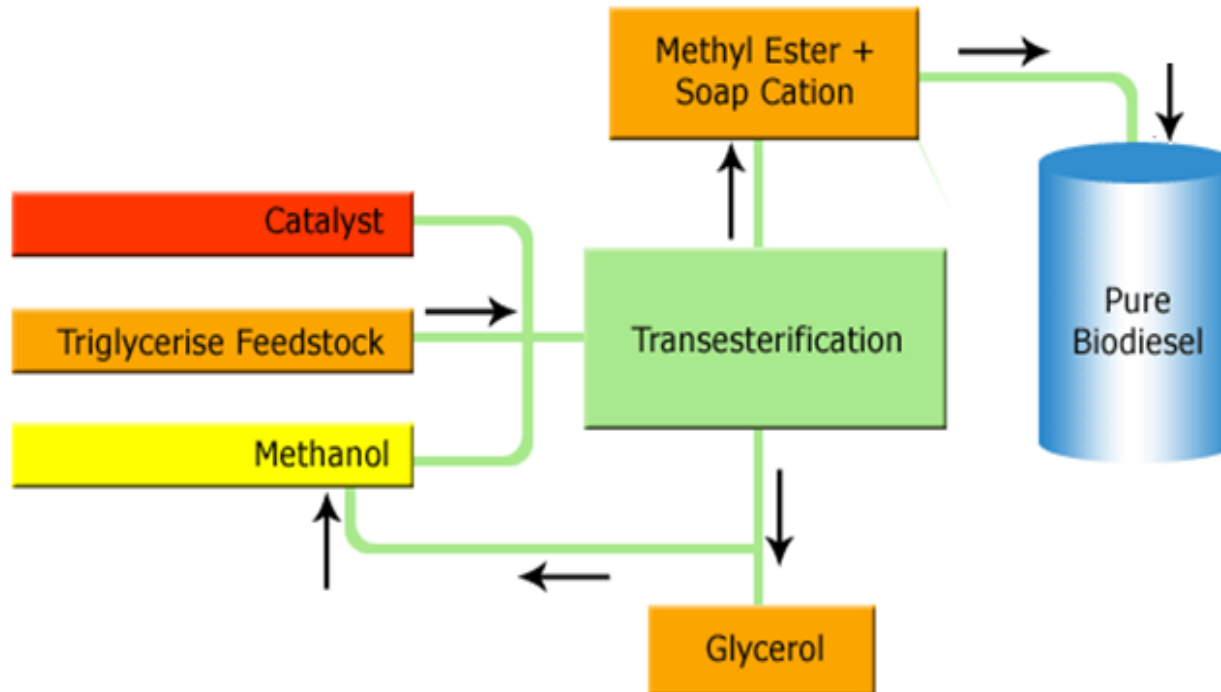
IMEI	Διακριτικό	Ανακυκλωτής	Πληρότητα	Μπαταρία	Τιμή	Υλικό	Κατάσταση
86071902782841	22 - Τσεσμές (Δούσμανης Μεταφορική)	22 - Τσεσμές (Δούσμανης Μεταφορική)	88.89%	80%	20	Τηγανέλαιο	Ενεργό
865691035514454	15 - Παρκινγκ Συνατσάκη	15 - Παρκινγκ Συνατσάκη	87.78%	100%	21	Τηγανέλαιο	Ενεργό
865691032833840	14 - Πλατανιάς (LIDL)	14 - Πλατανιάς (LIDL)	87.78%	99%	21	Τηγανέλαιο	Ενεργό
865691033279134	17 - Ατσιπόπουλο	17 - Ατσιπόπουλο	87.78%	96%	21	Τηγανέλαιο	Ενεργό
865691035626134	16 - Καζαντζάκη (Σχολή Αστυφυλάκων)	16 - Καζαντζάκη (Σχολή Αστυφυλάκων)	87.78%	100%	21	Τηγανέλαιο	Ενεργό
866029038348811	12 - Δασαρχείο (Μισιρία)	12 - Δασαρχείο (Μισιρία)	86.67%	100%	22	Τηγανέλαιο	Ενεργό
865691035512789	28 - Ρουσσοσιτί	28 - Ρουσσοσιτί	84.44%	96%	24	Τηγανέλαιο	Ενεργό
865691033278656	27-Αρμένιοι	27-Αρμένιοι	83.33%	100%	25	Τηγανέλαιο	Ενεργό
865691035779974	04 - Κουμουνδούρου	4 - Κουμουνδούρου	82.22%	100%	26	Τηγανέλαιο	Ενεργό
860719027628654	20 - Λούτρα	20 - Λούτρα	68.89%	96%	38	Τηγανέλαιο	Ενεργό
866029038280303	5 - Τρανταλίδου (Νοσοκομείο)	5 - Τρανταλίδου (Νοσοκομείο)	65.56%	100%	41	Τηγανέλαιο	Ενεργό
865691033279035	6 - Κονδυλάκη (ΙΚΑ)	6 - Κονδυλάκη (ΙΚΑ)	63.33%	100%	43	Τηγανέλαιο	Ενεργό
865691035512086	01 - Μαρίνα	1 - Μαρίνα	60.00%	100%	46	Τηγανέλαιο	Ενεργό
866029038288470	7 - Περιφερειακός (Ηλιοβασιλέματα)	7 - Περιφερειακός (Ηλιοβασιλέματα)	60.00%	96%	46	Τηγανέλαιο	Ενεργό
865691035512581	30-Πρινές	30-Πρινές	53.33%	100%	52	Τηγανέλαιο	Ενεργό
860719026982482	03 - Σαρακίνα (Τέρμα Αποστολάκη)	3 - Σαρακίνα (Τέρμα Αποστολάκη)	50.00%	100%	55	Τηγανέλαιο	Ενεργό
866029038921674	25 - Επισκοπή	25 - Επισκοπή	50.00%	100%	55	Τηγανέλαιο	Ενεργό
860719027828692	09 - Κολοκοτρώνη (Τέρμα)	9 - Κολοκοτρώνη (Τέρμα)	48.89%	100%	56	Τηγανέλαιο	Ενεργό
865691035554781	18 - Γάλλου	18 - Γάλλου	46.67%	100%	58	Τηγανέλαιο	Ενεργό
865691035512136	11 - Καστελάκια	11 - Καστελάκια	41.11%	100%	63	Τηγανέλαιο	Ενεργό
865691033278631	02 - Κουμπές	2 - Κουμπές	37.78%	96%	66	Τηγανέλαιο	Ενεργό
865691035670165	8 - Λιμάνι Ρεθύμνου	8 - Λιμάνι Ρεθύμνου	32.22%	96%	71	Τηγανέλαιο	Ενεργό
865691033279209	26 - Αργυρούπολη	26 - Αργυρούπολη	23.33%	96%	79	Τηγανέλαιο	Ενεργό
865691035544907	24 - Γεράνι	24 - Γεράνι	20.00%	96%	82	Τηγανέλαιο	Ενεργό
865691033279738	19 - Άδελε (Δημαρχείο)	19 - Άδελε (Δημαρχείο)	17.78%	82%	84	Τηγανέλαιο	Ενεργό
860719027649783	10 - Οπληρχηγού Παγλά (Περιβόλια)	10 - Οπληρχηγού Παγλά (Περιβόλια)	14.44%	100%	87	Τηγανέλαιο	Ενεργό



