**Co-creation with citizens and stakeholders in the development of nanotechnologies in energy applications**

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Introduction. Smart and sustainable nanotechnology product development necessarily includes the safe-by-design approach, and ethical and societal considerations, in order to fully-realise their potential benefits. Responsible research and innovation (RRI) is a core theme of “GoNano: Governing Nanotechnologies through Societal Engagement”, a Coordination and Support Action funded by European Union Horizon 2020 Research and Innovation program (Grant Agreement n° 768622; <http://gonano-project.eu/> ). Previous efforts in public engagement with new technologies that put citizens and stakeholders together in a session, have shown that discussions are hampered by the diverse levels of technical knowledge of participants. GoNano aims to solve this problem by separating citizen and stakeholder activities while still enabling 2-way dialogue between groups, by using methodologies to incorporate outputs from one session as inputs to another. Thus, GoNano is working to align the future of nanotechnology with societal needs by developing co-creation method-ologies, guidelines and online toolkits; with outcomes used in the GoNano winter school (RMIT Europe, Feb. 2020) and online microcredentials to train nanotechnologists and people involved in innovation processes.

Methods. The GoNano project related to energy is based at RMIT Europe in Spain, with concurrent projects on health and food based in the Netherlands and Czech Republic, respectively. These projects are engaging with citizens, researchers, professional users, civil society organisations (CSO), industry, and policy makers in a continuous process of deliberative workshops and online consultations to co-create research aims and concrete product suggestions for future nanotech. Step 1 of the co-creation process involved deliberative and envisioning citizen workshops (Oct. 2018), with participants from a wide range of the public providing: initial feedback on nanotechnology application areas; preferences (wishes) related to future nanotechnology applications in energy; requirements and principles that citizens wanted technology developers to comply with, or consider, when they develop these applications; and messages to stakeholder groups. Step 2 involved stakeholder workshops (March 2019) to explore opportunities and barriers for co-creation, with 4 main sessions: an initial *Exploration* session, where participants analysed the key needs and values of citizens surrounding the themes of energy and nanotechnology; and 3 creative design sessions on *Ideation*, *Prototyping*, and *Reflection*. Participants included researchers from natural and social sciences, engineering, design & CSO representatives. An IT tool ‘EngageSuite’ was used to facilitate workshop discussions/reporting.

Results & Discussion. The citizens’ main messages concerned: environment and sustainability, health and safety, and social aspects. Their messages called for products, R&D and manufacturing processes to be more sustainable and not endanger the environment – resulting in 3 themes: green energy production, portable energy devices, and energy in the home. The stakeholder workshop was successful in outlining the benefits of using a co-creation approach for nanotechnology research; stakeholders were receptive to the co-creation concept and many would consider applying it in future. The value of engaging with the public was evident to researchers; most were already aware of it and partially practicing it, albeit mainly via dissemination activities rather than actual co-creation. Responses to the evaluation questionnaire and follow-up interviews showed that participants appreciated the events, as they provided productive spaces for engagement and mutual learning between a wide range of stakeholders (i.e. researchers, producers, policy makers, CSOs and citizens). Workshop discussions produced interesting product suggestions, while raising stakeholder awareness of the need to incorporate social needs and values in nanotechnology development, as well as the complexity of realising this in practice. Next steps: online consultation with citizens to test whether outputs from the stakeholder workshop sufficiently reflected their concerns; and a 2nd round of stakeholder workshops.

Conclusion. Governance of nanotechnologies requires the involvement of societal engagement, preferably through co-creation processes, to address public concerns about how nano-products may affect them, their environment and workplace, and how it is controlled, regulated and labelled.