UCO collector's route optimization based on the full - level



Alcohol (methanol) & catalyst (NaOH & KOH) added to provide the final product



UCO to biodiesel
small scale
autonomous
production unit





Property	Unit	Measurement	Minimum	Maximum	Test Method
Ester Content	% (m/m)	91.20	96.50	0.00	prEN 14103
Density at 15 °C	kg/m ³	888.20	860.00	900.00	EN ISO 3675 EN ISO 12185
Viscosity at 40 °C	mm ²	5.33	3.50	5.00	EN ISO 310
Flash Point	°C	88.00	> 101.00	-	ISO / CD 3679
Cetane Number	-	53.40	51.00	-	EN ISO 5165
Water Content	mg/kg	1413.00	-	500.00	EN ISO 12937
Total Contamination	mg/kg	22.30	-	24.00	EN 12662
Copper Strip Corrosion (3hr at 50 °C)	rating	1.00	Class 1	Class 1	EN ISO 2160
Oxidation Stability, 110°C	hours	4.7	6.00		pr EN 14112
Acid Value	mg KOH/g	0.16	-	0.50	pr EN 14104
Iodine Value	-	112.0	-	120.00	pr EN 14111
Linolenic acid methyl ester	% (m/m)	1.9	-	12.00	pr EN 14103
Polyunsaturated (≥ 4 double bonds) methylesters	% (m/m)	<0.6	-	1.00	-
Monoglyceride Content	% (m/m)	0.9	-	0.80	pr EN 14105
Diglyceride Content	% (m/m)	1.8	-	0.20	pr EN 14105
Triglyceride Content	% (m/m)	4.1	-	0.20	pr EN 14105
Free Glycerol	% (m/m)	0.009	-	0.02	pr EN14105 pr EN14106
Total Glycerol	% (m/m)	0.9	-	0.25	pr EN 14105
Phosphorus Content	mg/kg	<0.5	-	10.0	pr EN 14107

UCO to biodiesel small
scale autonomous
production unit

Biodiesel produced through small
scale unit is expected to be
optimized **to fulfil the criteria set
by EN 14214**





Conclusions

- A viable solution for UCO proper management can be its **energy recovery**
- Besides the behavioural change & awareness raising campaigns, a **“smart approach”** can optimize the **collection process**
- **Smart sensors** can provide information on bins' location & fill level optimising **UCO collection routes**
- **Small biodiesel units can be proven an efficient “tool” for small municipalities**
- Produced biodiesel can be a certified output, **suitable for conventional diesel engines**





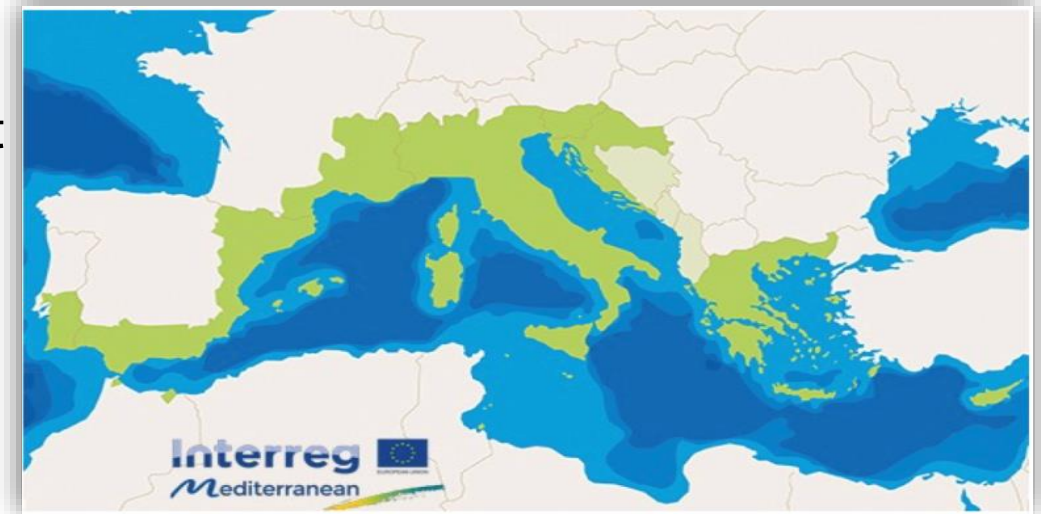
The **COMPOSE** model towards positive energy communities





COMPOSE main objectives

- **Increase the share of RES in the energy mix of Mediterranean countries**
- **Support rural/island communities towards the local development planning**, through the exploitation of RES potential & local capacity building at the decision-making & planning experts level
- Development of **new business models** to support local economies

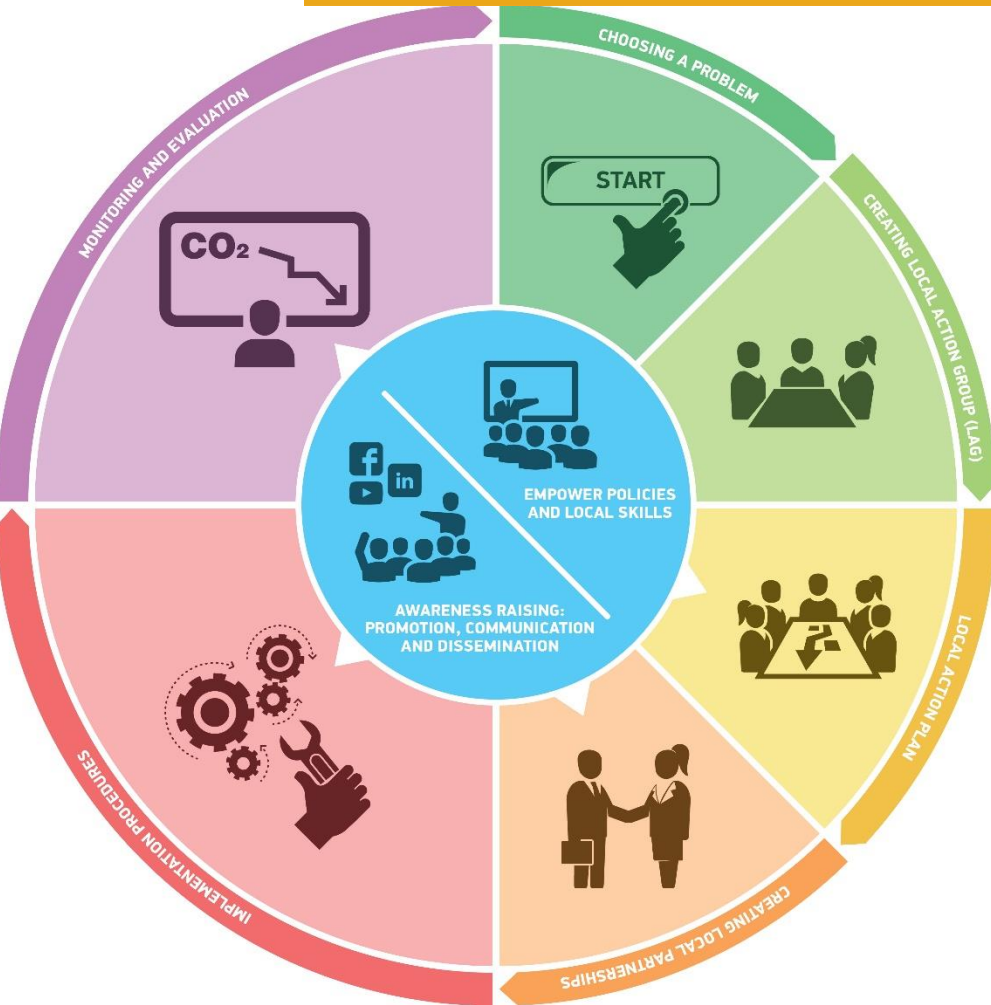




COMPOSE main activities

- **Development of common methodological approach for local RES development plans**, exploiting the existing expertise & know-how in EU level (**Lead Partner: TUC**)
- **Implementation of demonstration projects**, exploiting transnational synergies, knowledge transfer & good practice examples (**Lead Partner: TUC**)
- **Local Action Groups**, to support planning & implementation (**Lead Partner: TUC**)
- **Transfer of knowledge - Capacity Building Activities**
- **Technical guides and tools** for local stakeholders & decision makers
- **Policy recommendations** to support the uptake of RES projects at local/regional level





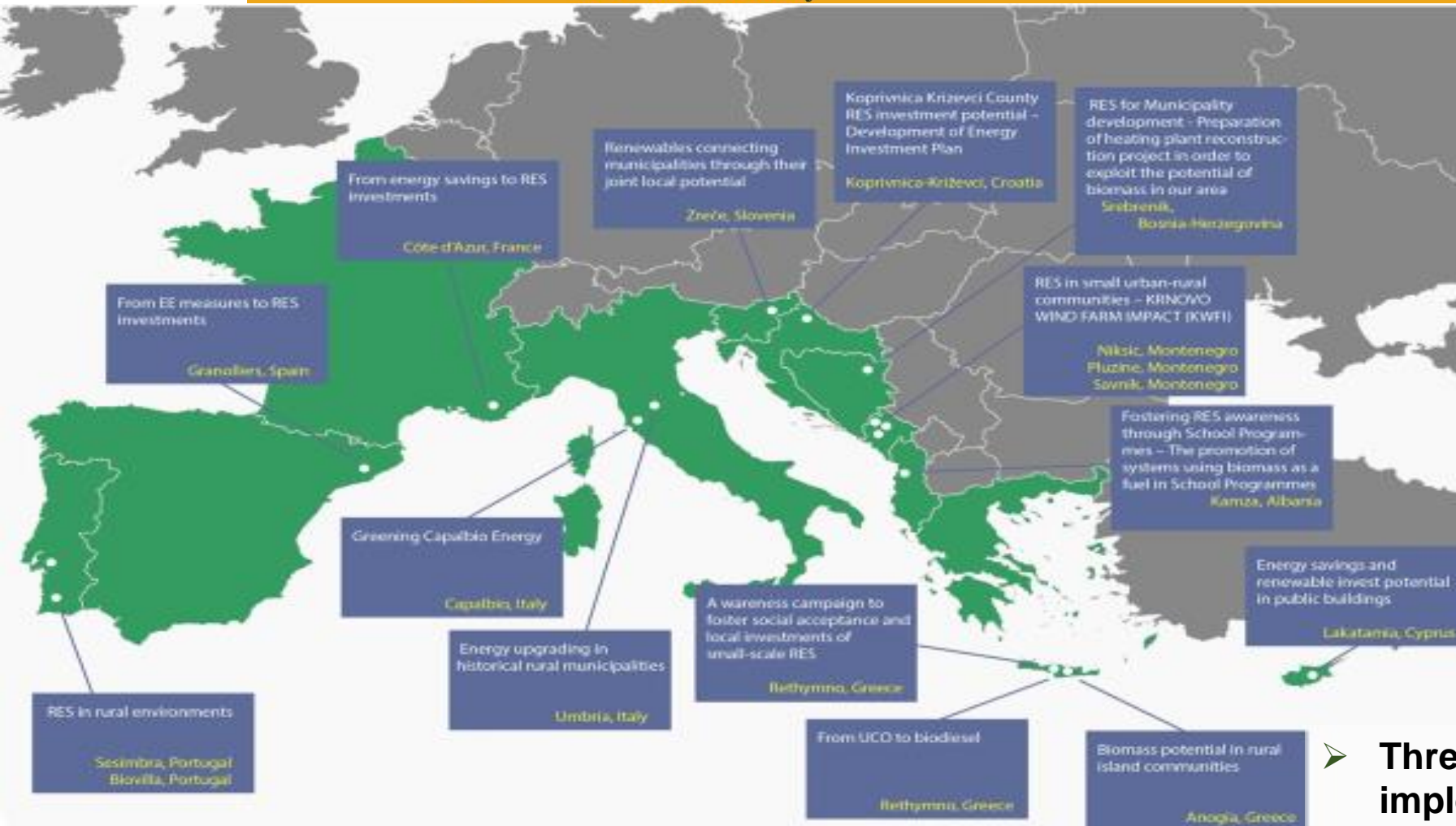
COMPOSE Common Methodology for Sustainable Energy Projects

COMPOSE presents a model for RES development planning, building on a bottom up, multi stakeholders, participatory approach

Approach based on existing experience from other INTERREG-MED projects & EU initiatives' experiences

Aim: support decision making & development planning of sustainable **energy projects** in local/regional level.





➤ **Three demonstration projects are implemented on the island of Crete**





15 real showcases of positive energy interventions

**Bottom up methodological
approach, tested-
transferable**



6,634,843 kWh/y Energy saved due the adoption of
energy efficiency measures



336,544,500 kWh/y Electricity generated from RES
782,180,301 kWh/y Thermal energy generated from
RES **till 2030**



558,722 t CO₂/y - Greenhouse Gas emissions
avoided **till 2030**



> **100 new SMEs** to be established



4,314 toe Waste to Energy

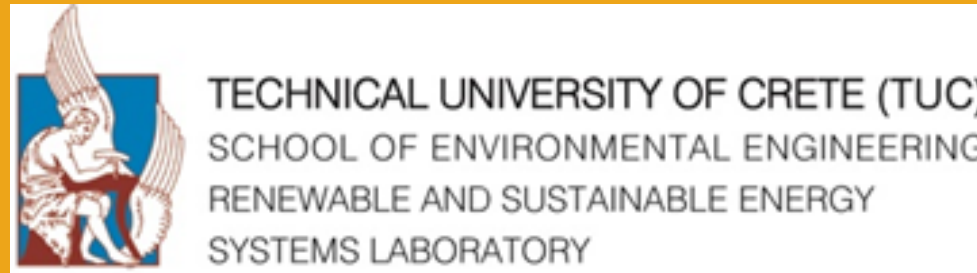




The COMPOSE team



Thank you for your attention



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